

City of Ottawa

Urban Forestry Management Plan



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OVERVIEW OF OTTAWA'S URBAN FOREST MANAGEMENT PLAN

Ottawa, Illinois currently manages 5,343 trees throughout its City parkways, right of ways, and various City park properties. There are also 323 open planting spaces that have been inventoried which represents potential for growth of the Urban Forest resource. The City's trees were inventoried as part of a project in April-June of 2021 culminating in this Urban Forestry Management Plan which will detail how these trees will be managed for the benefit of the City of Ottawa over the next 10 years, with a focus which begins in 2022, and projects out to 2032.

In terms of the condition of the Urban Forest in Ottawa, there are both strengths and opportunities for improvement. One strength is the fact that there are 120 species represented in the tree population which is quite impressive diversity. The Maple genus, however, makes up over 35% of the population which is far too high and this statistic certainly leaves much room for improvement. Additionally, the overall condition of the population as a whole is below average and this presents another opportunity for improvement and the City can use the tree inventory data to locate trees in need of maintenance or removal particularly with aging Hackberry and Silver Maple trees as a primary focus. There is significant work to do in terms of near-term maintenance and storm damage remediation. Once the necessary maintenance is complete, Ottawa will be able to focus on enhancements rather than remedial action. Also, the current budget being applied towards forestry management should likely be larger. At \$76,000 per year, this is enough to fulfill basic needs, even a modest increase in budget would allow Ottawa to accomplish much more.

In order to enhance the Urban Forestry program so it will create long term benefits to the community while reducing costs, the following Urban Forest Management Plan will address each one of these strengths and challenges, and create goals and milestones for each. Below is a broad view of the direct goals to come in the 2022-2032 period. Further detail is given in the body of the Plan, with separate sections detailing specific Urban Forestry activities, and how we propose they are achieved, along with standards and Best Management Practices for each.

An urban forestry program has been created in this Plan which attempts to achieve the greatest benefit for the community, based on the available data we have from the inventory, as well as input from stakeholders and residents of the City of Ottawa.

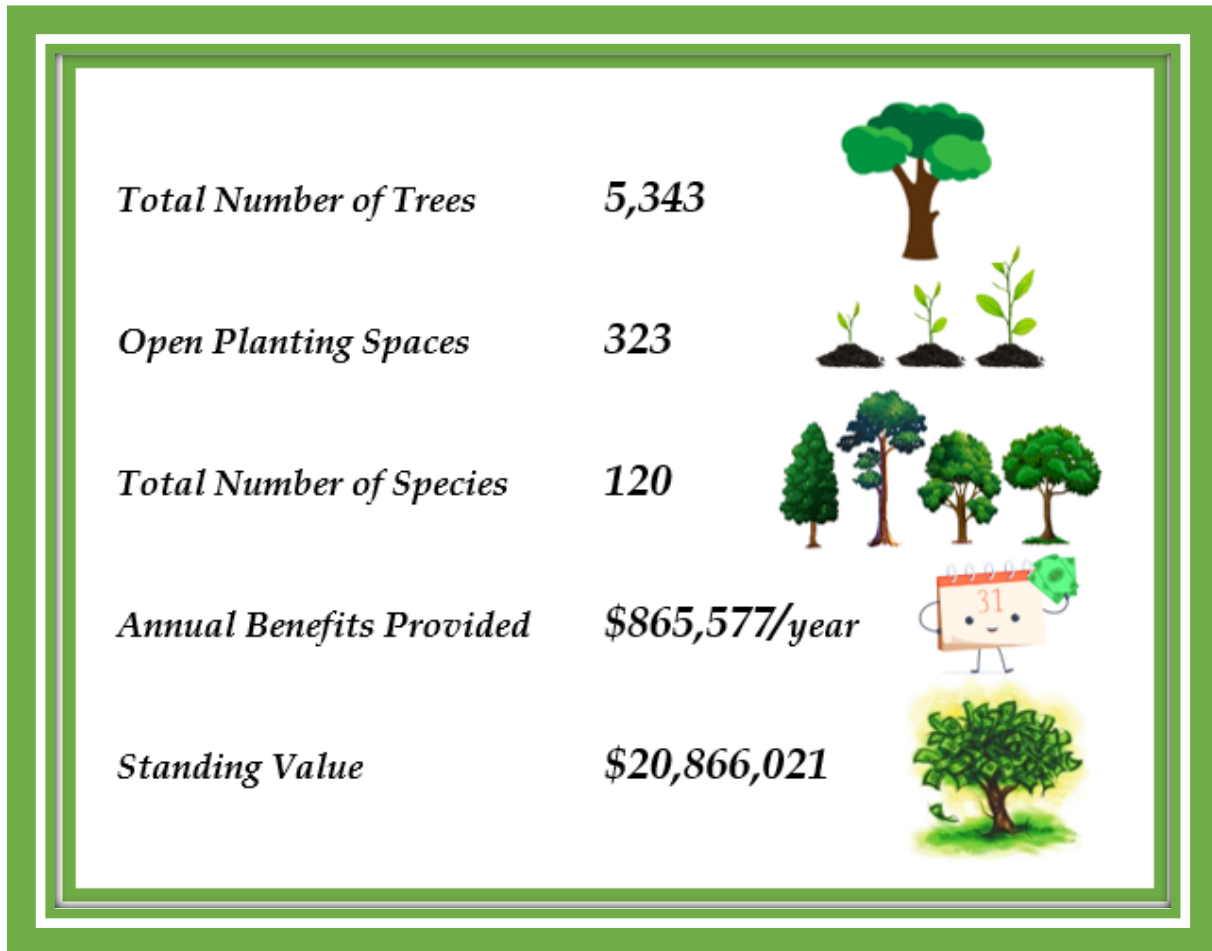
However, all plans are subject to change based on new information, budgets, or other unforeseen circumstances. For this reason, it is asked that readers consider that this plan is to be a living, breathing document, and goals and strategies will be updated to fit new circumstances as needed.

This Plan should be reviewed periodically, at which point the City, and its residents, business owners, and other stakeholders will have an opportunity to provide input and help improve the Plan during those annual reviews. These strategies and goals are not absolute, but rather serve as guideposts to mark the road to success.

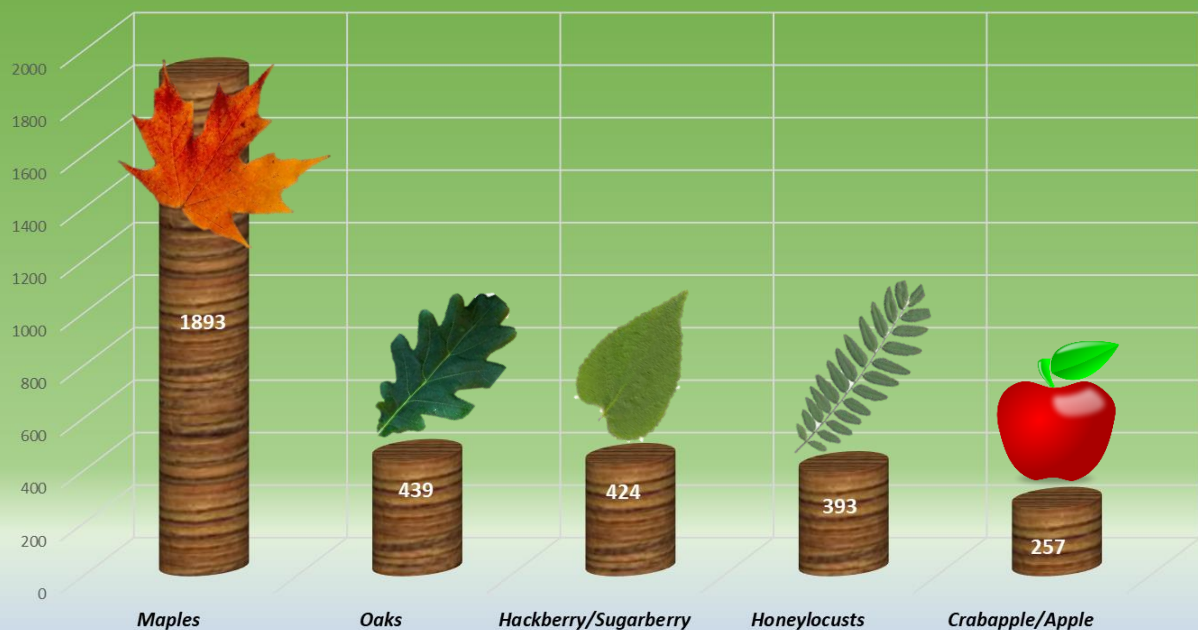
MISSION STATEMENT

It shall be the mission of this Urban Forest Management Plan to outline goals, budgets, and Arboricultural Best Management Practices for the management of the Urban Forest in the City of Ottawa, Illinois to increase canopy cover, maximize the benefits trees provide while minimizing cost, mitigate against climate change, and create a program to manage the Urban Forest Resource for the greatest public good in a manner that is both financially and programmatically sustainable, while maintaining flexibility for future adaptive management.

OTTAWA'S URBAN FOREST: AT A GLANCE...



Top 5 Types of Trees in Ottawa



DIRECT GOALS

Listed below are the direct goals of this Urban Forest Management Plan (herein referred to as “UFMP”, or “the Plan”), as well as a brief discussion of how they shall be met. Direct goals are those which this plan addresses very explicitly in describing pruning, removal, planting, and other activities. Every attempt was made to make these goals realistic and achievable, so they do not place an undue burden on the City of Ottawa, its residents, or its resources. Instead, the direct goals of this UFMP are to save money and provide greater benefits over time through proactive, as opposed to reactive, management. The Plan is also meant to be adaptive: New concepts, the introduction of new pests or pathogens, or changing climate (both social and meteorological) may all change the way the Urban Forest is viewed.

The Plan is intended to be reviewed periodically by the Ottawa City Council, its Tree Board, and any other stakeholders. The review process should include evaluation of progress made towards these goals. Goals may be altered after the review, as conditions warrant. This UFMP is written with the understanding that organizations, stakeholders, and residents change over time, and therefore its goals require a degree of flexibility. Since trees represent a long term (50-80 year) commitment, this UFMP is intended to provide guidance and continuity through those changes, while also adapting to them as the need arises.

Create a Needs Analysis for the Current Tree Population

Every tree population today is the result of decades of past management decisions. Over time, we increase our overall level of knowledge, skill, and efficiency in managing trees. Based on that new knowledge, we sometimes discover that decisions made decades ago may appear in retrospect to have been wrong, even though they seemed like a good idea at the time. It is the goal of this Plan to assess the current state of the City of Ottawa’s Urban Forest and examine its overall strengths and benefits, as well as look for opportunities for improvement to inform future decisions.

Each aspect of Ottawa’s tree data has been analyzed: How many trees, what condition they are in, how old they are, what needs do they have, and more were all examined to create goals to improve the tree population for the benefit of the organization, its residents, and other stakeholders. Specific goals in terms of planting, removals, pruning, budgets, personnel, and maintenance are all addressed by acknowledging both strengths and opportunities, and suggesting how they might be used to the City’s advantage. These strengths and opportunities will be the guiding principles for the management strategies and specific goals outlined in each section below. To avoid repeating past mistakes, the Plan shall also attempt to leave room for adaptive management, so the plan may be changed when appropriate.



Establish Goals in Order to Enhance Strengths and Realize Opportunities

In order to accomplish anything, goals are necessary to help guide organizations through the process. Establishing or enhancing a highly functional forestry program will require a series of attainable goals to in order to be achieved. This UFMP seeks to accomplish those goals within a realistic budget and attainable timespan. As stated previously, goals are intended to change over time as the City's capacity to manage the resource may increase or be reduced.

In each section of the Plan related to direct goals, language has been included which incorporate both a budget and a time frame in which those goals can be accomplished. The overarching goal will be to have Ottawa use this UFMP to create a more sustainable and adaptable forestry program within a 5-10 year period.

This program will include tree planting, tree maintenance, and tree removal for Ottawa's Urban Forest, so that the tree population will be healthy, and provide the greatest benefits and least risk to the community while maximizing benefits and minimizing risk. To learn more about the budgets, see the individual goals in each section below, or turn to the budget table on page 65.

Update City Ordinances for Enforcement of Tree Policies

As part of the IDNR grant program, work has been performed by Morton Arboretum working in tandem with Ottawa staff and relevant community stakeholders, in order to edit and improve ordinances governing trees in Ottawa. These ordinances are meant to reinforce proper practices while discouraging improper practices and care, and are not meant to be overly punitive, but rather to encourage the community to engage in proper tree care practices for the benefit of all parties. These ordinances are common industry regulations, such as enforcing rules about what trees cannot be planted because they are unsafe trees, or defining exactly what trees are the City's and the homeowner's responsibility, among other things. The goal of these ordinances is to create a tree population which is diverse, healthy, and improving, providing the greatest benefit to the City and its residents over the long term.

Increase Overall Diversity by 2032 Through Tree Planting

Tree species diversity is one of the most important concepts in Urban Forestry today. The reason pests and diseases like Emerald Ash Borer (EAB) and Dutch Elm Disease were so devastating is that there were too many Ash and Elm trees. When EAB arrived, many communities' Ash population was 20% or more, resulting in mass tree loss. This can be avoided by planting a greater diversity of tree species, so that when new pests or pathogens are introduced, we only lose small amounts of specific tree species. Diversity leads to stability, and stability leads to reduced costs and increased benefits over time.



An achievable “Diversity Vision” has been created for 2032 which will see the tree population become far more diverse than it is at present. The current population includes an impressive 120 individual species and the diversity vision included in the Plan aims to reduce the number of trees that are over-represented and/or lower quality species while also seeking to increase the number of species that are under-represented or not present in the tree population.

Not only will trees be planted which are underrepresented or not present in the current population, they will also be planted in such a manner that selects the right tree for the right site. A direct goal will be to create a tree planting program where trees are matched to existing sites for the next 10+ years. In 2020, Ottawa planted approximately 75 trees, and this plan seeks to increase that number to 280 trees per year over the course of this plan, to both be able to replace older declining trees, as well as to grow the tree population by over 1,100 trees overall by 2032. Ideas such contract growing, creating in house liner nursery and others will be explored. To learn more about tree planting and reforestation, turn to page 47, and Appendices A-E.

Maintain an Acceptable / Unacceptable Species List

The urban environment is a difficult place for a tree to live. Between road salts, urban pollutants, limited soil, and other challenges, not all trees will thrive in the urban environment. Trees which have very weak wood, which are known invasive species, which produce messy or foul-smelling fruits, or which create a public nuisance should also be avoided. Acceptable species are those which are adapted to our Midwest climate, are not invasive, and do not pose high risk. Included in this Plan is an “acceptable and unacceptable” which will detail specific trees which may be planted on boulevards, in parks, and by schools. City staff and the Tree Board will review the list periodically to ensure that it is being maintained in accordance with the latest information on specific trees. For more information on what species can and cannot be planted in Ottawa, see the Acceptable Species list in Appendix A.

Manage Tree Removals

For public safety, or to prevent the spread of tree pests and pathogens, sometimes tree removal is unavoidable. During the inventory, At present, there are 366 trees which have been called for removal during the inventory. Of these, 20 are listed as a Priority Removal, 238 are listed as Standard Removals, and 108 are listed as Low Priority Removals based on the tree inventory data. To keep the residents of Ottawa safe, a tree removal program has been created in this Plan which budgets for the safe removal of all these trees over the next 10 years in order to maintain public safety. Cost projections for tree removals have been made based on the number, age, and condition of trees in Ottawa for the next 10 years, so that long term budgeting projections can be made.



Also included are ANSI and ISA safety standards, as well as suggested bid specifications to ensure the City is hiring qualified contractors who will be held to the highest industry standards. For more information on Ottawa's proposed tree removal program, turn to page 43.

Create a Cycle Pruning Program

Properly pruned trees establish faster, grow quicker, and live longer lives than trees which are not pruned, or improperly pruned. Since large trees provide the greatest benefits to the community, pruning is a critical part of the Urban Forestry program in Ottawa. Pruning will be done by Ottawa staff, Certified Arborist contractors, and for some of the newer trees to be planted, potentially by local, well-trained volunteers. Over the next 2 years, the trees identified as requiring priority pruning, pruning of dead limbs, or establishment pruning will be budgeted. Details will be discussed in the Tree Pruning section of this plan. Currently, the City prunes a varying number of trees each year. Our goal will be to prune 1,034 trees which are in the greatest need of pruning over the next 2 years.

As Ottawa begins to increase its budgets and capacity for tree pruning, we hope to establish a cyclical pruning program. This program will ensure that all trees on public property are pruned at a minimum every 7 years, increasing tree health and vigor while reducing costs associated with storm damage and tree failure. We also propose that a volunteer group be trained in proper pruning and maintenance of young trees, so that the community can assist in caring for this important Urban Forest resource. This group may assist in other tasks as well, such as watering, and monitoring for new insects and diseases. For more information on tree pruning and maintenance, turn to page 52.

Maintain an Accurate Tree Inventory on an Annual Basis

Managing an urban forest requires a clear understanding of the trees, their ages, conditions, and locations, so that City crews and contractors can perform work on these trees. A stem-by-stem tree inventory was completed in April-June 2021. This inventory resulted in an unbiased assessment of all of the trees on public Right of Ways in the City, and will serve as the data which will guide the forestry program throughout the next 10 years.

All inventories are a snapshot in time. With 5,343 trees on City parkways and ROWs, the tree inventory should be maintained at a high level of accuracy so that it doesn't become out of date. Prior to the 2021 inventory, the City's tree data was maintained infrequently, however going forward it is recommended that the data be regularly updated to reflect changes in the population, such as plantings and removals. It is also recommended that the inventory be updated periodically by a Forestry Consultant, to keep the information at its most current on a City-wide scale. Maintaining this tree data at a high level is vital in the execution of this Management Plan.



Proper Mulching of All New Plantings

As noted above, the urban environment is a difficult place for a tree to become established and to live a long, healthy life. Proper mulching can significantly increase a tree's ability to do this. Mulch helps to conserve water during the summer by preventing it from evaporating from the soil. It also helps prevent weeds from growing around the tree and competing for water and nutrients, and keeps lawn equipment such as weed whips away from the trunk where they can damage the tree. All new City plantings will be properly mulched at the time of planting by the planting contractor.

Another intended outcome of this initiative will be to educate residents about proper mulching care, and notify them when poor mulching techniques are being used. Of particular concern is the practice known as "Volcano Mulching" which has the opposite effect of proper mulching and can severely damage a tree over time. For more information on proper mulching, turn to page 57.

Incorporation of Best Management Practices in Tree Care Operations

"Best Management Practices" is a term which means being on the cutting edge of your industry. All contractors working for the City should be compliant with the latest industry Best Management Practices, based on the appendices in this report. The ANSI and ISA Best Management Practices shall be integral parts of any Request for Proposal (RFP) or bid documents when seeking qualified contractors. Full text of all referenced standards shall be made available to all City employees and contractors performing tree care operations. Public outreach and education shall be performed by the City of Ottawa Tree Board or certified city staff arborists, ensuring that residents understand these practices as well. This UFMP will be placed in the public domain for all residents to use as a reference.

Creation, Utilization, and Maintenance of a Tree Risk Assessment Policy

Trees create great benefits, but they may also pose various degrees of risk. Tree limb failure can have catastrophic effects on people or property, and trees need to be well-managed and healthy to avoid that risk. A risk assessment policy has been created for the City of Ottawa as part of this Plan. This policy will aid in identifying, documenting, and designating for removal or mitigation, trees which may pose a threat to public safety in a timely manner. This will reduce the overall level of risk posed by trees, as well as exposure to liability from tree related incidents. Basic risk assessment language is included in this document, and a sample Tree Risk Assessment Policy has been created on page 64, and the ISA Basic Tree Risk Assessment form can be found in Appendix H.



Increase Urban Tree Canopy from 27.28% to 29%

Tree canopy is important to the community because more and larger trees provide greater benefits such as decreased heating and cooling costs, pollution reduction, and increased storm water uptake. Tree lined streets are more attractive to homebuyers and potential new businesses, which increases home values, home ownership, and tax revenue. All of these factors benefit the community, so a direct goal will be to increase tree canopy in the City of Ottawa. Currently, Ottawa contains 27.28% tree canopy coverage, compared to other land cover types. Increases in tree canopy also come with increases in total benefits provided to the community.

Based on data from the Chicago Region Trees Initiatives, we believe that an increase to 29% canopy cover is a realistic goal for Ottawa by 2032. This will be accomplished by increasing the number of trees on publicly owned property, as well as improving tree care allowing trees to live longer, become larger, and create more canopy cover.

Tree planting on private property will also be incentivized through public-private partnerships with local organizations and businesses. As we will show in the detailed portions of this Plan, these are real benefits that will help Ottawa Residents save money. For more information on Urban Tree Canopy, tree benefits, and other such information, turn to pages 30-35.

Tree Preservation / Invasive Species Management

Sometimes trees can become damaged by construction activities, costing the City money, and eliminating the benefit the tree had to the community. A basic tree survey and assessment should be conducted prior to the issuance of a permit for construction activities. A tree protection zone must be established and maintained during construction and the City should monitor construction activities to ensure local ordinances are adhered to. Tree removal, for trees of a certain size on the approved species list, should require prior approval by Ottawa during site planning. The removal of low quality or invasive species is also recommended. This not only increases the amount of planting space, but also increases public safety. A direct goal of this Urban Forestry Management plan is to preserve trees during construction, and reduce the amount of undesirable species within the City of Ottawa.



Increase Awareness of the Urban Forest in the City of Ottawa, and Engage Stakeholders

The reason for the establishment and enhancement of an Urban Forestry program in Ottawa is to improve the lives of the residents, business owners, and other stakeholders who want to see the City be a healthier, happier community. In order to make this happen, Ottawa is looking for partners in the community to provide support for this program. Ottawa staff is reaching out to local garden clubs, philanthropic organization, residents, and business owners to make the forestry program innovative and community based. In this manner, residents and business owners in Ottawa can take ownership of this important and beneficial resource, and allow it to work for them, their families, businesses, and the good of the whole City. For more on these innovative programs, and how you can get involved, turn to page 10.

Increase Stocking Density from 91% to 95%

Currently, there are 323 open planting spaces and 151 stumps which were inventoried on Ottawa's streets. These all represent available spaces for planting of new trees. With 5,343 trees out of 5,871 total available planting sites, the stocking density is very good at approximately 91%. While 100% stocking density would be possible to achieve over the 10 year scope of this plan, it is not actually always desirable, but a goal of 95% stocking density is attainable and desirable. This will be done primarily by increased tree plantings in the coming years, and use of innovative strategies to fund increases in tree planting. It should be noted here that due to large tracts of town without traditional parkways (no sidewalks), and at the direction of Ottawa staff, we were fairly conservative with where planting sites were located in those areas with nontraditional parkways. If the City wished, they could likely create even more space in these areas in the future.



Additional Goals

There are no strategic timelines set forth here for these programs. As the direct goals of the Urban Forestry program in Ottawa are met or exceeded, these are goals to be discussed by the City of Ottawa and its Tree Board as time and budgets become available. We believe that many of these programs represent some of the most progressive Urban Forestry policies in the current climate, and that they should all be seriously considered for implementation.

Volunteer Labor (TreeKeepers/Local Organizations)

As mentioned above, the ability to use well-trained residents as volunteer labor for pruning of young trees and planting of smaller sized nursery stock during Spring and Fall planting cycles may benefit the City's bottom line. In order to accomplish this, several training sessions will be required for these volunteers to be confident enough that they can perform these activities with minimal supervision.

The Forestry Consultant, working in tandem with the City Arborist and local organizations, will educate residents on the proper way to prune young trees, as well as how to plant container-grown trees, water and mulch trees, identify trees, and other basic tree knowledge.

There is a local chapter of the Open Lands Tree Keepers program active in the Chicago area. This organization is a non-profit which assist in educating people about trees, how to prune, plant, and manage them, and their benefits to society. There are other local organizations with which the City could partner with as well, please see page 14 for more details. Upon acceptance of this Plan, we expect the City will reach out to Open Lands or a similar local organization in order to establish a relationship, and assist in the creation of this volunteer program, which will engage the community, as well as save the City money overall on its maintenance program.

For residents who may not be interested in joining the volunteer program, but still want to know a little bit more about how to take care of their trees, it is recommended that Ottawa hold several annual tree education sessions, perhaps to coincide with annual Spring and Fall planting cycles. These sessions will be taught by the City Arborist and/or Forestry Consultant, or other such qualified parties, and cover tree watering, fertilization, pruning, and the basics of how to spot insects and diseases. In addition, basic tree care pamphlets might be made available at City Hall and tree care information could be posted on the City's website. An Arbor Day celebration is an example of one such outreach event where trees could be planted and education sessions run.

Establishment of City of Ottawa Propagation Nursery

Consideration might be given to the establishment of a small propagation nursery on Ottawa-owned land. The City of Ottawa can grow a share of its own trees, using much smaller trees obtained from wholesale nurseries at a fraction of the cost of a full-sized tree. Small trees can be purchased wholesale, and then grown to maturity in Ottawa. Such programs have been successfully instituted in many communities, and represents a quality investment that results in cost savings over the long term. Trees can be purchased when small, or donated from residents, and grown to plantable size on City-owned land.

We would recommend that the City work with the Forestry Consultant, Park District, local nurserymen, and other strategic partners in order to explore this concept, with a possible goal of having a functional nursery by 2030. The amount of time required for the care of young trees is minimal, and at an average cost of \$250-\$300 per 2" DBH tree wholesale, the City could save a significant amount of money in their tree planting program by pursuing this goal. In addition, not unlike a community garden, local residents could assist with the care of these nursery trees.



Contract Growing Program

One of the keys to a successful Reforestation Plan or Tree Planting Program is the availability of high-quality nursery stock from local sources. Incorporated with the UFMP for the City of Ottawa is a diversity vision for 2032 that includes a great variety and diversity of different trees. A new approved species list has also been developed, as well as the tree species that are prohibited on public property. Having this information is an advantage for the City, in that the nature of the urban forest in terms of species composition is already known. It is believed that a comprehensive tree planting plan will be an important part of this process as well.

This knowledge, however, does not guarantee the availability of those specific trees when the time arrives to fill a particular site. One way to assure the availability of nursery stock the City desires each year is to have trees contract grown by local nurseries, and reserved specifically for the City of Ottawa. This way, the City will not have to compete with the landscape industry, other local organizations responsible for tree planting, or local retailers. Trees are ordered in annual increments. Each year, Ottawa will purchase the trees previously ordered for that year, and place an order for the following year. This gives the supplying nursery time to procure, plant, and bring the agreed upon trees to the size and branching habit specified.

As numbers of trees required for planting vary from year to year based on removal rates, budgets, and other factors, tree order projections should be made conservatively to avoid the possibility of cancellation of orders. The City would reserve the right to increase orders when budgets allow. Supplying nurseries should be located within a specified distance from the City of Ottawa, to ensure climatic zone compatibility and reduced transportation costs and planting stock exposure to the elements. Nurseries should be of sufficient production capacity to furnish all trees ordered in advance by the City, as well as possible increases when necessary. Nurseries should be chosen not only on their capacity to produce stock, but to meet quality, form, and health standards as specified by the City. The nursery should allow tagging by the City Arborist or other representative as well.

A long-term tree planting contract may be developed alongside the nursery supply contract. This contract would specify all pick-up, transportation, planting, and spoil disposal procedures, as well as establish costs for planting trees. Trees should be evaluated one year after planting and assessed for health and survival. Responsibility for replacement of trees that have not survived the one-year guarantee period is divided equally between the supplier, the planter, and the City.

Cost-Sharing Program for Tree Purchase / Outright Resident Purchase

Seeing as publicly owned trees belong to the City, and not the residents, the City should ultimately make the decisions on what trees will be planted at which specific sites. However, if residents are interested in planting a specific species of tree in front of their homes instead of the species selected for them, a cost-share program should be considered, whereby the resident can pay for a portion of the cost of the installed tree which they have requested. Species must be approved by the City Arborist or Forestry Consultant, to ensure that the species selected is a good choice for the site.

In addition, the City could allow for residents to purchase their own tree and have it installed at their own cost. However, we would advise the City and/or Tree Board play an active role in determining what species are allowed to be planted on public land so that diversity standards are met. Educating residents at periodic meetings on the different species of trees available in the nursery trade would be a good community outreach tool for broadening resident's horizons of what trees are available and will grow well on their parkway.

Private Property Tree Planting Incentive Programs

Tree planting on private property is actually a direct goal of this Urban Forestry Management Plan, as noted above. Though the City has no formal jurisdiction to plant trees on private property, the benefits of tree planting on private property are substantial in terms of energy savings, storm water benefits, and other benefits. The City should consider incentivizing residents and business owners to plant trees on their property. Offering a slight reduction in water and sewer bills for each tree planted has been successfully utilized. Partnering with local nurseries to create a program where residents can purchase trees from that nursery at a reduced price may also be a way to encourage tree planting on private property.

Another idea which has been successfully implemented is having the City purchase trees from a wholesale nursery at wholesale prices, and then have an annual tree sale to local residents. The City resells the trees at a slight markup from the wholesale cost, but still less than retail, and uses the proceeds to fund its forestry initiatives. Such programs would encourage tree planting on private property by reducing tree costs to the residents.

Wood Utilization Program

As the UFMP recommendations take effect, a considerable amount of removed tree material will be generated that may be suitable for use as urban timber. Urban timber is defined as saw logs generated from urban tree removal operations. Larger and longer logs are suitable for dimensional lumber production, and smaller material may be used to produce many other products. Forming strategic partnerships with local sawmills, woodworkers, and carpenters would be an important early goal of this program, while creating a market for the finished goods will be an ongoing goal.



Urban timber can be utilized to mill wood into a large variety of products including dimensional lumber, fine furniture, and artisan pieces. In order to successfully upcycle urban timber into usable lumber, several steps must be followed in order to produce logs suitable for milling. Urban timber production will include specifications for tree removal operations that will produce saw logs of the proper dimension and quality. Specifications for the construction of public buildings that require a specified amount of upcycled, local urban timber may qualify for LEED certification points, and raising awareness of the benefits of the urban forest in general, creating a saleable product that can serve as a revenue stream. A sample Urban Timber Harvesting specification in Appendix M.

Strategic Partnerships



Strategic partnerships are a very effective means of getting forestry projects funded when tax funding may present a shortfall, or when additional volunteer labor is needed. These typically involve either public-private partnerships or partnering with other public entities. Typically, the organizations seen participating in these programs include local garden clubs, scout groups, rotary clubs, businesses, state departments of natural resources, and other such groups. This will be an ongoing goal, and continuing partnerships with new organizations shall always be sought.

The Conservation Foundation

The Conservation Foundation is one of the region's oldest and largest not-for-profit land and watershed conservation organizations dedicated to preserving and restoring open space, protecting rivers and watersheds and promoting stewardship of the environment in northeastern Illinois. The Foundation helps to manage areas such as Dayton Bluffs in Ottawa where conservation-minded land is preserved. The Conservation Foundation has a wealth of knowledge & resources and are worth reaching out to for partnership in accomplishing the goals of this plan.



Openlands TreeKeepers

Openlands is a highly diverse NPO in the Chicagoland area which focuses on many aspects of ecology in the urban and suburban environment such as natural areas, urban forestry, wetland conservation, and other such topics. They have a vast network of connections around the area, and also offer various instructive programs, such as the TreeKeepers program, which educates residents on the care of young trees, tree biology, and the like.



Illinois Department of Natural Resources

The IDNR's Urban and Community Forestry program is how Ottawa was funded for this UFMP. The IDNR's mission is to protect, perpetuate, restore, conserve, and manage the forest and related resources of Illinois, both public and private. To that end, they have an abundance of resources, staff, and a network of partners which can help Ottawa accomplish the goals laid out in this plan, including additional funding for such things as tree planting or local education and outreach.



Morton Arboretum

The Morton Arboretum, aside from being a wonderful place to visit to learn about trees, also has significant educational and operational resources available. As the overall administrator on the grant which funded this project, they have a vested interest in seeing it succeed and have already assisted Ottawa in forestry related endeavors. They also offer educational programs and a whole host of other services which can make this plan a success.



Ottawa Garden Club

The Ottawa Garden Club promotes an interest in gardening and the beautification of the landscape in the community. The Club is active in the community and in partnership with local organizations it contributes to the beauty of Ottawa through donations and volunteer service. Trees are an essential part of gardening, and spreading the word about the importance of trees can be accomplished through local volunteers like those at the Garden Club and may serve as a resource for education and other environmental initiatives.



Ottawa Elementary School District/Ottawa Township High School

Urban Forestry is by and large a fairly unknown profession, but there are many aspects of STEM concepts that go into it: GIS Mapping, chemistry, physics, biology, and math are all essential facets of Arboriculture. A relationship with local school districts could be a reciprocal relationship, where students could engage in study projects based around trees, citizen science, and volunteerism, and Ottawa staff or urban forestry consultants could provide guest lectures to the students in any of these areas and develop interest in or even promote careers in the green industry.



Reddick Public Library District

The local public library is a place where people congregate and learn. As such this would be a first-rate locations to advertise opportunities for education about urban forestry, as well as stocking and showcasing books related to urban forestry and its related disciplines.



Chicago Region Trees Initiative

CRTI is actually an amalgamation of many groups acting together as a driving force for establishing the importance of urban forestry in the Chicagoland area and abroad. CRTI has several working groups which handle topics such as forest composition, risk management, communications, etc. They are always looking to partner with local communities to get tasks accomplished and publicized, so they will be a first-rate resource for accomplishing the goals laid out in this plan.



Personnel

In order to streamline Urban Forestry Operations, tasks will be assigned to various staff and contractors/consultants.

Tree Board

The Tree Board as established by Ordinance is the steward of this Urban Forestry Management Plan. As the representatives of the residents of Ottawa, the Board is tasked with ensuring the proper oversight of the Urban Forest so that all residents can realize its benefits. The Board will be composed of a minimum of 5 and a maximum of 9 members and can be tasked with making informed decisions to bring to the City Council as it pertains to decisions affecting the Urban Forest. The Board may seek guidance from the Council, Forestry Consultant, and the City Arborist, and uses its opinions and independent research to make decisions. The Board is responsible for periodically updating the Urban Forestry Management Plan based on new information and new Board Members.

City Arborist

The City Arborist is responsible for implementing forestry programs with the approval and cooperation of governmental jurisdictions in Ottawa. This position or his or her designee will seek bids from qualified Tree Care Contractors to complete the work approved by the various agencies, as well as maintain the tree inventory when possible, and act as a representative for public concerns. At the request and/or approval of the Council and/or Board, the duties of the City Arborist may be performed by the Forestry Consultant, however, the Boards and/or Council will be tasked with ensuring that no conflict of interest exists in doing so.

Tree Care Contractors

Tree Care Contractors are responsible for performing work identified by City Arborist, Tree Board, or Forestry Consultant in a timely, safe, and expeditious manner. The Tree Care Contractor must have at least one International Society of Arboriculture Certified Arborist on site when work is being performed. The contractors will also guide and participate in the performance of Tree Trimming, Pruning, Removal, and Plant Health Care operations. Other operations, such as Tree Planting, Tree Watering, and Tree Mulching do not have to be performed under the direct supervision of a Certified Arborist.

Forestry Consultant

The Forestry Consultant is responsible for impartially assessing the tree population on an a periodic basis, at the discretion of the Board and the City Arborist. The Forestry Consultant communicates the needs of the trees to the Board and the City Arborist so that individual needs in terms of tree planting, removal, and maintenance can be performed. The Forestry Consultant may also function as the City Arborist during periods of the City Arborist's absence at the request of the City.

Community Development Staff

Community Development staff will exercise authority related to planning of large scale programs related to the Urban Forest, with the assistance and guidance of the Tree Board and Urban Forestry Consultant.

Director of Public Works and Assistant Superintendent of Public Works

Director of Public Works and Assistant Superintendent of Public Works or their designee will exercise authority related to decision-making concerning pruning or removal of Parkway Trees.

Ordinance Enforcement Officer

An Ordinance Enforcement Officer will exercise authority related to enforcing the existing and proposed changes to the City Code and Ordinances as referenced by this document.

State of the Urban Forest

Using the tree inventory data collected for the City of Ottawa, it was determined that there are a total of 5,343 trees and 151 stumps on City Owned Right Of Ways, along with 323 open planting spaces that were inventoried. The charts and statistics in this portion of the Management Plan illustrate that the tree population in Ottawa can be characterized as being in overall below average condition and the stocking density is very good, at 91.8%. The species diversity in Ottawa is high with 120 individual species represented. Based on the following data in the Management Plan, the City of Ottawa will be equipped to use this valuable information to address short term concerns, long term management considerations, and overall planning objectives.

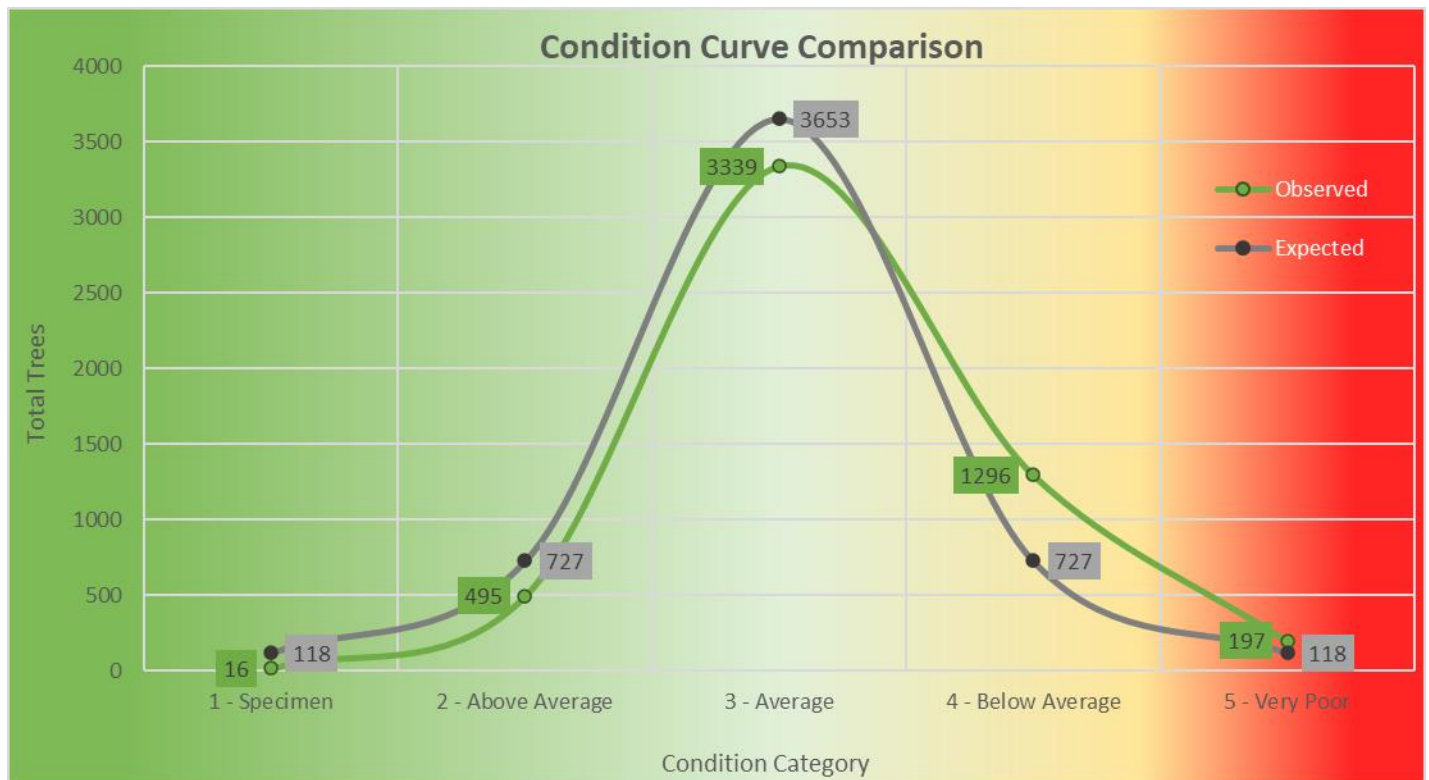
Basic Statistics – Managed Trees

Number of Trees Inventoried	5,343
Number of Stumps Inventoried	151
Number of Planting Spaces Inventoried	323
Total Number of Species	120
Total Diameter Inches	84,408"
Average Tree Diameter	15.80"
Average Tree Condition	3.22 (Below Average)
Average Mature (8" and up) Tree Condition	3.21 (Below Average)

Condition Statistics

During the tree inventory, the condition of each tree was rated using a 1-5 rating system. The rating criteria is as follows:

Condition 1	Specimen – Tree has no observable defects, wounds, diseases, and has perfect form for the species. Since younger trees are generally trouble free, a condition 1 tree must by the Forestry Consultant's definition be greater than 16" DBH. These are legacy trees, and as such are rare.
Condition 2	Above Average – Tree may have a small amount of deadwood, or a very limited number of minor defects. The overall form of the tree must be good, and consistent for the species. These trees, by the Forestry Consultant's definition, must be larger than 8" DBH.
Condition 3	Average – Tree has moderate amounts of deadwood, wounds, or other defects, but is generally healthy. A wide variety of forms is acceptable for this group, which is meant to define the middle ground around which better or worse trees can be defined.
Condition 4	Below Average – Tree has defects, deadwood, wounds, disease, etc. which are likely to cause a need for removal. Very poor form or architecture can put an otherwise healthy tree in this category as well.
Condition 5	Very Poor – Tree must be removed. Defects are too far advanced for the tree to be reasonably saved. Like condition 1 trees, these are rare, as generally trees approaching this level are removed before they deteriorate to this level.



The chart above represents the distribution of trees in each of the 5 categories. We have included the tree condition ratings we observed in the field, as well as a curve representing an “average” distribution so that comparisons can be made. The green line represents what we observed in the field, and the grey line represents an average or “normal” tree population.

The Condition 1, or specimen trees, were lower than would be predicted by the standard distribution alone, but we always expect that the specimen trees (and often Condition 5 trees as well) will come in lower than their statistical norm because of their rarity. A Condition 1 tree, by definition, must be at least 16” DBH (and generally much larger), have textbook perfect architecture for the species, and have no observable defects. Over half (57%) of Ottawa trees have a DBH less than 16” and are not eligible for the Condition 1 category. As younger trees are planted in sites with adequate growing space, and if they are properly pruned and maintained, they should develop with good structure and may mature to become Condition 2 and eventually Condition 1 trees.

The Condition 5, or very poor trees, are above the expected norm. It is recommended that Condition 5 trees be prioritized and removed in a timely manner.

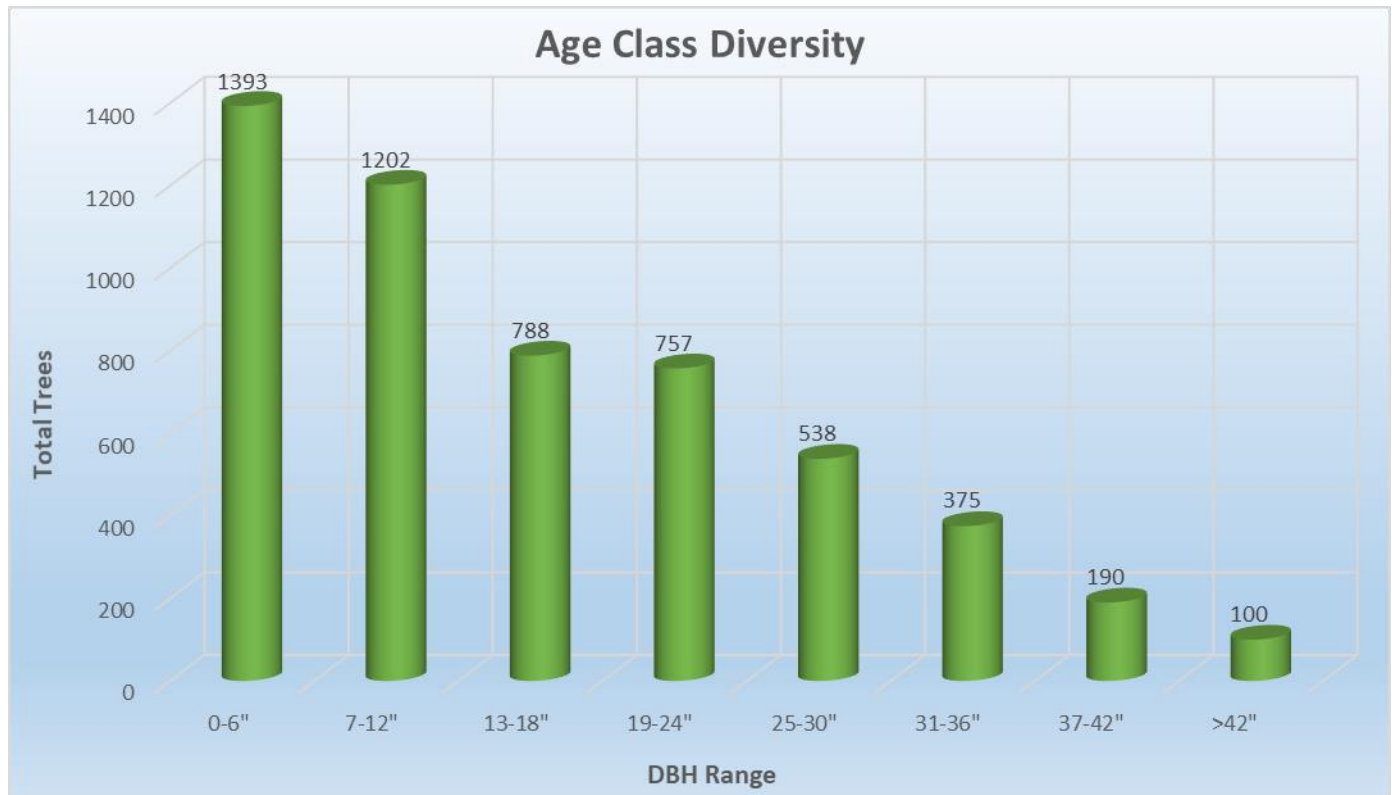
The Condition 2, or above average trees, are much lower than what statistical analysis would predict. Similar to the Condition 1 category, Condition 2 trees need to have good structure that is consistent with the species in question, be free of major defects, and also be over 8” DBH. Many of the trees in Ottawa that were eligible for a Condition 2 rating did not meet these standards. Looking toward the future, Ottawa has an opportunity to increase the number of trees in the Condition 2 category.

In general, if trees are properly planted, mulched, watered and established, and site selection for the trees is well matched to the species, followed with cyclical pruning and maintenance, trees will often mature with good form and without significant defects. These trees can eventually become Condition 2 trees.

The Condition 4, or below average trees, were quite a bit higher than what would be statistically expected. This data represents the significant number of overgrown, storm damaged, and aging trees that have developed structural defects, decay, and deadwood. Ottawa can use the data from this inventory to locate Condition 4 trees and prioritize them for maintenance or removal. Ottawa can look to further decrease this number over the next few years as they move forward and attend to issues that have been identified.

The trees in the Condition 3, or average, category are lower than the expected norm. The reason for this is the high number of trees in Category 4 due to overgrown, aging and storm damaged trees. As those trees are maintained, or are removed and replaced, the number of Category 3 trees will increase, improving the overall average condition of the City’s trees.

Age Class Analysis



In terms of the ages of trees in Ottawa, we have split the tree population into 8 “classes” of 6” diameter increments. This tells us how many trees are in each “age class”. Because trees are measured by Diameter at Breast Height (DBH) as a standard measure, this breakdown can help show where trees are in their life cycles. Some trees like Cottonwood and Silver Maple grow in diameter very quickly, up to 1” per year or possibly more. Other slower growing trees such as Oak and Hickory may only add ¼” or less every year. As a broad generalization, it can be said that most trees on average grow at around ½” per year.

This age class analysis chart illustrates a somewhat typical trend in the overall age spread of a tree population seen in a municipal setting. Often, we see many trees being younger to middle aged and a relatively lower number of trees in the older age categories. The Ottawa tree population is largely young with nearly half of the tree population measuring less than 13” DBH, an indication of relatively recent commitment to continual tree planting, as evidenced by the number of trees in the 1-12” ranges. As shown above, 26% of the total population has a DBH of 6” or less which we generally consider to be less than about 15 years old. Just over 22% of Ottawa’s trees have a DBH of 7-12” which are generally considered to be about 15-25 years old. The 13-18” DBH category makes up 15% of the population and is considered to be approximately 25-35 years old. The 757 trees (14%) in the 19-24” DBH category are generally mature trees over 35-45 years old.

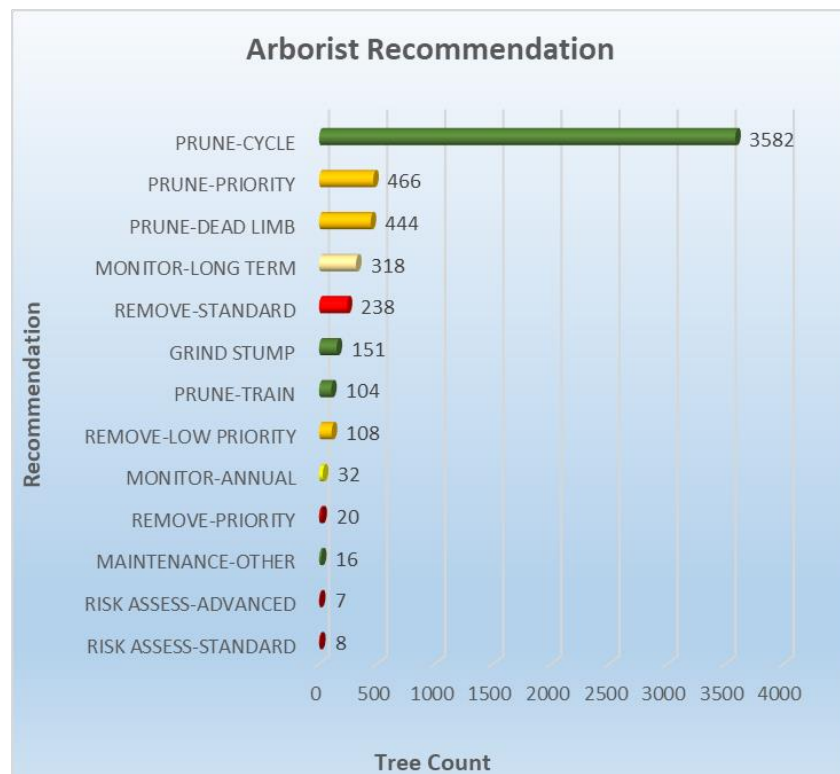
Trees measuring over 24" DBH account for 23% of the total tree population. The 1,203 trees in the 25" + DBH categories are considered to be about 45+ years old. Many of these may be nearing the end of their natural life. Almost 40% of these trees are in Below Average or worse condition. Trees in the 30" + categories are often in poorer condition due to the natural senescence and decline of trees in urban settings. The lower condition ratings were likely also exacerbated by the storm damage these trees experienced in the recent past.

A fairly equal number of trees in each age classification is, within reason, desirable and indicative of a consistent focus on tree planting and tree maintenance in Ottawa over the years and shows that the right trees are being planted in the correct locations. As the younger trees continue to grow, Ottawa will have an opportunity, over time, to bring the tree age classes to a more balanced level. Going forward, Ottawa should continue to take a targeted approach when it comes to choosing new species to plant on its parkways and focus on planting a wider variety of tree species and genera.

The table of Ottawa's population growth since 1920 is shown at the right, and it is apparent that the growth in the number of trees on the City ROWs increases around the same time as the population of the City was increasing. For the City, population growth spiked between 1920 and 1960. This corresponds with the increase in tree planting between 25-30" diameter inches ago, which equates to 50-60+ years ago, in tree terms!

Year	Population Size
1920	10,816
1930	15,094
1940	16,005
1950	16,957
1960	19,408
1970	18,716
1980	18,166
1990	17,451
2000	18,307
2010	18,768

Arborist Recommendation / Maintenance



During the inventory, the Forestry Consultant's staff recorded an Arborist Recommendation for each tree which outlines what maintenance work needs to be performed in the coming years.

In terms of Arborist Recommendations of maintenance needs in the Ottawa tree population, the statistics displayed above show that one-third of the population is recommended for a mitigation other than cycle prune. Most importantly, 366 trees are recommended for removal. The 366 trees in the "Remove" sets include a variety of tree species which have declined or developed structural defects and are beyond the point of salvaging. Many of these trees are aging trees in various stages of retrenchment, which is the natural die back of a tree's crown due to old age. The 20 Priority Removals should be prioritized over other removals. The 238 trees designated as standard removals should be prioritized and removed in a timely manner. The 108 trees in the low priority category should be removed as time and budget allow. The remaining categories, other than removals discussed above, were used to indicate trees in need of maintenance which should be prioritized over those in the Cyclical Prune category and will be discussed briefly below.

The 466 trees in the "Prune-Priority" group and the 444 trees in the "Prune-Dead Limb" group are trees which are simply overgrown or have parts which need to be removed promptly and should have pruning prioritized over the trees in the cyclical prune set. Generally, we consider this to be a "within 1-3 years" level of pruning.

The 350 total trees in the "Monitor" categories can be viewed as being in a transitional phase. For the most part, these trees show signs of potentially developing issues or general decline which must be observed. These trees should be reassessed periodically, and their maintenance status updated.

Trees categorized as "Prune-Train" are typically trees smaller than 8" DBH and have structural issues or are overgrown and require selective pruning to establish better architecture in the future.

Establishment pruning, or the pruning of young trees to establish proper branching habit and structure, is one of the least expensive yet most effective maintenance items that can be performed on a young tree.

The 16 trees in the "Maintenance-Other" category typically need some other form of maintenance not covered in the rest of the categories. A description of the maintenance needed should be found in the comments field. The trees designated as "Risk Assessment" recommendations are discussed below.

Risk Assessments

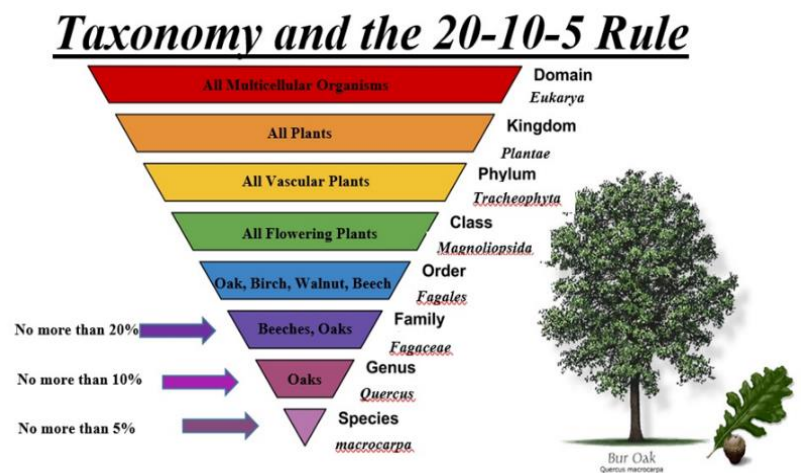
Each tree inventoried was subject to a rapid tree risk assessment. The International Society of Arboriculture has a professional qualification program called "TRAQ" (Tree Risk Assessment Qualification) which uses specific information for assessing how much risk a tree poses. The Forestry Consultant's staff used a rapid tree risk assessment based on this protocol. Such rapid assessments are used in applications such as disaster relief assessments after extreme weather events where tree risk must be documented, but time frames are very short. For this reason, we must state unequivocally that these assessments are NOT meant to be legally binding, and do not represent a full TRAQ evaluation of the level of risk individual trees may pose.



As illustrated in the chart above, 622 trees were found with some observable risk level. The City was notified immediately of the eight trees that were found with critical risk so that mitigating actions could be taken. Trees that fall into the substantial or critical risk level category should receive a Level 2 Risk Assessment and/or mitigating action. Any tree found to pose an elevated risk level should be monitored and/or inspected by Ottawa and a threshold of risk tolerance be established. Some of elevated risk level trees may also be considered for a Level 2 Risk Assessment and/or mitigating action. Great Lakes Urban Forestry Management would be pleased to assist Ottawa in any aspect of developing or managing a Tree Risk Assessment Policy or performing Level 2 Basic Risk Assessments or Level 3 Advanced Risk Assessments.

Diversity Analysis

Taxonomy is the method by which scientists classify plants, animals, and other life forms into distinct categories. A species is unique. There is only one type in that category, such as Burr Oak (*Quercus macrocarpa*), which refers to only one specific type of tree. A genus, however, is a group that may contain multiple species. All Oak trees, for instance, are in the genus *Quercus*. The further down the taxonomic ladder you go, the more similar things become.



The more similar tree species are to each other, the higher the likelihood that an insect or pathogen can exploit every species of that genus. Emerald Ash Borer is a classic example of this, as it affected every tree species in the ash genus. The most effective prevention of tree loss we have is to limit the number of trees planted that a new pest or pathogen can affect. While diversity at the species level is important, it is also important to achieve diversity on the genus and family levels, so that a large selection of trees are planted.

The “20-10-5” rule for Ottawa’s future tree plantings is recommended, which states that no more than 20% of any one family, 10% of any one genus, and 5% of any one species shall be planted during any one planting cycle. It will also be a long-term direct goal of the forestry program to have the tree population as a whole in compliance with the 20-10-5 Rule, although it may not be possible by the 2032 date used in this document. This level of taxonomic diversity is consistent with today’s arboricultural industry standards (see above graphic).

The old paradigm of urban forestry was to create tree lined streets and parks in which every tree was the same type, shape, age, and height. This was thought to produce a uniform appearance. Urban foresters have now learned that once a pest or pathogen is introduced into a monoculture planting such as this, an epicenter of infestation is created that may cause serious damage, both ecologically and financially. Diversity in the urban forest helps to prevent and reduce the impacts of pests and pathogens. There are three aspects of diversity in the urban forest. We will examine these in detail, below.

Taxonomic (Species) Diversity

Why is it important to plant a diverse set of trees at the species, Genus, and Family levels? Simply put, it is to ensure that we will not fall victim to mass tree loss from pests and pathogens in the future. The reason Emerald Ash Borer (EAB) was such a devastating expense for many organizations was because their tree populations were composed of over 20% Ash trees. When these trees died and had to be removed, those organizations lost 20% of their trees.

This comes with the obvious expenses of having to remove these trees and replace them. But it also comes with hidden expenses as well, namely the loss of the ecological services that those trees provided: Homes cost more to heat and cool, storm water infrastructure falls under heavier pressure, and increases in pollutants and greenhouse gases may be observed. For all of these reasons, a more diverse group of trees needs to be planted, such that we are never at risk of losing more than 5-10% of our trees at any given time due to a pest or pathogen.

As will be discussed in further detail below, the tree population in Ottawa is by far dominated by Maple species. In decreasing numbers, the remaining top 5 include Oak, Hackberry, Honeylocust, and Crabapple.

Spatial Diversity

Spatial diversity is the concept of mixing tree species over the whole geographic area. The easiest way to slow the spread of any new pest or pathogen is to increase the distance between potential host trees. Every pest or disease, such as EAB or Dutch Elm Disease (DED), has a limited area to which it can spread in a given time frame. The more difficult it is to get to the next host tree, the less of a problem the pest or pathogen becomes, and the easier quarantine becomes.

In addition to the functional benefits provided by increasing spatial diversity, organizations which have implemented diverse planting over the past several decades have demonstrated that such diversity yields an arboretum-like landscape that is both functional and aesthetically pleasing. At present, the Spatial Diversity in Ottawa is moderate. During the tree planting planning phase, extra care should be taken to ensure that new plantings are done in a manner that yields a highly spatially diverse tree population, and creation of areas of low spatial diversity (monocultures) will be avoided.

Age-Class Diversity

Age-class diversity is also an important consideration. A healthy natural forest has trees of many ages. Young, intermediate and mature trees allow for regeneration, replacement and vigor in the overall forest community. A mixture of tree species, locations, and ages will lead to great diversity, which insulates a natural forest against pest and pathogen outbreaks. The Urban Forest is no different. The outdated urban forestry paradigm promoted even-aged tree plantings, so that all trees were approximately the same size and age. However, once these trees begin to decline, most will require removal and replanting simultaneously. This can leave an entire street segment or neighborhood without shade and aesthetics for a long time.

The current approach of the urban forestry community is to strategically plant trees on streets or in neighborhoods over a longer timeframe. With this strategy, trees will grow to maturity in different stages, and decline at different times. When declining trees are eventually removed, there will always be a variety of age classes and tree sizes on a block or in a neighborhood. This reduces the pressure to plant trees in an area immediately after tree removal, helping to manage costs. A mixed age-class planting ensures that mature trees are always present in a neighborhood. It also will allow for strategic planting of smaller or medium sized trees.

An additional benefit of mixed-age plantings is the ability to plant shade-loving trees as well as sun-loving trees. When a street or neighborhood is newly planted with trees of the same age, all the trees are essentially in full sun. This reduces the ability to plant shade loving trees, as they have a tendency to dry out in the summer sun. With mixed-age stands, shade-tolerant, trees may be planted underneath the canopy of larger, mature trees. This approach will be used for future tree removal and replacement, and help to create an Urban Forest that has mature trees, middle aged trees, and young trees in similar quantities.

Current Tree Population

<u>SPECIES</u>	<u>COUNT</u>	<u>% OF TOTAL</u>	<u>AVG DBH</u>	<u>AVG COND</u>
AILANTHUS	6	0.11%	28.00	3.50
ALDER-SPP	6	0.11%	6.33	3.33
AMERICAN HORNBEAM	28	0.52%	5.21	3.18
AMERICAN REDBUD	130	2.43%	7.28	3.29
AMUR CORKTREE	1	0.02%	8.00	3.00
APPLE-CRAB SPP	248	4.64%	7.40	3.20
APPLE-EDIBLE	9	0.17%	6.44	3.11
APRICOT	2	0.04%	12.50	3.50
ARBOR VITAE	10	0.19%	13.30	3.20
ASH-BLACK	1	0.02%	16.00	3.00
ASH-GREEN	16	0.30%	13.50	4.13
ASH-WHITE	12	0.22%	11.75	3.58
ASPEN-QUAKING	3	0.06%	11.33	3.67
BALDCYPRESS	32	0.60%	9.69	2.97
BIRCH-GRAY	3	0.06%	10.67	3.00
BIRCH-RIVER	24	0.45%	16.50	2.71
BIRCH-WHITE	12	0.22%	9.75	3.00
BLACK LOCUST	27	0.51%	25.81	3.96
BLACKGUM	1	0.02%	2.00	3.00
BOXELDER	2	0.04%	22.50	4.00
BUCKEYE-OHIO	10	0.19%	18.90	3.70
BUCKTHORN	2	0.04%	8.00	3.50
BURNING BUSH	1	0.02%	9.00	3.00
CATALPA	66	1.24%	25.74	3.41
CHERRY-BLACK	8	0.15%	16.88	3.88
CHERRY-SPP	31	0.58%	6.48	3.26
COTTONWOOD	6	0.11%	52.00	2.50
DOGWOOD-PAGODA	2	0.04%	1.00	3.00
DOGWOOD-SPP	8	0.15%	5.63	3.13
DOUGLAS FIR	20	0.37%	7.40	3.55
EASTERN REDCEDAR	30	0.56%	15.03	3.17
ELM-AMERICAN	76	1.42%	19.86	3.16
ELM-CHINESE	2	0.04%	29.50	3.50
ELM-HYBRID	108	2.02%	8.40	2.93
ELM-RED	3	0.06%	16.33	3.00
ELM-SIBERIAN	120	2.25%	24.62	3.77
EUROPEAN HORNBEAM	1	0.02%	3.00	3.00
FIR-CONCOLOR	14	0.26%	9.71	3.36
FIR-SPP	3	0.06%	3.00	3.00
GINKGO	110	2.06%	4.87	3.09

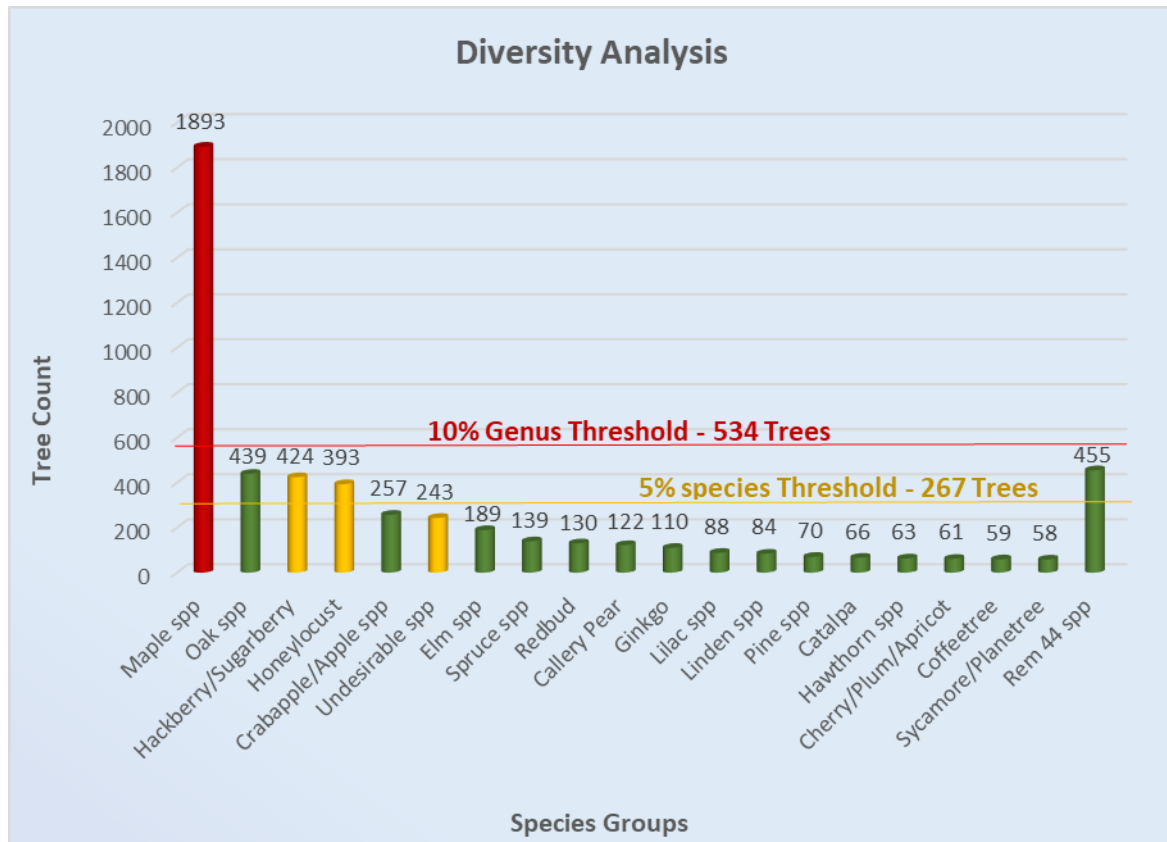
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GOLDEN RAINTREE	1	0.02%	1.00	3.00
HACKBERRY	423	7.92%	24.82	3.14
HAWTHORN-COCKSPUR	27	0.51%	7.15	3.04
HAWTHORN-SPP	16	0.30%	10.69	3.25
HAWTHORN-WASHINGTON	20	0.37%	10.85	3.30
HICKORY-BITTERNUT	3	0.06%	12.00	3.00
HONEYLOCUST	393	7.36%	15.46	3.30
HONEYSUCKLE	4	0.07%	13.00	3.00
HORSECHESTNUT	3	0.06%	13.33	3.00
HYDRANGEA-TREE	1	0.02%	1.00	4.00
IRONWOOD	8	0.15%	5.63	2.88
KATSURA	4	0.07%	4.00	4.25
KENTUCKY COFFEETREE	59	1.10%	4.56	3.15
LILAC-SHRUB	5	0.09%	8.80	3.00
LILAC-TREE	83	1.55%	3.73	3.12
LINDEN-AMERICAN	43	0.80%	22.16	3.00
LINDEN-LITTLELEAF	36	0.67%	12.78	3.19
LINDEN-SILVER	5	0.09%	21.20	2.60
LONDON PLANETREE	14	0.26%	3.93	3.43
MAGNOLIA-SAUCER	9	0.17%	11.67	3.00
MAGNOLIA-SPP	17	0.32%	7.00	3.24
MAGNOLIA-STAR	4	0.07%	7.00	3.25
MAPLE-AMUR	19	0.36%	13.42	3.05
MAPLE-AUTUMN BLAZE	231	4.32%	8.75	3.06
MAPLE-BLACK	14	0.26%	20.86	3.07
MAPLE-HEDGE	34	0.64%	5.68	3.09
MAPLE-JAPANESE	12	0.22%	3.33	3.25
MAPLE-MIYABEI	47	0.88%	6.49	2.89
MAPLE-NORWAY	410	7.67%	16.62	3.30
MAPLE-PAPERBARK	1	0.02%	6.00	3.00
MAPLE-RED	217	4.06%	11.74	3.09
MAPLE-SILVER	673	12.60%	28.13	3.35
MAPLE-SPP	2	0.04%	8.00	5.00
MAPLE-SUGAR	227	4.25%	18.12	3.14
MAPLE-TATARIAN	6	0.11%	16.33	3.67
MULBERRY-SPP	35	0.66%	21.11	3.91
OAK-BEBB	7	0.13%	9.14	2.71
OAK-BURR	69	1.29%	16.38	2.97
OAK-CHESTNUT	4	0.07%	13.75	2.75
OAK-CHINQUAPIN	10	0.19%	14.30	2.70
OAK-ENGLISH	7	0.13%	8.00	2.57
OAK-PIN	48	0.90%	27.02	2.96

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OAK-RED	127	2.38%	12.06	3.14
OAK-SAWTOOTH	1	0.02%	21.00	3.00
OAK-SCARLET	1	0.02%	33.00	5.00
OAK-SHINGLE	7	0.13%	9.14	2.71
OAK-SHUMARD	1	0.02%	3.00	3.00
OAK-SPP	2	0.04%	2.50	3.00
OAK-SWAMP WHITE	119	2.23%	6.42	3.02
OAK-WHITE	36	0.67%	19.56	2.72
PEAR-CALLERY	122	2.28%	10.75	3.33
PINE-AUSTRIAN	18	0.34%	8.61	3.28
PINE-MUGO	8	0.15%	4.75	3.00
PINE-RED	6	0.11%	9.83	3.67
PINE-WHITE	38	0.71%	13.42	2.97
PLUM-SPP	28	0.52%	7.25	3.43
POPLAR-LOMBARDY	2	0.04%	18.50	5.00
POPLAR-SPP	4	0.07%	16.25	2.50
POPLAR-WHITE	2	0.04%	35.00	3.00
ROSE OF SHARON	2	0.04%	4.50	3.00
SERVICEBERRY-SPP	53	0.99%	4.21	3.40
SEVENTH SON FLOWER	3	0.06%	7.00	3.00
SMOKETREE	2	0.04%	4.50	3.00
SPRUCE-BLUE	99	1.85%	12.41	3.29
SPRUCE-NORWAY	11	0.21%	9.73	3.36
SPRUCE-SPP	7	0.13%	11.00	4.43
SPRUCE-WHITE	22	0.41%	5.91	3.14
SUGARBERRY	1	0.02%	13.00	2.00
SUMAC	3	0.06%	3.33	3.00
SWEETGUM	21	0.39%	9.62	3.00
SYCAMORE	44	0.82%	29.57	2.75
TULIPTREE	30	0.56%	9.20	3.00
UNKNOWN	8	0.15%	11.50	3.75
VIBURNUM	2	0.04%	2.00	4.00
WALNUT-BLACK	36	0.67%	21.78	3.17
WALNUT-WHITE	4	0.07%	19.25	4.00
WILLOW-SPP	10	0.19%	24.70	3.50
WILLOW-WEEPING	15	0.28%	23.33	3.53
YELLOWWOOD	1	0.02%	9.00	4.00
YEW	2	0.04%	14.00	3.50

As shown in the table above, the City of Ottawa Tree population consists of 120 distinct tree species, accounting for 5,343 total trees. The above table shows the percent of the total population each species makes up, as well as the average Condition and Trunk Diameter. To see which trees are performing well, we would look for trees with a Condition rating of less than 3 and with a large DBH. This population is shown graphically below:



As can be seen above, the tree population in Ottawa is impressive overall, but by far is dominated by Maple species. In decreasing numbers, the remaining top 5 include Oak, Hackberry, Honeylocust, and Crabapple. From there, the number of tree species representing more than 1% of the total tree population drops off steadily. It should generally be said that reducing the number of Maples overall while increasing lesser represented species should be a strategic goal, and our Diversity Vision will help to accomplish this. Additionally, the Hackberry population is over-mature and this plan calls for their reduction in numbers.

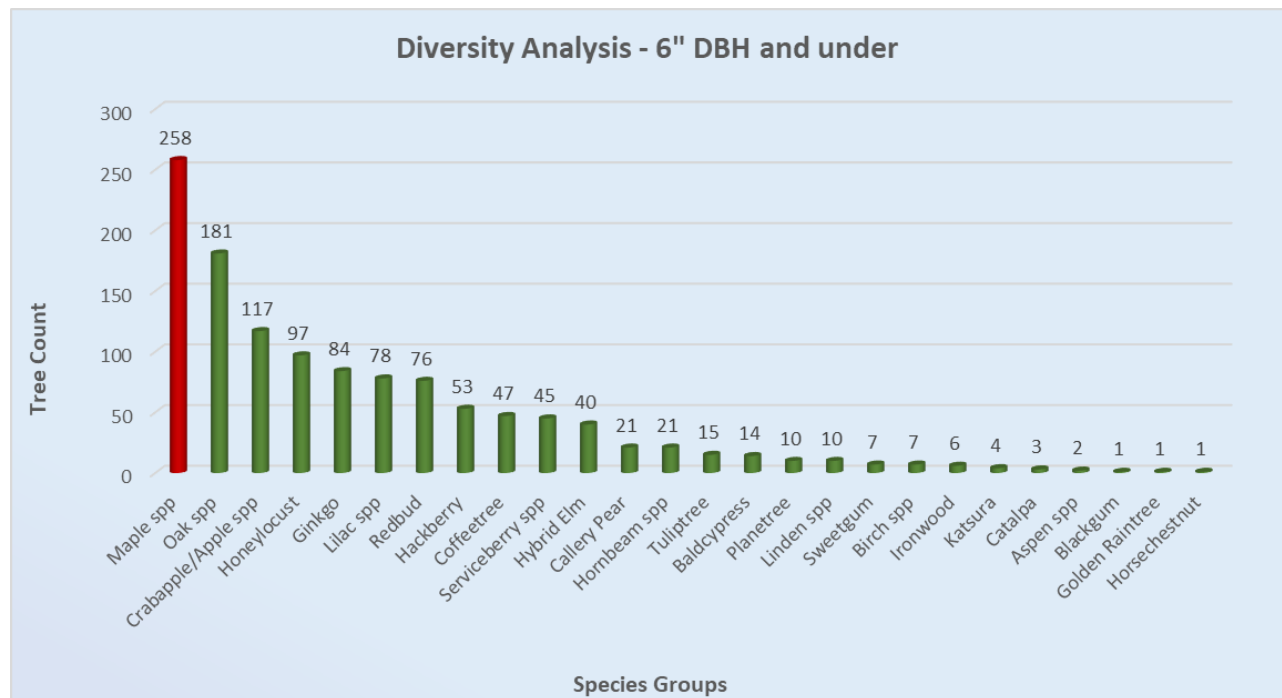
A long term tree planting plan would be an invaluable tool for Ottawa to pursue in the future. Such a plan would not only further improve overall diversity, but also maximize the lifespan of trees on the ROWs by carefully matching tree species requirements and tolerances with each individual planting site. Trees that are well adapted to their growing conditions will establish more quickly, require less maintenance, be healthier overall, and more resistant to disease and insect problems. By matching the right trees with the right planting spaces using a tree planting plan, the City of Ottawa can help protect its investment in each new tree.

Going forward it is recommended that the City sets a goal to limit widespread planting of Maple species and to opt for improved varieties of Maple species when absolutely necessary.

Additionally, the 243 trees in the “Undesirable spp” category include trees such as Ailanthus, Boxelder, Buckthorn, Black Cherry, Cottonwood, Siberian Elm, Honeysuckle, Mulberry, Poplar spp, and Willow spp. These trees are known for either being invasive or weak-wooded trees that often develop a variety of structural defects as they mature. For safety, aesthetic, and ecological reasons, it is recommended that the City set a goal of gradually reducing the number of undesirable trees on its parkways and replanting them with a diverse set of tree species to increase overall diversity and improve tree population stability.

Although Ottawa’s diversity is high overall (with the exception of the Maples), the City has a number species to choose from which are commercially available and underrepresented in their population. As mentioned above, the Urban Forest Management Plan will lay out strategies to even further improve diversity, and we will examine the specific species recommended in the “Future of the Urban Forest” Section below.

Young Tree Diversity



This Management Plan has spent time discussing the existing diversity, however it should be noted that the diversity of more recent plantings has been improved, as can be seen from the chart showing trees 6" in diameter and less above. This chart represents the trees planted in approximately the last 10 years. It is important to note that Maples continue to dominate the species chosen. It is important to reiterate that the City should make it a goal to significantly limit new Maple plantings.

i-Tree Report / Urban Tree Canopy Assessment

i-Tree is a state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides Urban Forestry analysis and benefits assessment tools. The i-Tree tools help communities of all sizes to strengthen their forest management and advocacy efforts by quantifying the structure of trees and forests, and the environmental services that trees provide.

The i-Tree suite calculates hard dollar values that trees provide to communities. Trees provide “ecological services” that save homeowners money, such as in heating and cooling costs, where large trees help shade houses in the summer, saving on air conditioning and electricity bills, and provide windbreaks during the winter, saving on heating and natural gas costs. They also provide CO₂ uptake, reducing the effects of climate change, as well as air quality improvements by the absorption of urban pollutants. Trees also absorb stormwater, which reduces strain on stormwater infrastructure, and saves money in replacement costs. Finally, trees contribute up to 15% of the total value of a property, so they have monetary aesthetic benefits as well.

Using the data from the tree inventory, several i-Tree reports has been prepared the City of Ottawa. Below you will find reports on the Net annual benefits of the tree population, replacement values, and breakdown of benefits per species. We performed both the i-Tree Streets analysis which looks primarily at energy savings, and an i-Tree Eco analysis which focuses more on ecological benefits such as Carbon Storage and Sequestration. The results of these analyses are below, and full tables and i-Tree Reports are appended.

i-Tree Streets Analysis Results

Ottawa

Total Annual Benefits, Net Benefits, and Costs for Public Trees

7/26/2021

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	55,551 (N/A)	10.40 (N/A)	3.03 (N/A)
CO ₂	11,569 (N/A)	2.17 (N/A)	0.63 (N/A)
Air Quality	12,950 (N/A)	2.42 (N/A)	0.71 (N/A)
Stormwater	536,926 (N/A)	100.49 (N/A)	29.26 (N/A)
Aesthetic/Other	197,428 (N/A)	36.95 (N/A)	10.76 (N/A)
Total Benefits	814,424 (N/A)	152.43 (N/A)	44.38 (N/A)

Total Standing Value of Ottawa's Tree Population

\$8,062,021

(Per CTLA's 9th Guide to Plant Appraisal)

i-Tree Eco Analysis Results

- Number of trees: 5,343
- Tree Cover: 69.1 acres
- Most common species of trees: Silver maple, Northern hackberry, Norway maple
- Percentage of trees less than 6" (15.2 cm) diameter: 26.0%
- Pollution Removal: 2.006 tons/year (\$23 thousand/year)
- Carbon Storage: 4.127 thousand tons (\$704 thousand)
- Carbon Sequestration: 40.83 tons (\$6.96 thousand/year)
- Oxygen Production: 108.9 tons/year
- Avoided Runoff: 125 thousand cubic feet/year (\$8.35 thousand/year)
- Building energy savings: N/A – data not collected
- Avoided carbon emissions: N/A – data not collected
- Structural values: \$12.1 million

Total Standing Eco Value of Ottawa's Trees **\$12,804,000**

Total Annual Eco Value of Ottawa's Trees **\$51,153/year**

To summarize all of these values together, we have created the following summary table:

Annual Values	
Benefits to Residents	\$814,424/year
Benefits to Environment	\$51,153/year
SUBTOTAL (Each Year)	\$865,577/Year
Standing Values	
As a Commodity	\$8,062,021
As an Ecological Resource	\$12,804,000
SUBTOTAL	\$20,866,021

As can be seen from the above tables, the tree population in the City of Ottawa currently provides approximately \$865,577 in benefits every year, directly related to trees and their effect on homes, businesses, and the environment. It should be noted that the annual budget for all forestry activities recommended in this plan, projected for the calendar year 2032, will total approximately \$263,465 per year, so the benefits from the tree population are worth over 3 times more than what the cost put into them is. We will examine this further below. In addition, the total standing value as a commodity and an ecological resource of the whole tree population is \$20,866,021.

These benefits can be viewed as “income” to Ottawa’s residents, and so long as the trees are well maintained, they will continue to provide these benefits, and more. As trees grow, they also increase their benefits! For example, a 3” diameter tree provides less than \$50/year in benefits, whereas a 20” tree can provide up to \$500 per year. The goal is to increase benefits even more, where the tree population pays for itself and even yields “profits”!

The replacement value of trees was also calculated. Currently, the standing value of all trees in the City of Ottawa population is \$8,062,021. This value is calculated using the industry standard reference, the *9th Edition Guide to Tree and Landscape Appraisal*, which is published by the Council of Tree and Landscape Appraisers.

The i-Tree Eco data looks at the value of the trees in the absence of the effect of homes or businesses, and looks at trees more from an ecological perspective, mostly what the tree’s value is in sequestering and storing Carbon. These numbers are based on peer reviewed science in both Arboriculture as well as Climatology and other disciplines.

The goal of this Urban Forestry Management Plan is to create a tree population which maximizes all of these ecological services to Ottawa residents by increasing the number of trees in City, and how long they live, while minimizing costs in order to create a healthy, well maintained, and vibrant tree population.

Urban Tree Canopy Assessment

Based on data available from the US Forest Service and Morton Arboretum, the total Urban Tree Canopy of Ottawa can be determined. This is expressed as the percent of the City covered by tree canopy from an aerial view. This assessment included 7 total land cover types, including trees, grass and shrub, bare soil, water, buildings, roads/railroads, and other paved surfaces. The result of this tree canopy assessment was that Ottawa contains 27.28% total tree canopy. The map of the canopy assessment appears on page 35.

The tree inventory itself was only conducted on publicly owned land such as parkways and boulevards, etc. Detailed information on each tree is not included in this assessment, only total coverage.

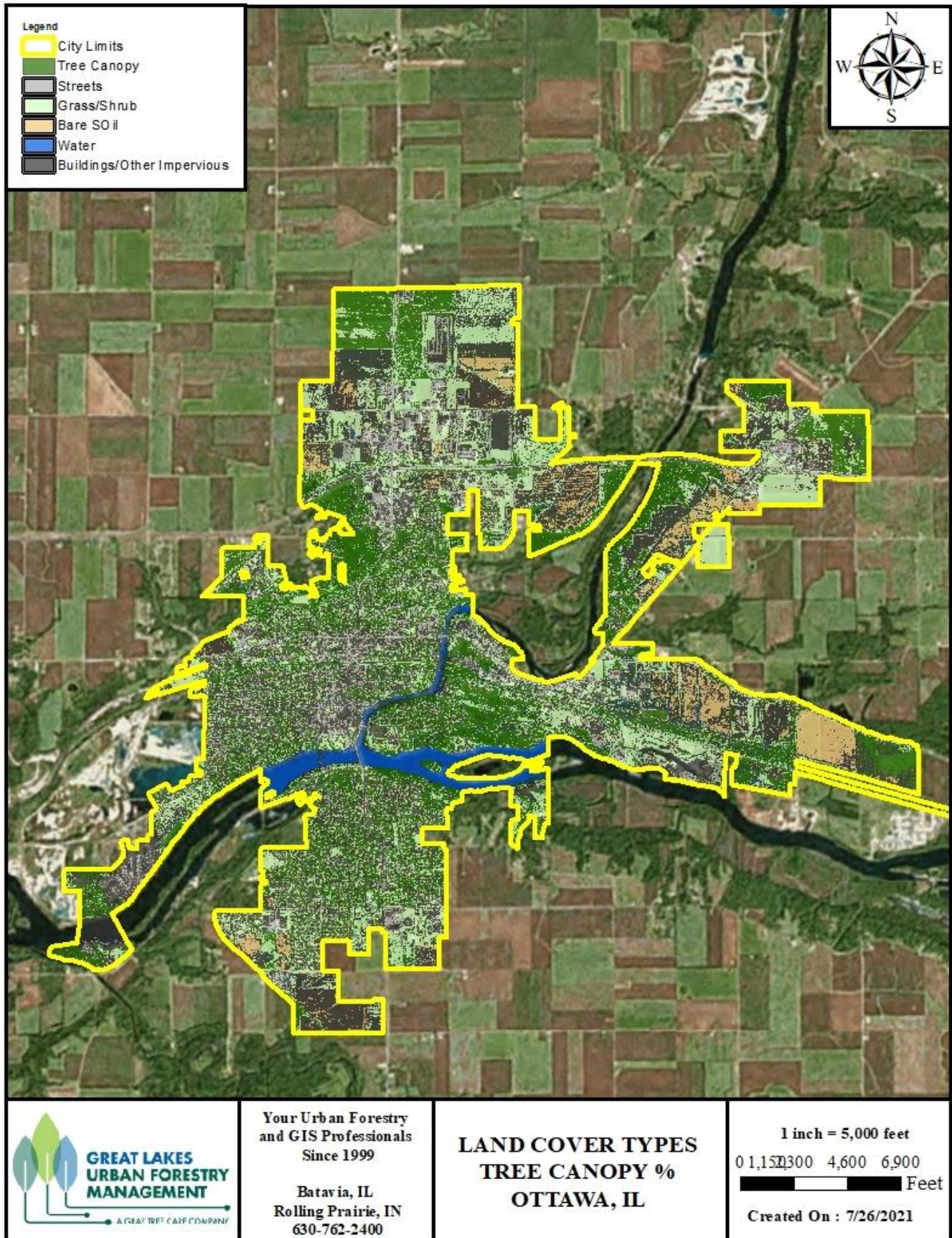
Land Cover Type	% Cover
Buildings/Impervious	33.33%
Tree Canopy	27.28%
Grass/Shrub	23.77%
Streets	7.23%
Bare Soil	5.20%
Water	3.19%

Aerial images were used to estimate how much tree and other land cover types were in the City using a software which is similar to Google Earth or other aerial imagery viewers.

The goal is to increase the total tree canopy in Ottawa to 29% by 2032. This goal has been estimated by analyzing data from many different urban tree populations in the Chicago and Northwest Indiana regions, and is based on preliminary data from the Chicago Region Trees Initiative's (CRTI) Forest Composition Workgroup.

We believe this is an attainable goal over this time period. Ottawa as a whole has an overall considerable amount of tree canopy, and it is fairly average compared to other similar communities. The goal set is a modest, but reasonable, increase, which will still yield beneficial results.

This will be accomplished through increasing the number of trees in the parks, municipal campuses, schools, and on the parkways. It will also be accomplished by maintaining the existing tree population in a proactive fashion, by enhancing the Urban Forestry program in Ottawa. This will ensure that existing trees will live longer as they are given appropriate care. Tree planting and maintenance will also be encouraged on private property, by incentivizing residents and business owners to plant trees through public-private partnerships. Outreach and education will also be provided to residents through events such as Arbor Day and Earth Day celebrations. This goal will be monitored by using aerial imagery analysis like the analysis presented below. Every 10 years, the imagery will be assessed, and a new canopy cover percentage will be calculated for Ottawa.



The Future of the Urban Forest

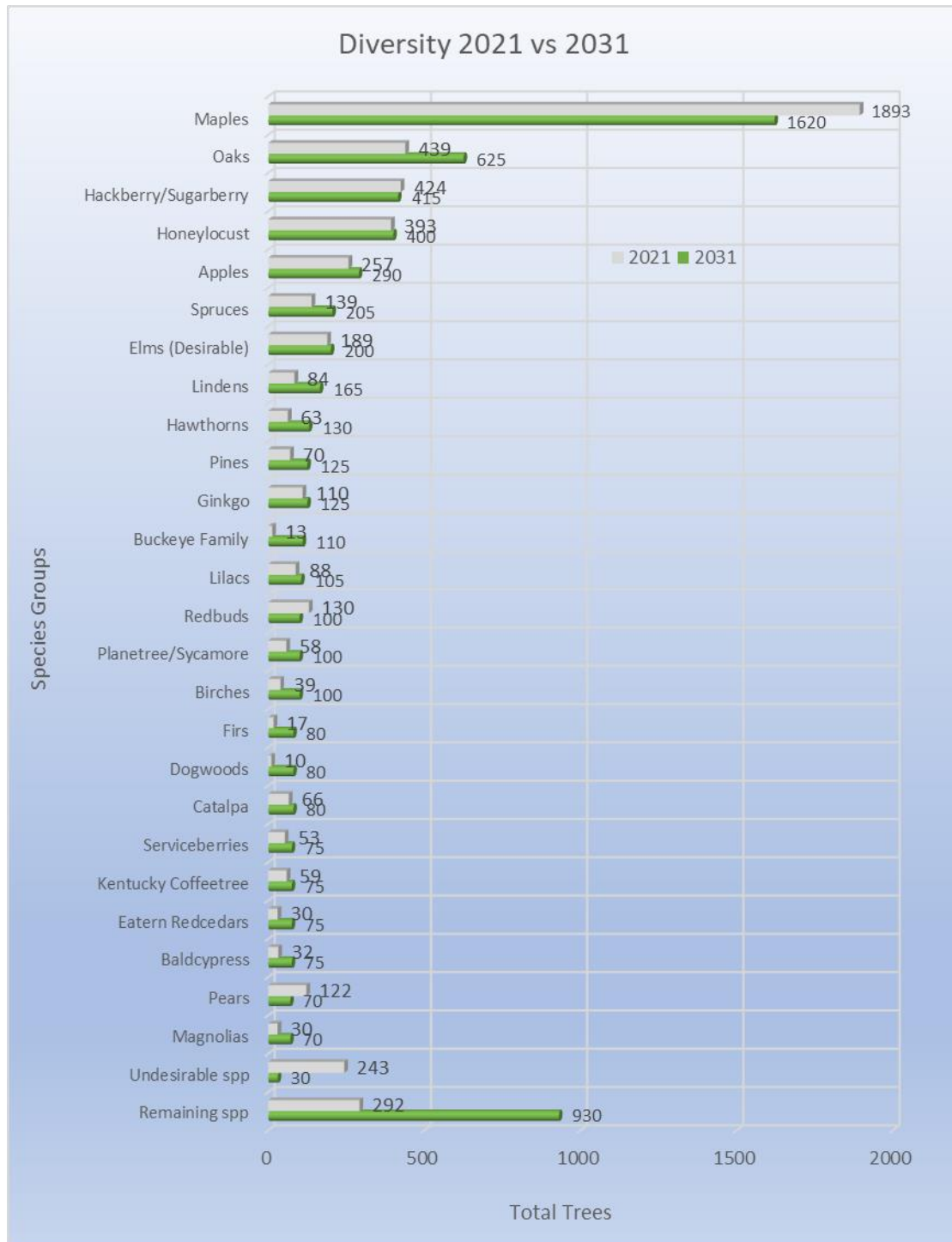
In this section, a vision of what the tree population of Ottawa could become by 2032 was created, and compared with the current population. Using the existing data, and the diversity vision, we will then define exactly how Ottawa can move from where it is now to where it could be.

Change in Species Composition 2022 – 2032

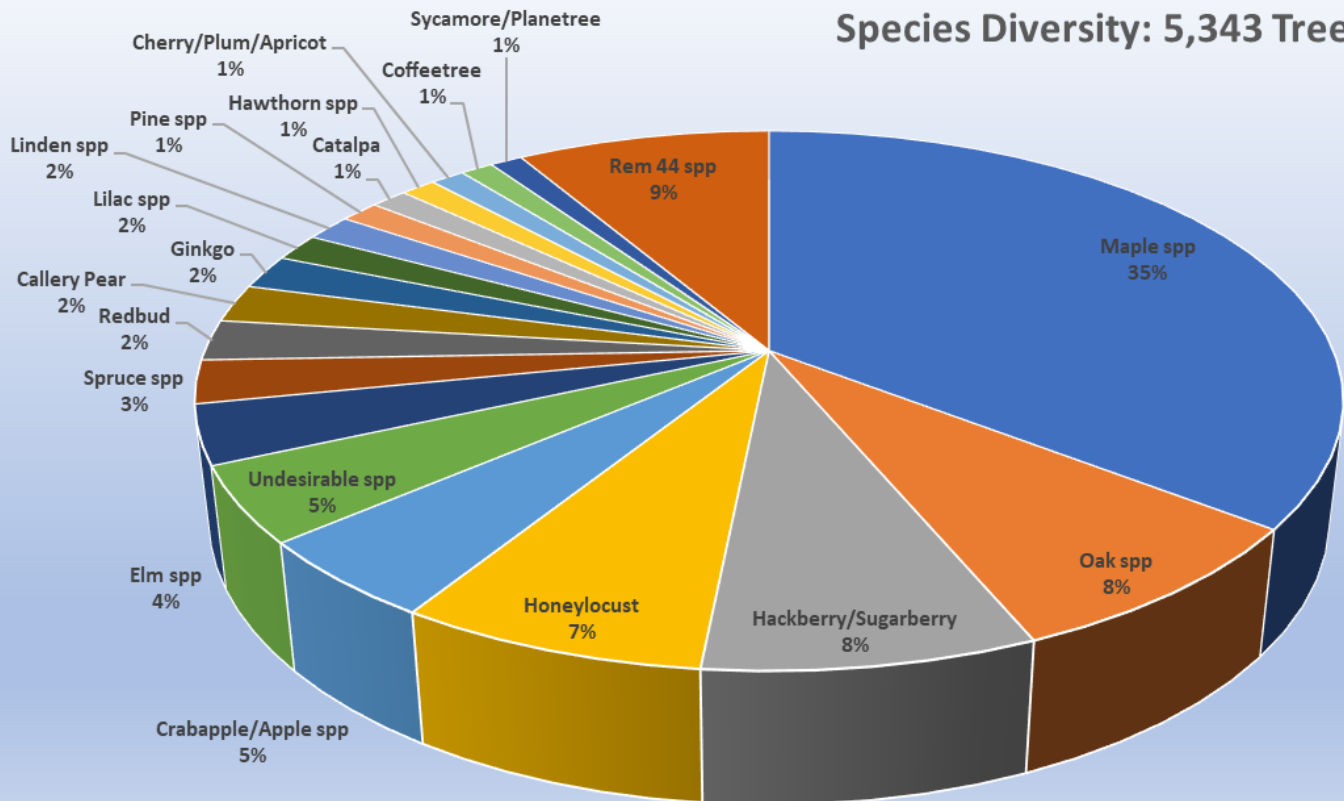
The full calculations for this change in diversity were performed by hand, not using automated software. Local knowledge of the trees, their conditions, what is growing well and what isn't were all used, and yielded this very customized forest composition change list. These goals are meant as general guideposts, and not absolutes. Be aware that this Plan, and the species composition goals, are meant to be adaptively managed over time, and as new information becomes available.

SPECIES	COUNT 2021	COUNT 2031	SPECIES	COUNT 2021	COUNT 2031	SPECIES	COUNT 2021	COUNT 2031
MAPLE-SILVER	673	500	ASH-GREEN	16	5	BOXELDER	2	0
HACKBERRY	423	375	HAWTHORN-SPP	16	50	BUCKTHORN	2	0
MAPLE-NORWAY	410	300	WILLOW-WEeping	15	5	DOGWOOD-PAGODA	2	20
HONEYLOCUST	393	400	FIR-CONCOLOR	14	40	ELM-CHINESE	2	10
APPLE-CRAB SPP	248	275	LONDON PLANETREE	14	75	MAPLE-SPP	2	0
MAPLE-AUTUMN BLAZE	231	250	MAPLE-BLACK	14	25	OAK-SPP	2	20
MAPLE-SUGAR	227	180	ASH-WHITE	12	5	POPLAR-LOMBARDY	2	10
MAPLE-RED	217	180	BIRCH-WHITE	12	20	POPLAR-WHITE	2	0
AMERICAN REDBUD	130	100	MAPLE-JAPANESE	12	20	ROSE OF SHARON	2	20
OAK-RED	127	100	SPRUCE-NORWAY	11	30	SMOKETREE	2	20
PEAR-CALLERY	122	60	ARBOR VITAE	10	30	VIBURNUM	2	10
ELM-SIBERIAN	120	25	BUCKEYE-OHIO	10	30	YEW	2	10
OAK-SWAMP WHITE	119	125	OAK-CHINQUAPIN	10	40	AMUR CORKTREE	1	1
GINKGO	110	125	WILLOW-SPP	10	0	ASH-BLACK	1	1
ELM-HYBRID	108	150	APPLE-EDIBLE	9	15	BLACKGUM	1	20
SPRUCE-BLUE	99	75	MAGNOLIA-SAUCER	9	20	BURNING BUSH	1	0
LILAC-TREE	83	100	CHERRY-BLACK	8	0	EUROPEAN HORNBEAM	1	20
ELM-AMERICAN	76	50	DOGWOOD-SPP	8	40	GOLDEN RAIN TREE	1	10
OAK-BURR	69	75	IRONWOOD	8	50	HYDRANGEA-TREE	1	10
CATALPA	66	80	PINE-MUGO	8	10	MAPLE-PAPERBARK	1	20
KENTUCKY COFFEETREE	59	75	UNKNOWN	8	0	OAK-SAWTOOTH	1	20
SERVICEBERRY-SPP	53	75	OAK-BEBB	7	25	OAK-SCARLET	1	20
OAK-PIN	48	40	OAK-ENGLISH	7	40	OAK-SHUMARD	1	20
MAPLE-MIYABEI	47	60	OAK-SHINGLE	7	40	SUGARBERRY	1	40
SYCAMORE	44	25	SPRUCE-SPP	7	40	YELLOWWOOD	1	40
LINDEN-AMERICAN	43	80	AILANTHUS	6	0	AMUR MAACKIA	0	20
PINE-WHITE	38	40	ALDER-SPP	6	40	BEECH-AMERICAN	0	10
LINDEN-LITTLELEAF	36	60	COTTONWOOD	6	0	BEECH-EUROPEAN	0	20
OAK-WHITE	36	40	MAPLE-TATARIAN	6	5	BUCKEYE-RED	0	20
WALNUT-BLACK	36	20	PINE-RED	6	30	BUCKEYE-YELLOW	0	20
MULBERRY-SPP	35	0	LILAC-SHRUB	5	5	DAWN REDWOOD	0	20
MAPLE-HEDGE	34	50	LINDEN-SILVER	5	25	DOGWOOD-CORNELIAN	0	20
BALDCEYPRESS	32	75	HONEYSUCKLE	4	0	FRINGETREE	0	10
CHERRY-SPP	31	30	KATSURA	4	15	HAZELNUT-TURKISH	0	10
EASTERN REDCEDAR	30	75	MAGNOLIA-STAR	4	15	HICKORY-SHAGBARK	0	10
TULIPTREE	30	50	OAK-CHESTNUT	4	20	LARCH	0	10
AMERICAN HORNBEAM	28	40	POPLAR-SPP	4	10	MAGNOLIA-CUCUMBER	0	10
PLUM-SPP	28	20	WALNUT-WHITE	4	2	MAPLE-TRIFLORUM	0	20
BLACK LOCUST	27	40	ASPEN-QUAKING	3	20	PAGODATREE	0	10
HAWTHORN-COCKSPUR	27	40	BIRCH-GRAY	3	20	PAWPAW	0	10
BIRCH-RIVER	24	60	ELM-RED	3	1	PEACH	0	10
SPRUCE-WHITE	22	40	FIR-SPP	3	40	PEAR-EDIBLE	0	10
SWEETGUM	21	60	HICKORY-BITTERNUT	3	10	PERSIAN IRONWOOD	0	10
DOUGLAS FIR	20	50	HORSECHESTNUT	3	40	PERSIMMON	0	10
HAWTHORN-WASHINGTON	20	40	SEVENTH SON FLOWER	3	10	PINE-LIMBER	0	20
MAPLE-AMUR	19	10	SUMAC	3	10	SPRUCE-SERBIAN	0	20
PINE-AUSTRIAN	18	25	APRICOT	2	10	WITCH HAZEL	0	20
MAGNOLIA-SPP	17	25				ZELKOVA	0	40

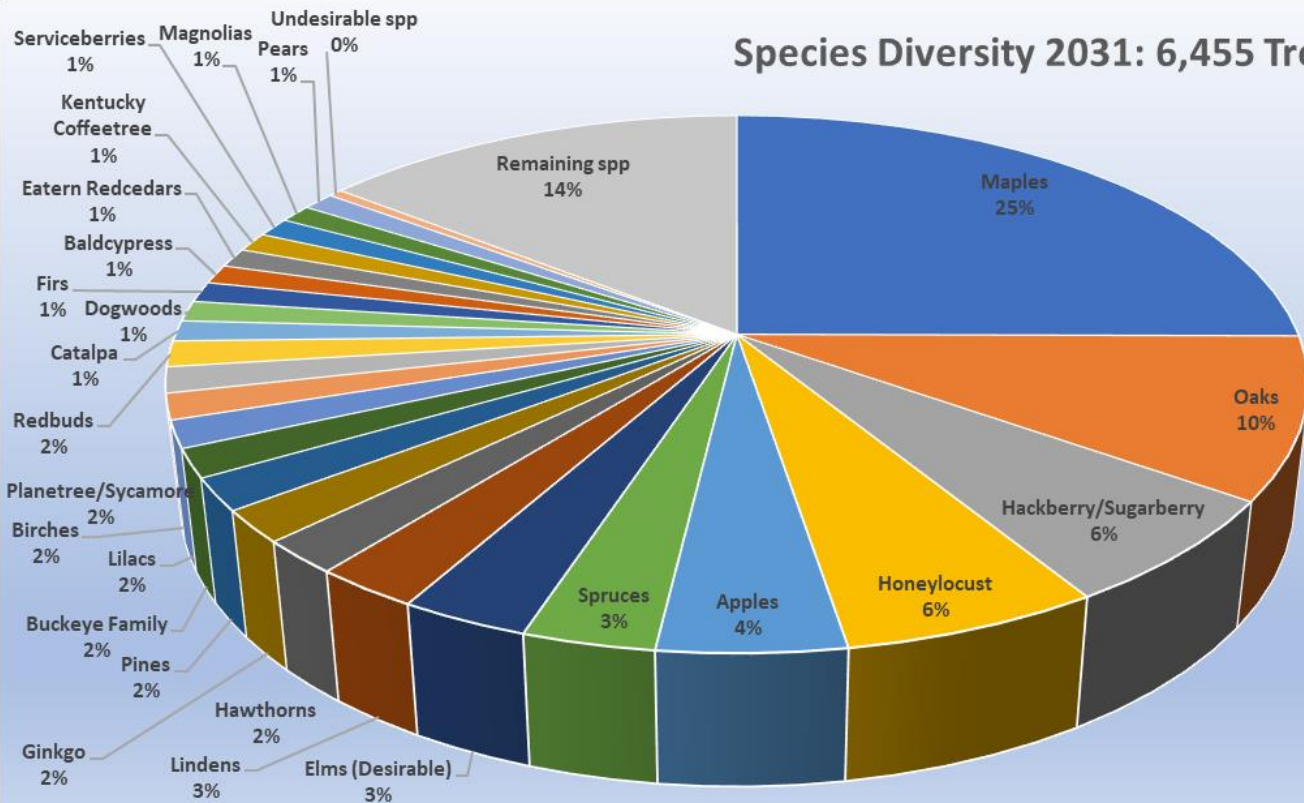
Change in Species Composition 2022 - 2032



Species Diversity: 5,343 Trees



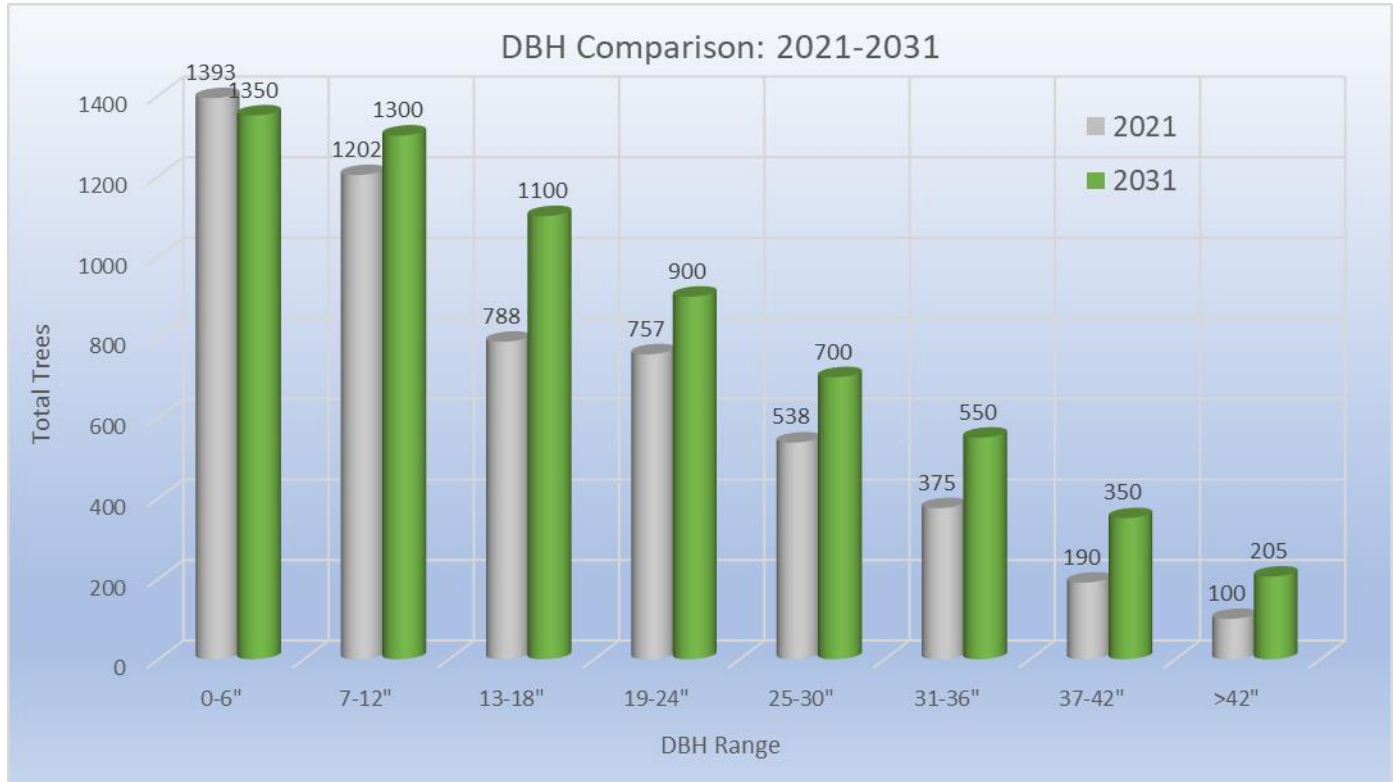
Species Diversity 2031: 6,455 Trees



As can be seen from the above several pages of charts showing the change in species composition over the next 10 years, there will broadly be a move away from the overrepresented or low quality species discussed above, and a variety of different species, those which are underrepresented or not present in the tree population, will be planted. This will lead to an overall increase from 5,343 to 6,455 trees total on the City's ROWs, as well as a change from the current total of 120 species to a total of 132 species. This will result in a more robust and resilient Urban Forest which is resistant to pest and pathogen outbreaks. It will also qualify Ottawa to certify the City as an Arboretum through the Morton Arboretum's ArbNet Certification program, which requires a minimum of 100 species.

The Benefits of Larger, Healthier Trees

Larger trees provide greater benefits to the community: They create more shade to offset cooling costs, absorb more storm water, create greater buffers against cool winter winds for heating costs, and absorb and sequester more carbon than smaller trees do. For the 2032 vision of the tree population, a variety of methods were used to arrive a reasonable age-class distribution. We used the current population structure, and anticipated high rates of survival based on new planting practices which would involve a "right tree/right site" approach, as well as increased survivorship of existing trees due to better management and care practices. Predicted growth, survivorship, and eventual tree losses are based on current species composition and future plantings and removals. This allowed the creation of a vision of what the tree population, including species and size, will look like 10 years from now.



It can be seen from the above chart that the existing tree population (grey bars) shows a predominantly younger tree population with a steady decline in numbers in the larger age class categories. The projected age class chart shows a reduction in the smallest age class category over the course of this Plan, and also projects more trees surviving into the older age classes, where they will provide the greatest benefits in terms of ecological services to the community. The table to the right shows this data in a tabular format.

	<u>2021</u>	<u>2026</u>	<u>2031</u>
0-6"	1393	1300	1350
7-12"	1202	1250	1300
13-18"	788	1000	1100
19-24"	757	750	900
25-30"	538	650	700
31-36"	375	450	550
37-42"	190	250	350
>42"	100	165	205
	5,343	5,815	6,455

This was based on the fact that increased levels of care for existing trees would enable them to survive longer. The graph and table show a general expectation of how the changes in tree diameters might change over the next 10 years based on the methods to be applied in this Urban Forestry Management Plan. The numbers were projected by hand, based on our prior experience, and the methods detailed below. If these projections hold, Ottawa could see a 33% increase in annual benefits of \$288,547 up from \$865,577 to \$1,154,124. Standing values of the tree population could increase by a similar percentage from their current level of \$20,866,021 to approximately \$27,751,808

For projections of future age classes of trees, a ½" per year growth rate was roughly estimated by assuming that it would take an average tree 10 years to go from one age class to the next (6" = appx 10 years growth). Also used were the number of trees to be planted and removed annually, as calculated below in the Tree Planting and Tree Removal sections. These numbers were arrived at based on all the above, as well as the best professional opinion of the Forestry Consultant. As time goes by, these projections will likely change. These are rough estimates for the purposes of this Plan.

The overall increase in size of the tree population and diameters of the individual trees will yield a much greater dollar figure when it comes to the ecological services provided, and provide residents with a greater sense of being in an arboretum-like setting when they are enjoying the urban forest. Below are several examples of Ecological Services provided by trees:

Energy Savings: During the summer when temperatures are warm, trees create shade, and temperatures are cooler in the shade. Cooler temperatures cause air conditioners to have to work less, which reduces the amount of energy a household uses. During the winter when temperatures are cold, winter winds cool your home quickly. Trees act as windbreaks, causing heating systems to use less natural gas, saving energy and money.

Carbon Dioxide (CO₂): The amount of CO₂ which is put into the atmosphere each year has a direct correlation with global climate change. That change causes more severe storms, greater drought conditions, and many other costly outcomes. Reducing CO₂ from our atmosphere lessens these effects. Trees uptake CO₂ and act as a carbon sink, putting carbon into long term storage in its woody tissues, removing it from our atmosphere, creating a net benefit to society, and saving money.

Air Quality: Industrial processes and vehicle emissions put pollutants into our air. These pollutants can cause or worsen health conditions such as heart disease, asthma, and lung disease. In addition, these pollutants can mix with water in the atmosphere and create nitric and sulfuric acid, causing acid rain, which can destroy fisheries and contaminate water supplies. Trees absorb these compounds with their leaves and other tissues, and prevent them from remaining in the atmosphere. Reductions in these pollutants results in overall better health, reducing the cost of healthcare to society, and saving communities money.

Storm water: The cost of delivering fresh water to homes, as well as removing and treating wastewater and storm water is considerable. One of the greatest costs comes when these systems are overwhelmed, such as during flooding, which can cause millions of dollars of damage to homes and vehicles, or when these systems need to be replaced. Fortunately, trees take water from the soil and put it back into the atmosphere through the process of transpiration. Therefore, the more trees an organization has, the less flooding is an issue, and the less strain is put on storm water infrastructure, resulting in fewer repairs and replacements. In addition, tree canopy slows rainfall's effects on flooding by "intercepting" it with leaves and branches, delaying how quickly rainfall can become floodwater. All of this adds up to savings for an organization.

Aesthetic/Other: Up to 15% of the value of a property can be attributed to its trees and other landscaping. Tree lined streets are much more appealing to homebuyers than streets devoid of trees, resulting in increased home sales, and therefore increased tax revenue, or increased tax revenue with which to fund initiatives relating to trees, attract new businesses, etc.

Return on Investment

Return On Investment (ROI) for an individual tree is strongly favorable over the life of a tree in terms of investment in planting, care, and removal versus the ecological benefits the tree provides. As we strive to justify the expenditures on trees and tree care, it is important that organizations and their staff are aware of this.

On the following page, we have provided an ROI calculation sheet. This sheet breaks the tree's lifetime down into three phases, based on the anticipated costs of pruning in the budgets sections below. These phases are the young (3-12" DBH), mature (13-24" DBH), and full grown (25-36") ranges shown below.

Data was taken from the i-Tree algorithm, and applied towards the average benefits provided by a tree at each of these life stages, and multiplies it out over the 20 year period each phase accounts for. We also looked at costs for planting, watering, routine maintenance, emergency maintenance, and eventual removal of that tree over 60 years. The results are pictured below, with the calculations on the following page.

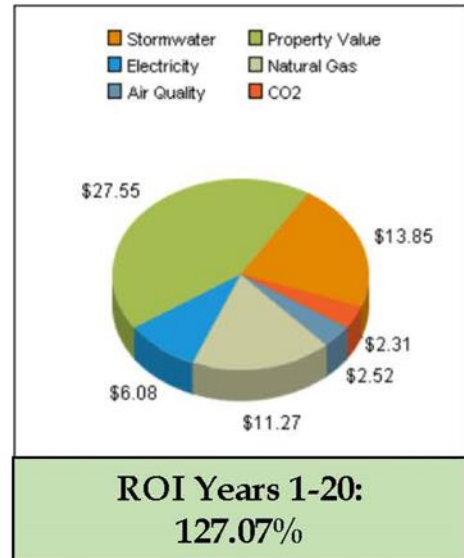
Total Investment	\$3,610.00
Total Return	\$10,819.60
Total ROI Over 60 Years	199.71%

Return on Investment: Years 1-20 (3-12" Diameter)

Costs

Initial Purchase and Installation	\$300.00
Watering for 2 Years	\$100.00
Pruning - 4x @ \$40/prune	\$160.00
TOTAL INVESTMENT	\$560.00

Benefits	Avg/Year	Over 20 Years
Electricity	\$6.08	\$121.60
Natural Gas	\$11.27	\$225.40
Property Value	\$27.55	\$551.00
Stormwater	\$13.85	\$277.00
Air Quality	\$2.52	\$50.40
CO2 Reduction	\$2.31	\$46.20
TOTAL RETURN		\$1,271.60

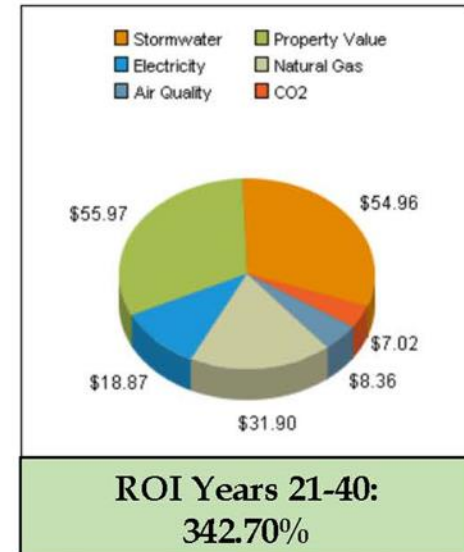


Return on Investment: Years 21-40 (13-24" Diameter)

Costs

Pruning - 4x @ \$75/prune	\$300.00
Emergency Maintenance (2x)	\$500.00
TOTAL INVESTMENT	\$800.00

Benefits	Avg/Year	Over 20 Years
Electricity	\$18.87	\$377.40
Natural Gas	\$31.90	\$638.00
Property Value	\$55.97	\$1,119.40
Stormwater	\$54.96	\$1,099.20
Air Quality	\$8.36	\$167.20
CO2 Reduction	\$7.02	\$140.40
TOTAL RETURN		\$3,541.60

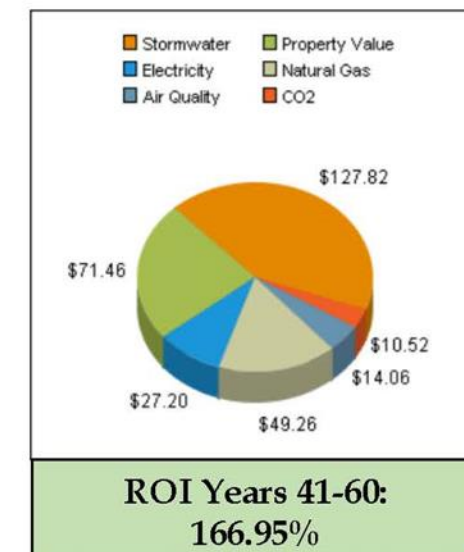


Return on Investment: Years 41-60 (25-36" Diameter)

Costs

Pruning - 4x @ \$150/prune	\$600.00
Emergency Maintenance (2x)	\$650.00
Eventual Cost of Removal	\$1,000.00
TOTAL INVESTMENT	\$2,250.00

Benefits	Avg/Year	Over 20 Years
Electricity	\$27.20	\$544.00
Natural Gas	\$49.26	\$985.20
Property Value	\$71.46	\$1,429.20
Stormwater	\$127.82	\$2,556.40
Air Quality	\$14.06	\$281.20
CO2 Reduction	\$10.52	\$210.40
TOTAL RETURN		\$6,006.40



Tree Removals

The first step towards attaining Ottawa's forestry goals will be to remove trees which are diseased, dying, or present a hazard. At present, there are 366 trees which have been called for removal during the inventory. Of these, 20 are listed as a Priority Removal, 238 are listed as Standard Removals, and 108 are listed as Low Priority Removals based on the tree inventory data. A direct goal of this Urban Forestry Management Plan is to have all identified trees marked as Removals during the inventory to be removed within 6-7 calendar years of this plan's adoption. Beginning this year, the 20 trees that are designated as priority removals can be budgeted for removal. In the second year the trees designated as priority removals and measuring 36" DBH or larger can be budgeted. In the third year, the standard removals measuring between 28" and 35" can be budgeted. In the fourth year, the standard removals measuring between 21" and 27" can be budgeted. The fifth year will see the standard removals measuring between 8" and 20" DBH budgeted. In each subsequent year, this plan projects a budget of the removal of 140 trees per year as an average as the remainder of the standard removals and all of the low priority removals are budgeted.

By percentage, 366 removals in a population of 5,343 is an above average number of removals in terms of comparably sized municipalities, with removals representing nearly 7% of the total population. Typically, municipal inventories reveal between 3-5% of the tree population requiring some form of removal.

After this initial 6-7 year period, in order to attain the goals set forth in the Diversity Standards, the background rate of tree removal is projected to hold steady at approximately 140 trees per year. Going forward, reevaluation of the tree population on an annual or semiannual basis by the City Forester or Forestry Consultant will specify which trees require removal. These numbers, detailed below, are meant to be placeholders for budget calculations and diversity standards. This does not require that 140 trees be removed each year, this is simply a projection based on the existing inventory data.

For purposes of projection, costs have been estimated using a rate of \$25/diameter inch for tree removal and stump grinding, which is a conservative estimate based on current market pricing. Rates could certainly be found lower than this in a competitive bid process or using in-house labor. As is the case with all cost projections for this Plan, no cost increase is assumed for the first 5 years, and a 3% annual cost increase is assumed thereafter. This is also a conservative estimate based on the Consumer Price Index, and actual costs are likely to be lower than projected. In addition, for trees in year 6 and beyond, these are anticipated averages of trees to be removed. Exact numbers of trees to be removed may vary.

REMOVALS	Milestones	2022	2023	2024	2025	2026	2027-2032
	Trees Removed	20	18	29	43	66	140/year avg
	Diameter Inches	522"	782"	923"	1034"	936"	N/A
	Notes	All Priority (20) Removals	Standard Removals 36" and Larger	Standard Removals Between 28 and 35"	Standard Removals Between 21 and 27"	Standard Removals Between 8 and 20"	Remaining Standard and all Low Priority Removals
	Removal Cost (2022)	\$13,050	\$19,550	\$23,075	\$25,850	\$23,750	\$30,000
	Removal Cost (CPI)	\$13,050	\$19,550	\$23,075	\$25,850	\$23,750	\$34,500

As the table above illustrates, there will be a gradual increase in the number of annual removals over the initial 6 year period. These cost estimates were prepared for the long-term removals, based on the tree inventory data. As this is a program to be adaptively managed, these budget tables can be revisited periodically to reflect actual costs being paid.

Tree Removal Activities

Safe Removal of a Tree to an Appropriate Flush Cut

Tree removal can be dangerous, but when performed by professionals is very safe. Therefore, all tree removal activities on Ottawa's public property shall be performed under the guidance of a Certified Arborist or Arborist Trainee. This may be the supervision of the City Arborist, or a staff Certified Arborist alongside a contractor. The safe removal of a tree involves the safe removal and lowering of all portions of the tree according to all relevant ANSI standards and Best Management Practices. The stump must be flush cut such that the highest portion of the cut is no greater than two inches from the highest part of the ground surface to prevent a tripping hazard on public property.

Stump Grinding

Within a reasonable amount of time following the removal, stumps and surface roots should be removed using an approved stump grinding machine, such that the stump is ground to a minimum depth of 6 inches, and no surface roots are visible. If the site is to be planted with a new tree, that depth should be increased to 12 inches below the soil surface. This will ensure that a new tree may be successfully planted, and that no re-sprouting will occur from the old stump. The depths to which the stump must be ground may be altered by the City of Ottawa depending on needs for specific circumstances or contracts. Until such time as the planting space is fully restored, the stump hole should be filled and compacted to ground level using the debris resulting from the stump removal.

Planting Site Restoration

Once the tree has been safely removed and the stump has been ground out, the open planting space must be fully restored if a tree is not scheduled to be planted in or adjacent to the old hole. Site restoration consists of removing the stump chips from the hole, filling it with a quality mineral topsoil, tamping down to match the surrounding grade, spreading grass seed over the top of the topsoil, and securing green turf blanket over the topsoil. This will ensure that grass grows back to restore the aesthetics and function of the parkway, and prevent tripping hazards from the removal scar.

Reasons for Tree Removal

Removal of trees on public spaces is an unavoidable reality of managing large tree populations. When the trunk, branches or roots fail, a standing tree can cause personal injury or property damage, and even small dead trees can be an eyesore and reduce property values. Old trees can hold great sentimental value, and many people become attached to them. However, there are times when their presence creates a public hazard, and it is at those times that action must be taken to ensure public safety. It's also important to remember that the removal of a tree today is the promise of a new tree for tomorrow!

Removal of trees on City of Ottawa public property shall always be at the discretion of the City Arborist and/or Forestry Consultant. Trees will never be removed without a sound reason from the City or Forestry Consultant. Residents may request a tree to be removed for reasons NOT covered below, and these requests will be reviewed by the City Arborist or Forestry Consultant. Removal requests may be granted and paid for under the annual forestry budget. However, trees with a greater need for removal based on public safety will always hold a higher priority. Under no circumstances will the City of Ottawa be responsible for trees which are not in the right of way.

Dead or Dying

If a tree is biologically dead or nearly dead, it will require removal. Trees which are standing dead, have approximately 50% dead crown or greater, or have less than approximately 40% structurally sound wood in the cross-section of the trunk shall be removed as expediently as practical. These determinations shall be at the discretion of the City Arborist or Forestry Consultant.

Diseased or Infested

Diseases are caused by viral, fungal, or bacterial pathogens. Infestations are caused by insects or other small animals. Dutch Elm Disease and Oak Wilt, for example, are fungal diseases that kill Elm and Oak trees when they are infected. Emerald Ash Borer is an insect which kills Ash trees by infesting them. The prompt removal of diseased or infested trees limits the exposure of other nearby trees. The removal of 1 tree may save dozens of others. Trees deemed to be diseased or infested by the City Arborist or Forestry Consultant shall be removed as expediently as possible in order to slow the spread of such insects and diseases.

High or Extreme Risk

"Tree Risk" is the potential of a tree or tree part to impact a nearby person or piece of property and cause property damage or personal injury. This topic is of great interest in Arboriculture today, and insurance companies are becoming increasingly involved in the process of assessing and managing the risk posed by trees. Litigation involving trees is a perennial concern for public entities.



All trees in Ottawa were assessed for a basic level of risk during the initial inventory, and a number of trees were found to be at elevated or substantial risk levels. If such risk can only be safely mitigated by tree removal, as opposed to pruning or other measures, then their timely removal is critical because of potential exposure of the public or property to potential harm.

The City Arborist, Forestry Consultant or any other TRAQ Qualified Risk Assessor must assess the tree and prepare a Tree Risk Assessment Report which will document the details of the situation, prior to removal. Often, risk can be mitigated by removing a portion of the tree, or other corrective measures. If the entire tree is deemed to be at high or extreme risk of failure, however, the entire tree shall be removed as a means of reducing its residual risk to zero.

Emergency / Storm Damage Removals

A tree shall be removed if it has been severely damaged and/or compromised by lightning, wind, or other such weather event. "Storm-damaged" shall be generally defined as a tree which has lost 33% or more of its crown, has a large crack or other wound in the trunk, has a lean of greater than ten degrees from vertical, has sustained a lightning strike, or other such issues directly related to storm events. The City Arborist or Forestry Consultant shall determine the need for removal of a tree in these cases, although in an emergency situation such as a tree impacting a person, vehicle, home, power lines, or other such emergency, the City may perform any actions necessary to abate public hazards so long as they are in compliance with all relevant Arboricultural standards and practices.

Damage from Construction or Vehicle Strike

The City Arborist or Forestry Consultant shall assess trees that have been impacted by a vehicle strike or piece of construction equipment. If the tree has suffered physical damage or extreme root compaction and is likely to decline and become high risk, it will be scheduled for removal in order to maintain public safety. That decision will be based on the best professional judgement of the Forestry Consultant or City Forester.

Reasonable Resident Request

If a tree has non-terminal pest or pathogen issues, moderately poor structure or is in somewhat poor condition, a resident may request the removal of the tree. Such requests will be reviewed by the City Arborist and/or Forestry Consultant, and evaluated on a case-by-case basis. If the tree shows significant potential to decline or pose a threat in the near term, the City may agree to the removal within the next five years. Note that young and/or healthy trees will generally not be considered eligible for this program. Priority will always be given to trees in danger of threatening public safety.

Interference with Utility or Signage

A tree shall be removed if it is interfering with the function or visibility of official traffic control devices or has impacted above or belowground utilities in a manner that cannot be mitigated by pruning or other measures. In these cases, it is likely that no new tree will be planted in these sites.

Overplanted and Underperforming

No healthy tree shall be removed for the sole reason of having been overplanted. As a result of this UFMP, Ottawa will be enhancing their use of industry best management practices for diversity in the urban forest, with the goal of building a diverse urban forest. Overplanted species listed as being in poor condition will be reviewed to assess further decline or recovery. Those trees in noticeable decline shall be removed at the discretion of the City Arborist and/or Forestry Consultant. This will be used as a preventative measure so that these trees do not continue to decline to a point where they become hazardous, and not used as a reason to remove an otherwise healthy tree.

Basic City Tree Removal Requirements and Standards

All of the following requirements and standards shall be met during tree removal activities as matter of local policy. For a more detailed view of the specific ANSI and ISA standards, please see Appendix I.

City of Ottawa

1. All personnel directly involved with process of chainsaw operation, climbing, bucket truck operation, and rigging limbs shall be provided with sufficient training and experience to perform such duties while employed by the City of Ottawa, as either Public Works and Forestry staff, or performing work as a contractor employed by the City.
2. All contractors are required to obtain an annual license from the City.
3. Only qualified utility arborists may perform tree removal operations within ten feet of an electric utility line. City of Ottawa employees or contractors may complete the process of trunk removal and stump grinding only if the remaining portion of the tree is greater than ten feet from a transmission line.
4. The City will not remove healthy trees in order to meet diversity goals, unless the tree poses a risk to persons or property.
5. The City of Ottawa shall not perform or assist, programmatically or financially, with the removal of trees on private property. Public/Private tree ownership is defined by Ordinance as having 51% or greater of its trunk diameter within the public right of way.

Tree Planting

Whereas tree removal is necessary to promote public safety, planting of new trees must happen in order to increase our diversity and canopy cover. At present, the inventory has identified 323 open planting spaces on its parkways. As a means of attaining the goals of increasing canopy cover to 29% and increasing overall diversity significantly, this plan calls for the planting about 2,600 trees over the coming 10 years. These trees will be planted by City staff, contractors, and possibly even volunteers who have been properly trained. This plan has a direct goal of planting trees where they have the best chances to establish and thrive based on their specific sites and species requirements.

For the goals and milestones shown below, the program began with being able to replace trees called out for removal above and also to begin planting in open spaces on the City's parkways. After the first year's planting of 200 trees, a gradual 20 trees planted per year increase is called for until a plateau of 280 trees per year is reached in 2026. This plan anticipates plantings to outpace removals.

For the costs of planting, \$450 per tree (installed) has been used. This is a conservative estimate based on retail costs, and likely the City will be able to perform planting at a more favorable rate. If volunteer labor is employed, and smaller trees planted, these costs could reduce significantly. We examine money saving proposals in further detail in the Strategic Partnerships section.

PLANTINGS	Milestones	2022	2023	2024	2025	2026	2027-2032
	Trees Planted	200	220	240	260	280	280/year avg
	Planting Cost (2022)	\$60,000	\$66,000	\$72,000	\$78,000	\$84,000	\$90,000
	Planting Cost (CPI)	\$60,000	\$66,000	\$72,000	\$78,000	\$84,000	\$103,500

The Importance of Planning Your Tree Planting

Right Tree in the Right Site

Urban Forestry has an unfortunate history of not planning carefully for tree planting. Whatever was readily available, inexpensive, urban tolerant, and grew fast was seen as desirable, and often planning of tree plantings was left to developers or nurseries and plantsmen. With our history of invasive insects and diseases in the Midwest region, and knowing these will only get worse in the future, it is more crucial than ever that we have a process to plan our tree plantings.

This process should involve assessing each site to be planted in much the same way we would assess a tree, except that in this case, we look for factors such as available above and below ground growing space, how much light the tree receives, amount of soil moisture present, and possibly other factors such as soil pH and texture. Once this information is collected, planting sites can be matched with trees which are well suited to those sites. Matching the right tree to the right site like this will result in trees which establish faster, grow more vigorously, live longer, and provide far greater benefits. Even a simpler version of this process is better than nothing. When you have your species list for each site assembled, it makes bidding nurseries and plantsmen much easier since you already have a plan in hand.

Playing an active role in your tree planting planning also allows for meeting diversity standards such as the taxonomic, spatial, and age class diversity principles outlined above and attempts to get the tree population into compliance with the "20-10-5 Rule". With 863 planting sites to be assessed, tree planting planning can be phased off each year as the planting budget takes shape and diversity is evaluated. Being targeted about species selection also allows the use of species which are slightly more difficult to find appropriate sites for. These species that are considered "less urban tolerant" can still be planted when the appropriate site is found! We anticipate that over the timeline of this plan, that nearly all of these spaces will be planted.

The success of a tree depends on where and how it is planted. The City Arborist or Urban Forestry Consultant should assess planting sites before trees are purchased and installed each year, to ensure the correct tree is being planted for the correct site. Each tree planted represents a 25-75+ year commitment, and this planning helps to increase the benefits the community can reap from this commitment. A list of acceptable species to be planted for all land use types appears in Appendix A.

Nursery Stock Procurement

Nursery stock quality is yet another aspect of planning which can help a tree establish, survive, and thrive to provide great benefits to the community. The City Forester or an Urban Forestry consultant should inspect and select every tree which is to be planted on City property to minimize the possibility of installing lower quality nursery stock. Specifications should be for material no smaller than 1.75" caliper, with good form for the species, planted as either balled and burlapped or minimum 5-gallon containerized stock.



Currently, the industry is recovering from a nursery stock shortage due to high demand to replace Ash trees lost to Emerald Ash Borer, which impacted the availability of some species. We strongly recommend to not to accept substitutions in the requested species lists, as many nurseries are still attempting to substitute overplanted trees for some of the higher diversity species which may still difficult to obtain. It is recommended to have an approved substitution prepared for each requested tree species.

Tree Transport and Planting

Proper transport and planting procedures determine a tree's success after planting. Even healthy trees from the field, if improperly transported, may dry out during transport, or have structural damage to root balls incurred. When it comes time to plant, trees planted too deeply will suffer from root compaction and trunk decay.

Trees planted without properly dug holes may suffer from stunting. Trees planted without proper removal of packaging materials may develop girdling roots. Trees planted too high may have surface root desiccation. Trees improperly staked or with improper trunk protection may suffer from trunk wounds or girdling of the entire trunk. The standards and Best Management Practices for tree transport and planting are detailed later in this section, as well as Appendix J. Trees may be planted by a local volunteer work force so long as the workers have been adequately trained by the Forestry Consultant or other local qualified organization prior to planting, and trees are of a smaller size such as containerized stock.

Tree Spacing and Visibility Requirements

Minimum tree spacing between large, medium, or small sized deciduous shade trees should be appropriate for the species and conform to the City's ordinance which reads: "The spacing of street trees must be in accordance with the three species size classes listed in the Urban Forestry Management Plan. No street trees may be planted closer together than as follows: small trees not less than 20 feet; medium trees not less than 25 feet; and large trees not less than 30 feet; except that special plantings may be clustered as determined appropriate by the Ottawa City Council based upon recommendation of the Ottawa Tree Board." This will allow trees to grow to their full potential without heavy competition for water and nutrients with neighboring trees, and without limited space for crown growth. In addition, it is recommended that no tree should be planted within 10 feet of a driveway, intersection, traffic control device, or known below ground utility. Trees may be planted under aboveground powerlines but must be from the "Small" selections listed in the Acceptable Species list in Appendix A. Lastly, it is recommended that no evergreen species be considered acceptable for street trees, as they can obscure views of the road and may lead to accidents. Evergreens are acceptable for parks, schools, municipal campuses, and waterways.

Watering

Watering of newly planted trees is essential to their establishment, growth, and survival, particularly during the first 2 years of their lives. Since watering is not included in our budget figures, this responsibility will have to fall on the property owners. It is recommended that when a tree site is selected for planting, that a basic letter or informational pamphlet be provided to property owners describing how much water to give a tree, and when it should be given. Such simple information can make the difference between a tree dying from drought stress, a tree dying from overwatering, and a happy, healthy tree. Below is a description of watering guidelines that should be provided to residents.

"Newer trees have a more difficult time handling heat and drought. You can help your trees by adding mulch and watering your tree 2-3 times per week. This schedule should continue for the first couple years. Start watering the new tree immediately after it is planted. Lay a garden hose on the grass near the root ball of the tree. Water your new tree for about 30 seconds with a steady stream of water. Not enough water is harmful for the tree but so is too much water. Over-watering is a common tree care mistake. Please note that moist is different than soggy, and you can judge this by feel. A damp soil that dries for a short period will allow adequate oxygen to permeate the soil. You can check soil moisture by using a garden trowel and inserting it into the ground to a depth of 2", and then moving the blade of the trowel back and forth to create a small narrow trench. Use your fingers to touch the soil. If it is moist to the touch, then the tree does not need watering. After two years, the roots will be established. This will allow your tree to withstand a wider range of water conditions on its own because it has a proper root structure."



Challenges of Urban Plantings

Urban planting sites are a difficult environment for a tree to thrive in, and based on long term data, it is expected that 5-10% of new plantings fail each planting cycle. The City's contracts for tree planting should include a one to two-year replacement warranty for any new trees that fail to thrive in their new environment. Urban tree plantings can pose an uphill battle in many ways, due to limited soil volume, salt runoff, airborne pollutants, and other factors. New planting mortality is to be expected, despite best efforts to prevent such an outcome, but the planning measures outlined above will help to mitigate annual new planting mortality.

Tree Planting Requirements and Standards

City of Ottawa

1. Planting sites shall be determined and monitored using the City's tree inventory, in conjunction with staff and Forestry Consultant input.
2. New planting sites should be 10 feet away from signage, driveways, intersections, and utility structures. If this distance cannot be maintained, the site should not be planted, even if a tree was removed from the same site.
3. Choice of species for planting should be done so according to the City's taxonomic, spatial, and age-class diversity goals. A diverse and resilient urban forest minimizes exposure to financial, environmental, and health risks while maximizing aesthetics, environmental benefits, and ecosystem services to its residents.
4. All planting stock shall be grown within 150 miles of the City/planting site.
5. Acceptable nursery stock shall conform to the following standards:
 - A. Minimum of 1.5-inch caliper, measured at six inches from the trunk flare
 - B. Root ball conforms to ANSI Z60.1 Standards for Nursery Stock
 - C. Less than 10% deadwood in the crown
 - D. Architecture consistent for the species, cultivar, or variety in question
 - E. No included bark or other such narrow branch attachments, unless consistent with species or variety
 - F. Free of pests or pathogens
 - G. Approved species list for the City of Ottawa
6. Planting and digging of certain species shall only occur at certain times of year, in accordance with nursery industry best management practices and professional judgement. These times are subject to the professional opinions of both the City of Ottawa and its approved contractors.

7. Residents shall be permitted to plant trees on the City-owned right-of-way, if purchased independently and conform to all species, spacing, and proper planting requirements as specified by the City of Ottawa.
8. JULIE, or another similar utility locating service shall be contacted, and all utilities located a minimum of three days before planting is scheduled to begin.
9. A minimum of a one-year replacement guarantee shall be extended from approved nurseries and plantsmen for all new plantings rated to hardiness zone five or lower.

Tree Pruning

When maintaining a tree population for its greatest benefits and lowest risk, tree pruning is one of the most cost-effective maintenance activities which can be performed. Pruning provides several important services for a tree: It reduces the risk of failure, provides clearance for utilities or other structures, reduces wind resistance and wind damage, maintains overall tree health, and improves overall aesthetics.

For the Goals and Milestones, the most critical needs of the City of Ottawa were prioritized. This priority list begins with trees identified as dead limb prunes, priority prunes, or young trees in need of establishment or training pruning. During the inventory, 1,014 such trees were identified, and can be pruned over the next 2 years under the City's existing annual forestry budget.

For the next 6 years, it is recommended that Ottawa slowly increase the number of trees pruned each year through 2027 until they are at full capacity to handle the 7-year pruning cycle which has been proposed for the City. Once in the full 7 year pruning cycle for the estimated tree population of 6,455 total trees by 2032, it is anticipated that approximately 920 trees per year will require pruning to maintain this cycle. For cost estimates associated with these activities, several assumptions were made:

First, because young trees (12" and less in diameter) are relatively easy to prune, it is assumed that City staff can prune all trees less than 12", and \$50 per tree was used as an estimate for this group, based on average cost in the industry at this time. For medium (12"-24") and large (24"+) trees, average figures of \$100 and \$150 per tree (respectively) were used, once again based on average cost in the industry (see tables below). Consistent with other budget tables, a 3% annual CPI increase was added for every year thereafter.

Currently, Ottawa prunes a varying number of trees per year using a combination of in-house labor and contracted services. Using well-trained volunteer labor to prune young, newly planted trees and smaller trees which can safely be pruned from the ground without power equipment, it is believed that these budget figures could become even more favorable. This makes the budget estimates below fairly conservative, as is the case with all budget projections in this Plan.

CITY OF OTTAWA URBAN FORESTRY MANAGEMENT PLAN

PRUNING	Milestones	2022	2023	2024	2025	2026	2027-2032
	Trees Pruned	755	775	800	825	830	925/year avg
	Notes	All Dead Limb Prunes (444) and All Priority Prunes 18" and Larger (331)	Remaining Priority Prunes (155) and Train Prunes (104), begin cycle prunes (516)	800 Cycle Prunes	825 Cycle Prunes	830 Cycle Prunes	Approximately 920 Cycle Prunes / year in perpetuity
	Cost (2022)	\$55,900	\$57,400	\$59,200	\$61,100	\$61,450	\$68,100
	Cost (CPI)	\$55,900	\$57,400	\$59,200	\$61,100	\$61,450	\$78,315

Provided below is a series of estimates based on the change in composition of the Urban Forest over time. As larger underperforming trees are removed and smaller trees planted in their place, the size breakdown of the Urban Forest will change. Given this expected change in the average size of trees, we have included several breakdowns below estimating costs as the composition of the Urban Forest changes. Please note these are estimates, and should be reviewed periodically to ensure accuracy.

2022 Cost Breakdown – Pruning 750 Trees/Year by 2022

	Total Trees	Avg %	Cost/Tree	Pruned/year	Cost/year
Evergreen	320	5.99%	\$20	45	\$ 898.37
Large (>24")	1320	24.71%	\$150	185	\$ 27,793.37
Medium (13-24")	1306	24.44%	\$75	183	\$ 13,749.30
Small (1-12")	2397	44.86%	\$40	336	\$ 13,458.73
					\$ 55,899.78

2027 Cost Breakdown – Pruning 830 Trees/Year by 2027

	Total Trees	Avg %	Cost/Tree	Pruned/year	Cost/year
Evergreen	375	6.47%	\$20	54	\$ 1,073.28
Large (>24")	1400	24.14%	\$150	200	\$ 30,051.72
Medium (13-24")	1600	27.59%	\$75	229	\$ 17,172.41
Small (1-12")	2500	43.10%	\$40	366	\$ 14,655.17
					\$ 62,952.59

2032 Cost Breakdown – Pruning 920 Trees/Year by 2032

	Total Trees	Avg %	Cost/Tree	Pruned/year	Cost/year
Evergreen	500	7.75%	\$20	71	\$ 1,425.25
Large (>24")	1650	25.56%	\$150	235	\$ 35,274.98
Medium (13-24")	1800	27.89%	\$75	257	\$ 19,240.90
Small (1-12")	2500	38.73%	\$40	356	\$ 14,252.52
					\$ 70,193.65

Pruning Activities

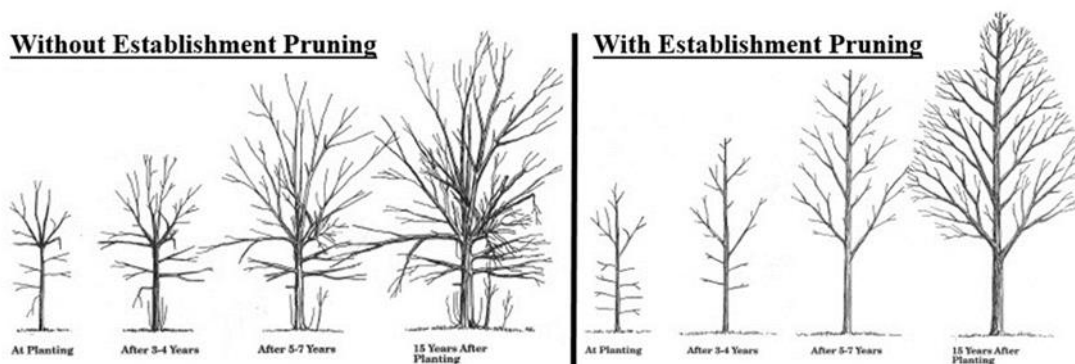
Creation of a Pruning Cycle

Initially, the City should prioritize the trees identified in the inventory as requiring either Priority, Dead Limb, or Training pruning, regardless of where they are located. This is to prioritize public safety before routine maintenance. After these trees are pruned, Ottawa should aim to create a 7 year pruning cycle based on the size of its tree population both now and in 2032. With approximately 6,455 parkway trees total by 2032, this would mean that over a 7 year period, approximately 920 trees would require pruning each year. As noted above, the number of trees as well as their overall sizes will be changing over that time period, hence above tables showing adaptive management of the tree pruning program. We believe this is a realistic goal based on communications with City staff.

Though tree pruning may seem expensive, the cost of maintaining trees is significantly less than the costs associated with trees damaging property or injuring residents. The benefits trees provide when healthy and well maintained can be prolonged and significantly increased, as shown in the projections above. A cycle pruning program is the hallmark of an effective forestry program, and it is highly recommended that Ottawa begin to budget for this essential expense.

Pruning of Young Trees

For the purposes for this Plan, a young tree is considered to be under 12" DBH. Young trees are still trying to acclimate to their sites. The pruning of young trees has different goals and outcomes than the pruning of larger, mature trees. Standard nursery stock has been meticulously pruned for four to ten years to have a single trunk, and the specific branching patterns which are considered common to the various tree species. Without proper establishment pruning, these trees might have multiple trunks, poor branch structure, and overall poor form and architecture. Pruning of young trees to establish proper form is one of the most cost-effective maintenance activities which can be performed. It is an inexpensive task that does not require a great time commitment, and saves thousands of dollars in pruning and maintenance costs later in the tree's life. As mentioned above, due to not having to climb trees or use dangerous equipment, young trees may be pruned by City staff, or even well-trained residents, with proper training from the Forestry Consultant or a similarly qualified organization, and with the approval of the Tree Board.



Pruning of Mature Trees

A mature tree, for the purposes of this Plan, is considered to be greater than 12" in diameter. Mature trees are established in and acclimated to their sites. The pressure these trees face from their environment generally comes from above-ground factors such as pests, pathogens, man-made structures, other trees, windstorms, or lightning strikes, as well as some below ground factors like girdling roots, limited soil volume, or poor soil quality. Pruning is performed to mitigate the above-ground issues, as well as balance out any below ground issues when possible. Natural aging and limb dieback are additional reasons these trees are pruned.

Pruning of mature trees may mitigate a short-term risk, such as after a storm, or pruning may be done to maintain a tree's long-term health and structure. In the wild, trees lose limbs frequently. This is called self-pruning. Allowing trees to self-prune over time is not advisable in an urban setting. Safety factors may arise, and the process of self-pruning may bring up aesthetic issues in an urban environment. Mature public trees should only be pruned by professional Certified Arborists and done in accordance with industry Best Management Practices and accepted ISA and ANSI standards.

Private Property Trees

The City of Ottawa shall not be responsible for the pruning of trees located on private property. The City reserves the right to prune portions of trees overhanging public property, but is under no legal obligation to do so, and will perform such pruning at the discretion of the City Arborist and/or Forestry Consultant.

Reasons for Pruning

Establishment Pruning

Establishment pruning of newly planted trees is the single most cost-saving measure in tree care, as it establishes good form and branch structure for the life of the tree. Establishment pruning should be performed a minimum of one time prior to the tree reaching six inches in diameter. Once established, the tree will only require periodic cycle pruning to maintain an appropriate form for the urban forest and to maintain health and keep the tree free of dead limbs. As mentioned above, because establishment pruning can be done without the use of dangerous equipment, the use of well-trained volunteers can be an effective means of pruning these young trees.

Cycle Pruning

A Best Management Practice in Urban Forestry is that trees should be pruned on a cyclical basis as preventative maintenance. No tree should go more than seven years without proper pruning. Cycle pruning ensures that dead branches, storm damaged limbs, or unsightly growth are removed before becoming hazardous or bad for the health of the tree. Cyclical pruning also ensures the proper leaf to stem ratio, which provides structural support for the tree. It also ensures that pruning stays relatively inexpensive, as severe issues do not have time to develop. Cycle pruning is a maintenance activity which if performed regularly, actually needs to be performed less often!

Emergency / Storm Damage Pruning

Emergency pruning is nearly always necessary to mitigate severe risk after storm events, such as limbs which have fallen and are blocking traffic, have impacted a structure, are interfering with a utility, or are hanging and in imminent danger of doing any of the above. Emergency and Storm Damage Pruning should be conducted at the discretion of the City, with the best interests of the public in mind. This is one of the few occasions on which the recommendations of this Plan may be temporarily suspended. When life or property are in imminent danger due to conditions associated with a downed tree or tree part, the City may take whatever remedial action is practical and reasonable to mitigate such imminent risk.

Sanitation Pruning

When a tree has been diagnosed as having been diseased or infested with a pest or disease, sanitation pruning may be employed to maintain the tree while removing the diseased or infested portions. This technique is only effective when the host tree is infected/infested with certain pests and pathogens, and only in a localized area of the tree. With more widespread cases of disease or insect infestation, removal will be the most cost-effective and safest option to avoid endangering other nearby trees, as these pests and diseases tend to spread, particularly when there is more of the same species nearby.

Removal of High Risk Limbs

At times, a tree as a whole may not pose a high risk, but a single limb may have defects that make it hazardous. At these times, the removal of such limbs or parts may render the tree to be low risk again, without causing permanent damage to the tree.

Tree Pruning Requirements and Standards

City of Ottawa

1. All activities directly related to the operation of a chainsaw, bucket truck, limb rigging, or tree climbing shall be performed by a qualified employee, or under the supervision of a certified arborist or arborist trainee.
2. No pruning or maintenance activity that takes place within ten feet of a power transmission line shall be accomplished by a City of Ottawa employee unless certified as a qualified Utility Arborist.
3. No cabling, bracing, or other such support systems shall be installed in City-owned trees, either by the City of Ottawa, its residents, or any contractors. Exception may be made by obtaining prior written approval of the City.
4. No topping, heading, pollarding or espalier pruning shall be conducted on City-owned trees, and no wound dressings shall be used under any circumstances, without a permit and prior written approval of the City of Ottawa.

5. The need for pruning and maintenance of individual trees and parkways shall be at the discretion of the City of Ottawa and its designated contractors.
6. No more than 25% of a tree's crown shall be removed during pruning operations to preserve the health of the tree. Any more than 25% of the crown being removed put the tree in danger of severe dieback, and removal should be considered at that point.

Other General Maintenance

Maintenance Activities

Retaining a Consultant

The task of establishing or enhancing a robust Urban Forestry program can be difficult! There may be many new challenges and learning curves, contracts to renegotiate, bid documents to create, resident concerns to manage, and other responsibilities which may require the assistance of a professional.

The Forestry Consultant may be involved in sourcing and interviewing contractors and vendors for tree pruning, removal, and planting operations, assisting in maintaining the tree inventory, training City staff on tree health and risk assessments, assisting in explaining policies to homeowners, preparing contract and bid specifications, and teaching residents how to help the City in caring for their trees. The importance of this early relationship cannot be overstated, no matter how large or small the organization.



Chemical Applications

Trees, like people, sometimes contract pests and pathogens. Often these pests and pathogens can be controlled with a simple chemical application just as illnesses in humans can be controlled with medication. This practice is called Plant Health Care. When financially practical, chemical control for common pests or pathogens may be utilized as a preventative or curative method, and increase the aesthetics and benefits of the tree population.

At present, Ottawa does not have a chemical treatment program and does not employ staff with PHC experience, nor do they have the necessary equipment. In the future, if the need arises and budgets allow, the City may explore training staff in PHC or hiring a PHC contractor.

Residents of Ottawa may perform chemical applications on the parkway trees, such as treatment for Emerald Ash Borer, Dutch Elm Disease, Apple Scab, or other common disorders with prior permission from the City. The City will not bear any financial responsibility associated with the costs of such treatments, and treatments must be performed by a Certified Arborist who holds a valid Pesticide Applicators license.



Such an allowance would be strictly informational, to allow the City to be aware of chemical treatments occurring on trees that it owns. Such work may be denied or revoked for utilizing unqualified contractors, potentially hazardous chemicals, or any other reason at the discretion of the City. Additionally, trees being treated by residents may still be removed at the discretion of the City for any of the reasons listed above.

Water Management

The importance of water in the establishment, growth, and survivorship of trees cannot be overstated. Most trees adapted to our climate zone (USDA Zone 5b) are also adapted to the amount of moisture we have in an average year. However, younger trees with less expansive root systems are susceptible to prolonged drought. Young trees need supplemental watering, which is an essential maintenance activity and can prevent newly planted tree mortality.

As we anticipate 2,600 additional trees being planted over the course of the next 10 years, this concept becomes very important. A general rule would be to expect to pay somewhere on the order of \$50/tree for the first 2 years of its life to water it several times throughout the first 2 growing seasons. So, with planting 280 trees per year, there would be 560 trees requiring water at any given time, for a total cost of around \$28,000 each year. Once again however, these numbers can be highly variable. A watering program paid for by the City, using contracted labor, is likely beyond the scope of current budgets. There is always an option to rely on well-informed residents to water trees. Upon receiving a newly planted tree on the parkway in front of their homes, residents should be supplied with an informational pamphlet or letter which explains how often to water their new tree during the first 2-3 years. It is also suggested that the City, acting in conjunction with the Forestry Consultant, hold basic tree maintenance classes open to all residents.

Mulch

Proper application of mulch is a necessary and cost-effective maintenance activity. Mulch has many benefits, including reducing weed growth in the root zone, protecting the tree trunk and root flare from lawn maintenance equipment, allowing water to move into the soil, reducing evaporation and drought stress, and creating a naturally fertile soil environment. Turf grass typical of parkways competes for water and nutrients, and mulch reduces this competition.

Improper Mulching



Proper Mulching



But not all mulching is beneficial. The practice known as “Volcano Mulching” is the practice of piling mulch against the trunk in excess of 3” deep. This causes moisture build up against the trunk, and can cause decay of the trunk tissue, and possibly death. Material such as crushed limestone, red volcanic rock, or rubber pellets can alter the soil chemistry in an undesirable way, and cause dieback or tree death.

Fortunately, mulch is a commodity most communities can get for free so long as they are pruning and removing trees each year. A marshall yard for wood chips can be established in City limits easily. These chips can be made available for free to residents as well as planting contractors. This arrangement works well for everyone: Contractors do not have to pay to dispose of chips or for transportation, residents get free woodchips, and planting contractors don’t have to charge the City for mulch when new trees are planted. All newly planted trees should have mulch applied appropriately. A goal for Ottawa should be to mulch all trees 12” DBH and smaller, but for now, mulch for all newly planted trees, and preventing volcano mulching should be a primary concern.

Tree Preservation and Management During Construction

In many municipalities, ordinances exist to protect trees and shrubs from construction activities. The intent of these ordinances is to protect the benefits those tree and shrubs provide to the community. Trees and shrubs may be privately owned but are also community resources that provide benefits such as aesthetics, storm water benefits, energy savings, carbon sequestration and increased property values. Therefore, tree and shrub protection and preservation during construction represents an investment in the community! Ensuring the protection and preservation of these trees while minimizing burdens to businesses, developers, and residents is essential to a healthy urban forest.



Tree protection and preservation during periods of construction involves protecting trees from damage caused by construction activities. This damage includes physical and chemical damage to the trunk, branches, and roots. Damage may be caused by equipment such as backhoes, skid steers, or other appendage-type equipment. Effects of damage to the visible above ground portions of the tree can be obvious, as when branches are broken. But hidden effects such as root compaction or improper grading may not become evident for years until the tree begins to die back. The standards set forth below and in Appendix L are industry standards with a proven record of success.

Tree Preservation Requirements and Standards

City of Ottawa

1. A tree survey should be performed by a qualified individual prior to the beginning of any development activities. The survey shall detail the size, species, and condition of each tree six inches DBH and greater OR managed landscape tree (intentionally planted, non-volunteer tree) of any size.
2. The Tree Survey and a Tree Protection Plan shall be submitted to the City of Ottawa and all relevant architects, engineers, and workers, detailing the following:
 - A. Trees to be removed
 - B. Trees to be preserved
 - C. Location and size of the Tree Protection Zone (TPZ) for each tree
3. The Tree Protection Zones for each tree shall be visibly delineated by the site engineer, using orange snow fencing or other high visibility exclusion material. When such a delineation is not possible, all workers on site shall be made aware of the TPZ verbally.

Tree Risk Assessment Policy

Trees provide ecosystem and aesthetic benefits, but all trees also pose some degree of risk. Determining the acceptable level of risk, along with effectively managing that risk, is a key priority for urban forestry operations. As a tree manager, the City of Ottawa always must always assume some degree of risk. It is up to the City to track that risk to ultimately decide how to take steps to mitigate trees which pose such risk in a manner which is responsible both economically as well as in the interest of public safety.

Levels of Risk Assessment – An Overview

These Risk Assessment Levels are based on the International Society of Arboriculture's (ISA) Tree Risk Assessment Qualification (TRAQ) protocols, as well as the ANSI A300 Part 9 (Tree Risk Assessment) Standards. The TRAQ forms can be found in Appendix H at the end of this report. All trees in Ottawa were assessed for a basic level of risk during the inventory. These assessments were rapid assessments, and do not represent any formal level of TRAQ risk assessment, and are not legally binding. They are solely intended to provide Ottawa with data showing a need for a more detailed assessment of individual trees such as those listed below.



Level 1 Assessment

Also called a “limited visual assessment”, whereby a tree has a basic analysis of obvious physical defects and condition. The assessor walks or drives by the tree, assesses it quickly for defects, evaluates the risk posed by the subject tree, and reports the results of the assessment to the tree owner. Often, prior to a recommendation, a more detailed (Level 2 or Level 3) assessment will be required to gather additional data.

Level 2 Assessment

A Level 2 Assessment, also called a “basic assessment”, is a report detailing the information collected during a detailed visual inspection of the tree and the surrounding site. Such an inspection requires a 360 degree walk around, and may include the use of simple tools, such as binoculars, magnifying lenses, mallets, probes, and trowels or shovels. The goal is to get a more complete picture of the tree in its environment, as well as previous histories of failures, and a root to branch evaluation of not only the tree but also potential “targets” which falling tree limbs may impact. Targets are things such as structures, people, vehicles, or other things which may be damaged or injured by trees.



Level 3 Assessment

A Level 3 Assessment, also called an “advanced assessment”, provides detailed information about specific tree parts, targets, and risk associated with each potential interaction. By definition, it requires specialized equipment known as “advanced tools”, such as bucket trucks, resistance drills, sonic tomographs, and other such equipment. This is the most detailed and time-intensive type of assessment, and is typically only performed when a decision to retain or remove a tree is very difficult, as would be the case for a high quality tree near a potential target that has significant defects, the extent of which are not known, but must become known before making a decision.

Considerations in Assessing Risk

The following are meant for the reader to gain additional insight into the TRAQ process. Once again, TRAQ inspections were not performed on City trees during the inventory data collection, but this information will help the reader understand the terminology better, and help inform staff and residents as to how and why these inspections are performed.

Likelihood of Tree Part Failure

Like it sounds, this is a process of determining how likely a tree part is to fail, and then how likely that failure is to impact a target. Likelihood of failure is an assessment of the tree’s defects, and the load on those defects, like weight, gravity, ice, or wind. The parts impacted are generally the roots, root plate, trunk, branches, or potentially whole tree failure at multiple points.

Likelihood of Tree Failure Impacting a Target

Determining the likelihood of impacting a target is figuring out the occupancy rate, or the amount of time that targets (particularly people or high value property) are within the fall zone. A large tree in the middle of a field could fail with little impact, but that same tree in a playground might have serious consequences. In many roadways, motor traffic is present day and night. All of the City's inventoried 5,343 trees are in rights-of-way adjacent to roads, where failure of a tree not only impacts motorists, but it also has a potential effect on pedestrian traffic and utilities within right-of-way also.



Consequences of a Tree Failure Impacting a Target

The potential consequences of the tree failure impacting a target are a cumulative function of both the "value" of the target (person vs car) and the consequences to that target if the tree fails. Whereas the previous step was concerned with occupancy rates, this step looks at the consequences of the impact, and assumes that the target is always present. To follow with the above example, it is assumed that if a parkway tree were to fail, that a car, utility line, and person are all underneath it at the time of failure, and the consequences to those targets is evaluated. Consequences are generally considered to be "minor" for targets that can be easily replaced or repaired, and step up through 4 levels with the highest level being "severe", which would constitute severe injury to a person, or even a fatality (see the table below).

Weather

Every tree, no matter how healthy, can fail from wind, lightning strikes, ice loading or soil saturation. "Normal" weather can cause tree or tree part failures for trees which have existing defects, like deadwood, cavities, or poor architecture. Extreme weather events, by contrast, can cause the failure of perfectly healthy trees. For all Tree Risk Assessments, Risk should be assessed assuming "normal" weather conditions. Though it should be noted that "normal" weather conditions for northeastern Illinois do include gusty winds, thunderstorms, snow, and even an occasional ice storm. It is the extremes of these events that should be considered abnormal.



DRAFT City of Ottawa Tree Risk Assessment Policy

The City of Ottawa has created this policy to maintain an acceptable level of risk from its tree population(s). In order to maintain a high level of public safety, while mitigating undue burden, the City shall adopt the following risk assessment protocols:

1. The City of Ottawa maintains a tree inventory detailing the species, size, and condition of all trees on City Parkways, as well as a basic level of risk posed by each tree. This UFMP recommends that the trees listed as being in elevated risk categories during the initial inventory be audited on an ad hoc basis. During these audits, the City Arborist and/or Forestry Consultant should inspect these trees and identify trees potentially posing an unacceptable level of risk. Such trees identified shall either be scheduled for a more detailed risk assessment (Level 2 or 3), or shall be mitigated, either by pruning, bracing, or removal, as soon as practical following the assessment.
2. During subsequent years, staff shall perform limited visual assessments on an ad hoc basis by driving by trees during the normal course of daily operations. Trees which may appear to present an elevated risk level shall be scheduled for a more detailed risk assessment (Level 2 or 3), or shall be mitigated, either by pruning, bracing, or removal, as soon as practical following the assessment.
3. Upon notification from a resident of a concern about a potentially high-risk tree, the City Arborist and/or Urban Forestry Consultant perform a Level 1 limited visual inspection within a reasonable amount of time of the notification by the resident. If a Level 2 or Level 3 Risk Assessment is required based on that inspection, it shall be performed within an additional (14) business days. A decision shall be made by the City Arborist and/or Forestry Consultant as to what the appropriate mitigation measures are, if any.
4. All trees determined to be in need of mitigating actions (removal, pruning, etc.) should be documented in writing by the City Arborist and/or Urban Forestry Consultant. The documentation shall include the date the assessment was performed, the species, size, and condition of the tree, and a brief narrative detailing which parts of the tree are likely to fail, the likelihood of failure, the likelihood of impacting a target, the consequences of tree or tree part failure, and the overall tree risk rating, per the ISA's TRAQ system of risk assessment.
5. A minimum branch diameter of three (3) inches, by ocular estimate, shall be the standard to which this risk assessment policy applies. Assessing all branches smaller than three inches represents an undue burden to the City.

TRAQ Forms can be found in Appendix H at the end of this report.

TRAQ Tree Risk Assessment Matrices**Likelihood of Tree Failure Impacting Target**

<u>Likelihood of Tree Failure</u>	<u>Likelihood of Impacting Target</u>			
	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

Risk Rating Matrix

<u>Likelihood of Failure and Impact</u>	<u>Consequences</u>			
	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

Projected Budget

The budget numbers below, as mentioned several times through this Urban Forestry Management Plan, are conservative figures based on current industry rates for the services listed. Based on input from City staff, the budget begins this year with a dollar amount that is within their current annual budget for tree related expenses. From there, generally the budget increases slightly each year, and projects through 2032, at which time, including CPI, the budget will have increased approximately 60% from the current level of approximately \$161,450 in 2022 to approximately \$263,465 by 2032. This represents a necessary budget increase for such an increase in values of the Urban Forest.

REMOVALS	Milestones	2022	2023	2024	2025	2026	2027-2032
	Trees Removed	20	18	29	43	66	140/year avg
	Diameter Inches	522"	782"	923"	1034"	936"	N/A
	Notes	All Priority (20) Removals	Standard Removals 36" and Larger	Standard Removals Between 28 and 35"	Standard Removals Between 21 and 27"	Standard Removals Between 8 and 20"	Remaining Standard and all Low Priority Removals
	Removal Cost (2022)	\$13,050	\$19,550	\$23,075	\$25,850	\$23,750	\$30,000
	Removal Cost (CPI)	\$13,050	\$19,550	\$23,075	\$25,850	\$23,750	\$34,500

PLANTINGS	Milestones	2022	2023	2024	2025	2026	2027-2032
	Trees Planted	200	220	240	260	280	280/year avg
	Planting Cost (2022)	\$90,000	\$99,000	\$108,000	\$117,000	\$126,000	\$126,000
	Planting Cost (CPI)	\$90,000	\$99,000	\$108,000	\$117,000	\$126,000	\$144,900

PRUNING	Milestones	2022	2023	2024	2025	2026	2027-2032
	Trees Pruned	755	775	800	825	830	925/year avg
	Notes	All Dead Limb Prunes (444) and All Priority Prunes 18" and Larger (331)	Remaining Priority Prunes (155) and Train Prunes (104), begin cycle prunes (516)	800 Cycle Prunes	825 Cycle Prunes	830 Cycle Prunes	Approximately 920 Cycle Prunes / year in perpetuity
	Cost (2022)	\$55,900	\$57,400	\$59,200	\$61,100	\$61,450	\$68,100
	Cost (CPI)	\$55,900	\$57,400	\$59,200	\$61,100	\$61,450	\$78,315

FORESTRY CONSULTANT	Milestones	2022	2023	2024	2025	2026	2027-2032
	Notes	Basic Assistance with contract prep, etc	Appraisals and Risk Management	Inventory Updates / Risk Management	Inventory Updates / Risk Management	Inventory Updates / Risk Management	Inventory Updates / Risk Management
	Cost (2022)	\$2,500	\$2,500	\$5,000	\$5,000	\$5,000	\$5,000
	Cost (CPI)	\$2,500	\$2,500	\$5,000	\$5,000	\$5,000	\$5,750

TOTALS	TOTALS - 2022 \$	\$161,450	\$178,450	\$195,275	\$208,950	\$216,200	\$229,100
	TOTALS - CPI 3%	\$161,450	\$178,450	\$195,275	\$208,950	\$216,200	\$263,465

Conclusion

By creating this Urban Forestry Management Plan, the City of Ottawa has taken an important step in investing in their urban forest's future by creating both shorter and longer term goals that will serve as milestones. These are all goals which, as they are undertaken, will help strengthen the urban forestry program in Ottawa, maximizing the benefits that trees provide to the community and minimizing cost and risk. There are many local partners we have suggested, as well as many yet to be discovered, who can help along the way and actually can become promoters of the urban forestry program in Ottawa. The more public support and engagement this program receives, the better it will be equipped to tackle difficult situations in the future.

Certainly, none of this can be done without funding streams and innovative thinking along the way. As the basic budget and i-Tree reporting demonstrates, the return on investment for the forestry program in Ottawa is remarkable at over 3 times the projected budget costs invested. As we bring information like this to light, that the forestry program yields dividends and doesn't just cost money, the more people will become interested and engaged in promoting these efforts.

Great Lakes Urban Forestry Management thanks the City of Ottawa, its residents, stakeholders, and the grant funding organizations which have made this endeavor possible. It has been a pleasure to work with the City on this inventory update, and to update the Urban Forestry Management Plan. We look forward to continuing to assist the City their Urban Forestry endeavors.

Ottawa, Illinois



Glossary of Terms

Aerial Device: Any piece of equipment expressly intended to elevate a human worker above the level at which they typically stand with their feet on the ground surface. Can include but is not limited to bucket trucks, scissor lifts, etc

Aggressive: A floral or faunal organism which is native (endemic) to the United States or northern Indiana, but which is known to outcompete other more desirable organisms

Arborist: An individual engaged in the profession of arboriculture who is educated, trained and licensed to provide for or supervise the management of trees and other woody plants

Arborist Trainee: Any person working under the direct supervision of an Arborist or Certified Arborist

Balled and Burlapped: A tree, shrub, or other plant prepared for transplanting by allowing the roots to remain covered by a ball of soil around which canvas or burlap is tied and secured with a basket.

Bare Root: Harvested plants from which the soil or growing medium has been removed

Best Management Practices (BMP): Methods or techniques found to be the most effective and practical means in achieving an objective while making the optimum use of resources.

Caliper: Standard nurseryman's measure of tree diameter (size). Caliper measurement of the trunk shall be taken six inches above the ground up to and including four-inch caliper size. If the caliper at six inches above the ground exceeds four inches, the caliper should be measured at 12 inches above the ground.

Certified Arborist: An individual who has sufficient experience in the field of Arboriculture, and has been certified by the International Society of Arboriculture as being a Certified Arborist

Border Trees: Trees whose trunks, when measured at DBH, are situated on both Public and private property

Branch Collar: The branch collar is the point where a branch joins the trunk or another branch. This is the area the arborist chooses to make a proper cut.

Climbing Line: Any rope or other such material explicitly intended for bearing the weight of a human being

Collected Plants: Trees or shrubs which have been sourced from private property for the intent of transplanting elsewhere

Compacted Soil: A high-density soil lacking structure and porosity, characterized by restricted water infiltration and percolation (drainage), and limited root penetration

Consumer Price Index: an index of the variation in prices paid by typical consumers for retail goods and other items

Containerized: A tree, shrub, or other plant prepared for transplanting, or grown in, a solid-walled container such as a plastic pots or wooden boxes

Contracted Staff: People working for the City as part of an independently owned and operated private company which performs work for the City, but who are not directly employed by the City

Controlling Authority: An agency, organization, or corporate entity with the legal authority and/or obligation to manage individual trees or tree populations

Crew Leader: Any personal who has by direction or implication been chosen to lead a team of In-House or Contracted Staff

Crown: The upper part of a tree, measured from the lowest branch, including all branches and foliage

Critical Root Zone (CRZ): The minimum volume of roots necessary for a tree to have health and stability

Cycle Pruning: The process of routine maintenance pruning of trees, not related to storm damage or other hazard or emergency related-pruning, that occurs on a set and predictable time scale set forth by the City

Deadwood: Wood on a tree or shrub which is no longer biologically living and becomes brittle or prone to failure

Decline/Declining: Trees or shrubs which are experiencing symptoms of a general decline on health due to age, pest, or pathogen related issues

Desirable: A Tree or other plant whose characteristics are sought after due to ecology, aesthetics, or public safety

Diameter or DBH: Diameter at Breast Height. A standard forestry measure of tree diameter (size), measured at 4.5' above ground level on the uphill side of a tree using a Diameter Tape or Biltmore Stick

Digging Machine(s): Any piece of mechanical equipment whose express purpose is to remove soil and plants from their current locations

Diseased: The status of a tree which has been negatively impacted by a pathogen, bacterial, fungal, viral, or similar lower life forms

Drip Line: The soil surface delineated by the branch spread of a single plant or group of plants

Drought: A period of two weeks or greater, during which there is less than one inch of rainfall, when the average daytime temperature during that same period exceeds 75 degrees Fahrenheit.

Dutch Elm Disease: A fungal pathogen which causes the decline and death of specific species of Elm trees.

Dying: A tree which is in the process of biological death due to senescence, disease, infestation, or other such malady from which there is very little to no hope of long-term survival

EAB: Emerald Ash Borer. An invasive beetle pest which affects all Ash trees.

Establishment Pruning: The pruning of a young tree in order to establish proper form and branching habit.

Established Trees: Those trees which have been permanently planted for a period of no less than 6 months, and which have permanent roots established in the soil

Failure (tree failure): Breakage of stem or branches, or loss of mechanical support in the root system

Feeder Root: Any portion of the below ground portions of the tree whose purpose is to absorb water and nutrients

Floodplain: Land which has been determined to be periodically inundated with water from a nearby moving or static water body, such as a lake or river. Determined by the Federal Emergency Management Agency

Flush Cut: Either a pruning cut or final cut to remove a stump, for which the maximum acceptable distance from the ground or the branch bark ridge shall be no greater than 2 inches.

Full-Time: An employee who has regular employment through the City and whose work hours exceed 36 hours in a week, and who is employed year-round.

Fungal: Any of a group of spore-producing organisms feeding on organic matter, including molds, yeast, mushrooms, and toadstools.

Grade: The level or pitch of a certain piece of land, as defined by the trees or shrubs which inhabit it

Hardscape: The nonliving or man-made fixtures of a planned outdoor area, such as sidewalks, retaining walls, street lamps, etc.

Hazard: A known and documented state of imperiling public safety

Healthy Tree: Any tree which is successfully adapting to it's environment, and shows no signs of disease, pests, pathogens, or other such maladies, as determined by the City or Forestry Consultant(s)

Host: An organism which is susceptible to a known pest or pathogen

Infested: The status of a tree which has been negatively impacted by pests

In-House Staff: Staff directly employed by the City of Ottawa, on either a full-time or Part-Time Basis

Invasive: A floral or faunal organism which is not native (endemic) to the United States or northern Indiana

Job Site: Any geographic location where a person or persons will be performing activities related to the care and maintenance of City of Ottawa property

J.U.L.I.E. (311): The Illinois underground utility locating service

Liner Nursery: A privately owned plant propagation facility which specializes in the growth of small trees which are intended to be planted for growth into a full form

Managed: A tree or shrub which is in an area of the City which is routinely mowed and managed. Not a wild forest grown tree or shrub, or area containing such trees and shrubs

Manufacturer's Recommendations: Any expressly written instruction manual for a given piece of equipment that details how said equipment is supposed to be managed or maintained

Mineral Soil: Any substrate which is composed of a variety of rocks and minerals in various states of decomposition, leading to the development of a substance on which living plants may live

Mitigation: The process of diminishing risk

Monoculture: A population of trees in close proximity to one another which is comprised of 3 species or less of trees and shrubs which is prone to pest or pathogen outbreak

Natural Resources: Flora, fauna, and other such living and non-living parts of the environment which the City of Ottawa maintains

Nursery Stock: Woody Perennials which are of a "Tree Form" growth habit and are supplied by a nursery contractor for planting. Not established trees.

Park District Property: Land which, by deed or title, belongs to the City of Ottawa

Parkway Tree: Any woody plant within a Publicly-Owned right-of-way, or any other property owned or managed by the City of Ottawa

Part-Time: An employee who has regular employment through the City and whose work hours are less than 36 hours in a week, and who is employed year-round.

Pathogen: A fungus, virus, or other such microscopic organism which causes decline or death of trees

Pest: An insect or other macrofaunal organism which causes decline or death of trees

Private Property: Land which, by deed or title, does not belong to the City of Ottawa

Public Safety: The welfare and protection of the general public

Reforestation: The process by which trees are planted to replace trees which have been removed

Rigging Line: Any rope or other such material explicitly intended for bearing the weight of a tree limb. Not to be used for supporting a human being.

Right-of-Way (ROW): The publicly-owned land on which a road, drainage ditch, trail, or other public access is built

Risk: A situation involving potential exposure to danger or endangering public safety

Root Protection Zone (RPZ): The area on the ground surrounding a tree in which excavation, compaction, and other construction-related activities should be avoided or mitigated

Saddle: A piece of equipment expressly intended to hold a human being above ground level with the assistance of a rope or other such device

Sanitation Pruning: The removal of tree limbs that have become diseased or infested, in order to prevent the spread of disease or infestation from spreading throughout the rest of the tree e.g., Dutch Elm Disease, Black Knot Fungus, etc.

Seasonal Employees: Those employees retained by the City for less than 6 months out of the calendar or budget year

Shrub: Any woody perennial which has a multi-stemmed growth habit not consistent with being considered a tree. Can be subject to interpretation by Ottawa Staff.

Sound Wood: Structurally sound, non-decayed, non-compromised wood in the trunk or Scaffold Branches

Staff: Those employees retained by the City on a full-time basis with benefits provided

Structural Root: Any portion of the below ground portions of the tree whose purpose is to stabilize the plant against the forces of wind and gravity

TRAQ: Tree Risk Assessment Qualification. The International Society of Arboriculture's formal status of an individual who is qualified to assess the risk that trees may bring to the general public

Tree Protection Zone (TPZ): The area surrounding a tree in which excavation and other construction-related activities should be avoided.

Tree Risk: The likelihood and consequences of failure of a tree or tree parts

Tree Risk Assessment: A systematic process used to identify, analyze, and evaluate tree risk

Underperforming: Trees which have systematic health and vigor issues resulting in poor health, architecture, or other such maladies as determined by City staff

Undesirable: A tree which is not desired in the landscape due to ecological, aesthetic, or public safety reasons, as determined by Ottawa Staff.

Unmanaged: A tree or shrub which is in an area of the City of Ottawa which is not routinely mowed and managed. A wild forest grown tree or shrub, or area containing such trees and shrubs.

Urban Wood: Any tree or other woody perennial material which has been harvested for the sole purpose of long term storage in the form of furniture, recreational material, etc. Differentiated from “Reclaimed Wood”

Utility Arborist: A person explicitly trained in the management of trees and other plants in relation to energized power lines. Someone who is licensed to work with conflicts between trees and such energized power lines.

Appendix A: Acceptable and Unacceptable Species

Species not appearing on this list can be approved or disallowed by consensus of the Tree Board, acting under the supervision of the City Arborist and/or Forestry Consultant

NOT APPROVED	APPROVED SPECIES			
Any Size	Large Trees	Medium Trees	Small Trees	Evergreens
AILANTHUS	BALDCYPRESS	ALDER	AMERICAN REDBUD	ARBOR VITAE
AMUR CORKTREE	BEECH-AMERICAN	AMUR MAACKIA	APPLE-CRAB	DOUGLAS FIR
ASH-EUROPEAN	BEECH-EUROPEAN	BIRCH-RIVER	APPLE-EDIBLE	EASTERN REDCEDAR
ASH-GREEN	BUCKEYE-OHIO	BIRCH-WHITE	BUCKEYE-RED	FIR-CONCOLOR
ASH-WHITE	BUCKEYE-YELLOW	BLACKGUM	CHERRY-ORNAMENTAL	HEMLOCK-SPP
BOXELDER	CATALPA	ELM-CHINESE	DOGWOOD-SPP	JUNIPER-COMMON
BUCKTHORN	CHESTNUT-CHINESE	HARDY RUBBER TREE	HAWTHORN-COCKSPUR	PINE-AUSTRIAN
BURNING BUSH	DAWN REDWOOD	HAZELNUT-TURKISH	HAWTHORN-SPP	PINE-MUGO
CHERRY-BLACK/PIN	ELM-HYBRID	HORNBEAM-AMERICAN	HYDRANGEA-PEEGEE	PINE-WHITE
COTTONWOOD	GINKGO*	HORNBEAM-EUROPEAN	LILAC-SHRUB	SPRUCE-BLUE
ELM-AMERICAN	HACKBERRY	IRONWOOD	LILAC-TREE	SPRUCE-NORWAY
ELM-SIBERIAN	HICKORY-SPP	KATSURA	MAGNOLIA-SAUCER	SPRUCE-SPP
HONEYSUCKLE	HONEYLOCUST	MAPLE-HEDGE	MAPLE-AMUR	YEW
MAPLE-NORWAY	HORSECHESTNUT	MAPLE-MIYABEI	MAPLE-JAPANESE	
MAPLE-SILVER	KENTUCKY COFFEETREE*	MAPLE-PAPERBARK	PEACH/NECTARINE	
MULBERRY-SPP	LARCH	MAPLE-SHANTUNG	PLUM-SPP	
PEAR-CALLERY	LINDEN-AMERICAN	MAPLE-TRIFLORUM	ROSE OF SHARON	
POPLAR-SPP	LINDEN-LITTLELEAF	OAK-CHINKQUAPIN	SERVICEBERRY-SPP	
POPLAR-WHITE	LONDON PLANETREE	OAK-ENGLISH	SMOKETREE	
PRINCESS TREE	MAGNOLIA-CUCUMBER	OAK-SHINGLE	WITCH HAZEL	
RUSSIAN OLIVE	MAPLE-SUGAR	PERSIAN IRONWOOD		
WALNUT-ANY	OAK-BLACK	YELLOWWOOD		
	OAK-BURR	GOLDEN RAINTREE		
	OAK-PIN	MOUNTAIN ASH		
	OAK-RED	PEAR-EDIBLE		
	OAK-SWAMP WHITE	SASSAFRASS		
	OAK-WHITE	SEVENTH SON FLOWER		
	PAGODATREE			
	PERSIMMON			
	SWEETGUM			
	SYCAMORE			
	TULIPTREE	* - Male Only		
	ZELKOVA			

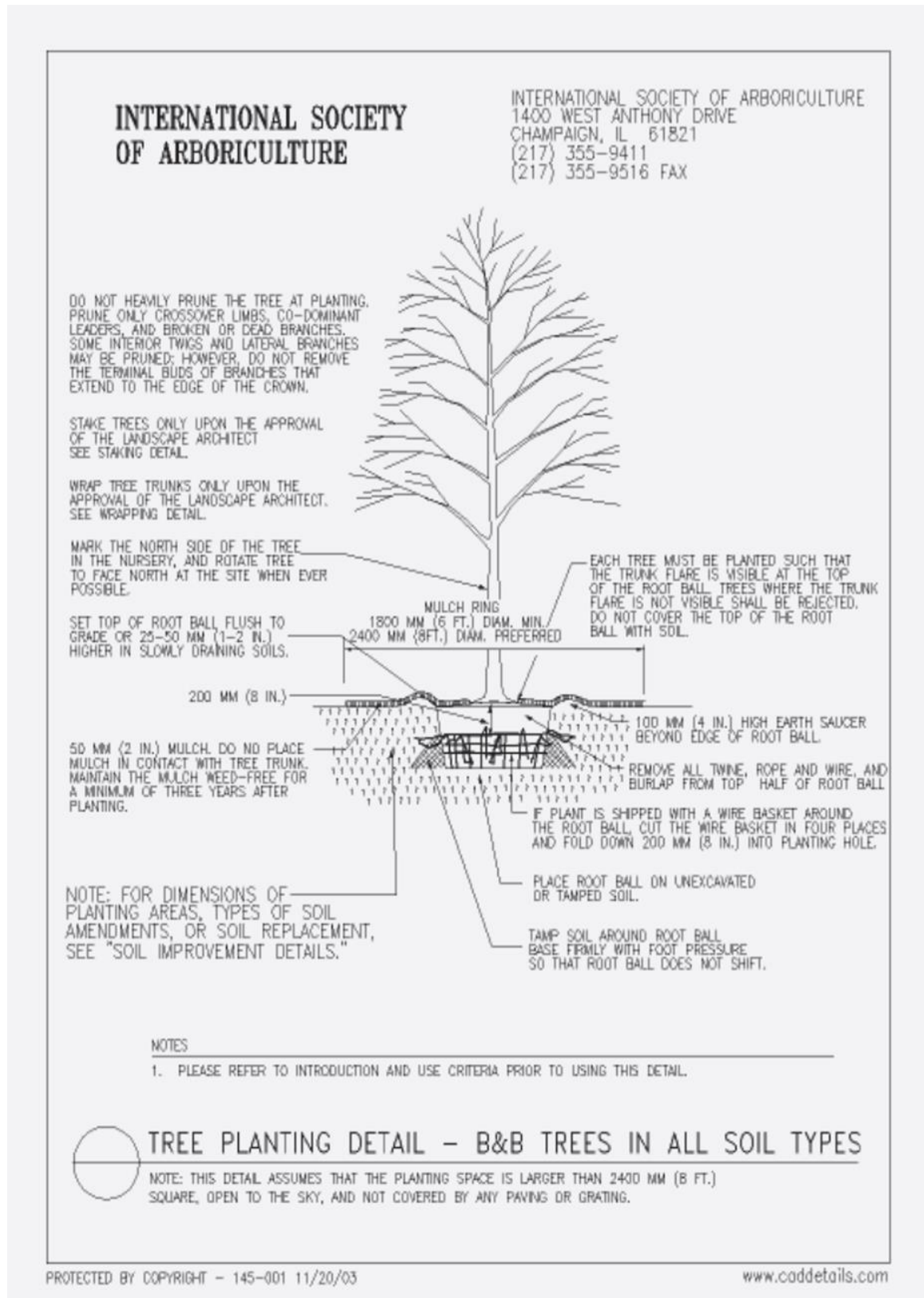
Appendix B: Additional Comments on Species

SPECIES	COMMENTS	SPECIES	COMMENTS
AILANTHUS	NOT APPROVED	LILAC-SHRUB	Parks Only
ALDER-SPP		LILAC-TREE	Improved varieties, tree form only
AMERICAN HORNBEAM		LINDEN-AMERICAN	
AMERICAN REDBUD		LINDEN-LITTLELEAF	
AMUR MAACKIA		LINDEN-SILVER	
APPLE-CRAB SPP	Apple Scab resistant varieties only	LINDEN-SPP	
APPLE-EDIBLE	Parks Only	LONDON PLANETREE	Prefer 'Exclamation!', 'Bloodgood' not allowed
APRICOT	NOT APPROVED	MAGNOLIA-CUCUMBER	
ARBOR VITAE	Parks only	MAGNOLIA-SAUCER	Scale resistant varieties only
ASH-BLUE	NOT APPROVED	MAGNOLIA-SHRUB	Star Magnolia or similar Magnolia pruned to tree form
ASH-GREEN	NOT APPROVED	MAPLE-AMUR	Parks only unless pruned to tree form
ASH-WHITE	NOT APPROVED	MAPLE-AUTUMN BLAZE	Or other similar Acer x freemannii
ASPEN	Improved varieties only	MAPLE-BLACK	
BALDCYPRESS	Prefer 'Shawnee Brave'	MAPLE-HEDGE	
BEECH-AMERICAN		MAPLE-JAPANESE	Small growing space only
BEECH-SPP	Prefer 'Tricolor' or 'Riversii'	MAPLE-MIYABEI	Prefer 'State Street'
BIRCH-RIVER	Prefer Single stem only	MAPLE-NORWAY	NOT APPROVED
BIRCH-SPP	Sweet Birch, Yellow Birch, or other new introductions	MAPLE-PAPERBARK	
BIRCH-WHITE	Bronze Birch Borer resistant only, prefer 'Whitespire'	MAPLE-RED	Improved varieties only
BLACK LOCUST	Improved varieties only, prefer 'Purple Robe'	MAPLE-SILVER	NOT APPROVED
BLACKGUM		MAPLE-SUGAR	Prefer 'Green Mountain'
BOXELDER	NOT APPROVED	MOUNTAIN ASH	Improved varieties only
BUCKEYE-OHIO		MOUNTAIN ASH-EUROPEAN	Improved varieties only
BUCKEYE-RED	Prefer 'Ft. McNair' or Bottlebush	MULBERRY-SPP	NOT APPROVED
BUCKEYE-YELLOW		OAK-BURR	
BUCKTHORN	NOT APPROVED	OAK-CHESTNUT	
BURNING BUSH	NOT APPROVED	OAK-CHINKQUAPIN	
CAROLINA SILVERBELL	Protected sites only	OAK-ENGLISH	
CATALPA		OAK-PIN	
CHERRY-BLACK	NOT APPROVED	OAK-RED	
CHERRY-PURPLE LEAF		OAK-SWAMP WHITE	
CHERRY-SPP	Ornamental, Black Knot resistant varieties only	OAK-WHITE	
COTTONWOOD	NOT APPROVED	OTHER	Open for new introductions
DAWN REDWOOD		PAGODATREE	
DOGWOOD-SPP	Hardy varieties only	PEACH	Parks only
DOUGLAS FIR	Parks only	PEAR-CALLERY	NOT APPROVED
EASTERN REDCEDAR	Parks only	PEAR-EDIBLE	Parks Only
ELM-AMERICAN	NOT APPROVED	PERSIAN IRONWOOD	Medium growing space only
ELM-HYBRID	Hardy varieties only	PERSIMMON	American variety preferred (Diospyros virginiana)
ELM-RED	NOT APPROVED	PINE-AUSTRIAN	Parks Only
ELM-SIBERIAN	NOT APPROVED	PINE-SCOTCH	Parks only
ELM-SPP	New cultivar introductions	PINE-WHITE	Parks only
EUONYMUS	Eastern Wahoo ONLY no non-native varieties	PLUM-SPP	Parks Only
FIR-SPP	Parks only	PUSSYWILLOW	Parks only
FRINGETREE		ROSE OF SHARON	
GINKGO	Male only	SASSAFRAS	
GOLDEN RAINTREE		SERVICEBERRY-SPP	Prefer 'Autumn Brilliance'
HACKBERRY		SEVENTH SON FLOWER	
HARDY RUBBER TREE		SHRUB-SPP	Parks only, open for new introductions
HAWTHORN-SPP	Thornless varieties only	SMOKETREE	American variety preferred, small growing space only
HICKORY-BITTERNUT		SPRUCE-BLUE	Parks only
HICKORY-SHAGBARK		SPRUCE-NORWAY	Parks only
HONEYLOCUST	Prefer 'shademaster' or 'inermis'	SPRUCE-SPP	Parks only
HONEYSUCKLE	NOT APPROVED	SUMAC	Parks only
HORNBEAM-EUROPEAN		SWEETGUM	Prefer 'Happidaze'
HORSECHESTNUT		SYCAMORE	In natural areas only, London Planetree preferred
HYDRANGEA-PEEGEE		TULIPTREE	
IRONWOOD		VIBURNUM	Tree form only
JUNIPER-COMMON	Parks Only	WALNUT-BLACK	NOT APPROVED
KATSURA		WILLOW-SPP	NOT APPROVED
KENTUCKY COFFEETREE	Fruitless varieties only	YELLOWWOOD	
LARCH		YEW	Parks Only
		ZELKOVA	Prefer 'Green Vase'

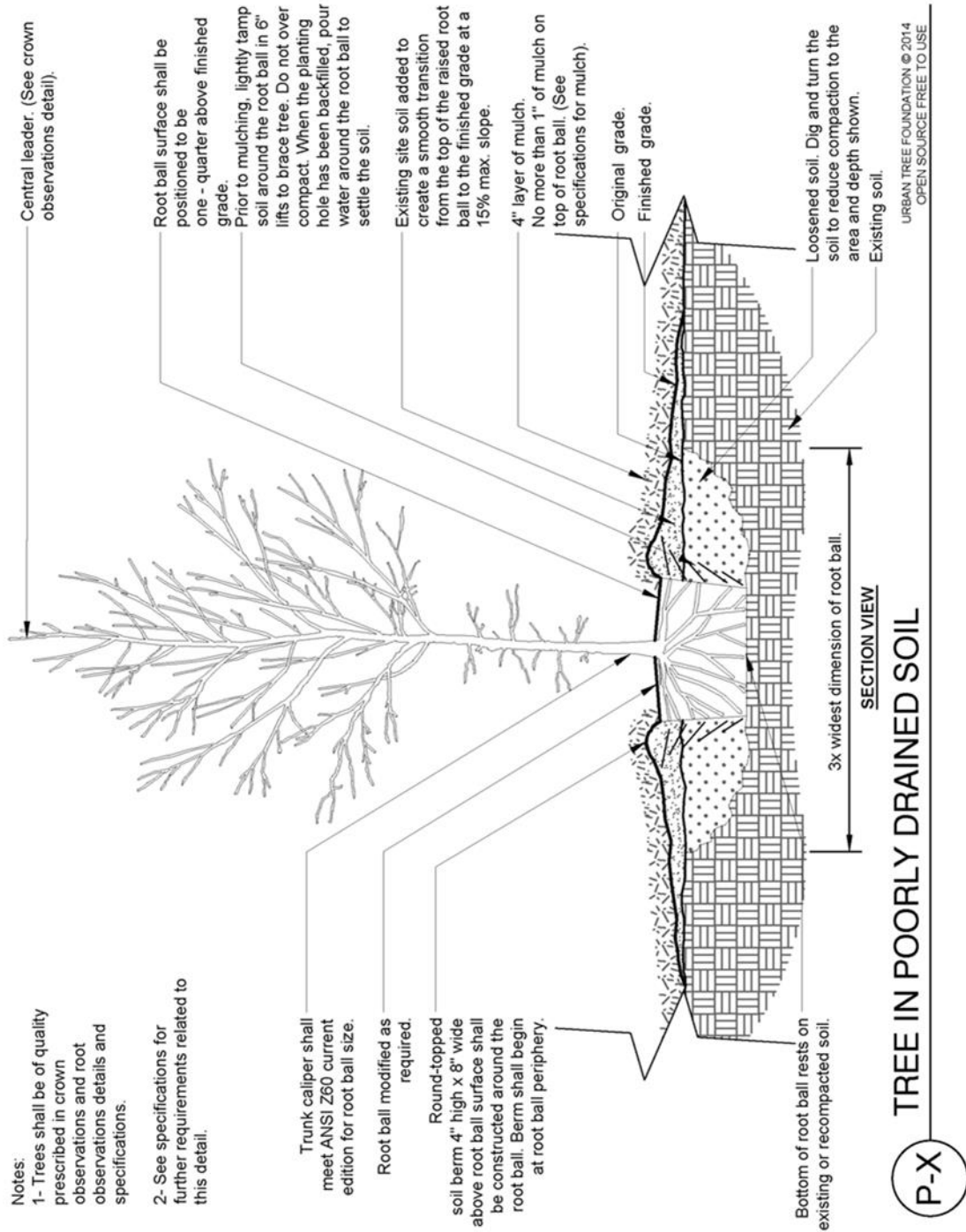
Appendix C: Species Substitutions

Species	Planting Time	Acceptable Substitutes
Alder, Black/Speckled	Spring	River Birch, Planetree
Amur Maackia	Spring	Yellowwood, Shingle Oak
Baldcypress	Spring	Larch, Dawn Redwood
Beech, European	Spring	Red Oak, Buckeye
Birch, River (Multi Stem)	Spring	Alder, Swamp White Oak
Birch, White	Spring	River Birch, Alder
Black Locust (Purple Robe)	Any	Honeylocust, Kentucky Coffeetree
Blackgum	Spring	Sweetgum, Dogwood
Buckeye, Ohio (Autumn Splendor)	Any	Horsechestnut, Catalpa
Buckeye, Red	Spring	Dogwood, Hawthorn
Buckeye, Yellow	Spring	Planetree, Sweetgum
Catalpa	Any	Kentucky Coffeetree, Tuliptree
Cherry, Sargent	Spring	Red Buckeye, Tree Lilac
Chestnut, Chinese	Spring	Turkish Hazelnut, Persimmon
Crabapple (Larger)	Any	Tree Lilac, Hawthorn
Dawn Redwood	Spring	Baldcypress, Larch
Dogwood, Cornelian	Spring	Tree Lilac, Hawthorn
Dogwood, Pagoda	Spring	Sargent Cherry, Smoketree
Douglas Fir	Spring	Concolor Fir, Spruce
Elm, Hybrid (Larger)	Any	Hackberry, Hardy Rubbertree
Fir, Concolor	Spring	Douglas Fir, Spruce
Ginkgo (Standard)	Any	Tuliptree, Catalpa
Golden Raintree	Spring	Katsura, Magnolia
Hackberry, Common	Any	Hybrid Elm, Hardy Rubbertree
Hardy Rubber Tree	Any	Tuliptree, Zelkova
Hawthorn, 'Inermis'	Any	Crab Apple, Dogwood
Hawthorn, Winterking	Any	Tree Lilac, Smoketree
Hazelnut, Turkish	Spring	Persimmon, Catalpa
Hickory, Bitternut	Spring	Oak spp, Beech spp
Hickory, Shagbark	Spring	Oak spp, Beech spp
Hornbeam, American	Spring	Ironwood, Hawthorn
Hornbeam, European (Columnar)	Spring	English Oak (columnar)
Horsechestnut (Baumani)	Any	Buckeye, Catalpa
Ironwood	Spring	American Hornbeam, Hawthorn
Katsura	Spring	Magnolia, Seventh Son Flower
Kentucky Coffeetree	Any	Honeylocust, Black Locust
Larch	Spring	Baldcypress, Dawn Redwood
Lilac, Japanese Ivory Silk	Any	Hawthorn, Sargent Cherry
Linden, Greenspire	Any	Kentucky Coffeetree, Hybrid Elm
Linden, Redmond	Any	Catalpa, Hackberry
Locust, Skyline	Any	Kentucky Coffeetree, Black locust
London Planetree	Spring	Sweetgum, Blackgum
Magnolia, Cucumber	Spring	Yellow Buckeye, Catalpa
Magnolia, Saucer	Spring	Persian Ironwood, Katsura
Magnolia, Star	Spring	Sargent Cherry, Smoketree
Maple, Autumn Blaze	Any	Black Maple, Shantung Maple
Maple, Black	Any	Shantung Maple, Autumn Blaze
Maple, Paperbark	Spring	Triflorum Maple, Tree Lilac
Maple, Shantung	Any	Sugar Maple, Miyabei Maple
Maple, Sugar	Any	Autumn Blaze, Shantung Maple
Maple, Triflorum	Spring	Paperbark Maple, Tree Lilac
Mountain Ash	Spring	Black Locust, Hawthorn
Oak, Burr	Spring	Shingle Oak, Swamp White Oak
Oak, English (Columnar)	Any	European Hornbeam
Oak, English (Standard)	Any	White Oak, Burr Oak
Oak, Red	Spring	Black Oak, Chinquapin Oak
Oak, Shingle	Spring	Chinquapin Oak, English Oak
Oak, Swamp White	Spring	London Planetree, Burr Oak
Oak, White	Spring	Burr Oak, English Oak
Oak, Chinquapin	Spring	Shingle Oak, Red Oak
Persian Ironwood	Spring	Seventh Son Flower, Katsura
Persimmon	Spring	Turkish Hazelnut, Zelkova
Pine, Limber	Spring	Spruce, Concolor Fir
Pine, Red	Spring	Douglas Fir, Eastern Redcedar
Poplar, Hybrid	Any	London Planetree, Baldcypress
Redbud	Any	Serviceberry, Hawthorn
Redcedar, Eastern	Spring	Spruce, Douglas Fir
Serviceberry	Any	Redbud, Tree Lilac
Seventh Son Flower	Spring	Persian Ironwood, Katsura
Smoketree	Spring	Magnolia, Seventh Son Flower
Sourwood	Spring	Blackgum, Sweetgum
Spruce, Black Hills	Spring	Eastern Redcedar, Concolor Fir
Spruce, Blue	Spring	Eastern Redcedar, Douglas Fir
Spruce, Norway	Spring	Eastern Redcedar, Concolor Fir
Spruce, Serbian	Spring	Eastern Redcedar, Douglas Fir
Sweetgum	Spring	Yellow Buckeye, Larch
Tuliptree	Any	Zelkova, Ginkgo
Yellowwood	Spring	Amur Maackia, Shingle Oak
Zelkova	Spring	Tuliptree, Ginkgo

Appendix D: Balled and Burlapped Planting Detail

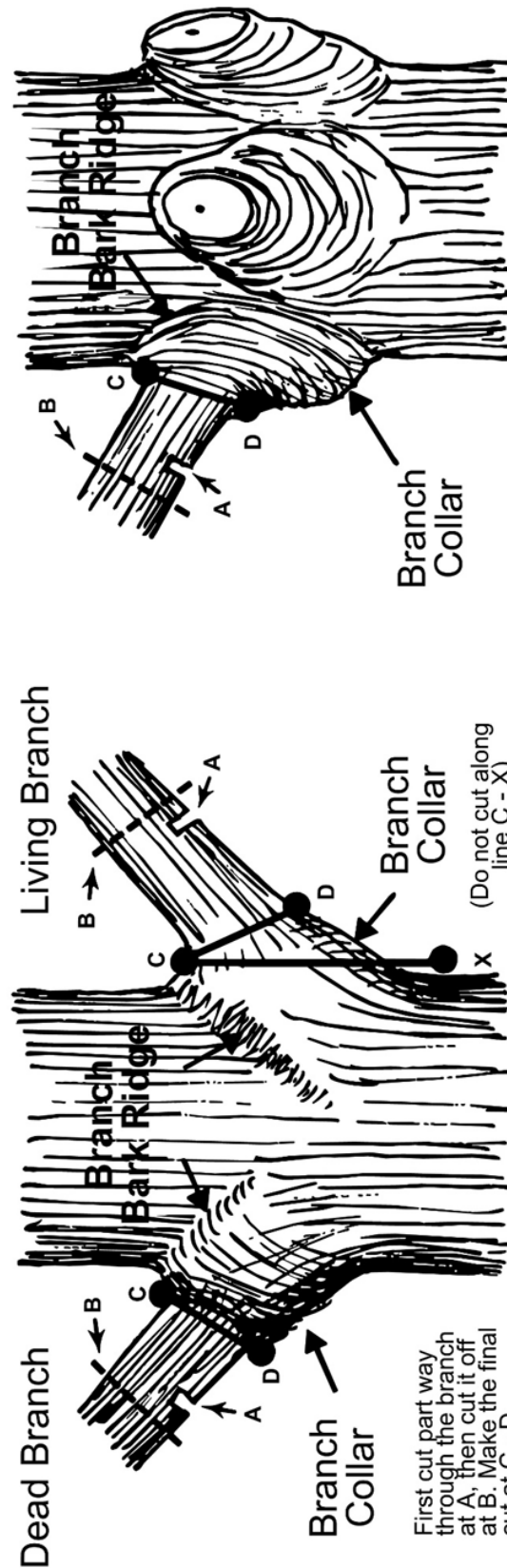


Appendix E: Containerized Planting Detail



Appendix F: Tree Pruning Detail

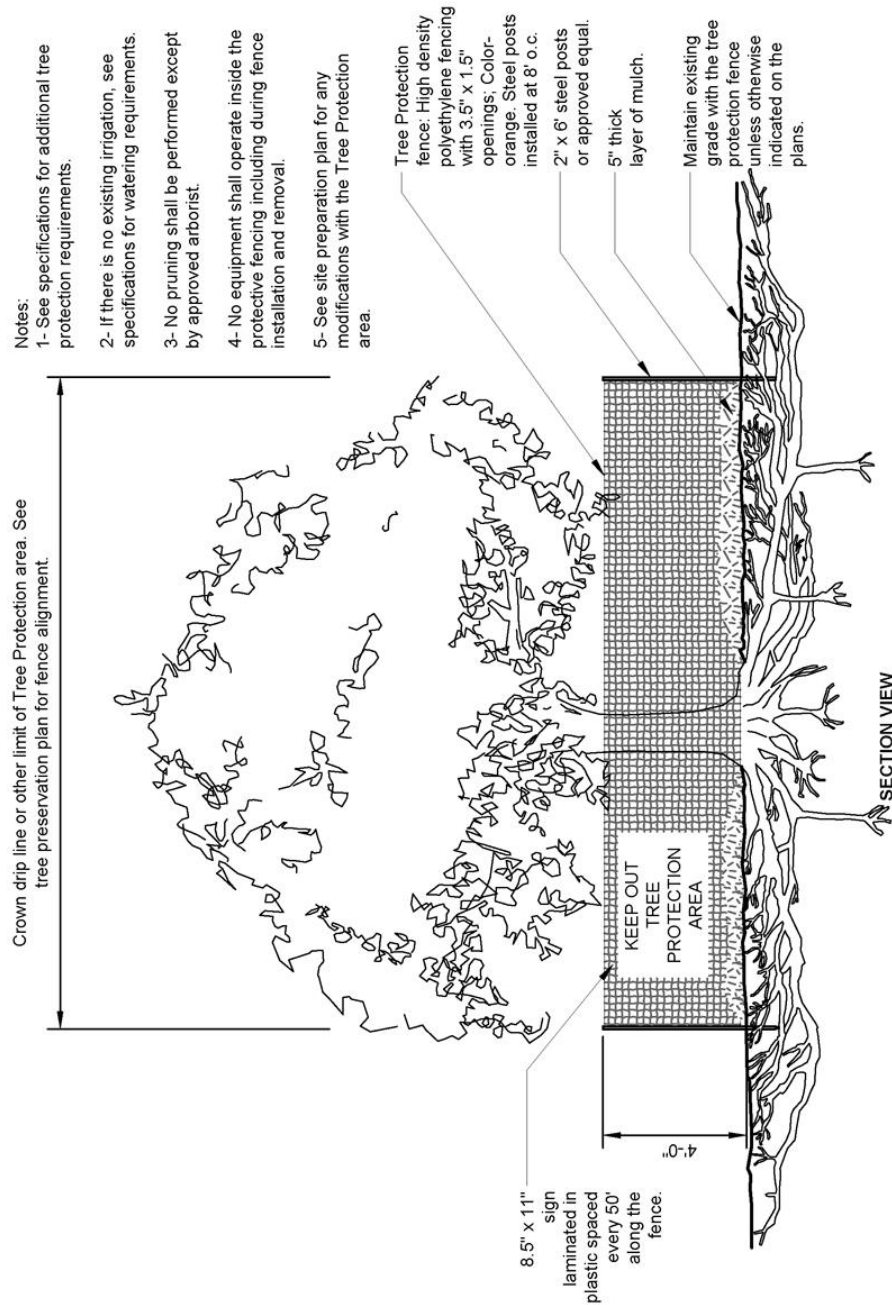
Proper Pruning Principles



Conifers

Hardwoods

Appendix G: Tree Protection Detail



TREE PROTECTION



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Appendix H: ISA Tree Risk Assessment Form (TRAQ Level 2-Basic)

ISA Basic Tree Risk Assessment Form

Client _____ Date _____ Time _____
 Address/Tree location _____ Tree no. _____ Sheet _____ of _____
 Tree species _____ dbh _____ Height _____ Crown spread dia. _____
 Assessor(s) _____ Time frame _____ Tools used _____

Target Assessment						
Target number	Target description	Target zone			Occupancy rate 1 – rare 2 – occasional 3 – frequent 4 – constant	Practical to move target?
		Target within drip line	Target within 1 x Ht.	Target within 1.5 x Ht.		
1						
2						
3						
4						

Site Factors

History of failures _____ Topography Flat ☐ Slope ☐ _____ % Aspect _____
 Site changes None ☐ Grade change ☐ Site clearing ☐ Changed soil hydrology ☐ Root cuts ☐ Describe _____
 Soil conditions Limited volume ☐ Saturated ☐ Shallow ☐ Compacted ☐ Pavement over roots ☐ _____ % Describe _____
 Prevailing wind direction _____ Common weather Strong winds ☐ Ice ☐ Snow ☐ Heavy rain ☐ Describe _____

Tree Health and Species Profile

Vigor Low ☐ Normal ☐ High ☐ Foliage None (seasonal) ☐ None (dead) ☐ Normal _____ % Chlorotic _____ % Necrotic _____ %
 Pests _____ Abiotic _____
 Species failure profile Branches ☐ Trunk ☐ Roots ☐ Describe _____

Load Factors

Wind exposure Protected ☐ Partial ☐ Full ☐ Wind funneling ☐ _____ Relative crown size Small ☐ Medium ☐ Large ☐
 Crown density Sparse ☐ Normal ☐ Dense ☐ Interior branches Few ☐ Normal ☐ Dense ☐ Vines/Mistletoe/Moss ☐ _____
 Recent or planned change in load factors _____

Tree Defects and Conditions Affecting the Likelihood of Failure

— Crown and Branches —

Unbalanced crown ☐ LCR _____ % Cracks ☐ _____ Lightning damage ☐
 Dead twigs/branches ☐ _____ % overall Max. dia. _____ Codominant ☐ _____ Included bark ☐
 Broken/Hangers Number _____ Max. dia. _____ Weak attachments ☐ _____ Cavity/Nest hole _____ % circ.
 Over-extended branches ☐ Previous branch failures ☐ _____ Similar branches present ☐
Pruning history
 Crown cleaned ☐ Thinned ☐ Raised ☐ Dead/Missing bark ☐ Cankers/Galls/Burls ☐ Sapwood damage/decay ☐
 Reduced ☐ Topped ☐ Lion-tailed ☐ Conks ☐ Heartwood decay ☐ _____
 Flush cuts ☐ Other _____ Response growth _____
 Main concern(s) _____

Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐ _____
 Likelihood of failure Improbable ☐ Possible ☐ Probable ☐ Imminent ☐ _____

— Trunk —

Dead/Missing bark ☐ Abnormal bark texture/color ☐
 Codominant stems ☐ Included bark ☐ Cracks ☐
 Sapwood damage/decay ☐ Cankers/Galls/Burls ☐ Sap ooze ☐
 Lightning damage ☐ Heartwood decay ☐ Conks/Mushrooms ☐
 Cavity/Nest hole _____ % circ. Depth _____ Poor taper ☐
 Lean _____ ° Corrected? _____
 Response growth _____
 Main concern(s) _____

Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐
 Likelihood of failure Improbable ☐ Possible ☐ Probable ☐ Imminent ☐

— Roots and Root Collar —

Collar buried/Not visible ☐ Depth _____ Stem girdling ☐
 Dead ☐ Decay ☐ Conks/Mushrooms ☐
 Ooze ☐ Cavity ☐ _____ % circ.
 Cracks ☐ Cut/Damaged roots ☐ Distance from trunk _____
 Root plate lifting ☐ Soil weakness ☐
 Response growth _____
 Main concern(s) _____

Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐
 Likelihood of failure Improbable ☐ Possible ☐ Probable ☐ Imminent ☐

Risk Categorization																							
Condition number	Tree part	Conditions of concern	Part size	Fall distance	Target number	Target protection	Likelihood												Consequences				Risk rating of part (from Matrix 2)
							Failure				Impact				Failure & Impact (from Matrix 1)								
							Improbable	Possible	Probable	Imminent	Very low	Low	Medium	High	Unlikely	Somewhat	Likely	Very likely	Negligible	Minor	Significant	Severe	
1																							
2																							
3																							
4																							

Matrix 1. Likelihood matrix.

Likelihood of Failure	Likelihood of Impacting Target			
	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

Matrix 2. Risk rating matrix.

Likelihood of Failure & Impact	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

Notes, explanations, descriptions _____

Mitigation options _____ Residual risk _____

_____ Residual risk _____

_____ Residual risk _____

_____ Residual risk _____

Overall tree risk rating Low ☐ Moderate ☐ High ☐ Extreme ☐Work priority 1 ☐ 2 ☐ 3 ☐ 4 ☐Overall residual risk Low ☐ Moderate ☐ High ☐ Extreme ☐

Recommended inspection interval _____

Data ☐ Final ☐ Preliminary ☐ Advanced assessment needed ☐ No ☐ Yes-Type/Reason _____Inspection limitations ☐ None ☐ Visibility ☐ Access ☐ Vines ☐ Root collar buried Describe _____

Appendix I: ANSI Z133.1 Standards – Applies to All Sections

All of the ANSI Z133.1 safety standards shall apply to all tree care operations outlined in the Urban Forestry Management Plan. Listed below is a basic overview of the standard, and it is not verbatim. A full text of this manual will be made available to all City of Ottawa employees and contractors involved with tree care operations.

1. All tools and equipment utilized during tree care operations, including those not specifically mentioned below, shall be inspected and maintained by qualified personnel in accordance with the manufacturer's care instructions.
2. All staff shall be trained in the proper use, inspection, and maintenance of said equipment.
3. Certified arborists or arborist trainees shall conduct job briefings daily prior to tree care operations of any kind and the information shall be communicated to all workers.
4. All activities performed on any job site for any activity outlined in this Urban Forestry Management Plan shall comply with all applicable OSHA guidelines and standards.
5. Traffic and pedestrian control shall be established around the job site prior to the beginning of tree care operations.
6. Emergency contact information and a safety kit conforming to the ANSI Z308.1 standards shall be made available to all workers. All employees shall have basic instruction on the use of CPR and First Aid.
7. Personal Protective Equipment (PPE) shall be required when there is a reasonable probability of injury or illness on the job site. Such a determination will be made by the Certified Arborist or Arborist Trainee prior to the beginning of tree care operations each day, and PPE shall be made available. PPE shall be well-maintained in accordance with the manufacturer's requirements.
8. Head protection shall conform to ANSI Z89.1, face and eye protection shall conform to ANSI Z87.1, respiratory protection shall comply with ANSI Z88.2, and leg protection shall always be worn when using a chainsaw.
9. Flammable liquids shall be kept a minimum of ten feet from open sources of flame or high heat and shall be stored in approved containers.
10. All City staff and contractors working near electrical hazards shall be qualified to do so and shall be educated in the full ANSI standards for Electrical Hazards and Line Clearance.
11. Vehicles and mobile equipment shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements and shall be equipped with all standard safety devices, decals, and instructions, and shall be operated within all federal, state, and local motor vehicle codes and ordinances.

12. Aerial devices shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements, and shall be equipped with all standard safety devices, decals, and instructions.
13. Aerial devices shall be stabilized by wheel chocks, outriggers, or stabilizers as necessary for the device, and shall never be used to lift, hoist, or lower logs or equipment unless specifically designed to do so.
14. Aerial devices shall be equipped with fall protection devices and permanent load ratings, both in accordance with ANSI/SIA 92.2 or 92.5, as applicable to the specific aerial device.
15. No aerial device shall be allowed to make contact with electrical conductors, and minimum safe distances shall be maintained in accordance with the ANSI Z133.1 Standard.
16. All brush chippers shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements, and shall be equipped with all standard safety devices, decals, and instructions.
17. Sprayers and related plant health care equipment shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements, and shall be equipped with all standard safety devices, decals, and instructions.
18. Sprayer tanks or other similar enclosed spaces shall not be entered unless performed through a confined-space entry plan in accordance with OSHA 1910.46 Requirements, including air-quality testing, training, and PPE.
19. Chain saws and other similar portable power tools shall not be operated unless the manufacturer's safety devices are in proper working order. Such safety devices shall not be removed or modified.
20. Forestry staff shall have a minimum of two points of attachment to the tree or aerial device while operating a chainsaw at all times, unless the hazard posed by the second point of attachment poses a greater hazard than utilizing one point of attachment.
21. A visual hazard assessment, including a root collar inspection, shall be performed by a certified arborist or arborist trainee prior to climbing, entering, or performing work in or on any tree, and a second crew member shall be within visual or voice communication at all times during arboricultural operations that are in excess of 12 feet from the ground surface.
22. All ropes, saddles, carabiners, and other similar climbing equipment shall be: a) approved for use in the tree care industry by the manufacturer, b) have a minimum breaking strength or load capacity of 5,000 lbs., c) be inspected before each use, d) Equipment shall be removed from service when it shows signs of excessive wear or deterioration.

23. All pruning, removal, and rigging operations shall have a designated drop zone where limbs, trunks, and tools can be dropped from aloft without impacting pedestrians or passersby. A visual or verbal communication system between the employee aloft and the employee(s) on the ground shall be established to determine when the employee aloft will safely drop tree parts or tools.
24. Any tree parts which cannot be safely dropped or controlled from aloft shall have a separate rigging line tied to them to help control their fall. The tree shall be inspected for structural stability prior to the establishment of a rigging system in the tree. When trees appear to have defects that could jeopardize the ability to safely use a rigging system to drop or control a limb, an alternate plan shall be implemented.
25. All equipment utilized in rigging shall meet the load ratings for the limb being rigged, and a qualified employee, trained in proper rigging procedure shall determine the rigging procedure and equipment to be utilized. Any equipment which has been damaged or overloaded shall be removed from service.
26. When felling (removing) a tree, a crew leader shall make the determination of what equipment is necessary, and how many crew members are to be directly involved in drop zone operations. A well-established escape route shall be planned for involved workers prior to the beginning of felling operations. Any non-involved workers shall be beyond twice the height of the trunk or tree being removed during felling operations.
27. Notches shall be used on all trees and trunks greater than five inches in diameter during felling operations, and should conform to the standards set forth in the ANSIZ133.1 Standard.
28. Loose clothing, ropes, lanyards, and saddles shall not be worn during any tree care activity where the risk of entanglement with tools or machinery is possible, particularly with brush chippers.

Appendix J: Tree Planting Standards (ANSI/ISA BMP)

ANSI Z60.1

1. All root ball and container sizes for all balled and burlapped stock shall conform to the Z60.1 standards for width and depth, such that they encompass enough of the fibrous root system as necessary for the full recovery of the plant upon installation.
2. All bare root stock shall conform to ANSI Z60.1 standards for minimum root spread.
3. All containerized stock shall conform to ANSI Z60.1 standards for plant and container size, as specified by the City, and shall be healthy, vigorous, well-rooted and established in the container in which it is growing. The root system shall reach the sides of the container, but shall not have excessive growth encircling the inside of the container.
4. All collected plants (those grown on unmanaged land) shall be so designated, and shall be considered to be nursery-grown stock when they have been successfully reestablished in a nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons.
5. The trunk or stem of the plant shall be in the center of the ball or container, with a 10% overall variance in location.
6. The use of digging machines in both the packaging and installation of trees is considered an acceptable nursery practice.

ANSI A300 – Part 6

1. Planting sites and work sites shall be inspected for hazards by the City prior to the beginning of work each day. If portions of the work site are outside of the original scope of work, the controlling authority shall be notified immediately.
2. Location of utilities, obstructions, and other such hazards above and below ground shall be taken into account prior to planting and transplanting operations. These include, but are not limited to, gas, electric, sewer, communication, drainage, and signage.
3. The following shall be taken into consideration prior to transport and planting: Requirements of individual trees, compass orientation of field-grown trees, site feasibility assessments, soil assessment, and drainage assessment.
4. Tools for planting and transplanting shall be properly labelled or purchased for their intended use, and be maintained in accordance with the manufacturer's recommendations
5. The system used to move and store the plant shall minimize desiccation and other damage to the crown, trunk or rootball, and the health and vigor of the plant shall be maintained during these periods.

6. The hole to be dug for all new plantings shall be a minimum of 150% larger than the rootball or container diameter, as deep as the root flare of the tree to be planted, and shall have sides from which soil has been loosened in order to aid in root penetration.
7. For balled and burlapped trees, all rootball supporting materials shall be removed from the upper third of the rootball, and removed from the planting hole prior to final backfilling.
8. Prior to planting, container root balls shall be managed by approved methods such as, shaving the root ball, slicing the root ball, and redirecting or removing encircling roots.
9. Backfill shall comprise of either the same soil created when the hole was excavated, or a similarly amended mixture to meet a specific objective, and shall be applied in a layered fashion to reduce future settling and prevent air pockets.
10. Mulch shall be applied at a depth of two to four inches, near - but not touching - the trunk of the tree, and extending to the perimeter of the planting.
11. Support systems such as guy-wires or stakes shall not be installed except where needed.

ISA BMP Manual – Tree Planting

1. Timing of planting shall be determined based on the species, and the best professional opinion of the employees of or contractors working for the City of Ottawa.
2. All employees and contractors employed by or working for the City of Ottawa shall be familiar with the following types of planting types, and when it is appropriate to use each:
 - A. **Bare-Root:** Field-grown, and dug without soil during the dormant season
 - B. **Ball and Burlap:** Field grown and packaged with a soil ball, using burlap, twine, and a retaining basket of some kind
 - C. **Tree Spade:** Transplanted using a mechanical tree spade to hold the soil ball during transport
 - D. **In-Ground Fabric Bag:** Field grown with the root mass contained in a semi-permeable fabric bag
 - E. **Container Grown:** Grown above ground in containers of various shapes, sizes, and materials
3. Trees packaged with root balls must have their first structural root within two inches of the soil surface. Trees with deeper structural roots will not perform well when transplanted, and should be avoided when selecting nursery stock.

4. Trees with root balls shall be handled by the ball, not the stem, to ensure no damage occurs to the root-soil interface or to the stem itself.
5. Trees with leaves shall be transported with a fabric tarp to minimize desiccation, and have had their root balls wetted prior to transport.
6. Sites shall be tested for drainage, nutrient levels, and pH prior to planting (or prior to species selection, if possible).
7. Container stock shall be removed from its container. For balled and burlapped trees, wrappings shall be left on until the tree is in the hole; wrapping shall then be removed from the third to fourth of the wire basket and burlap from the top of the ball. For all types, ensure any encircling (girdling) roots are removed, and root ball is shaved as necessary.
8. As soil is added, wet and tamp each layer down to ensure good moisture and reduction of air bubbles.
9. Do not prune trees at time of planting, unless to remove dead, dying, diseased, or cracked branches, as it may take away from root development to have the tree attempt to heal these above-ground wounds.
10. The use of trunk wrap may be considered in areas with harsh winters, specifically on trees with thin bark, such as London Planetree and certain Maple species.

Appendix K: Tree Pruning Standards (ANSI/ISA BMP)

ANSI A300 - Part 1

1. A designated Arborist or Arborist Trainee shall visually inspect each tree before beginning work. If any condition is observed above and beyond the original scope of work, said condition shall be reported to the controlling authority before any work begins.
2. Pruning cuts which remove a branch at its point of origin shall be made close to the trunk or parent branch without cutting into the branch-bark collar or leaving a stub.
3. Pruning cuts made to reduce the length of a limb or parent stem shall be made at a slight angle relative to the remaining stem, and not damage the remaining stem. If pruning to a lateral branch, the lateral should be large enough to assume the terminal role.
4. Final cuts shall be made such that the result is a flat surface, with the adjacent bark firmly attached.
5. Not more than 25% of the foliage shall be removed during an annual growing season, depending on the tree species, size, age, and condition. If more frequent pruning due to utilities, vistas, or health considerations is necessary, removal of the tree should be considered as an alternative to pruning.

ISA BMP Manual

1. All employees or contractors directly involved with the pruning of trees shall be familiar with the following pruning types and how they are to be used in conjunction with one another:
 1. **Pruning to Clean:** Selective removal of dead, diseased, detached, cracked, and broken branches
 2. **Pruning to Thin:** Selective removal of small live branches to reduce crown density
 3. **Pruning to Raise:** Selective removal of branches to provide vertical clearance
 4. **Pruning to Reduce:** Selective removal of branches and stems to decrease the height or spread of a tree or shrub
 5. **Structural Pruning:** Selective removal of live branches and stems to influence the orientation, spacing, growth rate, strength of attachment, and ultimate size of branches and stems
 6. **Pruning to Restore:** Selective removal of branches, sprouts, and stubs from trees and shrubs which have been topped, severely headed, vandalized, lion-tailed, storm damaged, or otherwise damaged
2. Every effort shall be made to time pruning of individual tree species to be done in accordance with best management practices for the tree species in question. All pruning work shall be done so at the discretion of the City of Ottawa and its approved contractors.

Appendix L: Tree Protection (ANSI/ISA BMP)

ANSI A300 – Part 5

1. Tree management plans and specifications for tree management shall be written and administered by a certified arborist qualified in the management of trees and shrubs during site planning, development, and construction. Such activities may include, but are not limited to: demolition, grading, building construction, walkway or roadway construction, excavation, trenching and boring, or other such activity which has the potential to negatively impact trees.
2. The management of trees and shrubs shall be incorporated into the following phases of the site development process:
 - A. Planning
 - B. Design
 - C. Pre-Construction
 - D. Construction
 - E. Landscape
 - F. Post-Construction
3. During the Planning phase, an assessment of tree and shrub resources on the site shall be performed by a certified arborist. The assessment shall identify the species, condition, and size of each tree and shall be incorporated into the site design. Trees to be retained or protected shall appear on site design maps. Trees on neighboring property which could also be impacted should also be considered.
4. During the design phase, a tree management report shall be developed for trees to be conserved on the site, and shall be included in the construction plans and specifications, which may include, but are not limited to:
 - A. Trees to be retained
 - B. Tree and Root Protection Zones
 - C. Tree Protection Zone barriers
 - D. Tree Protection plans
 - E. Soil erosion control
 - F. Soil compaction controls
 - G. Staging and storage areas
 - H. Other relevant on-site activities

5. Grading and demolition plans shall include all trees to be retained and removed, as well as the tree protection plans for working around trees to be retained. Plans shall also include equipment routes for avoiding the TPZ. Consequences for non-compliance shall be specified.
6. During the pre-construction phase, all tree protection plans shall be effectively communicated to all parties involved with the site development, and tree protection zone barriers shall be in place prior to the beginning of any construction activities.
7. The TPZ shall be delineated around all trees to be protected during construction, and shall be based on the size, species, and condition of the tree and its root system. Six to 18 times the diameter of the tree is generally considered to be acceptable. Deviations from this diameter may be made at the discretion of a certified arborist. Activities which could damage tree roots or compact soil should be avoided in the TPZ
8. Fencing or other visible barriers to the TPZ shall be installed prior to site clearing, grading, and demolition, and maintained throughout the construction and landscaping phase. When this is not feasible, alternate methods may be considered.
9. During the construction phase, compliance with tree protection plans shall be monitored by a certified arborist, and any damage to tree barriers or trees, or non-compliance shall be reported to the project manager or owner, or other controlling authority.
10. When removing vegetation or pavement during demolition, equipment used adjacent to the TPZ shall be specified to avoid damage to the tree and the surrounding soil, and soil protection measures shall be in place prior to vehicle or heavy traffic in or near the TPZ.
11. Storage or disposal of construction materials or hazardous materials shall not occur in the TPZ.
12. Fill within the TPZ shall not be permitted without mitigation to allow for proper air and water availability to existing roots. If fill cannot be avoided in the TPZ, compaction of fill shall be avoided, and consideration shall be given to a permanent well installation to protect the tree and its roots.
13. During the landscape, irrigation, and lighting phase, levels of compliance shall be documented and reported by a certified arborist. Non-compliance shall be reported to the project manager.
14. During the post-construction phase, a remedial and long-term maintenance plan shall be specified for existing and new landscaping, to ensure success of preservation efforts and newly planted landscaping.
15. Pruning shall be considered to reduce wind sail when necessary. It should not be considered to compensate for root loss.
16. Mulch shall be applied to as much of the tree protection zone as possible, in order to create a favorable soil environment for root recovery after construction activities.

ISA BMP Manual

1. A cost-benefit analysis shall be conducted during the planning phase. In some cases, money may be better invested in tree planting post-construction.
2. The species and age of tree shall be evaluated by a certified arborist, so that trees in good condition with desirable characteristics are preserved, but those in poor condition or with undesirable characteristics are not.
3. A tree inventory and tree management report shall be conducted during the planning phase, and a certified arborist shall work closely with developers to ensure best management practices are being met for both parties.
4. Effort shall be made to retain groups of trees, such that there is a wind and solar buffer around the highest quality trees if possible.
5. The Critical Root Zone (CRZ) is the area around the tree trunk where roots essential for tree health and stability are located. A Tree Protection Zone (TPZ) is an arborist-defined area around the tree which should include the CRZ, as well as additional area to ensure future stability and growth. The TPZ is subject to the professional opinion of the certified arborist.
6. An attempt shall also be made to preserve native soil for landscape planting as native soil with horizons and development is preferred over fill or black dirt.
7. If a sufficient TPZ cannot be established, a 6-12" layer of hardwood mulch, 3/4-inch plywood mat over a four-inch layer of hardwood mulch, or other such measures shall be temporarily installed over the CRZ in order to prevent root and soil compaction.
8. Trunk protection shall be installed on trees very close to construction activities, and should consist of 2x4 or 2x6 planks, strapped snugly to the tree trunk with wire or other strapping, preferably with a closed-cell foam between the trunk and the planks.
9. When roots over one inch cannot be avoided, they shall be pruned, not left torn or crushed. Acceptable methods of pruning are:
 - A. Excavation using supersonic air tools, pressurized water, or hand tools, followed by selective root cutting
 - B. Cutting through the soil along a predetermined line with a tool designed to cut roots
 - C. Mechanically excavating the soil and selectively pruning remaining roots.
10. Wells, tree islands, retaining walls, and other such structures or strategies shall be considered as alternatives to any cut/fill work in the CRZ or TPZ.
11. Monitoring shall take place during construction and post-construction phases, and any non-compliance should be reported to the proper controlling authority right away, so that timely remediation or mitigation efforts may be undertaken.

Appendix M: Urban Timber Harvesting

Log Removal Specification for Urban Timber Harvesting

This tree removal standard shall not take precedence over applicable industry safe work practices and shall be implemented by a qualified arborist, urban forest manager, and /or practitioner who, through related training or on-the-job experience, or both, are familiar with the standards, practices and hazards of recovering urban forest products and the equipment used in such operations. Additionally:

- Logs shall be felled to obtain minimum 8', 10', or 12' lengths with an additional 6" of trim on each log to a minimum diameter of 11" inside the bark. Maximum log length shall be 20'6".
- If a tree must be removed in sections, every effort should be made to retain the lowest log, at the longest possible length that can be safely felled.
- Branches should be trimmed flush with the bole/trunk, root flares should be trimmed flush with the bole/trunk, and the ends of the log should be square.
- Logs shall be flush cut with no crotches or splits. All obvious defects such as decay, large holes, and rot shall be removed.
- Logs with significant sweep shall be cut in order to eliminate as much sweep as possible while yielding the longest possible straight logs to ensure logs are flush for proper milling.

