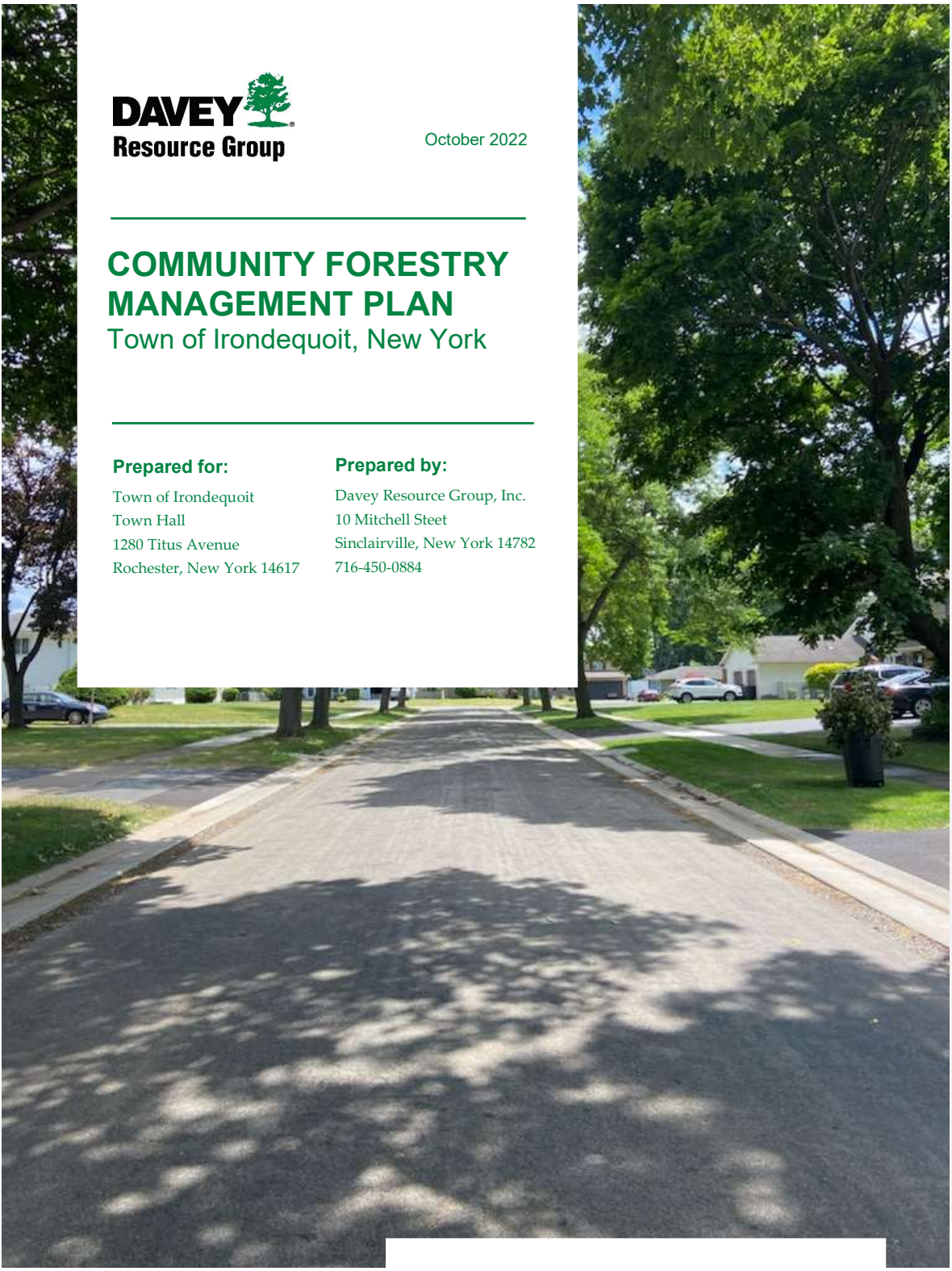

DAVEY Resource Group

October 2022

COMMUNITY FORESTRY MANAGEMENT PLAN

Town of Irondequoit, New York

Prepared for:

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ACKNOWLEDGMENTS

This project supports the Town of Irondequoit's vision to promote and enhance community well-being through public tree conservation and improved forestry management practices. This Community Forestry Management Plan offers expertise in preserving and expanding urban canopy so the environmental, economic, and social benefits it provides continue for generations.

Irondequoit's Forestry Department is thankful for the funding and support it receives from its Town Supervisor, Town Board, and Commissioner of Public Works:

Town Supervisor Rory Fitzpatrick

Deputy Supervisor John Perticone

Councilwoman Kimie Romeo

Councilman Peter Wehner

Councilwoman Patrina Freeman

Commissioner of Public Works Erin Magee

Five-Year Tree Resource Maintenance Schedule

EXECUTIVE SUMMARY

The Town of Irondequoit *Community Forestry Management Plan*, written by Davey Resource Group, Inc. "DRG", focuses on quantifying the benefits provided by the inventoried tree resource and addressing its maintenance needs. DRG completed a tree inventory for Irondequoit during May through August 2022 and analyzed the inventory data to understand the structure of the town's inventoried tree resource. DRG also estimated the economic values of the various environmental benefits provided by this public tree resource by analyzing inventory data with i-Tree Eco and recommended a prioritized management program for future tree care.

The functions of Irondequoit's inventoried tree population provide benefits with an estimated total value of $69,300 annually. The town's annual tree maintenance budget ranges between $475,000 to $435,000), making Irondequoit's return on investment at least 15% annually. Supporting and funding proactive maintenance of the public tree resource is a sound long-term investment that will reduce tree management costs over time.

High priority tree removal and pruning is costly, accounting for the larger budget in Year 1 of the five-year schedule, as shown in Figure 1. After high priority work has been completed, budgets are expected to decrease and stabilize as tree management transitions from reactive to proactive maintenance. This also reduces the number of new elevated risk trees over time by preventing deteriorating conditions of trees with initial minor defects. As trees are planted and less vacant sites exist, planting costs will decrease. The budget below (Figure 1) splits tree care work between the town (in-house) and contractors to better reflect how tree care is being done in Irondequoit.

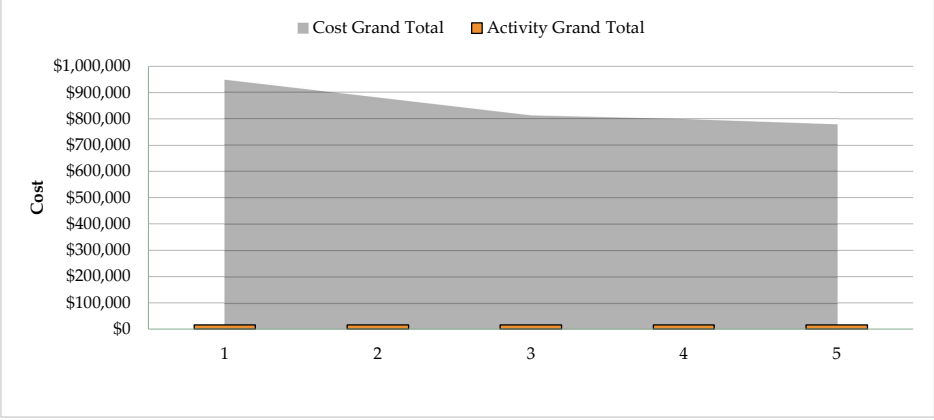

Figure 1. Projected budget for five years.

Recommended Maintenance Types

Tree Removal

Trees designated for removal have defects that cannot be cost-effectively or practically corrected. Most of the trees in this category have a large percentage of dead crown.

Total = 1,150 trees
High Priority = 16 trees
Moderate Priority = 357 trees
Low Priority = 554 trees
Stumps = 243

Priority Pruning

Priority pruning removes defects such as Dead and Dying Parts or Broken and/or Hanging Branches. Pruning the defected branch(es) can lower risk associated with the tree while promoting healthy growth.

Total = 1,293 trees
High Priority = 38 trees
Moderate Priority = 1,255 trees

Routine Pruning Cycle

Over time, routine pruning of Low and Moderate Risk trees can minimize reactive maintenance, limit instances of elevated risk, and provide the basis for a robust risk management program.

Total = 6,029 trees
Number in cycle each year = at least 1,206 trees

Young Tree Training Cycle

Younger trees can have branch structures that lead to potential problems as the tree ages, requiring training to ensure healthy growth. Training is completed from the ground with a pole pruner or pruning shear.

Total = 1,647 trees
Number in cycle each year = at least 549 trees

Tree Planting

Planting new trees in areas that have poor canopy continuity is important, as is planting trees where there is sparse canopy, to ensure that tree benefits are distributed evenly across the city.

Total replacement plantings = 1,170 trees
Total new plantings = 1,500 trees

Routine Tree Inspection

Routine inspections are essential to uncovering potential problems with trees and should be performed by a qualified arborist who is trained in the art and science of planting, caring for, and maintaining individual trees.

Total = 10,427 existing trees + 300 new trees
Number in drive-by assessment cycle each year = near 10,427 trees
Number in walk-by assessment cycle each year = near 2,086 trees

INTRODUCTION

The Town of Irondequoit is home to 51,034 residents (U.S. Census Bureau 2020, retrieved from:) benefitting from public trees in their community. The town's urban forestry program manages all trees, stumps, and planting sites along the street rights-of-way (ROW) and throughout public parks and Cemetery. For 18 years, Irondequoit's Department of Public Works staff in the Division of Forestry have shown continued commitment to developing a thriving public tree resource.

Urban forestry program budgets are funded by the town's General Fund. Irondequoit has a tree committee, has a tree ordinance, spends more than $2 per capita on tree maintenance, celebrates Arbor Day, and has been a Tree City USA community for 3 years.

The town's urban forestry program is well on its way to creating a sustainable and resilient public tree resource, and it is important to stay on track by consistently renewing program funding and routinely updating the tree inventory.

RECOMMENDED APPROACH TO TREE MANAGEMENT

An effective approach to tree resource management follows a proactive and systematic program that sets clear and realistic goals, prescribes future action, and periodically measures progress. A robust urban forestry program establishes tree maintenance priorities and utilizes modern tools, such as a tree inventory accompanied by TreeKeeper® or other asset management software.

In May through August 2022, Irondequoit worked with DRG to inventory its public trees and develop this management plan. Consisting of three sections, this plan considers the diversity, distribution, and condition of the inventoried tree population and provides a prioritized system for managing the town's public tree resource.

- *Section 1: Structure and Composition of the Public Tree Resource* summarizes the inventory data with trends representing the current state of the tree resource.
- *Section 2: Functions and Benefits of the Public Tree Resource* summarizes the estimated value of benefits provided to the community by public trees' various functions.
- *Section 3: Recommended Management of the Public Tree Resource* details a prioritized management program and provides an estimated budget for recommended maintenance activities over a five-year period.

Section 1:

Structure and Composition

of the Public Tree Resource

SECTION 1: STRUCTURE AND COMPOSITION OF THE PUBLIC TREE RESOURCE

In May through August 2022, DRG arborists collected site data on trees and stumps along the street ROW and on trees in the Irondequoit Cemetery for a tree inventory contracted by the Department of Public Works of Irondequoit. Of the total 10,670 sites inventoried, 97.7% were collected along the street ROW, and the remaining 2.3% were collected in the Irondequoit Cemetery. Figure 2 breaks down the total sites inventoried by type for each location; planting sites were not collected along street ROW or in the Irondequoit Cemetery. See Appendix A for details about DRG's methodology for collecting site data.

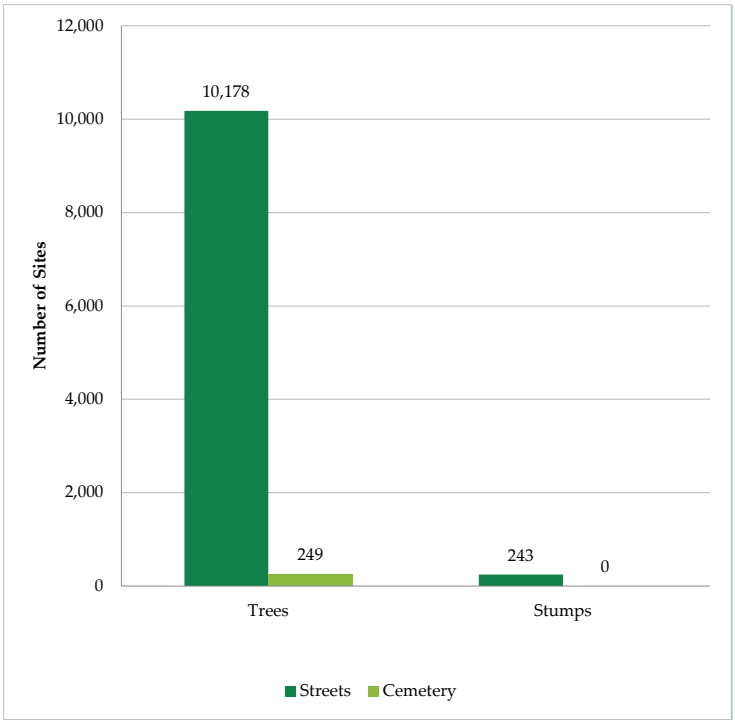

Figure 2. Number of inventoried sites by location and type.

SPECIES, GENUS, AND FAMILY DISTRIBUTION

The 10-20-30 rule is a common standard for tree population distribution, in which a single species should compose no more than 10% of the tree population, a single genus no more than 20%, and a single family no more than 30% (Santamour 1990).

Figures 3 and 4 shows Irondequoit's distribution of the most abundant tree species inventoried in the right-of-way compared to the 10% threshold. Norway maple (*Acer platanoides*) is the most abundant species, making up 35% of the population of inventoried ROW trees, followed by silver maple (*A. saccharinum*) at 15% of the population (Figure 3). The remaining ROW population does not exceed the 10% threshold and is not immediately concerning from this data alone.

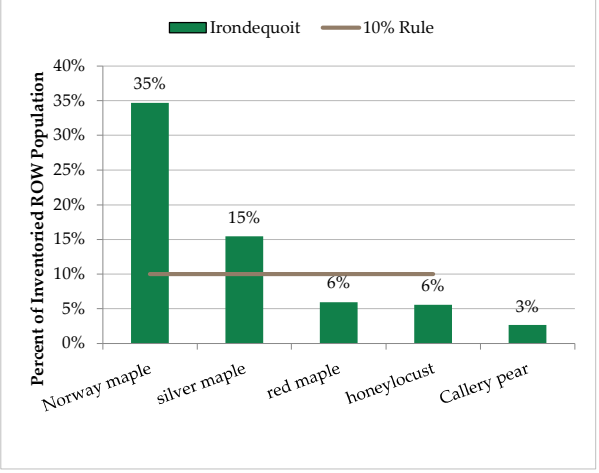

Figure 3. Species distribution of inventoried trees in the ROW.

In the Irondequoit Cemetery, Norway maple and northern white cedar (*Thuja occidentalis*) exceed the 10% threshold, at 18% and 12% of the inventoried population, respectively. Austrian pine (*Pinus nigra)* meet the 10% threshold, while the remaining 59% of the population is below the threshold.

RESILIENCE THROUGH DIVERSITY

The Dutch elm disease epidemic of the 1930s provides a key historical lesson on the importance of diversity (Karnosky 1979). The disease killed millions of American elm trees, leaving behind enormous gaps in the urban canopy of many Midwestern and Northeastern communities. In the aftermath, ash trees became popular replacements and were heavily planted along city streets. History repeated itself in 2002 with the introduction of the emerald ash borer into America. This invasive beetle devastated ash tree populations across the Midwest. Other invasive pests spreading across the country threaten urban forests, so it's vital that we learn from history and plant a wider variety of tree genera to develop a resilient public tree resource.

Ash trees in an urban forest killed by emerald ash borer.

USDA Forest Service (2017)

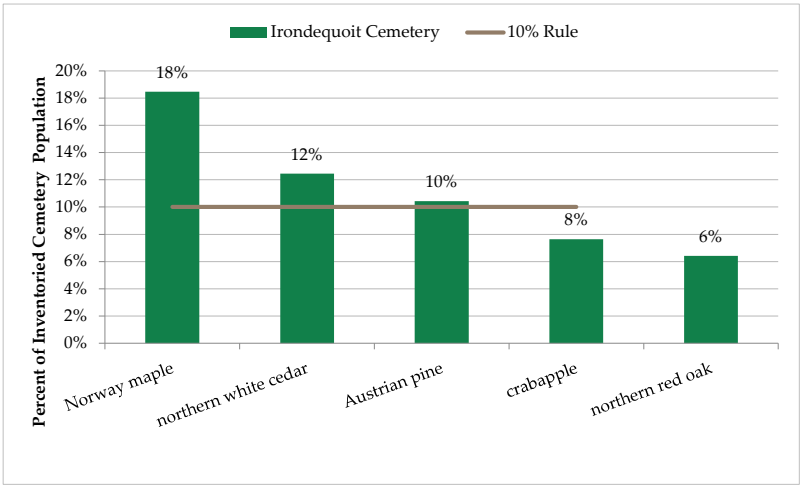

Figure 4. Species distribution of inventoried trees in the Cemetery.

Following the same pattern as the 10% rule, the maple population, specifically the genera, *Acer*, is significantly higher than the 20% threshold and composes 62% of the inventoried population of street trees (Figure 5). No other genera of trees exceed the 20% threshold, as the second highest genera population falls under *Gleditsa*, the same genera as honey locust. This genus composes only 6% of the population of street trees.

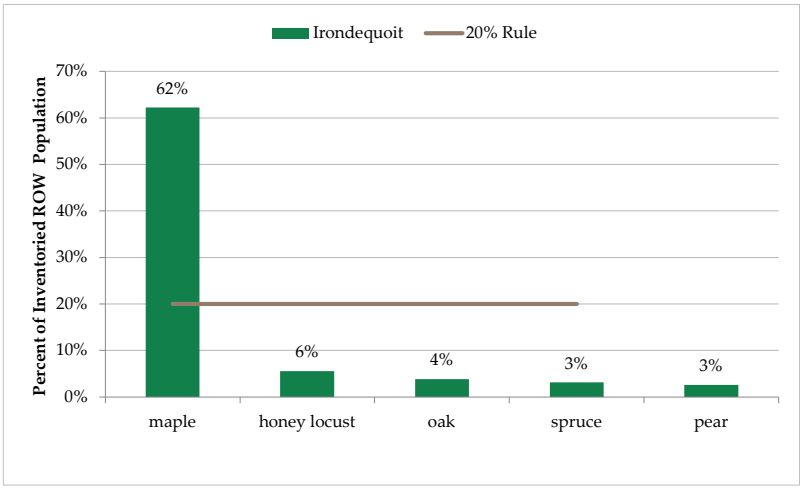

Figure 5. Genus distribution of inventoried trees in the ROW.

The Irondequoit Cemetery had a similar population distribution such that the maple genus exceeded the 20% threshold, but less severely so. Figure 5 shows that maple compose 22% of the Irondequoit Cemetery population; whereas, the remaining population do not come close to the threshold. The remainder of the population does not come close to exceeding the 20% threshold.

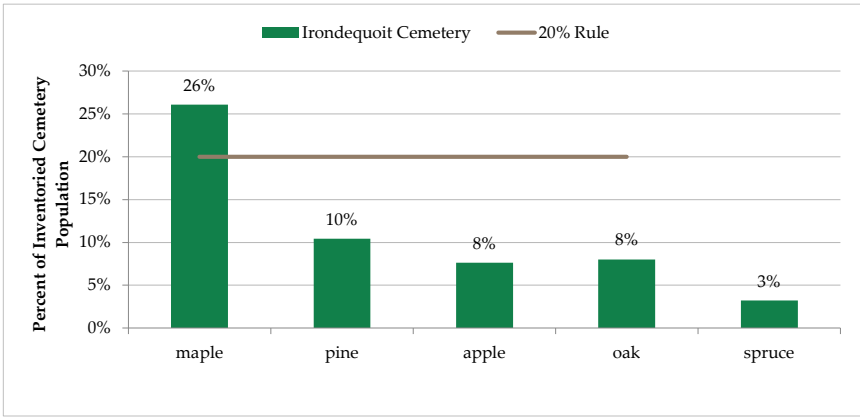

Figure 6. Genus distribution of inventoried trees.

Figure 7 shows the town's distribution of the most abundant tree families inventoried compared to the 30% threshold. While most tree families are fairly far from the threshold (less than 10%), Sapindaceae (63%) is the only family that exceeds the 30% threshold, composing the majority of the street tree population. Specifically, Norway maple (*Acer platanoides*) and silver maple (*A. saccharinum*) make up most of the population on a species level, and *Acer* composes over 50% of the population on a genus level. Future plantings should consider species that are not maple, or from the *Acer* genus or Sapindaceae family.

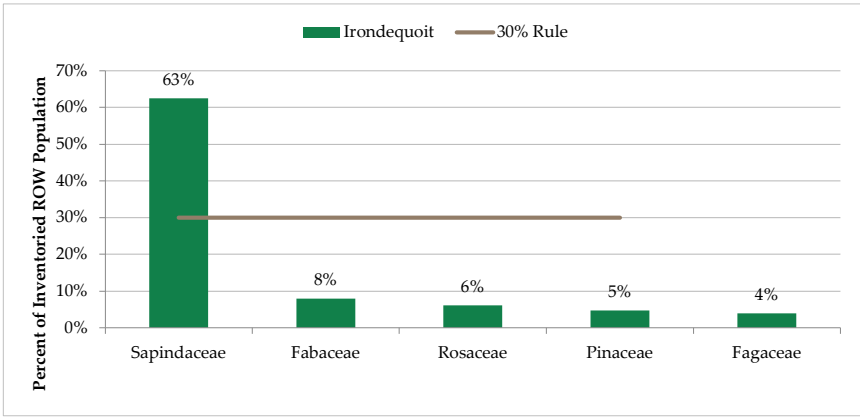

Figure 7. Family distribution of ROW sites.

The Sapindaceae family has the highest tree population (26%) in the Irondequoit cemetery but does not exceed the 30% threshold (Figure 8). Rosaceae, Cupressaceae, Pinaceae, and Fagaceae do not exceed or come close to the threshold (18%, 16%, 14%, and 8%, respectively).

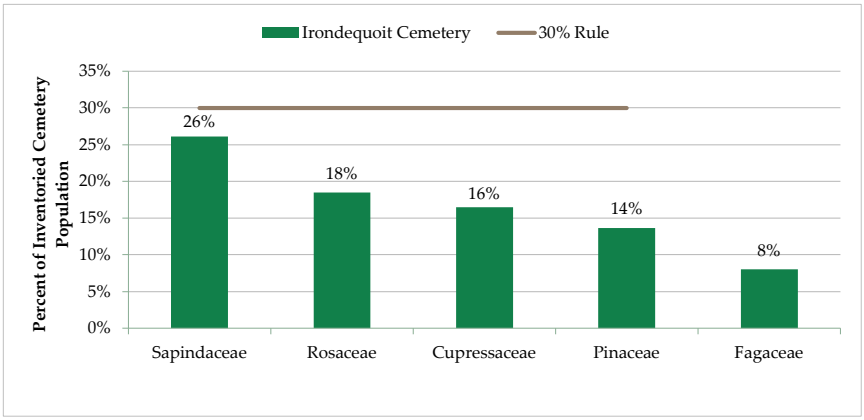

Figure 8. Family distribution of cemetery trees.

Species diversity and population distributions can be used as an indicator of the ability of the urban forest to resist disruption from pests, pathogens, and weather events that can damage or kill trees, and of the urban forest's resilience or ability of the forest to recover from these disruptions. A well-known example of these disruptions would be emerald ash borer (EAB), which specifically targets the ash (*Fraxinus*) genera as their host. Extreme weather events, such as ice storms and heavy winds, may also influence the urban forest population, as different species have differing susceptibility to weather events. An urban forest population that has low species diversity will be more susceptible to pests and weather events and will have lower resilience to these disruptions.

For this reason, the Town of Irondequoit should not plant Norway maple, silver maple, or any other maple species along streets until this distribution becomes more ideal. Seeing as more than half of the population of street trees belongs to the maple genus (*Acer*), it is important to monitor the population for pests that target that specific genus, such as Asian longhorned beetle (ALB), eastern tent caterpillar (ETC), and spotted lantern fly (SLF). An outbreak of these pests, combined with the high population of host trees, could lead to a large decline in the health and overall population of the urban forest in Irondequoit. When looking at the Irondequoit cemetery, the tree population is better distributed across genera and species. Although the maple genus does make up a larger percent of the population of trees in the cemetery, it is less of a threat to the population's ability to resist and recover from disruptions, as maple does not make up most of the population of trees in the cemetery. Continuing to maintain the diversity of species within the Irondequoit cemetery will reduce the risk that disruptions present to that population.

The management, removal, and replacement of trees can become costly if a large portion of the tree population falls victim to pests, pathogens, or weather events. Thus, it is important that homeowners and the town work together to plant a mix of species that will improve diversity at the genus and family level to help mitigate the risk that pests, pathogens, and other disturbances present to the urban forest.

PEST SUSCEPTIBILITY

Figure 9 shows the percent of inventoried trees throughout the town susceptible to some of the known pests in and around New York. It is important to remember that this figure only represents data collected during the inventory. Many more trees throughout Irondequoit, especially those on private property, may be susceptible to hosting these invasive pests. Spotted lantern fly (SLF, *Lycorma delicatula*), Asian longhorned beetle (ALB, *Anoplophora glabripennis*), and eastern tent caterpillar (ETC, *Malacosoma Americanum*) are known threats to a large percentage of the inventoried street tree resource. In the Irondequoit Cemetery, 64% of the inventoried population are threatened by ALB and 50% by the ETC, respectively. Emerald ash borer, or EAB, only presents a threat to a small portion of the population, as *Fraxinus* makes up less than 1% of the street tree and cemetery tree population.

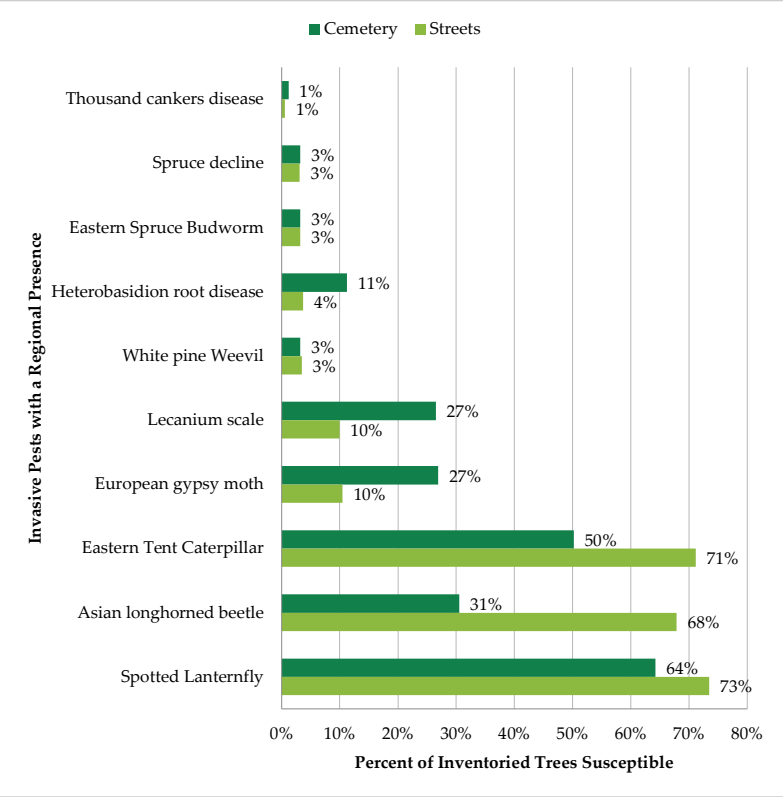

Figure 9. Inventoried tree susceptibility to invasive pests with a regional presence.

Pest Susceptibility Recommendations

The overabundance of maple in Irondequoit's tree resource is a management concern because it creates unnecessary risk in the event of an invasive pest outbreak. This abundance creates a larger tree resource to lose and provides more habitat for the pests it is susceptible to, such as SLF or ALB, making it easier for them to spread. Increasing species diversity is a critical goal that will help Irondequoit's tree resource be resilient in the event of future pest invasions.

As the Town of Irondequoit progresses with future tree planting, DRG recommends removing maple trees from their acceptable planting list. As previously discussed, trees in the *Acer* genus make up 62% of the total population, which means that over half of the total population of street trees is susceptible to pests that affect that genus, such as Asian longhorned beetle (ALB), eastern tent caterpillar (ETC), and spotted lantern fly (SLF). It is also recommended that these trees in the *Acer* genus are inspected on a routine basis to catch symptoms of a pest infestation and quarantine affected trees. As of August 24, 2022, there are no confirmed infestations of SLF outside of Onondaga, Tompkins, and Broome counties in NY. However, individual finds of SLF have been reported within Monroe County, where Irondequoit resides, and in Ontario County, which shares a border with southern Monroe County.

CONDITION

Several factors affecting condition were considered for each tree, including root characteristics, branch structure, trunk, canopy, foliage condition, and the presence of pests. The condition of each inventoried tree was rated by an arborist as Good, Fair, Poor, or Dead. The general health of the inventoried tree population was characterized by the most prevalent condition assigned during the inventory.

Figure 10 shows most of the inventoried street trees were recorded in Good or Fair condition, 26% and 61%, respectively. Based on these data, the general health of the inventoried ROW tree population is rated as Fair. Irondequoit has a low percentage of Dead ROW trees (1%) and ROW trees in Poor condition (11), so the general health of the town's tree resource is approaching Good. Inventoried trees in the Irondequoit Cemetery were mostly recorded as Good or Fair condition (13% and 75%, respectively), and has a low percentage of its inventoried population as Dead or Poor (12% total). Overall, the general health of the inventoried cemetery trees is rated as Fair. It is important to note that with proper pruning and maintenance, the condition of a tree can be improved and shift the overall health of the population towards a Fair or Good condition.

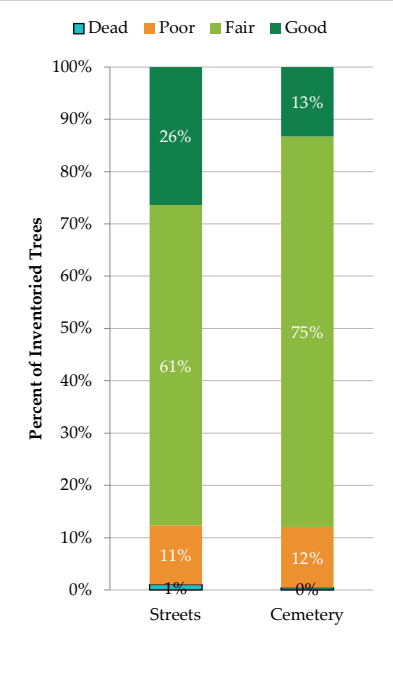

Figure 10. Inventoried tree susceptibility to invasive pests with a regional presence.

Condition Recommendations

- Dead trees and trees in Poor condition should be removed as soon as possible because the health of these trees is unlikely to recover even with increased care and present a risk.
- Younger trees rated in Fair or Poor condition may benefit from structural pruning to improve their health over time. Pruning should follow *ANSI A300 (Part 1)* guidelines.
- Poor condition ratings among mature trees were generally due to visible signs of decline and stress, including decay, dead limbs, sparse branching, or poor structure. These trees will likely require corrective pruning and intensive plant health care to improve their vigor and should be monitored for worsening conditions.

RELATIVE AGE DISTRIBUTION

Analysis of a tree population's relative age distribution is performed by assigning age classes to the size classes of inventoried trees, offering insight into the maintenance needs of Irondequoit's tree resource. The inventoried trees are grouped into the following relative age classes:

- Young trees (0–8 inches diameter at breast height (DBH))
- Established trees (9–17 inches DBH)
- Maturing trees (18–24 inches DBH)
- Mature trees (greater than 24 inches DBH)

These size classes were chosen so that the inventoried tree resource can be compared to the ideal relative age distribution, which holds that the largest proportion of the inventoried tree population (approximately 40%) should be young trees, while a smallest proportion (approximately 10%) should be mature trees (Richards 1983). Since tree species have different lifespans and mature at different diameters, actual tree age cannot be determined from diameter size class alone, yet size classifications can be extrapolated into relative age classes.

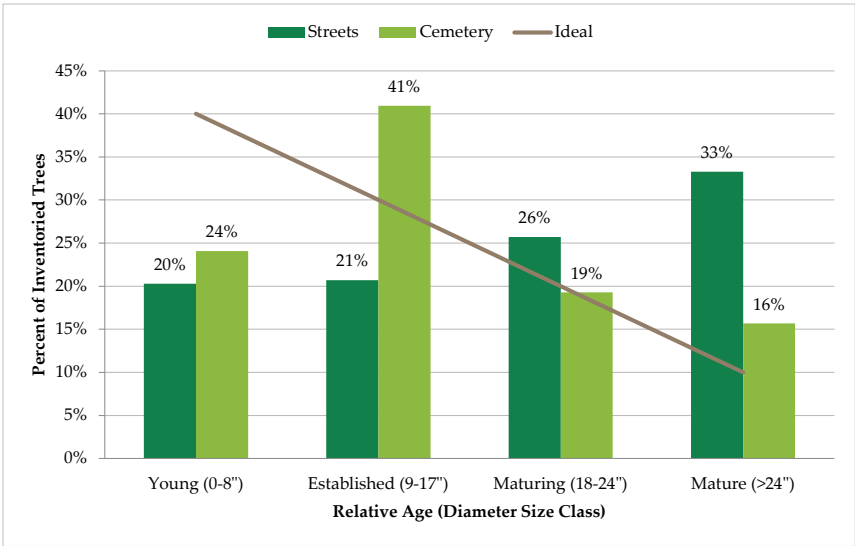

Figure 11. Relative age distribution of inventoried trees.

Figure 11 compares Irondequoit's relative age distribution of the inventoried tree population to the ideal. The town's inventoried tree resource has a larger population of maturing and mature trees along the ROW (26% and 33%, respectively), and most of the population of inventoried trees in the cemetery is established (41%). Only one size class of trees in the cemetery falls along the ideal, which would be the maturing size class (19%). Young trees (0-8" DBH) consist of 20% of the population of inventoried street trees, and 24% of the population of inventoried cemetery trees. The higher proportion of larger, older trees will contribute to increased budget costs.

Figures 12 and 13 cross analyze the condition of the inventoried tree resource with its relative age distribution, providing insight into the inventoried population's stability. When analyzing street trees, 85% of mature trees and 86% of maturing trees are rated in Fair condition or better, which matters because these larger trees would have a more damaging impact in the event of failure. 88% of established trees and 95% of young trees are rated in Fair condition or better, so it is important to provide the maintenance they need to remain healthy as they age and grow, to reduce the proportion of mature and maturing trees in Poor condition or worse.

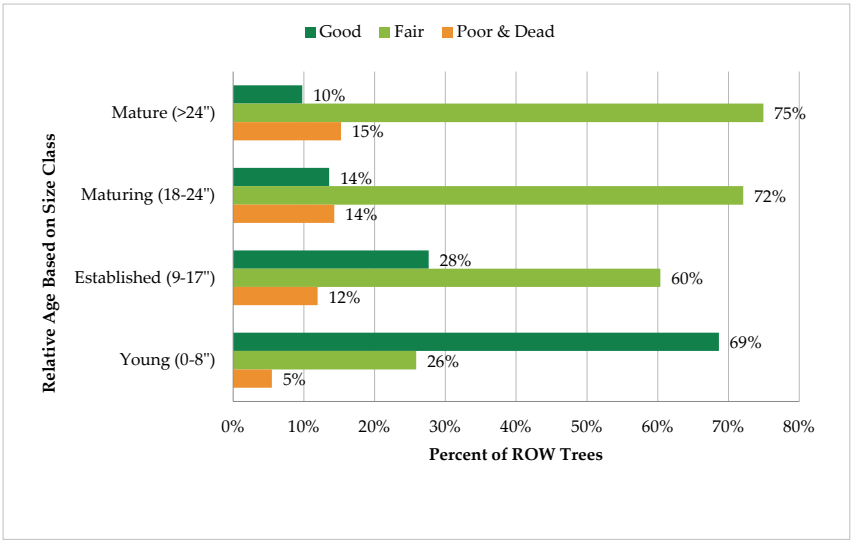

Figure 12. Condition of inventoried trees by relative age class.

For inventoried trees in the Irondequoit Cemetery, 77% of mature trees were in Fair condition, and none were in Good condition. 88% of established trees and 96% of young trees were in Fair or better condition. It is important to consider the rate of visitation of this cemetery and if many monuments that are meaningful to the community are at risk when planning future management of the cemetery.

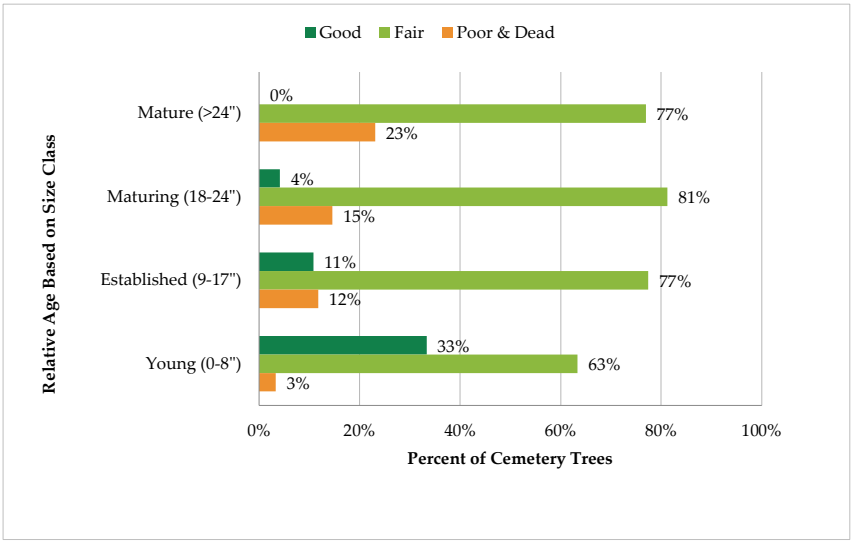

Figure 13. Cemetery condition by age.

Relative Age Recommendations

While Irondequoit has an excess of mature street trees and a shortage of young street trees, the town has a low percentage of trees in Poor condition, indicating that young trees have the potential of reaching maturity if they are well maintained. DRG recommends that Irondequoit implement a robust maintenance program to conserve the condition of young and established trees as they age so they replace removed trees and fill canopy gaps in maturity. The town should also focus on tree preservation and proactive care to protect mature and maturing trees from unnecessary removal and to prevent them from succumbing to treatable defects. Since planting was emphasized as a management goal, DRG would recommend planting a health mix of small and large trees to shift the relative age by size class distribution. The Irondequoit Cemetery has an excess of established trees and a shortage of young trees. A very small percentage of young or established trees falls within Poor or worse condition (3% and 12%, respectively), which indicates that the young trees have the potential to reach maturity if properly maintained. DRG would recommend planting trees to reach the ideal distribution of relative age within the Irondequoit Cemetery and removal of mature trees that are in Poor or Dead condition that cannot return to a healthy state through pruning and plant care.

DEFECT OBSERVATIONS

For each tree inventoried, DRG assessed conditions indicating the presence of structural defects and recorded the most significant condition. Defects were limited to the following categories:

- Branch attachment
- Broken and/or hanging branches
- Cracks
- Dead and dying branches
- Decay or cavity
- None
- Other
- Root problems
- Tree architecture
- Trunk condition

Table 1. Tree defect categories recorded during the inventory.

Defect	Street Trees	Percent of Street Trees	Cemetery Trees	Percent of Cemetery Trees
Branch Attachment	1,781	17%	51	21%
Broken and/or hanging branches	295	3%	1	0%
Cracks	48	0%	3	1%
Dead and dying branches	5,449	52%	128	52%
Decay or cavity	1,160	11%	26	10%
None	641	6%	13	5%
Other	7	0%	0	0%
Root problem	78	1%	1	0%
Tree Architecture	338	3%	5	2%
Trunk Condition	624	6%	20	8%
Total	10,421	94%	248	92%

The two most frequently recorded defect categories were Dead and Dying Branches and Branch Attachment at 54% and 17% of inventoried street trees, respectively (Table 1). Of the 5,449 street trees with Dead & Dying Parts, 443 were recommended for removal. The Irondequoit Cemetery had similar outcomes, such that Dead and Dying Parts composed of 51% of defects recorded, and Branch Attachment composed 21% of defects recorded. Of the 128 inventoried trees with Dead and Dying Branches, only 1 was recommended for removal.

Defect Observation Recommendations

When considering the defect recorded for each tree, there are two important qualifiers to keep in mind. First, the categories are broadly inclusive. For example, the "Dead and Dying Parts" category can include trees with just one or two smaller diameter dead limbs as well as trees found with large-diameter dead limbs or entire sections of dead canopy. Therefore, inferences on overall tree condition or risk rating cannot be derived solely from the presence or absence of a defect recorded during the inventory. Second, an inventoried tree may have multiple defects; the 2022 Irondequoit inventory recorded only the most significant defect observed for each tree. These two qualifiers are important to keep in mind when considering urban forest management planning and the prioritization of maintenance or monitoring activities.

Structural defects can be prevented by performing young tree training while a tree is 7 inches DBH or below. The object of young tree training is to train the tree to grow in the most ideal form. For example, poor branch attachment could be prevented by pruning a young tree that has branches with excessive included bark. Branches with weak attachment are more likely to fail and can cause wounds to a tree that provide an opening for pests and pathogens to infect the tree. Another defect that can be prevented with young tree training would be co-dominant leaders. Ideally, trees will have one dominant leader. A co-dominant tree can fail at the union of the leaders, which can result in a large wound that is susceptible to cavities or decay, or whole tree failure. By reducing a co-dominant leader while the tree is young, the likelihood of failure will decrease. Removing diseased and dying branches on young trees can help improve the health and longevity of that tree by preventing the disease from spreading throughout the tree, and preventing issues with decay at old branch unions.

INFRASTRUCTURE CONFLICTS

In an urban setting, space is limited both above and below ground. Trees in this environment may conflict with infrastructure, such as buildings, sidewalks, utility wires, and pipes, which could pose risks to public safety. Existing or possible conflicts between trees and infrastructure recorded during the inventory include:

- *Overhead Utilities*—The presence of overhead utility lines above a tree or planting site was noted; it is important to consider these data when planning pruning activities and selecting tree species for planting.

Table 2. Tree conflicts with overhead infrastructure recorded during the inventory

Overhead Utilities	Street Trees	Percent of Street Trees	Cemetery Trees	Percent of Cemetery Trees
Conflicting and Present	453	4%	0	0%
Not Conflicting and Present	842	8%	5	2%
Not Conflicting and Not Present	9,126	88%	244	98%
Total	**10,421**	**100%**	**249**	**100%**

Table 2 shows 453 street trees and no cemetery trees recorded with an infrastructure conflict, that being overhead utilities. There were 842 street trees with utilities directly above the tree canopy. Of those trees, approximately 82% were large trees that could grow into the powerlines, and 18% were small trees that would not grow into the powerlines. There were no trees within the Irondequoit Cemetery with utilities directly above, or passing through, the tree canopy.

Infrastructure Recommendations

Planting only small-growing trees within 20 feet of overhead utilities, medium-size trees within 20–40 feet, and large-growing trees outside 40 feet will help improve future tree conditions, minimize future utility line conflicts, and reduce the costs of maintaining trees under utility lines.

When planting around hardscape, it is important to give the tree enough growing room above ground. Guidelines for planting trees among hardscape features are as follows: give small-growing trees 4–5 feet, medium-growing trees 6–7 feet, and large-growing trees 8 feet or more between hardscape features. In most cases, this will allow for the spread of a tree's trunk taper, root collar, and immediate larger-diameter structural roots.

GROWING SPACE

Growing Space Recommendations

To prolong the useful life of street trees, small-growing tree species should be planted in tree lawns 4–5 feet wide, medium-size tree species in tree lawns 6–7 feet wide, and large-growing tree species in tree lawns at least 8 feet wide. The useful life of a public tree ends when the cost of maintenance exceeds the value contributed by the tree. This can be due to increased maintenance required by a tree in decline, or it can be due to the costs of repairing damage caused by the tree's presence in a restricted site. The town should also consider if there will be conflicts with power lines located above the planting site. A potential site may be wide enough to accommodate a large tree's root system, but there may be issues with clearance later as the tree grows. It is recommended then to plant a small tree in a site like so, as it will not grow and conflict with the overhead utilities.

While this inventory did not collect data regarding vacant sites or potential planting sites, the inventory arborists did observe many vacant spaces that have potential to be future planting sites. As the town is preparing to plant trees to fulfill their goal of 300 trees planted per year, it will be important to follow these suggestions to ensure the growing space is suitable for each tree planted.

STOCKING LEVEL

Stocking is a traditional forestry term used to measure the density and distribution of trees. For an urban/community forest, stocking level is used to estimate the total number of sites along the street ROW that could contain trees. Stocking level is the ratio of street ROW spaces occupied by trees to the total street ROW spaces suitable for trees. Cemetery trees and other non-ROW public property trees are excluded from this measurement.

As mentioned above, DRG did not record vacant sites during this inventory. However, it was observed by the inventory arborists that there were many potential planting sites along the right-of-way in Irondequoit. Although the Town of Irondequoit has a goal of planting 300 trees per year, DRG recommends accessing the number of vacant sites within Irondequoit to properly determine appropriate stocking practices and planting sites for the town as future planting is ongoing.

Section 2:

Functions and Benefits

of the Public Tree Resource

SECTION 2: FUNCTIONS AND BENEFITS OF THE PUBLIC TREE RESOURCE

Trees occupy a vital role in the urban environment by providing of a wide array of economic, environmental, and social benefits far exceeding the investments in planting, maintaining, and removing them. Trees reduce air pollution, improve public health outcomes, reduce stormwater runoff, sequester and store carbon, reduce energy use, and increase property value. Using advanced analytics, such as i-Tree Eco and other models in the i-Tree software suite, understanding the importance of trees to a community continues to expand by providing tools to estimate monetary values of the various benefits provided by a public tree resource.

Environmental Benefits

- Trees decrease energy consumption and moderate local climates by providing shade and acting as windbreaks.
- Trees act as mini reservoirs, helping to slow and reduce the amount of stormwater runoff that reaches storm drains, rivers, and lakes. One hundred mature tree crowns intercept roughly 100,000 gallons of rainfall per year (U.S. Forest Service 2003a).
- Trees help reduce noise levels, cleanse atmospheric pollutants, produce oxygen, and absorb carbon dioxide.
- Trees can reduce street-level air pollution by up to 60% (Coder 1996). Lovasi (2008) suggested that children who live on tree-lined streets have lower rates of asthma.
- Trees stabilize soil and provide a habitat for wildlife.

Economic Benefits

- Trees in a yard or neighborhood increase residential property values by an average of 7%.
- Commercial property rental rates are 7% higher when trees are on the property (Wolf 2007).
- Trees moderate temperatures in the summer and winter, saving on heating and cooling expenses (North Carolina State University 2012, Heisler 1986).
- On average, consumers will pay about 11% more for goods in landscaped areas, with this figure being as high as 50% for convenience goods (Wolf 1998b, Wolf 1999, and Wolf 2003).
- Consumers also feel that the quality of products is better in business districts surrounded by trees than those considered barren (Wolf 1998b).
- The quality of landscaping along the routes leading to business districts had a positive influence on consumers' perceptions of the area (Wolf 2000).

Social Benefits

- Tree-lined streets are safer; traffic speeds and the amount of stress drivers feel are reduced, which likely reduces road rage/aggressive driving (Wolf 1998a, Kuo and Sullivan 2001a).
- Chicago apartment buildings with medium amounts of greenery had 42% fewer crimes than those without any trees (Kuo and Sullivan 2001b).
- Chicago apartment buildings with high levels of greenery had 52% fewer crimes than those without any trees (Kuo and Sullivan 2001a).
- Employees who see trees from their desks experience 23% less sick time and report greater job satisfaction than those who do not (Wolf 1998a).
- Hospital patients recovering from surgery who had a view of a grove of trees through their windows required fewer pain relievers, experienced fewer complications, and left the hospital sooner than similar patients who had a view of a brick wall (Ulrich 1984, 1986).

i-TREE ECO ANALYSIS

i-Tree Eco utilizes tree inventory data along with local air pollution and meteorological data to quantify the functional benefits of a community's tree resource. By framing trees and their benefits in a way that everyone can understand, dollars saved per year, i-Tree Eco helps a community to understand trees as both a natural resource and an economic investment. Knowledge of the composition, functions, and monetary value of trees helps to inform planning and management decisions, assists in understanding the impact of those decisions on human health and environmental quality, and aids communities in advocating for the necessary funding to manage their vested interest in the public tree resource appropriately.

ANNUAL RETURN ON INVESTMENT FROM THE PUBLIC TREE RESOURCE

The i-Tree Eco analysis of the Town of Irondequoit's inventoried trees quantified the functional benefits of three critical ecosystem services that they provide: air pollution removal, carbon sequestration, and avoided surface runoff. The town's annual tree maintenance budget is approximately $265,000 to $315,000, making Irondequoit's return on investment minimally 22% annually.

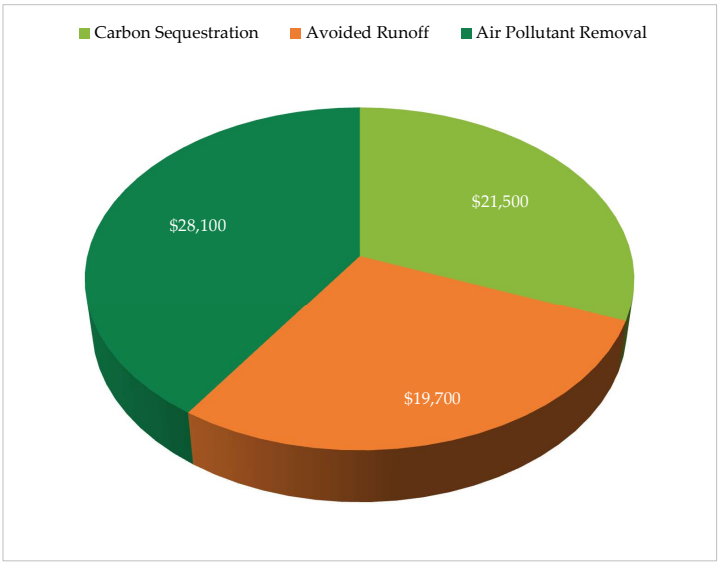

Figure 14. Estimated value of the benefits provided by inventoried trees.

Urban environments have unique challenges that make the estimated $69,600 of functional benefits provided by Irondequoit's inventoried tree population an essential asset to the town (Figure 14). Compared to rural landscapes, urban landscapes are characterized by high emissions in a relatively small area, valuing the 4,546 lbs. of airborne pollutants removed by Irondequoit's tree resource at an estimated $28,100. Avoiding stormwater runoff reduces the risk of flooding and combined sewer overflow, both of which impact people, property, and the environment, valuing the 2,206,753 gals. of runoff avoided with Irondequoit's tree resource at an estimated $20,000. Carbon dioxide ($CO_2$) also impacts people, property, and the environment as the primary greenhouse gas driving climate change, valuing the 252,000 lbs. sequestered by Irondequoit's tree resource at an estimated $21,500. Trees in the urban landscape can also provide shade and cooling benefits to the community. Trees cover 103 acres of Irondequoit and provide the town with 704.6 acres of leaf cover.

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The replacement value of the town's inventoried tree population is estimated to be $27,796,306. In Irondequoit, only two species account for almost half of the public tree resource and half of the functional benefits it provides. If either of these species were lost to invasive pests, disease, or other threats, its loss would have significant costs. It is critical to promote species diversity with future plantings to minimize susceptibility to potential threats, and to plant large-statured broadleaf tree species wherever possible to maximize potential environmental and economic benefits. See Appendix D for a tree species list recommended by DRG.

SEQUESTERING AND STORING CARBON

Trees are carbon sinks, which are the opposite of carbon sources. While carbon is emitted from cars and smokestacks, carbon is absorbed into trees during photosynthesis and stored in their tissue as they grow. The i-Tree Eco model estimates both the carbon sequestered each year and total carbon stored. Irondequoit's inventoried trees have stored 28,460,000 lbs. of carbon, which is all the carbon each tree has amassed throughout their lifetimes and is valued at $2,430,000. When looking at the most populous tree species in the inventory, Norway maple and silver maple together store approximately 66% of the total amount of carbon. However, corkscrew willow (*Salix mastudana* "Tortuosa") and elm (*Ulmus* spp.), sequestered the most amount of carbon per tree; 60 lbs. per tree and 42.9 lbs. per tree, respectively.

Overall, 126.1 tons, or 252,200 lbs., of carbon is sequestered per year by street trees located in the Irondequoit cemetery. Despite being more suited for either the storage of or sequestering of carbon, corkscrew willow and elm trees do not make up a considerable amount of the population of street trees or cemetery trees. While considering new species to plant as street or cemetery trees, Irondequoit may benefit from planting trees that can store or sequester more carbon.

Table 3. Summary of benefits provided by inventoried trees ranked by species importance value.

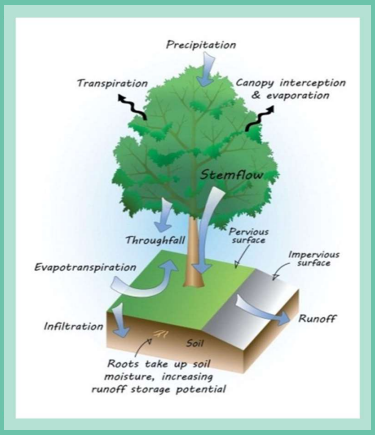
Most Common Trees Inventoried		Count	Percent of Total	Benefits Provided by Street Trees				
				CO_2 Stored	CO_2 Sequestered	Avoided Runoff	Air Pollution Removed	Replacement Value
Common Name	Botanical Name		%	tons	tons/year	gal/year	lbs/year	Dollars
Norway maple	*Acer platanoides*	3,574	34.4%	4,823.2	52.1	662,702	1,360	$9,754,349
silver maple	*Acer saccharinum*	1,588	15.3%	4,503.3	27.1	671,809	1,380	$5,833,885
red maple	*Acer rubrum*	607	5.8%	389.5	6.5	76,898	160	$1,002,727
thornless honeylocust	*Gleditsia triacanthos* v. *inermis*	570	5.5%	962.0	10.1	119,767	240	$1,953,079
Callery pear	*Pyrus calleryana*	278	2.7%	68.4	1.5	16,526	40	$219,018
northern red oak	*Quercus rubra*	259	2.5%	689.0	3.7	70,735	140	$1,632,364
sugar maple	*Acer saccharum*	254	2.4%	375.4	2.5	47,220	100	$916,224
London planetree	*Platanus hybrida*	180	1.7%	314.8	2.1	66,155	140	$955,641
apple species	*Malus*	178	1.7%	34.5	0.5	4,951	20	$109,157
Freeman maple	*Acer* x *freemanii*	170	1.6%	74.0	1.8	15,667	40	$116,283
blue spruce	*Picea pungens*	169	1.6%	68.0	0.7	22,316	40	$262,165
eastern redbud	*Cercis canadensis*	156	1.5%	7.4	0.2	3,257	0	$50,943
littleleaf linden	*Tilia cordata*	144	1.4%	129.6	1.4	30,211	60	$483,106
cherry species	*Prunus*	124	1.2%	78.5	0.5	11,770	20	$128,611
northern white cedar	*Thuja occidentalis*	124	1.2%	13.9	0.2	2,877	0	$65,763
All Other Trees Inventoried		2,027	19.5%	1,694	15.4	383,011	680	$4,312,990
Total		**10,402**	**100%**	**14,225**	**126.1**	**2,205,872**	**4,420**	**$27,796,306**

CONTROLLING STORMWATER

Trees intercept rainfall with their leaves and branches, helping lower stormwater management costs by avoiding runoff. The inventoried trees in the Town of Irondequoit avoid 2,206,753 gals. of runoff annually. Avoided runoff accounts for 32% of the annual functional benefits provided by Irondequoit's public tree resource.

Of all species inventoried, silver maple (*Acer saccharinum*) contributed the most annual stormwater benefits. The silver maple population (15.3% of inventoried trees) avoided 671,809 gals. of runoff. The most abundant species in the inventoried tree population, Norway maple (34.4%) only avoided approximately 662,702 gals. of runoff. At a per-tree level, larger trees with leafy canopies provided the most functional benefits regarding stormwater, such as Norway maple and silver maple, compared to smaller trees. Eastern redbud (*Cercis canadensis*) and callery pear (*Pyrus calleryana*) are smaller canopied trees in this inventory, and, together, avoid less than 3% of the runoff that Norway maple or silver maple do. However, it is worth noting here that eastern redbud and callery pear only make up 1.5% and 2.7% of the total population, compared to 34.3% Norway maple and 15.3% silver maple. When compared to larger leaf trees that are closer in species count to eastern redbud or callery pear, the larger leaved trees such as northern red oak (*Quercus rubra*), sugar maple (*A. saccharum*), and London planetree (*Platanus hybrida*) avoided at least 58% more runoff. As such, larger, leafy canopied trees are recommended for planting in areas of Irondequoit that may have issues regarding flooding.

CANOPY FUNCTIONS



Trees provide many functions and benefits all at once simply by existing, such as:

- Catching rainfall in their crown so it drips to the ground with less of an impact or flows down their trunk.
- Helping stormwater soak into the ground by slowing down runoff.
- Creating more pore space in the soil with their roots, helping stormwater to move through the ground.
- Cooling the surrounding landscape by casting shade with their canopy and releasing water from their leaves.
- Catching airborne pollutants on their leaves and absorbing them with their roots when they wash off in the rain.
- Transforming some pollutants into less harmful substances and preventing other pollutants from forming.

IMPROVING AIR QUALITY

The inventoried tree population annually removes 4,546 lbs. of air pollutants, including sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and particulate matter ($PM_{2.5}$). The i-Tree Eco model estimated the value of this benefit at $28,100, which is 34% of the value of all annual benefits. As shown in Figure 15, a small reduction of $PM_{2.5}$ is the more valuable than any of the other pollutants removed. The trees that removed the most amount of pollutants per year were Norway maple and silver maple, which removed 1,360 lbs. of pollutants per year and 1,380 lbs. of pollutants per year, respectively. On a per tree basis, pignut hickory (*Carya glabra*) and American sycamore (*Platanus occidentalis*) removed the most pollutants per tree per year: 2.5 lbs. per tree, and 2.02 lbs. per tree, respectively. As discussed above, pignut hickory and American sycamore do not exceed population threshold and would be beneficial to plant in areas of Irondequoit where air quality is poor, due to their ability to remove pollutants in the air.

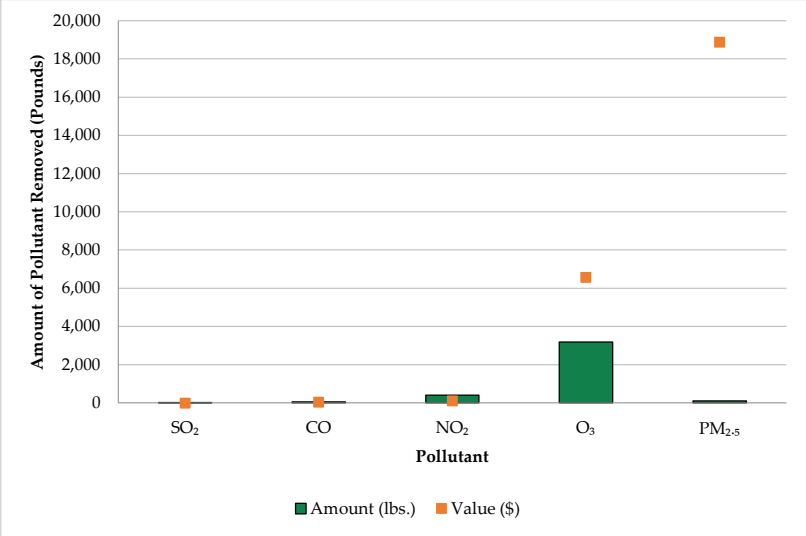


Figure 15. Estimated value of removing airborne pollution by weight and type.

Section 3:

Recommended Management

of the Public Tree Resource

SECTION 3: RECOMMENDED MANAGEMENT OF THE PUBLIC TREE RESOURCE

During the inventory, both a risk rating and a recommended maintenance activity were assigned to each tree. DRG recommends prioritizing and completing each tree's recommended maintenance activity based on the assigned risk rating. This five-year tree management program takes a multi-faceted and proactive approach to tree resource management.

RISK MANAGEMENT AND RECOMMENDED MAINTENANCE

Although tree removal is usually considered a last resort, and may sometimes create a reaction from the community, there are circumstances in which removal is necessary. Trees fail from natural causes such as diseases, insects, and weather conditions, and from physical injury due to vehicles, vandalism, and root disturbances. DRG recommends that trees be removed when corrective pruning will not adequately mitigate risk or when correcting problems would be cost-prohibitive. DRG recommends that tree maintenance activities are prioritized and completed based on the risk rating that was assigned to each tree during the inventory. The following section describes recommended maintenance for each risk rating category.

Trees that cause obstructions or interfere with power lines or other infrastructure should be removed when their defects cannot be corrected through pruning or other maintenance practices. Diseased and nuisance trees also warrant removal. Even though large short-term expenditures may be required, it is important to secure the funding needed to complete priority tree removals. Expedient removal reduces risk and promotes public safety. Figures 16 and 17 present tree pruning and tree removals by risk rating and diameter size class. The following sections briefly summarize the recommended removals identified during the inventory.

High Priority Recommended Maintenance

Pruning or removing High Risk trees is strongly recommended to be prioritized and completed as soon as possible. In general, maintenance activities should be completed first for the largest diameter trees (>25″) that pose the greatest risk. Once addressed, recommended tree maintenance activities should be completed for smaller diameter trees (<25″) that pose the greatest risk. Addressing High Risk trees in a timely and proactive manner often requires significant resources to be secured and allocated. However, peforming this work expediently will mitigate risk, improve public safety, and reduce long-term costs.

High Priority Pruning Recommendations

High Risk trees should be pruned immediately based on assigned risk rating, which generally requires removing defects such as dead and dying parts, broken and/or hanging branches, and cavities or decayed wood that may be present in tree crowns, even when most of the tree is sound. In these cases, when pruning the defected branch(es) can correct the problem, risk associated with the tree is reduced while promoting healthy growth. Moderate Risk trees can then be pruned, following the completion of High Risk pruning.

The inventory identified 36 High Risk streets trees to be pruned (Figure 16). The diameter size classes for trees with recommended high-priority pruning ranged between 15–24 inches DBH and >49 inches DBH. Of these trees, 30 had broken or hanging branches as their defect. Once pruned, the risk rating of these trees may become lower. This maintenance should be performed immediately based on assigned risk rating and may be performed concurrently with other High Risk removals. Figure 16 shows the distribution of High Risk and Moderate Risk street trees across size classes that require pruning. Most of the Moderate Risk trees fall into the 25–36" DBH size class, indicating that they are mature trees. Of the 1,239 street trees that require pruning, 87% had dead and dying branches as their defect. The remaining 165 street trees have either branch attachment, broken or hanging branches, cracks, and cavities or decay as their defects.

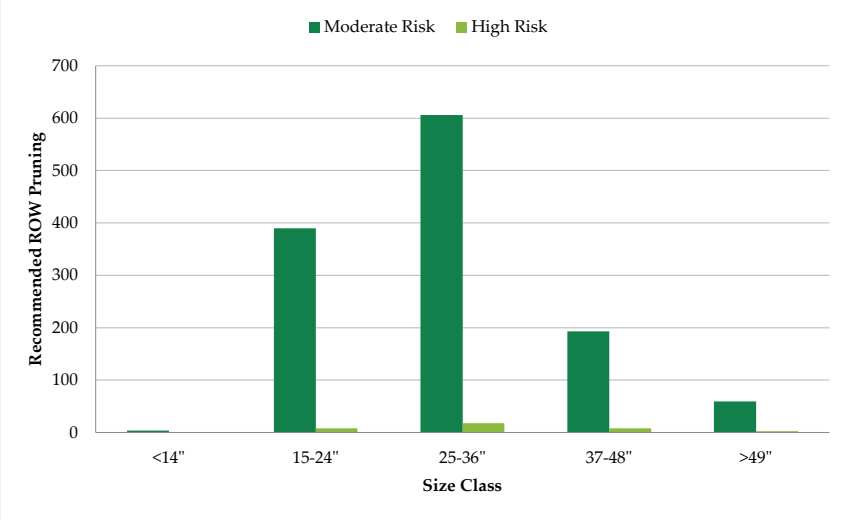


Figure 16. Recommended ROW pruning by size class and risk rating.

Figure 17 shows the distribution of tree size per High Risk and Moderate Risk of the trees located in the Irondequoit Cemetery. Only one tree was identified as a High Risk tree, with a DBH falling in the range of 25–36 inches, and three trees were recorded as a Moderate Risk tree. These trees share the same defect; dead and dying branches. Once these trees are pruned and maintained, their risk may be lowered, and their condition can improve.

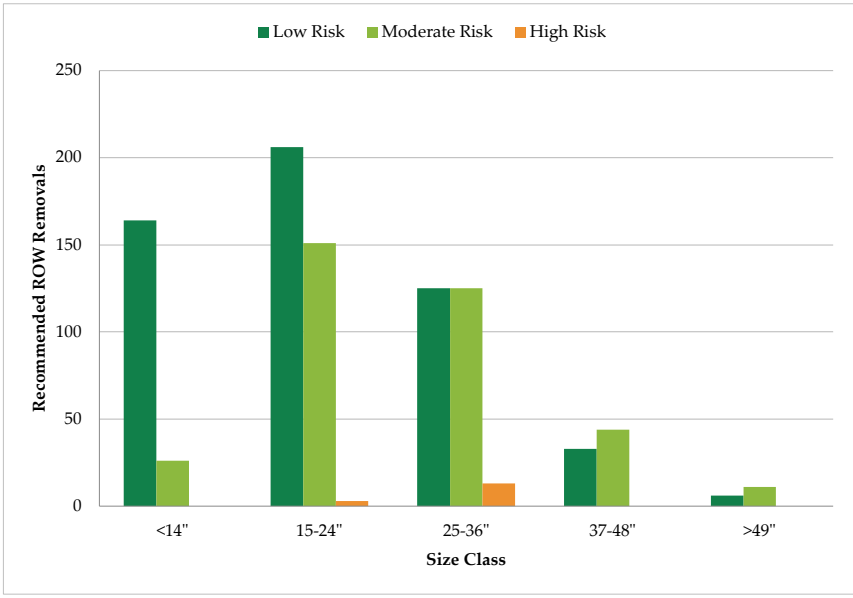


Figure 17. Recommended cemetery pruning by size class and risk rating.

High Priority Removal Recommendations

DRG identified 16 High Risk streets trees recommended for removal. The diameter size classes for High Risk trees ranged between 15–24 inches DBH and 25–36 inches DBH. Half of these trees have broken or hanging branches as their defect, and four trees had either a cavity or decay. Cavities or decay in trees does not immediately indicate that the tree must be removed, as specific species are either rot resistant, such as honey locust, or have very strong wood despite being hollow throughout, such as trees in the apple genus (*Malus*). However, the trees that were recorded to have cavities and decay in this inventory that were recommended for removal exhibited signs of whole tree failure, such as crown dieback, decay fungus infections, or had cavities or decay in a location that would cause whole tree failure, such as at the base of the trunk, or at the union of co-dominant leaders. As with cavities and decay, the presence of dead and dying branches does not automatically indicate that a tree must be removed. However, these trees would have likely suffered from crown dieback, or treatment of the dead and dying branch requires removing over 60% of the canopy. At this point, the tree is unlikely to survive a canopy reduction of 60%, and thus removal is the most cost-effective option.

DRG recommends that trees be removed when pruning will not correct their defects, eliminate the risks that their defects cause, or when corrective pruning would be cost-prohibitive. These trees should be removed immediately based on their risk rating and size class.

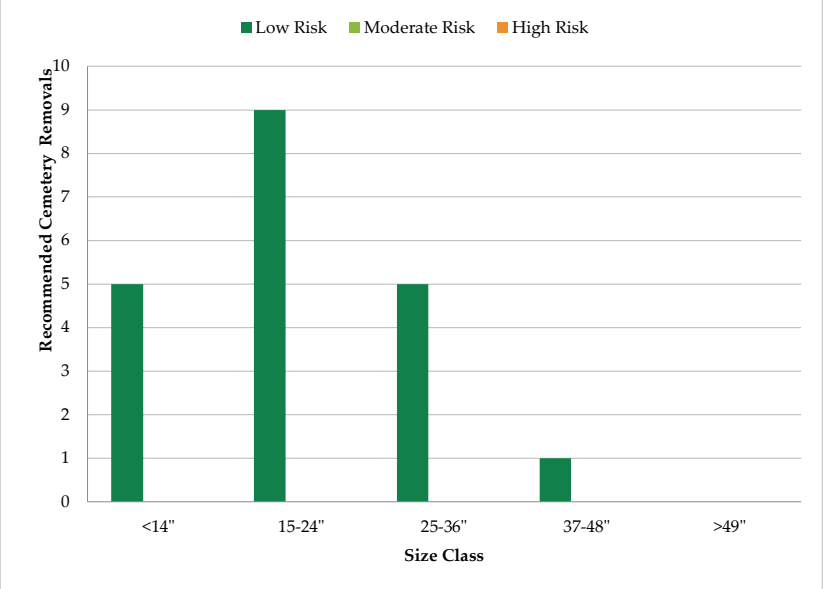


Figure 18. Recommended ROW removals by size class and risk rating.

No High Risk trees in the cemetery were recommended for removal in the Irondequoit Cemetery (Figure 19). All of the 20 trees recommended for removal from the cemetery fall were recorded to have a Low Risk. Most of the trees that are recommended for removal fall within the 15–24″ DBH size class; 19 of these trees had cavities or decay as their defect, and one tree had dead and dying branches.

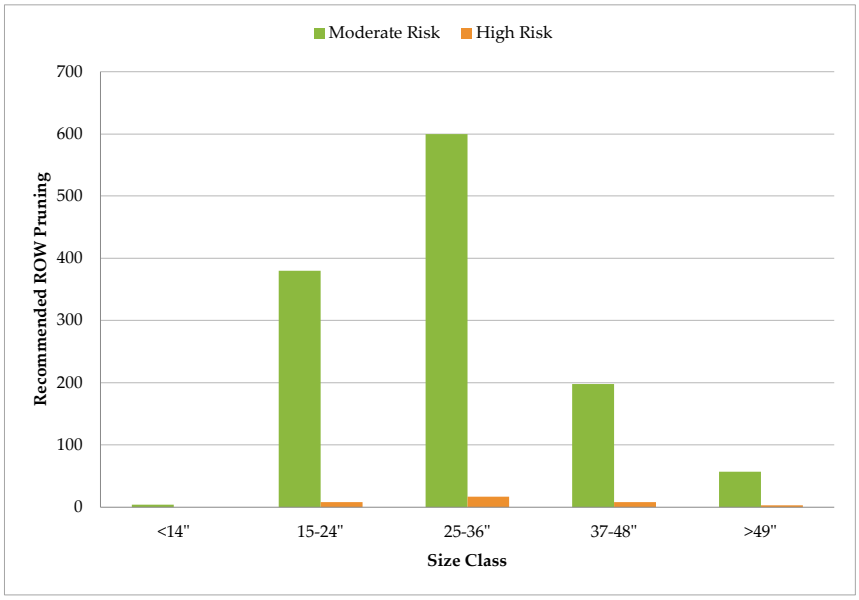


Figure 19. Recommended cemetery removals by size class and risk rating.

FURTHER INSPECTION

Moderate and Low Priority Recommended Maintenance

Pruning or removing Moderate and Low Risk trees are generally the next priorities for maintenance activities. For efficiency, Moderate and Low Risk removals may also be addressed when removing adjacent higher risk trees. Most trees recommended for pruning with these risk levels can be maintained during proactive, routine pruning cycles. DRG recommends implementing proactive maintenance programs incrementally over time as the backlog of risk is reduced.

Moderate Risk Pruning Recommendations

Moderate Risk pruning should be performed after all High Risk recommended maintenance is complete and may be performed concurrently with other Moderate Risk removals. The inventory identified 1,239 Moderate Risk street trees recommended for pruning (Figure 16). The diameter size classes for Moderate Risk trees ranged between <14 inches DBH and >49 inches DBH. Most Moderate Risk prune ROW trees had dead and dying branches as their main defect (1074) or broken and hanging branches (113). Only three trees were identified and recorded as Moderate Risk trees in the Irondequoit Cemetery. These trees ranged from a size class of 15–24 inches DBH to 25–36 inches DBH, and all three had dead and dying branches (Figure 17). Proper maintenance and pruning of these trees can improve their overall condition and reduce the risk they have in their environment.

Moderate Risk Removal Recommendations

DRG identified 357 Moderate Risk street trees recommended for removal (see Figure 18). Most Moderate Risk trees recommended for removal were smaller than 36 inches DBH. A majority of Moderate Risk street trees (227) that should be removed had dead and dying branches as their most significant defect, and 102 trees had issues with cavity or decay. These trees may be located in an area were the likelihood of impacting a target is lower, or the consequence of failure is not as significant, despite having a majority of trees in the same size classes and with the same defects as High Risk removals. There were no trees within the cemetery that are classified as Moderate Risk removals (Figure 19).

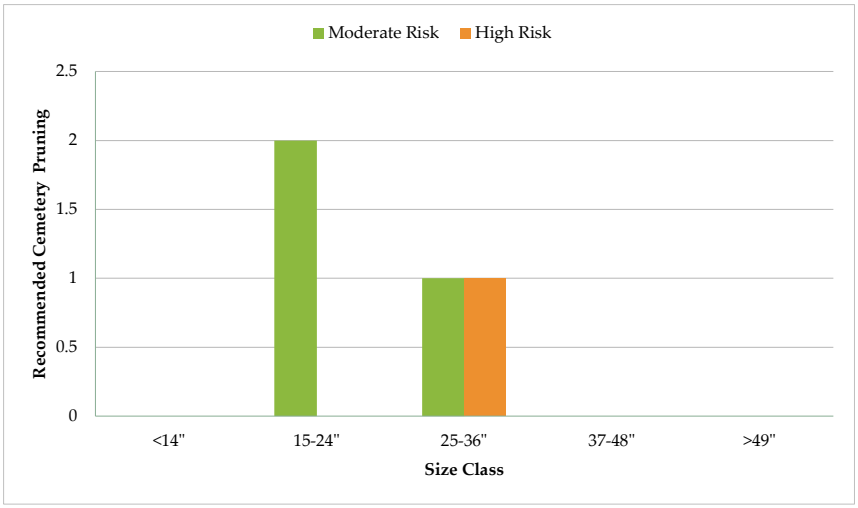


Figure 20. Cemetery priority pruning.

If corrective pruning cannot correct a tree's defects and/or adequately mitigate risk, then the tree should be removed. These trees should be removed as soon as possible after all High Risk removals and pruning have been completed. Removal of these trees as soon as possible can prevent their risk from increasing and creating a greater danger to the community.

Low Priority Pruning Recommendations

There were 3,084 Low Risk street and cemetery trees recommended for pruning. Low Risk trees with the assigned maintenance of either "Prune", "Discretionary Prune", or "None" should be included in a proactive Routine Pruning cycle after all the higher risk trees are addressed. More than half of the Low Risk street trees had dead and dying branches, or problems with cavities or decay. Low Risk trees with dead and dying branches typically had a few small branches that had a low likelihood of impacting a target, such as a small branch falling within the tree lawn, or a low consequence when hitting a target, leaving the target with a small bruise or a scratch if it is a being, or leaving a car with a small dent or nick in the paint.

Low Risk trees in the cemetery had either dead or dying branches, or problems with branch attachment. Overall, there were 63 trees in the Irondequoit cemetery that were recorded as Low Risk and required pruning. Weak branch attachments can be prevented through young tree training. It is important to monitor Low Risk trees, especially after weather events, to ensure that their risk does not increase. If so, that tree should have greater priority of maintenance (see Figure 20 in section Routine Pruning Cycle).

Low Priority Removal Recommendations

DRG identified 534 Low Risk street trees (Figure 17) and 20 Low Risk cemetery trees (Figure 15) recommended for removal. As with low priority pruning, over half of the Low Risk street trees either had dead and dying branches, or had cavities or decay. Low Risk removals pose little threat; these trees are generally small, dead, invasive, poorly formed trees that need to be removed, or are unlikely to fail within the next year. For this inventory, most street trees fell into the size class of 15" DBH to 24" DBH, or had a DBH of less than 14".

Eliminating these trees will reduce breeding site locations for insects and diseases and will increase the aesthetic value of the area. Healthy trees growing in poor locations or undesirable species are also included in this category. If pruning cannot correct a tree's defects and/or adequately mitigate risk, then the tree should be removed. All Low Risk trees should be removed when convenient after all higher risk pruning and removals have been completed and may be performed concurrently with routine pruning.

ROUTINE INSPECTIONS

Inspections are essential to uncovering potential problems with trees. They should be performed by a qualified arborist who is trained in the art and science of planting, caring for, and maintaining individual trees. Arborists are knowledgeable about the needs of trees and are trained and equipped to provide proper care. Ideally, the arborist will be ISA Certified and also hold the ISA Tree Risk Assessment Qualification credential.

Routine Inspection Recommendations

All trees along the street ROW should be regularly inspected and attended to as needed. When trees require additional or new work, they should be added to the maintenance schedule. The budget should also be updated to reflect the additional work. Utilize computer management software such as TreeKeeper® to make updates, edits, and keep a log of work records. In addition to locating trees with unidentified defects, inspections also present an opportunity to look for signs and symptoms of pests and diseases. Irondequoit has a large population of trees that are susceptible to pests and diseases, such as ash, maple, oak, and spruce.

DRG recommends that Irondequoit perform routine inspections of inventoried trees by windshield survey (inspections performed from a vehicle) in line with *ANSI A300 (Part 9)* annually and after all severe weather events, to identify defects with heightened risk, signs of pest activity, and symptoms of disease. Drive-by inspections may also be done concurrently with pruning and other maintenance activities. When trees need additional maintenance, they should be added to the work schedule immediately. Use asset management software such as TreeKeeper® to update inventory data and schedule work records.

ROUTINE PRUNING CYCLE

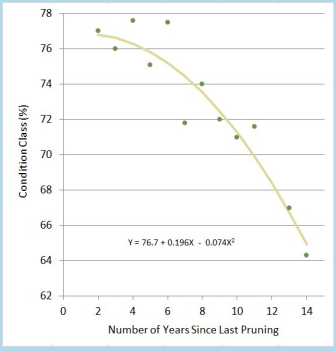
The Routine Pruning cycle includes all Low Risk trees that received a "Prune", "Discretionary Prune", or "None" maintenance recommendation. These trees pose some risk but have a smaller defect size and/or a lower probability of impacting a target. Over time, routine pruning can minimize reactive maintenance, limit instances of elevated risk, and provide the basis for a robust risk management program.

Based on Miller and Sylvester's research, DRG recommends five-year Routine Pruning cycles to maintain the condition of the inventoried tree resource. However, not all municipalities are able to remain proactive with a five-year cycle based on budgetary constraints, the size of the public tree resource, or both. In these cases, extending the length of the Routine Pruning cycle is an option; however, it is in the municipality's best interest to not approach or exceed a 10-year pruning cycle. The reason is that this is around when tree condition deteriorates significantly without regular pruning, because their once-minor defects have worsened, reducing tree health and potentially increasing risk (Miller and Sylvester 1981).

Routine Pruning Cycle Recommendations

Irondequoit's inventory has 6,029 trees that should be routinely pruned, and DRG recommends that the Irondequoit establish a five-year Routine Pruning cycle with approximately 1,206 trees pruned each year. If this is not feasible for Irondequoit, a six-year Routine Pruning cycle with approximately 1,005 trees pruned each year, or a seven-year Routine Pruning cycle with approximately 862 trees pruned each year, is acceptable considering the inventoried tree population's size. DRG recommends that the Routine Pruning cycle begins in Year One of the proposed five-year program, after all High Risk Recommended Maintenance is complete.

PROACTIVE PRUNING



Relationship between tree condition and years since previous pruning.

(adapted from Miller and Sylvester 1981)

Miller and Sylvester studied the pruning frequency of 40,000 street trees in Milwaukee, Wisconsin. Trees that had not been pruned for more than 10 years had an average condition rating 10% lower than trees that had been pruned in the previous several years. Their research suggests that a five-year pruning cycle is optimal for urban trees.

Routine pruning cycles help detect and correct most defects before they reach higher risk levels. DRG recommends that pruning cycles begin after all Extreme and High Risk tree maintenance has been completed.

DRG recommends two pruning cycles: a Young Tree Training cycle and a Routine Pruning cycle. Newly planted trees will enter the Young Tree Training cycle once they become established and will move into the Routine Pruning cycle when they reach maturity. A tree should be removed and eliminated from the Routine Pruning cycle when it outlives its usefulness.

Figure 21. Routine pruning by size class.

Approximately 56% of the inventoried street tree population would benefit from routine pruning. Figure 20 shows that a variety of size classes recommended for pruning; however, most of the trees inventoried have a DBH of less than 25". A majority of Low Risk street trees (65%) have dead and dying branches as their defect, whereas only 46% of street trees that need routine pruning have dead and dying branches as their defect. Most trees that are Low Risk and need routine pruning in the Irondequoit Cemetery have the same defect, dead and dying branches. Branch attachment is a close second defect for trees that need routine pruning in the cemetery.

As with Moderate Risk and High Risk trees, the location and size of the dead and dying branches plays a role in determining the priority of pruning per each tree. Trees that have low risks tend to be in a location where branches that fall from the canopy are either close to the ground, are unlikely to strike a target, such as a vehicle or pedestrian walking, or are unlikely to damage or hurt a vehicle or pedestrian.

YOUNG TREE TRAINING CYCLE

Trees included in the Young Tree Training cycle are generally less than 8 inches DBH. These younger trees sometimes have branch structures that can lead to potential problems as the tree ages. Potential structural problems include codominant leaders, multiple limbs attaching at the same point on the trunk, or crossing/interfering limbs. If these problems are not corrected, they may worsen as the tree grows, increasing its risk rating and creating potential liability. The overall goal of training a young tree is to promote the best growing form and habit for that tree.

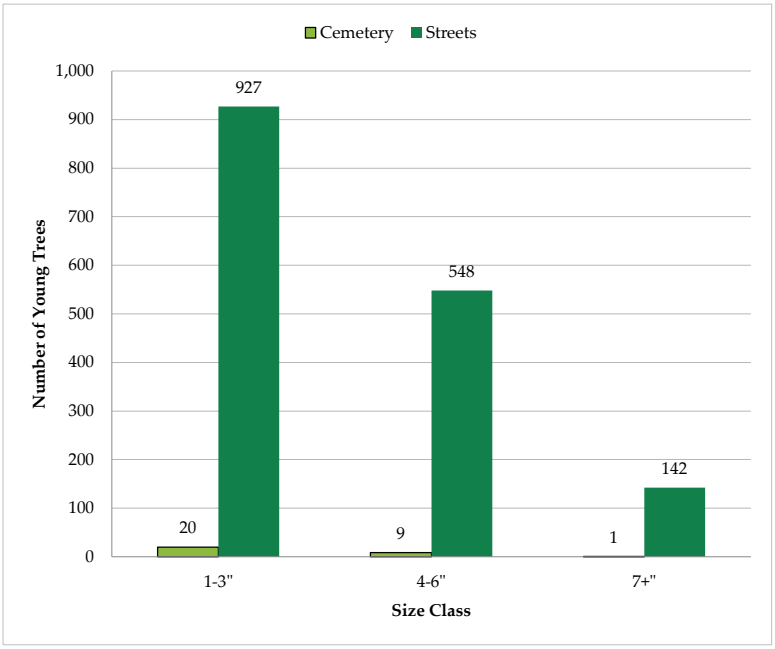


Figure 22. Three-year Young Tree Training cycle by size class.

The recommended length of a Young Tree Training cycle is three years because young trees tend to grow at faster rates than mature trees. The Young Tree Training cycle differs from the Routine Pruning cycle in that the Young Tree Training cycle generally only includes trees that can be pruned from the ground with a pole pruner or pruning shear.

Young Tree Training Cycle Recommendations

DRG recommends that Irondequoit implement a three-year Young Tree Training cycle beginning after the completion of all Extreme and High Risk Recommended Maintenance activities. For this inventory, 1,647 trees less than or equal to 7 inches DBH were recorded and recommended for young tree training (Figure 21). Trees recommended for young tree training all had low risk ratings, as most trees are relatively small. Within the population of young trees along the streets of Irondequoit, most young trees, about 35% or 571 trees, had problems with weak branch attachment and 326 trees, or 20% had dead or dying branches. Pruning involved in young tree training would mean removing the branches that have weak attachment or are dead, since they are more likely to fail and cause injury to the tree. Nearly half of the population of young trees in the Irondequoit cemetery had no defects, and the most common defect was a trunk condition on the tree, which can include mechanical damage from lawn mowers or weed whackers and frost cracks. Figure 21 shows the distribution of young trees by size class.

Since Irondequoit has a low number of young trees (approximately 16% of the population), approximately 550 trees be trained with structural pruning each year over three years, beginning in Year One of the management program. When new trees are planted, they should enter the Young Tree Training cycle after establishment, typically within 2–3 years after planting. In future years, the number of trees in the Young Tree Training cycle will be based on tree planting efforts and growth rates of young trees. The town should strive to training prune approximately one-third of its young trees each year.

TREE PLANTING AND STUMP REMOVAL

Planting new trees in areas where there is sparse canopy already is the most important. It is also important to plant more trees in areas with poor canopy continuity or gaps in existing canopy. While Irondequoit as a whole receives value from the ecosystem services provided by the public tree resource, those benefits usually are not distributed evenly across the town.

The Right Tree in the Right Place is a mantra for tree planting used by the Arbor Day Foundation and many utility companies nationwide. Trees come in many different shapes and sizes, and often change dramatically over their lifetimes. Before selecting a tree for planting, make sure it is the right tree—know how tall, wide, and deep it will be at maturity. Equally important to selecting the right tree is choosing the right spot to plant it. Blocking an unsightly view or creating some shade may be a priority, but it is important to consider how a tree may impact existing utility lines and hardscape as it grows taller, wider, and deeper. If the tree at maturity will reach overhead lines, or conflict with sidewalks and curbs, it is best to choose another tree or a different location. It is worth noting again, that species should be considered when choosing a tree to plant. Data from above shows that the genus and family distribution of trees are skewed towards the *Acer* genus and the Sapindaceae family. Educational outreach for the community will be important to ensure that homeowners do not plant trees from the Sapindaceae family to improve species distribution. Other species such as northern red oak, London planetree, pignut hickory, black oak, and willow have the potential to increase environmental benefits and should be considered over maple species for planting to improve environmental benefits and species diversity of the urban forest in Irondequoit.

Tree Planting and Stump Removal Recommendations

While arborists did not collect vacant or planting site data for this inventory, a proper planting technique can improve the health and vitality of street trees. As Irondequoit continues to work towards the town's goal of planting 300 trees per year, it will be beneficial to the town to assess the size and suitability of planting sites. DRG recommends following the suggested techniques when planting new trees. Creating larger growing sites for trees in the municipal ROW can be the single most beneficial management practice to improve the survival rate of planted and developing trees. Increasing planting space can also reduce the amount of tree-related infrastructure conflicts, as the trees will be planted further from curbs and sidewalks. Depending on the site, there are several methods available to create and/or increase the growing space for newly planted trees:

- Install or enlarge tree wells/pits in existing sidewalks of sufficient width. Ideally, the minimum growing space of a small-sized tree is 32 square feet. Where Irondequoit has sidewalks of a sufficient width and length, the town could install tree pits with enough space remaining for the sidewalk to still comply with American Disability Act (ADA) standards.
- Planting trees 4 feet behind a curb without a sidewalk, or 4 feet behind an existing sidewalk, can be a low-cost alternative to more construction intensive methods. This can result in less damage to the sidewalk and give tree roots room to grow into the open soil.
- Re-routing the sidewalk around an area to create designated large tree sites is a relatively cost-effective method to increase growing spaces. This method can also be applied to existing large tree sites, where tree roots have already come in conflict with the sidewalk.
- A landscape bump-out/curb extension is a vegetative area that protrudes into the parking lane of a street, to provide a growing space for plants or trees. These spaces can be used quite effectively by municipalities to beautify a streetscape, provide greater storm water retention, along with the added benefit of slowing car speeds at the bump-out location.

The inventory identified 243 stumps recommended for removal, with a wide range of sizes from 2" to 71"in diameter. Stump removals should occur when convenient and be included regular planting plans if the site would be feasible for planting after the stump is removed. For this reason, it is most convenient to remove all stumps in areas with scheduled tree planting work, so all feasible sites in an area are stocked at once.

A list of suggested tree species is provided in Appendix D. These tree species are specifically selected for the climate of Irondequoit. This list is not exhaustive but can be used as a guideline for species that meet community objectives and to enhance any existing list of approved species.

MAINTENANCE SCHEDULE AND BUDGET

Utilizing 2022 Town of Irondequoit tree inventory data, an annual maintenance schedule was developed detailing the recommended tasks to complete each year. DRG made budget projections using industry knowledge and public bid tabulations. Four different budgets were calculated for Irondequoit's five-year plan, to account for the difference of cost between in-house tree care and tree care from contractors. Each budget was made with a different proportion of tree care done either in-house, or from contractors; these proportions being all tree care done in-house, three fourths of tree care done in-house and the remaining tree care done by contractors, half of the work done in-house and the other half done by contractors and three fourths of tree care done by contractors and the remaining done in-house. Overall, the most cost-effective budget plan would be to have all tree care work done in-house over the next five years, totaling at $4,338,814, as opposed to the most expensive budget, where most of the tree care work is conducted by contractors, totaling $5,618,531. Over the past four years, tree care work has been spread out between both in-house operations and contractors such that most of the work was completed in-house, and contractors finished the rest. To follow that pattern, the budget that splits tree care such that three fourths of the work is done in-house will be reported on below. This budget does not include additional costs, such as those to hire more employees or to purchase and maintain equipment. Eventually, to keep costs low, the town would have all tree care done in house, as contractors are more expensive.

This schedule provides a framework for completing the recommended inventoried tree maintenance over the next five years. Following this schedule can shift tree maintenance activities from being reactive to a more proactive tree care program.

To implement the maintenance schedule, Irondequoit's tree maintenance budget should be:

- No less than $995,926 for the first year of implementation.
- No less than $1,735,330 for the second and third years.
- No less than $1,607,558 for the final two years of the maintenance schedule.

Annual budget funds are needed to ensure that High Risk trees are expediently managed and that the vital Young Tree Training and Routine Pruning cycles can begin as soon as possible. If routing efficiencies and/or contract specifications allow more tree work to be completed in a given year, or if this maintenance schedule requires adjustment to meet budgetary or other needs, then it should be modified accordingly. Unforeseen situations such as severe weather events may arise and change the maintenance needs of trees. If maintenance needs change, then budgets, staffing, and equipment should be adjusted to meet the new demand.

Table 4. Estimated costs for five-year tree management program

All In-House Costs

Activity Cost				Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree In-house	Cost/Tree Contractors	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
High Priority Removals	<14"	$200	$318		$0		$0		$0		$0		$0	$0
	15-24"	$400	$636		$0	3	$1,200		$0		$0		$0	$1,200
	25-36"	$1,000	$1,272	10	$10,000	3	$3,000		$0		$0		$0	$13,000
	37-48"	$2,000	$2,544		$0		$0		$0		$0		$0	$0
	>49"	$2,500	$3,180		$0		$0		$0		$0		$0	$0
Activity Total(s)				**10**	**$10,000**	**6**	**$4,200**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$14,200**
Moderate Priority Removals	<14"	$200	$318		$0		$0		$0		$0		$0	$0
	15-24"	$400	$636	16	$6,400	10	$4,000		$0		$0		$0	$10,400
	25-36"	$1,000	$1,272	90	$90,000	61	$61,000		$0		$0		$0	$151,000
	37-48"	$2,000	$2,544	30	$60,000	14	$28,000		$0		$0		$0	$88,000
	>49"	$2,500	$3,180	6	$15,000	5	$12,500		$0		$0		$0	$27,500
Activity Total(s)				**142**	**$171,400**	**90**	**$105,500**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$276,900**
Low Priority Removals	<14"	$200	$318		$0		$0	50	$10,000	75	$15,000	44	$8,800	$33,800
	15-24"	$400	$636		$0		$0	75	$30,000	75	$30,000	65	$26,000	$86,000
	25-36"	$1,000	$1,272		$0		$0		$0		$0		$0	$0
	37-48"	$2,000	$2,544		$0		$0	14	$28,000	14	$28,000	6	$12,000	$68,000
	>49"	$2,500	$3,180		$0		$0	6	$15,000		$0		$0	$15,000
Activity Total(s)				**0**	**$0**	**0**	**$0**	**145**	**$83,000**	**164**	**$73,000**	**115**	**$46,800**	**$202,800**
Stump Removals	Any	$300	$350	202	$60,600	146	$43,800	195	$58,500	214	$64,200	158	$47,400	$274,500
Activity Total(s)				**202**	**$60,600**	**146**	**$43,800**	**195**	**$58,500**	**214**	**$64,200**	**158**	**$47,400**	**$274,500**
High Priority Pruning	Any	$220	$250	20	$4,400	18	$3,960		$0		$0		$0	$8,360
Activity Total(s)				**20**	**$4,400**	**18**	**$3,960**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$8,360**
Moderate Priority Pruning	Any	$220	$250	500	$110,000	500	$110,000	255	$56,100		$0		$0	$276,100
Activity Total(s)				**500**	**$110,000**	**500**	**$110,000**	**255**	**$56,100**	**0**	**$0**	**0**	**$0**	**$276,100**
Routine Inspection	Drive-by Assessment	$1		10,427	$10,427	10,427	$10,427	10,427	$10,427	10,427	$10,427	10,427	$10,427	$52,135
	Walk-by Assessment	$5		2,086	$10,430	2,086	$10,430	2,085	$10,425	2,085	$10,425	2,085	$10,425	$52,135
Activity Total(s)				**12,513**	**$10,430**	**12,513**	**$10,430**	**12,512**	**$10,425**	**12,512**	**$10,425**	**12,512**	**$10,425**	**$52,135**
Young Tree Training (3-year Cycle)	1-3"	$75	$250	320	$24,000	620	$46,500	907	$68,025	1,257	$94,275	1,507	$113,025	$345,825
	4-6"	$75	$250	250	$18,750	250	$18,750	57	$4,275	250	$18,750	300	$22,500	$83,025
	6"<	$75	$250	75	$5,625	68	$5,100		$0	75	$5,625	75	$5,625	$21,975
Activity Total(s)				**645**	**$48,375**	**938**	**$70,350**	**964**	**$72,300**	**1,582**	**$118,650**	**1,882**	**$141,150**	**$450,825**
Routine Pruning (5-year Cycle)	Any	$235	$250	1,206	$283,410	1,205	$283,175	1,205	$283,175	1,205	$283,175	1,205	$283,175	$1,416,110
Activity Total(s)				**1,206**	**$283,410**	**1,205**	**$283,175**	**1,205**	**$283,175**	**1,205**	**$283,175**	**1,205**	**$283,175**	**$1,416,110**
Planting Tree		$275	$495	300	$82,500	300	$82,500	300	$82,500	300	$82,500	300	$82,500	$412,500
Activity Total(s)				**300**	**$82,500**	**300**	**$82,500**	**300**	**$82,500**	**300**	**$82,500**	**300**	**$82,500**	**$412,500**
Natural Mortality (1%)	Tree Removal	$1,000	$1,272	104	$104,000	104	$104,000	104	$104,000	104	$104,000	104	$104,000	$520,000
	Stump Removal	$315	$350	104	$32,760	104	$32,760	104	$32,760	104	$32,760	104	$32,760	$163,800
	Replacement Tree	$275	$495	104	$28,600	104	$28,600	104	$28,600	104	$28,600	104	$28,600	$143,000
Activity Total(s)				**312**	**$165,360**	**312**	**$165,360**	**312**	**$165,360**	**312**	**$165,360**	**312**	**$165,360**	**$826,800**
Activity Grand Total				**15,850**		**16,028**		**15,888**		**16,289**		**16,484**		**80,539**
Cost Grand Total					**$946,475**		**$879,275**		**$811,360**		**$797,310**		**$776,810**	**$4,211,230**

One Quarter Contractor Work, Three Quarters Done In-house

Activity Cost				Year 1			Year 2			Year 3			Year 4			Year 5			Five-Year Cost
Activity	Diameter	Cost/Tree In-house	Cost/Tree Contractors	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	
High Priority Removals	<14"	$200	$318			$0			$0			$0			$0			$0	$0
	15-24"	$400	$636			$0	2	1	$1,436			$0			$0			$0	$1,436
	25-36"	$1,000	$1,272	7	3	$10,816	2	1	$3,272			$0			$0			$0	$14,088
	37-48"	$2,000	$2,544			$0			$0			$0			$0			$0	$0
	>49"	$2,500	$3,180			$0			$0			$0			$0			$0	$0
Activity Total(s)				**7**	**3**	**$10,816**	**4**	**2**	**$4,708**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**$15,524**
Moderate Priority Removals	<14"	$200	$318			$0			$0			$0			$0			$0	$0
	15-24"	$400	$636	12	4	$7,344	7	3	$4,708			$0			$0			$0	$12,052
	25-36"	$1,000	$1,272	67	23	$96,256	45	16	$65,352			$0			$0			$0	$161,608
	37-48"	$2,000	$2,544	23	7	$63,808	10	4	$30,176			$0			$0			$0	$93,984
	>49"	$2,500	$3,180	4	2	$16,360	4	1	$13,180			$0			$0			$0	$29,540
Activity Total(s)				**106**	**36**	**$183,768**	**66**	**24**	**$113,416**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**$297,184**
Low Priority Removals	<14"	$200	$318			$0			$0	37	13	$11,534	56	19	$17,242	33	11	$10,098	$38,874
	15-24"	$400	$636			$0			$0	56	19	$34,484	56	19	$34,484	49	16	$29,776	$98,744
	25-36"	$1,000	$1,272			$0			$0			$0			$0			$0	$0
	37-48"	$2,000	$2,544			$0			$0	10	4	$30,176	10	4	$30,176	4	2	$13,088	$73,440
	>49"	$2,500	$3,180			$0			$0	4	2	$16,360			$0			$0	$16,360
Activity Total(s)				**0**	**0**	**$0**	**0**	**0**	**$0**	**107**	**38**	**$92,554**	**122**	**42**	**$81,902**	**86**	**29**	**$52,962**	**$227,418**
Stump Removals	Any	$315	$350	151	51	$65,415	109	37	$47,285	146	49	$63,140	161	53	$69,265	119	39	$51,135	$296,240
Activity Total(s)				**151**	**51**	**$65,415**	**109**	**37**	**$47,285**	**146**	**49**	**$63,140**	**161**	**53**	**$69,265**	**119**	**39**	**$51,135**	**$296,240**
High Priority Pruning	Any	$220	$250	15	5	$4,550	13	5	$4,110			$0			$0			$0	$8,660
Activity Total(s)				**15**	**5**	**$4,550**	**13**	**5**	**$4,110**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**$8,660**
Moderate Priority Pruning	Any	$220	$250	375	125	$113,750	375	125	$113,750	192	63	$57,990			$0			$0	$285,490
Activity Total(s)				**375**	**125**	**$113,750**	**375**	**125**	**$113,750**	**192**	**63**	**$57,990**	**0**		**$0**	**0**		**$0**	**$285,490**
Routine Inspection	Drive-by Assessment	$1		10,427		$10,427	10,427		$10,427	10,427		$10,427	10,427		$10,427	10,427		$10,427	$52,135
	Walk-by Assessment	$5		2,086		$10,430	2,085		$10,425	2,086		$10,430	2,085		$10,425	2,085		$10,425	$52,135
Activity Total(s)				**12,513**	**0**	**$10,430**	**12,512**	**0**	**$10,425**	**12,512**	**0**	**$10,430**	**12,512**		**$10,425**	**12,512**		**$10,425**	**$52,135**
Young Tree Training (3-year Cycle)	1-3"	$75	$250	240	80	$38,000	465	155	$73,625	456	151	$71,950	612	204	$96,900	612	203	$96,650	$377,125
	4-6"	$75	$250	187	63	$29,775	187	63	$29,775	43	14	$6,725	187	63	$29,775	187	63	$29,775	$125,825
	6"<	$75	$250	56	19	$8,950	51	17	$8,075			$0	56	19	$8,950	56	19	$8,950	$34,925
Activity Total(s)				**483**	**162**	**$76,725**	**703**	**235**	**$111,475**	**499**	**165**	**$78,675**	**855**	**286**	**$135,625**	**855**	**285**	**$135,375**	**$537,875**
Routine Pruning (5-year Cycle)	Any	$220	$250	904	302	$274,380	904	301	$274,130	904	301	$274,130	904	301	$274,130	904	301	$274,130	$1,370,900
Activity Total(s)				**904**	**302**	**$274,380**	**904**	**301**	**$274,130**	**904**	**301**	**$274,130**	**904**	**301**	**$274,130**	**904**	**301**	**$274,130**	**$1,370,900**
Planting Tree		$275	$495	225	75	$99,000	225	75	$99,000	225	75	$99,000	225	75	$99,000	225	75	$99,000	$495,000
Activity Total(s)				**225**	**75**	**$99,000**	**225**	**75**	**$99,000**	**225**	**75**	**$99,000**	**225**	**75**	**$99,000**	**225**	**75**	**$99,000**	$495,000
Natural Mortality (1%)	Tree Removal	$1,000	$1,272	78	26	$111,072	78	26	$78,000	78	26	$111,072	78	26	$111,072	78	26	$111,072	$522,288
	Stump Removal	$315	$350	78	26	$24,570	78	26	$24,570	78	26	$24,570	78	26	$24,570	78	26	$24,570	$122,850
	Replacement Tree	$275	$495	78	26	$21,450	78	26	$21,450	78	26	$21,450	78	26	$21,450	78	26	$21,450	$107,250
Activity Total(s)				**234**	**78**	**$157,092**	**234**	**78**	**$124,020**	**234**	**78**	**$157,092**	**234**	**78**	**$157,092**	**234**	**78**	**$157,092**	**$752,388**
Activity Grand Total					**15,850**			**16,027**			**15,588**			**15,848**			**15,742**		**0**
Cost Grand Total						**$995,926**			**$902,319**			**$833,011**			**$827,439**			**$780,119**	**$4,338,814**

One Half Contractor Work, One Half Done In-house

Activity Cost				Year 1			Year 2			Year 3			Year 4			Year 5			Five-Year Cost
Activity	Diameter	Cost/Tree In-house	Cost/Tree Contractors	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	
High Priority Removals	<14"	$200	$318			$0			$0			$0			$0			$0	$0
	15-24"	$400	$636			$0	2	1	$1,436			$0			$0			$0	$1,436
	25-36"	$1,000	$1,272	5	5	$11,360	2	1	$3,272			$0			$0			$0	$14,632
	37-48"	$2,000	$2,544			$0			$0			$0			$0			$0	$0
	>49"	$2,500	$3,180			$0			$0			$0			$0			$0	$0
Activity Total(s)				**5**	**5**	**$11,360**	**4**	**2**	**$4,708**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**$16,068**
Moderate Priority Removals	<14"	$200	$318			$0			$0			$0			$0			$0	$0
	15-24"	$400	$636	8	8	$8,288	5	5	$5,180			$0			$0			$0	$13,468
	25-36"	$1,000	$1,272	45	45	$102,240	31	30	$69,160			$0			$0			$0	$171,400
	37-48"	$2,000	$2,544	15	15	$68,160	7	7	$31,808			$0			$0			$0	$99,968
	>49"	$2,500	$3,180	3	3	$17,040	3	2	$13,860			$0			$0			$0	$30,900
Activity Total(s)				**71**	**71**	**$195,728**	**46**	**44**	**$120,008**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**$315,736**
Low Priority Removals	<14"	$200	$318			$0			$0	25	25	$12,950	38	37	$19,366	22	22	$11,396	$43,712
	15-24"	$400	$636			$0			$0	38	37	$38,732	38	37	$38,732	33	32	$33,552	$111,016
	25-36"	$1,000	$1,272			$0			$0			$0			$0			$0	$0
	37-48"	$2,000	$2,544			$0			$0	7	7	$31,808	7	7	$31,808	3	3	$13,632	$77,248
	>49"	$2,500	$3,180			$0			$0	3	3	$17,040			$0			$0	$17,040
Activity Total(s)				**0**	**0**	**$0**	**0**	**0**	**$0**	**73**	**72**	**$100,530**	**83**	**81**	**$89,906**	**58**	**57**	**$58,580**	**$249,016**
Stump Removals	Any	$300	$350	101	101	$65,650	73	73	$47,450	98	97	$63,350	107	107	$69,550	79	79	$51,350	$297,350
Activity Total(s)				**101**	**101**	**$65,650**	**73**	**73**	**$47,450**	**98**	**97**	**$63,350**	**107**	**107**	**$69,550**	**79**	**79**	**$51,350**	**$297,350**
High Priority Pruning	Any	$220	$250	10	10	$4,700	9	9	$4,230			$0			$0			$0	$8,930
Activity Total(s)				**10**	**10**	**$4,700**	**9**	**9**	**$4,230**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**$8,930**
Moderate Priority Pruning	Any	$220	$250	250	250	$117,500	250	250	$117,500	128	127	$59,910			$0			$0	$294,910
Activity Total(s)				**250**	**250**	**$117,500**	**250**	**250**	**$117,500**	**128**	**127**	**$59,910**	**0**	**0**	**$0**	**0**	**0**	**$0**	**$294,910**
Routine Inspection	Drive-by Assessment	$1		10,427		$10,427	10,427		$10,427	10,427		$10,427	10,427		$10,427	10,427		$10,427	$52,135
	Walk-by Assessment	$5		2,086		$10,430	2,086		$10,430	2,085		$10,425	2,085		$10,425	2,085		$10,425	$52,135
Activity Total(s)				**12,513**		**$10,430**	**12,513**		**$10,430**	**12,512**		**$10,425**	**12,512**		**$10,425**	**12,512**		**$10,425**	**$52,135**
Young Tree Training (3-year Cycle)	1-3"	$75	$250	160	160	$52,000	320	320	$104,000	450	450	$146,250	600	600	$195,000	700	700	$227,500	$724,750
	4-6"	$75	$250	125	125	$40,625	125	125	$40,625	29	28	$9,175	125	125	$40,625	200	200	$65,000	$196,050
	6"<	$75	$250	38	37	$12,100	34	34	$11,050			$0	38	37	$12,100	38	37	$12,100	$47,350
Activity Total(s)				**323**	**322**	**$104,725**	**479**	**479**	**$155,675**	**479**	**478**	**$155,425**	**763**	**762**	**$247,725**	**938**	**937**	**$304,600**	**$968,150**
Routine Pruning (5-year Cycle)	Any	$235	$250	603	603	$292,455	603	602	$292,205	603	602	$292,205	603	602	$292,205	603	602	$292,205	$1,461,275
Activity Total(s)				**603**	**603**	**$292,455**	**603**	**602**	**$292,205**	**603**	**602**	**$292,205**	**603**	**602**	**$292,205**	**603**	**602**	**$292,205**	**$1,461,275**
Planting Tree		$275	$495	150	150	$115,500	150	150	$115,500	150	150	$115,500	150	150	$115,500	150	150	$115,500	$577,500
Activity Total(s)				**150**	**150**	**$115,500**	**150**	**150**	**$115,500**	**150**	**150**	**$115,500**	**150**	**150**	**$115,500**	**150**	**150**	**$115,500**	**$577,500**
Natural Mortality (1%)	Tree Removal	$1,000	$1,272	52	52	$118,144	52	52	$118,144	52	52	$118,144	52	52	$118,144	52	52	$118,144	$590,720
	Stump Removal	$315	$350	52	52	$16,380	52	52	$16,380	52	52	$16,380	52	52	$16,380	52	52	$16,380	$81,900
	Replacement Tree	$275	$495	52	52	$14,300	52	52	$14,300	52	52	$14,300	52	52	$14,300	52	52	$14,300	$71,500
Activity Total(s)				**156**	**156**	**$148,824**	**156**	**156**	**$148,824**	**156**	**156**	**$148,824**	**156**	**156**	**$148,824**	**156**	**156**	**$148,824**	**$744,120**
Activity Grand Total					**15,850**			**16,048**			**15,881**			**16,232**			**16,477**		**0**
Cost Grand Total						**$1,066,872**			**$1,016,530**			**$946,169**			**$974,135**			**$981,484**	**$4,985,190**

Three Quarters Contractor Work, One Quarter Done In-house

Activity Cost				Year 1			Year 2			Year 3			Year 4			Year 5			Five-Year Cost
Activity	Diameter	Cost/Tree In-house	Cost/Tree Contractors	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	Count for in-house	Count for contractors	Cost	
High Priority Removals	<14"	$200	$318			$0			$0			$0			$0			$0	$0
	15-24"	$400	$636			$0	1	2	$1,672			$0			$0			$0	$1,672
	25-36"	$1,000	$1,272	3	7	$11,904	1	2	$3,544			$0			$0			$0	$15,448
	37-48"	$2,000	$2,544			$0			$0			$0			$0			$0	$0
	>49"	$2,500	$3,180			$0			$0			$0			$0			$0	$0
Activity Total(s)				**3**	**7**	**$11,904**	**2**	**4**	**$5,216**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**$17,120**
Moderate Priority Removals	<14"	$200	$318			$0			$0			$0			$0			$0	$0
	15-24"	$400	$636	4	12	$9,232	3	7	$5,652			$0			$0			$0	$14,884
	25-36"	$1,000	$1,272	23	67	$108,224	16	45	$73,240			$0			$0			$0	$181,464
	37-48"	$2,000	$2,544	7	23	$72,512	4	10	$33,440			$0			$0			$0	$105,952
	>49"	$2,500	$3,180	2	4	$17,720	1	4	$15,220			$0			$0			$0	$32,940
Activity Total(s)				**36**	**106**	**$207,688**	**24**	**66**	**$127,552**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**$335,240**
Low Priority Removals	<14"	$200	$318			$0			$0	13	37	$14,366	19	56	$21,608	11	33	$12,694	$48,668
	15-24"	$400	$636			$0			$0	19	56	$43,216	19	56	$43,216	16	49	$37,564	$123,996
	25-36"	$1,000	$1,272			$0			$0			$0			$0			$0	$0
	37-48"	$2,000	$2,544			$0			$0	4	10	$33,440	4	10	$33,440	2	4	$14,176	$81,056
	>49"	$2,500	$3,180			$0			$0	2	4	$17,720			$0			$0	$17,720
Activity Total(s)				**0**	**0**	**$0**	**0**	**0**	**$0**	**38**	**107**	**$108,742**	**42**	**122**	**$98,264**	**29**	**86**	**$64,434**	**$271,440**
Stump Removals	Any	$300	$350	13	37	$16,850	13	37	$16,850	13	37	$16,850	13	37	$16,850	11	32	$14,500	$81,900
Activity Total(s)				**13**	**37**	**$16,850**	**13**	**37**	**$16,850**	**13**	**37**	**$16,850**	**13**	**37**	**$16,850**	**11**	**32**	**$14,500**	**$81,900**
High Priority Pruning	Any	$220	$250	5	15	$4,850	5	13	$4,350			$0			$0			$0	$9,200
Activity Total(s)				**5**	**15**	**$4,850**	**5**	**13**	**$4,350**	**0**	**0**	**$0**	**0**	**0**	**$0**	**0**	**0**	**$0**	**$9,200**
Moderate Priority Pruning	Any	$220	$250	125	375	$121,250	125	375	$121,250	192	63	$57,990			$0			$0	$300,490
Activity Total(s)				**125**	**375**	**$121,250**	**125**	**375**	**$121,250**	**192**	**63**	**$57,990**	**0**		**$0**	**0**		**$0**	**$300,490**
Routine Inspection	Drive-by Assessment	$1		10,427		$10,427	10,427		$10,427	10,427		$10,427	10,427		$10,427	10,427		$10,427	$52,135
	Walk-by Assessment	$5		2,086		$10,430	2,086		$10,430	2,085		$10,425	2,085		$10,425	2,085		$10,425	$52,135
Activity Total(s)				**12,513**	**0**	**$10,430**	**12,513**	**0**	**$10,430**	**12,512**	**0**	**$10,425**	**12,512**	**0**	**$10,425**	**12,512**	**0**	**$10,425**	**$52,135**
Young Tree Training (3-year Cycle)	1-3"	$75	$250	80	240	$66,000	155	465	$127,875	151	456	$125,325	204	612	$168,300	203	612	$168,225	$655,725
	4-6"	$75	$250	63	187	$51,475	63	187	$51,475	14	43	$11,800	63	187	$51,475	63	187	$51,475	$217,700
	6"<	$75	$250	19	56	$15,425	17	51	$14,025			$0	19	56	$15,425	19	56	$15,425	$60,300
Activity Total(s)				**162**	**483**	**$132,900**	**235**	**703**	**$193,375**	**165**	**499**	**$137,125**	**286**	**855**	**$235,200**	**285**	**855**	**$235,125**	**$933,725**
Routine Pruning (5-year Cycle)	Any	$235	$250	302	904	$296,970	301	904	$296,735	301	904	$296,735	301	904	$296,735	301	904	$296,735	$1,483,910
Activity Total(s)				**302**	**904**	**$296,970**	**301**	**904**	**$296,735**	**301**	**904**	**$296,735**	**301**	**904**	**$296,735**	**301**	**904**	**$296,735**	**$1,483,910**
Planting Tree		$275	$495	75	225	$132,000	75	225	$132,000	75	225	$132,000	75	225	$132,000	75	225	$132,000	$660,000
Activity Total(s)				**75**	**225**	**$132,000**	**75**	**225**	**$132,000**	**75**	**225**	**$132,000**	**75**	**225**	**$132,000**	**75**	**225**	**$132,000**	**$660,000**
Natural Mortality (1%)	Tree Removal	$1,000	$1,272	26	78	$125,216	26	78	$26,000	26	78	$125,216	26	78	$125,216	26	78	$125,216	$526,864
	Stump Removal	$315	$350	26	78	$8,190	26	78	$8,190	26	78	$8,190	26	78	$8,190	26	78	$8,190	$40,950
	Replacement Tree	$275	$495	26	78	$7,150	26	78	$7,150	26	78	$7,150	26	78	$7,150	26	78	$7,150	$35,750
Activity Total(s)				**78**	**234**	**$140,556**	**78**	**234**	**$41,340**	**78**	**234**	**$140,556**	**78**	**234**	**$140,556**	**78**	**234**	**$140,556**	**$603,564**
Activity Grand Total					**15,698**			**15,932**			**15,443**			**15,684**			**15,627**		**78,384**
Cost Grand Total						**$1,075,398**			**$949,098**			**$900,423**			**$930,030**			**$893,775**	**$4,748,724**

All Contractor Work, None Done In-house

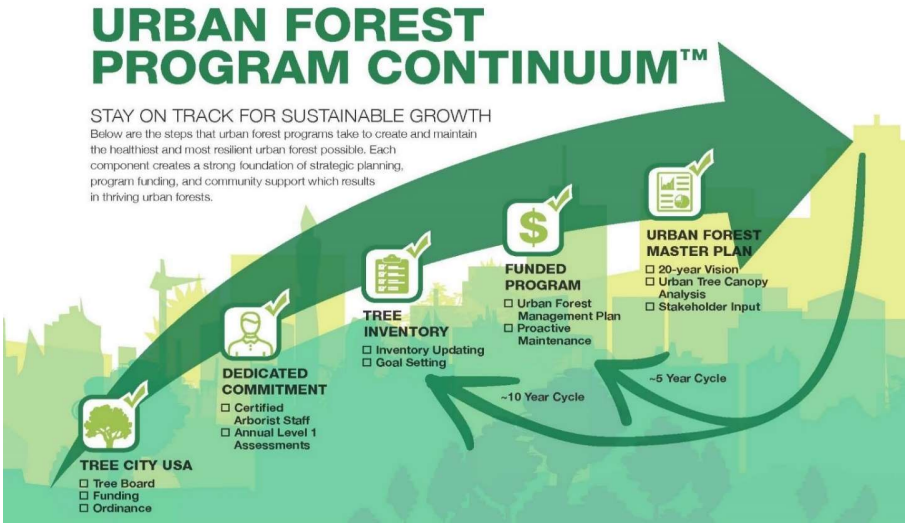
Activity Cost														Five-Year Cost
Activity	Diameter	Cost/Tree In-house	Cost/Tree Contractors	Count for contractors	Cost	Count for contractors	Cost	Count for contractors	Cost	Count for contractors	Cost	Count for contractors	Cost	
High Priority Removals	<14"	$200	$318		$0		$0		$0		$0		$0	$0
	15-24"	$400	$636		$0	3	$1,200		$0		$0		$0	$1,200
	25-36"	$1,000	$1,272	10	$10,000	3	$3,000		$0		$0		$0	$13,000
	37-48"	$2,000	$2,544		$0		$0		$0		$0		$0	$0
	>49"	$2,500	$3,180		$0		$0		$0		$0		$0	$0
Activity Total(s)				**10**	**$10,000**	**6**	**$4,200**		**$0**		**$0**		**$0**	**$14,200**
Moderate Priority Removals	<14"	$200	$318		$0		$0		$0		$0		$0	$0
	15-24"	$400	$636	16	$6,400	10	$4,000		$0		$0		$0	$10,400
	25-36"	$1,000	$1,272	90	$90,000	61	$61,000		$0		$0		$0	$151,000
	37-48"	$2,000	$2,544	30	$60,000	14	$28,000		$0		$0		$0	$88,000
	>49"	$2,500	$3,180	6	$15,000	5	$12,500		$0		$0		$0	$27,500
Activity Total(s)				**142**	**$171,400**	**90**	**$105,500**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$276,900**
Low Priority Removals	<14"	$200	$318		$0		$0	50	$10,000	75	$15,000	44	$13,992	$38,992
	15-24"	$400	$636		$0		$0	75	$30,000	75	$30,000	65	$41,340	$101,340
	25-36"	$1,000	$1,272		$0		$0		$0		$0		$0	$0
	37-48"	$2,000	$2,544		$0		$0	14	$28,000	14	$28,000	6	$15,264	$71,264
	>49"	$2,500	$3,180		$0		$0	6	$15,000		$0		$0	$15,000
Activity Total(s)				**0**	**$0**	**0**	**$0**	**145**	**$83,000**	**164**	**$73,000**	**115**	**$70,596**	**$226,596**
Stump Removals	Any	$300	$350	202	$60,600	146	$43,800	195	$58,500	214	$64,200	158	$55,300	$282,400
Activity Total(s)				**202**	**$60,600**	**146**	**$43,800**	**195**	**$58,500**	**214**	**$64,200**	**158**	**$55,300**	**$282,400**
High Priority Pruning	Any	$220	$250	20	$4,400	18	$3,960		$0		$0		$0	$8,360
Activity Total(s)				**20**	**$4,400**	**18**	**$3,960**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$8,360**
Moderate Priority Pruning	Any	$220	$250	500	$110,000	500	$110,000	255	$56,100		$0		$0	$276,100
Activity Total(s)				**500**	**$110,000**	**500**	**$110,000**	**255**	**$56,100**		**$0**		**$0**	**$276,100**
Routine Inspection	Drive-by Assessment	$1		10,427	$10,427	10,427	$10,427	10,427	$10,427	10,427	$10,427	10,427	$10,427	$52,135
	Walk-by Assessment	$5		2,086	$10,430	2,086	$10,430	2,085	$10,425	2,085	$10,425	2,085	$10,425	$52,135
Activity Total(s)				**12,513**	**$10,430**	**12,513**	**$10,430**	**12,512**	**$10,425**	**12,512**	**$10,425**	**12,512**	**$10,425**	**$52,135**
Young Tree Training (3-year Cycle)	1-3"	$75	$250	320	$80,000	620	$155,000	607	$151,750	816	$204,000	815	$203,750	$794,500
	4-6"	$75	$250	250	$62,500	250	$62,500	57	$14,250	250	$62,500	250	$62,500	$264,250
	6"<	$75	$250	75	$18,750	68	$17,000		$0	75	$18,750	75	$18,750	$73,250
Activity Total(s)				**645**	**$161,250**	**938**	**$234,500**	**664**	**$166,000**	**1,141**	**$285,250**	**1,140**	**$285,000**	**$1,132,000**
Routine Pruning (5-year Cycle)	Any	$235	$250	1,206	$301,500	1,205	$301,250	1,205	$301,250	1,205	$301,250	1,205	$301,250	$1,506,500
Activity Total(s)				**1,206**	**$301,500**	**1,205**	**$301,250**	**1,205**	**$301,250**	**1,205**	**$301,250**	**1,205**	**$301,250**	**$1,506,500**
Planting Tree		$275	$495	300	$148,500	300	$148,500	300	$148,500	300	$148,500	300	$148,500	$742,500
Activity Total(s)				**300**	**$148,500**	**300**	**$148,500**	**300**	**$148,500**	**300**	**$148,500**	**300**	**$148,500**	**$742,500**
Natural Mortality (1%)	Tree Removal	$1,000	$1,272	104	$132,288	104	$132,288	104	$132,288	104	$132,288	104	$132,288	$661,440
	Stump Removal	$315	$350	104	$36,400	104	$36,400	104	$36,400	104	$36,400	104	$36,400	$182,000
	Replacement Tree	$275	$495	104	$51,480	104	$51,480	104	$51,480	104	$51,480	104	$51,480	$257,400
Activity Total(s)				**312**	**$220,168**	**312**	**$220,168**	**312**	**$220,168**	**312**	**$220,168**	**312**	**$220,168**	**$1,100,840**
Activity Grand Total				**15,850**		**16,028**		**15,588**		**15,848**		**15,742**		**79,056**
Cost Grand Total					**$1,198,248**		**$1,182,308**		**$1,043,943**		**$1,102,793**		**$1,091,239**	**$5,618,531**

CONCLUSION

When properly maintained, the valuable benefits trees provide over their lifetime far exceed the time and money invested in planting, pruning, and inevitably removing them. The 10,427 public trees inventoried provide $69300 in estimated annual economic value, which is almost 24%/21% of the town's annual tree maintenance budget of $475,000 to $435,000. Successfully implementing the five-year program may increase Irondequoit's ROI over time, or at least maintain it over the years.

The program is ambitious and is a challenge to complete in five years but becomes easier after all high priority tree maintenance is completed. This *Community Forestry Management Plan* could potentially help the town advocate for an increased urban forestry budget to fund the recommended maintenance activities and growth of the Department of Public Work's Division of Forestry. Getting started is the most difficult part because of the expensive maintenance in the first year, which represents the transition from reactive maintenance to proactive maintenance. Significant investment early on can reduce tree maintenance costs over time.

As the urban forest grows, the benefits enjoyed by the Town of Irondequoit and its residents will increase as well. Inventoried trees are only a fraction of the total trees in Irondequoit when including private property, which is why it is important to also incentivize private landowners to care for their trees and to plant new ones. The town's urban forestry program is well on its way to creating a sustainable and resilient public tree resource, and can stay on track by setting goals, updating inventory data to check progress, and setting more ambitious goals once they are reached.



EVALUATING AND UPDATING THIS PLAN

This *Community Forestry Management Plan* provides management priorities for the next five years, and it is important to update the tree inventory using TreeKeeper® as work is completed, so the software can provide updated species distribution and benefit estimates. This empowers Irondequoit to self-assess the town's progress over time and set goals to strive toward by following the adaptive management cycle. Below are some ways of implementing the steps of this cycle:

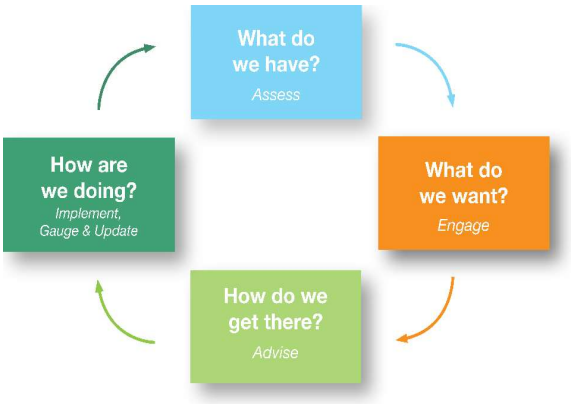


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Table 5. Goals, timeframe, and action items for Irondequoit's urban forestry program

Goal	Timeframe	Action Items
Complete priority tree maintenance tasks	1-3 years	• secure funding to remove or prune elevated risk trees
		• remove elevated risk trees recommended for removal
		• prune elevated risk trees recommended for pruning
Reduce risk associated with town trees	ongoing	• routinely inspect town trees for defects which may elevate risk
		• continue routine pruning program
		• train young trees to prevent structural problems which may elevate risk
Establish young tree training program	1–3 years	• secure or set aside necessary funding
		• hire contractors or train staff on structural pruning techniques
		• divide town into thirds and prune young trees in 1/3 of town each year
Update tree inventory	ongoing	• edit inventoried trees as work is completed
		• add new trees as they are planted
		• remove or edit trees to stumps or vacant sites as they are removed
		• remove or edit stumps to vacant sites as they are removed
		• plan to conduct a full re-inventory within the next 5-10 years

Goal	Timeframe	Action Items
Establish planting program	1–3 years	• apply for planting grants
		• secure or set aside necessary funding
		• identify high priority locations for planting
		• identify suitable planting sites in high priority locations
		• hire contractors or train staff on tree planting
		• coordinate with volunteer groups to provide watering services during tree establishment
		• set goals for annual planting (i.e., replace removed trees, x trees annually, x trees by set date, etc.)
Continue Arbor Day celebrations	ongoing	• coordinate between departments
		• provide public education on tree planting, care, and benefits
		• source seedlings to hand out to citizens
		• plant trees on town properties
Educate citizens about trees	ongoing	• provide free presentations or classes during Arbor Day celebrations
		• post urban forestry updates to town websites
		• provide approved tree planting lists and do-not-plant lists
Reduce conflicts with utilities and infrastructure	ongoing	• plant only small stature trees (15–30 feet tall at maturity) below utility lines
		• plant medium stature trees (30–40 feet tall at maturity) at least 20 feet from utility lines
		• plant large stature trees (40+ feet fall at maturity) at least 40 feet from utility lines
		• routinely prune town trees to minimize conflicts with utilities, signs, and buildings
		• locate trees to avoid blocking important road signage
		• plant trees at least:
		• 5 feet from underground utilities
		• 10 feet from driveways
		• 15 feet from utility poles
		• 15 feet from buildings
		• 20 feet from stop signs
		• 20 feet from fire hydrants
		• 30 feet from intersections

Goal	Timeframe	Action Items
Improve tree cover in cemetery and on public properties	ongoing	• identify cemetery and public properties with greatest occupancy rates and greatest need of trees
		• identify suitable planting sites in these high priority areas
		• select tree species well suited to site conditions
		• install trees using best practices
		• maintain young trees on a regular basis
Compensate for ash decline due to emerald ash borer	ongoing	• remove dead and dying ash trees on public property which pose a hazard
		• continue to treat high-value ash trees on public property to prevent EAB
		• identify additional high-value ash trees to treat
		• replant with non-host species
Increase tree species and genus diversity	ongoing	• routinely analyze species and genus composition of the urban forest
		• identify species and genera which are overabundant
		• update approved planting list and do not plant list to correspond to species and genus data
		• plant a greater variety of tree species and genera
Prepare for future invasive species threats	1–3 years	• draft an invasive species management plan
		• identify likely areas for invasive species establishment
		• routinely monitor high-priority areas to identify new invasions early
		• manage new invasive species in ways which are cost-efficient, environmentally sound, and socially acceptable
		• routinely check with organizations like the United States Department of Agriculture (USDA) and the western New York Partnership for Regional Invasive Species Management (WNY PRISM) for updates on invasive species in your area
Select "Right Tree for the Right Place"	ongoing	• analyze site conditions before planting and select trees well suited to the site
		• select trees which will not outgrow available space at maturity
		• create and maintain approved planting lists and do not plant lists based on species and genera prevalence and presence of invasive threats
Create an approved tree species planting list	1–3 years	• modify DRG provided potential planting list using town information
		• distribute list on town websites
		• use list to guide tree planting decisions

Goal	Timeframe	Action Items
Create and enforce a do not plant list	1–3 years	• identify tree species and genera which are overabundant in town
		• identify tree species which are susceptible to current or future invasive species threats
		• identify tree species which are known to be invasive in the area
		• create a list of these undesirable species
		• distribute list on town websites
		• use list to guide tree planting decisions
		• update list as needed when species and genus distribution shift or as new information on invasive species is available

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APPENDIX A
DATA COLLECTION AND SITE LOCATION METHODS

DATA COLLECTION METHODS

DRG collects tree inventory data using their proprietary GIS software, called Rover, loaded onto pen-based field computers. At each site, the following data fields were collected:

- Address
- Comments
- Condition
- Date of Inventory
- Maintenance Recommendation
- Multi-stem Tree
- Notes
- Relative Location
- Size*
- Species and Identification Confidence Level
- Utility Interference
- X and Y Coordinates

* measured in inches in diameter at 4.5 feet above ground or diameter at breast height (DBH]).

The knowledge, experience, and professional judgment of DRG's arborists ensure the high quality of inventory data.

SITE LOCATION METHODS

Equipment and Base Maps

Inventory arborists use FZ-G1 Panasonic Toughpad® units with internal GPS receivers. Geographic information system (GIS) map layers are loaded onto these units to help locate sites during the inventory. This table lists these base map layers, along with each layer's source and format information.

Data Source	Data Year	Projection
Shapefile Big Rapids, MI Information Technology Department	2019-2020	NAD 1983 State Plane Michigan South, FT
Aerial Imagery Big Rapids, MI Information Technology Department	2014	NAD 1983 State Plane Michigan South, FT

STREET ROW SITE LOCATION

Individual street ROW sites were located using a methodology that identifies sites by *address number*, *street name*, *side*, and *on street*. This methodology was used to help ensure consistent assignment of location.

Address Number and Street Name

Where there was no GIS parcel addressing data available for sites located adjacent to a vacant lot, or adjacent to an occupied lot without a posted address number, the arborist used their best judgment to assign an address number based on nearby addresses. An "X" was then added to the number in the database to indicate that it was assigned, for example, "37X Choice Avenue."

Sites in medians were assigned an address number by the arborist in Rover using parcel and streets geographical data. Each segment was numbered with an assigned address that was interpolated from addresses facing that median and addressed on that same street as the median. If there were multiple medians between cross streets, each segment was assigned its own address. The *street name* assigned to a site was determined by street centerline information.

Side Value

Each site was assigned a *side value*, including *front*, *side*, *median*, or *rear* based on the site's location in relation to the lot's street frontage. The *front* is the side facing the address street. *Side* is either side of the lot that is between the front and rear. *Median* indicates a median or island surrounded by pavement. The *rear* is the side of the lot opposite of the address street.

CEMETERY AND PUBLIC SPACE SITE LOCATION

Cemetery and/or public space site locations were collected using the same methodology as street ROW sites, however nearly all of them have the "Assigned Address" field set to 'X' and have the "Cemetery Name" data field filled.

Site Location Example

Corner Lot A

Address/Street Name:	205 Hoover St.
Side:	Side
On Street:	Taft St.
Address/Street Name:	205 Hoover St.
Side:	Side
On Street:	Taft St.
Address/Street Name:	205 Hoover St.
Side:	Side
On Street:	Taft St.
Address/Street Name:	205 Hoover St.
Side:	Front
On Street:	Hoover St.

Corner Lot B

Address/Street Name:	226 E Mac Arthur St.
Side:	Side
On Street:	Davis St.
Address/Street Name:	226 E Mac Arthur St.
Side:	Front
On Street:	E Mac Arthur St.
Address/Street Name:	226 E Mac Arthur St.
Side:	Front
On Street:	E Mac Arthur St.

APPENDIX B
INVASIVE PESTS AND DISEASES

In today's worldwide marketplace, the volume of international trade brings increased potential for pests and diseases to invade our country. Many of these pests and diseases have seriously harmed rural and urban landscapes and have caused billions of dollars in lost revenue and millions of dollars in cleanup costs. Keeping these pests and diseases out of the country is the number one priority of the USDA's Animal and Plant Inspection Service (APHIS).

Updated pest range maps can be found at: https://www.nrs.fs.fed.us/tools/afpe/maps/ and updated pest information can be found at: https://www.aphis.usda.gov/aphis/resources/pests-diseases/hungry-pests/Pest-Tracker

Although some invasive species naturally enter the United States via wind, ocean currents, and other means, most invasive species enter the country with some help from human activities. Their introduction to the U.S. is a byproduct of cultivation, commerce, tourism, and travel. Many species enter the United States each year in baggage, cargo, contaminants of commodities, or mail.

Once they arrive, invasive pests grow and spread rapidly because controls, such as native predators, are lacking. Invasive pests disrupt the landscape by pushing out native species, reducing biological diversity, killing trees, altering wildfire intensity and frequency, and damaging crops. Some pests may even push species to extinction. The following sections include key pests and diseases that adversely affect trees in America at the time of this plan's development. This list is not comprehensive and may not include all threats.

It is critical to the management of community trees to routinely check APHIS, USDA Forest Service, and other websites for updates about invasive species and diseases in your area and in our country so that you can be prepared to combat their attack.

SPOTTED LANTERNFLY

The spotted lanternfly (SLF, *Lycorma delicatula*) is native to China and was first detected in Pennsylvania in September 2014. SLF feeds on a wide range of fruit, ornamental, and woody trees, with tree-of-heaven being one of its preferred hosts. SLF is a hitchhiker and can be spread long distances by people who move infested material or items containing egg masses.

If allowed to spread in the United States, this pest could seriously impact the country's grape, orchard, and logging industries. Be sure to inspect for the pest. Egg masses, juveniles, and adults can be on trees and plants, as well as on bricks, stone, metal, and other smooth surfaces. Also thoroughly check vehicles, trailers, and even the clothes you are wearing to prevent accidently moving SLF.

Symptoms of SLF are plants oozing or weeping with a fermented odor, buildup of a sticky fluid called honeydew on the plant or on the ground underneath them, and sooty mold growing on plants. The following trees are susceptible to SLF: almond, apple, apricot, cherry, maple, nectarine, oak, peach, pine, plum, poplar, sycamore, walnut, and willow, as well as grape vines and hop plants.

Pinned spotted lanternfly.

Photograph courtesy of PA Dept of Agriculture

Pinned spotted lanternfly nymph with wingspan open.

Photograph courtesy of USDA APHIS

EASTERN TENT CATERPILLAR

Eastern tent caterpillar (*Malacosoma americanum*) was first observed in the United States in 1646. In spring, caterpillars make nests in the forks and crotches of tree branches. Caterpillars do not feed within the nest; they leave the nest to feed up to 3 feet from nest and return to rest and take shelter in wet weather. Large infestations may occur at 8- to 10-year intervals. Egg masses overwinter on twigs. Trees are rarely killed by eastern tent caterpillar, but health is compromised that year and aesthetic value is decreased.

Easter tent caterpillar have a wide range of hosts, including apple (*Malus*) and cherry (*Prunus*.

Eastern tent caterpillar nest.

Photograph courtesy of Prairie Haven (2008)

ASIAN LONGHORNED BEETLE

The Asian longhorned beetle (ALB, *Anoplophora glabripennis*) is an exotic pest that threatens a wide variety of hardwood trees in North America. The beetle was introduced in Chicago, New Jersey, and New York Town, and is believed to have been introduced in the United States from wood pallets and other wood-packing material accompanying cargo shipments from Asia. ALB is a serious threat to America's hardwood tree species.

Adult Asian longhorned beetle.

Photograph courtesy of New Bedford Guide (2011)

Adults are large (3/4- to 1/2-inch long) with very long, black and white banded antennae. The body is glossy black with irregular white spots. Adults can be seen from late spring to fall depending on the climate. ALB has a long list of host species; however, the beetle prefers hardwoods, including several maple species. Examples include: box elder (*Acer negundo*); Norway maple (*A. platanoides*); red maple (*A. rubrum*); silver maple (*A. saccharinum*); sugar maple (*A. saccharum*); buckeye (*Aesculus glabra*); horsechestnut (*A. hippocastanum*); birch (*Betula);* London planetree (*Platanus × acerifolia*); willow (*Salix*); and elm (*Ulmus*).

EUROPEAN GYPSY MOTH

The gypsy moth (GM, *Lymantria dispar*) is native to Europe and first arrived in the United States in Massachusetts in 1869. This moth is a significant pest because its caterpillars have an appetite for more than 300 species of trees and shrubs. GM caterpillars defoliate trees, which makes the species vulnerable to diseases and other pests that can eventually kill the tree.

Close-up of male (darker brown) and female (whitish color) European gypsy moths.

Photograph courtesy of USDA APHIS (2019)

Male GMs are brown with a darker brown pattern on their wings and have a 1/2-inch wingspan. Females are slightly larger with a 2-inch wingspan and are nearly white with dark, saw-toothed patterns on their wings. Although they have wings, the female GM cannot fly.

The GMs prefer approximately 150 primary hosts but feed on more than 300 species of trees and shrubs. Some trees are found in these common genera: birch (*Betula*); cedar (*Juniperus*); larch (*Larix*); aspen, cottonwood, poplar (*Populus*); oak (*Quercus*); and willow (*Salix*).

THOUSAND CANKERS DISEASE

A complex disease referred to as Thousand cankers disease (TCD) was first observed in Colorado in 2008 and is now thought to have existed in Colorado as early as 2003. TCD is considered to be native to the United States and is attributed to numerous cankers developing in association with insect galleries.

Walnut twig beetle, side view.

Photograph courtesy of USDA Forest Service (2011)

TCD results from the combined activity of the *Geosmithia morbida* fungus and the walnut twig beetle (WTB, *Pityophthorus juglandis*). The WTB has expanded both its geographical and host range over the past two decades, and coupled with the *Geosmithia morbida* fungus, walnut (*Juglans*) mortality has manifested in Arizona, California, Colorado, Idaho, New Mexico, Oregon, Utah, and Washington. In July 2010, TCD was reported in Knoxville, Tennessee. The infestation is believed to be at least 10 years old and was previously attributed to drought stress. This is the first report east of the 100th meridian, raising concerns that large native populations of black walnut (*J. nigra* walnut) in the eastern United States may suffer severe decline and mortality.

The tree species preferred as hosts for TCD are walnut.

OAK WILT

Oak wilt was first identified in 1944 and is caused by the fungus *Ceratocystis fagacearum*. While considered an invasive and aggressive disease, its status as an exotic pest is debated since the fungus has not been reported in any other part of the world. This disease affects the oak genus and is most devastating to those in the red oak subgenus, such as scarlet oak (*Quercus coccinea*), shingle oak (*Q. imbricaria*), pin oak (*Q. palustris),* willow oak *(Q. phellos*), and red oak (*Q. rubra*). It also attacks trees in the white oak subgenus, although it is not as prevalent and spreads at a much slower pace in these trees.

Oak wilt symptoms on red and white oak leaves.

Photograph courtesy of USDA Forest Service (2011a)

Just as with DED, oak wilt disease is caused by a fungus that clogs the vascular system of oak and results in decline and death of the tree. The fungus is carried from tree to tree by several borers common to oak, but the disease is more commonly spread through root grafts. Oak species within the same subgenus (red or white) will form root colonies with grafted roots that allow the disease to move readily from one tree to another.

HEMLOCK WOOLY ADELGID

The hemlock woolly adelgid (HWA, *Adelges tsugae*) was first described in western North America in 1924 and first reported in the eastern United States in 1951 near Richmond, Virginia.

In their native range, populations of HWA cause little damage to the hemlock trees, as they feed on natural enemies and possible tree resistance has evolved with this insect. In eastern North America and in the absence of natural control elements, HWA attacks both eastern or Canadian hemlock (*Tsuga canadensis*) and Carolina hemlock (*T. caroliniana*), often damaging and killing them within a few years of becoming infested.

The HWA is now established from northeastern Georgia to southeastern Maine and as far west as eastern Kentucky and Tennessee.

Hemlock woolly adelgids on a branch.

Photograph courtesy of Connecticut Agricultural Experiment Station, Bugwood.org (2011)

EMERALD ASH BORER

Emerald ash borer *(EAB) (Agrilus planipennis*) is responsible for the death or decline of tens of millions of ash trees in 14 states in the American Midwest and Northeast. Native to Asia, EAB has been found in China, Japan, Korea, Mongolia, eastern Russia, and Taiwan. It likely arrived in the United States hidden in wood-packing materials commonly used to ship consumer goods, auto parts, and other products. The first official United States identification of EAB was in southeastern Michigan in 2002.

Adult beetles are slender and 1/2-inch long. Males are smaller than females. Color varies but adults are usually bronze or golden green overall with metallic, emerald-green wing covers. The top of the abdomen under the wings is metallic, purplish-red and can be seen when the wings are spread.

The EAB-preferred host tree species are in the genus *Fraxinus* (ash).

Close-up of an emerald ash borer.

Photograph courtesy of USDA APHIS (2020)

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APPENDIX C
i-TREE STREETS METHOLOGY

i-Tree Streets regionalizes the calculations of its output by incorporating detailed reference town project information for 16 climate zones across the United States. Big Rapids falls within the Midwest Climate Zone. Sample inventory data from Minneapolis represent the basis for the Midwest Reference Town Project for the Midwest Community Tree Guidelines. The basis for the benefit modeling in this study compares the inventory data from Big Rapids to the results of Midwest Reference Town Project to obtain an estimation of the annual benefits provided by Big Rapids' tree resource.

Growth rate modeling information was used to perform computer-simulated growth of the existing tree population for one year and account for the associated annual benefits. This "snapshot" analysis assumed that no trees were added to or removed from the existing population. Calculations of carbon dioxide (CO_2) released due to decompositions of wood from removed trees did consider average annual mortality. This approach directly connects benefits with tree-size variables such as diameter at breast height (DBH) and leaf-surface area. Many benefits of trees are related to processes that involve interactions between leaves and the atmosphere (e.g., interception, transpiration, photosynthesis); therefore, benefits increase as tree canopy cover and leaf surface area increase.

For each of the modeled benefits, an annual resource unit was determined on a per-tree basis. Resource units are measured as megawatt-hours of electriTown saved per tree; therms of natural gas conserved per tree, pounds of atmospheric CO_2 reduced per tree; pounds of nitrogen dioxide (NO_2), particulate matter (PM_{10}), and volatile organic compounds (VOCs) reduced per tree; cubic feet of stormwater runoff reduced per tree; and square feet of leaf area added per tree to increase property values.

Prices were assigned to each resource unit using economic indicators of society's willingness to pay for the environmental benefits trees provide. Estimates of benefits are initial approximations as some benefits are difficult to quantify (e.g., impacts on psychological health, crime, and violence). In addition, limited knowledge about the physical processes at work and their interactions make estimates imprecise (e.g., fate of air pollutants trapped by trees and then washed to the ground by rainfall). Therefore, this method of quantification provides first-order approximations. It is meant to be a general accounting of the benefits produced by urban trees—an accounting with an accepted degree of uncertainty that can, nonetheless, provide science-based platform for decision-making.

A detailed description of how the default benefit prices are derived, refer to the *Town of Minneapolis, Minnesota Municipal Tree Resource Analysis* (McPherson *et al.* 2005) and the *Midwest Community Tree Guide: Benefits, Costs, and Strategic Planning* (McPherson *et al.* 2009). i-Tree Streets' default values from the Midwest Climate Zone were used for air quality and stormwater benefit prices and local values were used for energy usage, aesthetics, and other benefits.

Benefit Prices Used by i-Tree Streets in the Analysis of Big Rapids' Tree Inventory

Benefits	Price	Unit	Source
ElectriTown	$0.00759	$/Kwh	Xcelenergy 2004
Natural Gas	$0.0098	$/Therm	Centerpoint Energy
CO_2	$0.0075	$/lb	US EPA 2003
PM_{10}	$2.84	$/lb	US EPA 2003
NO_2	$3.34	$/lb	US EPA 2003
O_3	$3.34	$/lb	US EPA 2003
SO_2	$2.06	$/lb	US EPA 2003
VOCs	$3.75	$/lb	Ottinger and others
Stormwater Interception	$0.0046	$/gallon	McPherson & Xiao
Aesthetic Value	$218,000	Average Midwest Housing Price	TreeKeeper®

Using these prices, the magnitude of the benefits provided by the public tree resource was calculated based on the science of i-Tree Streets using DRG's TreeKeeper® inventory management software. For a detailed description of how the magnitudes of benefit prices are calculated, refer to the *Midwest Community Tree Guide: Benefits, Costs, and Strategic Planning* (McPherson *et al.* 2009).

APPENDIX D
SUGGESTED TREE SPECIES

Proper landscaping and tree planting are critical components of the atmosphere, livability, and ecological quality of a community's urban forest. The tree species listed below have been evaluated for factors such as size, disease and pest resistance, seed or fruit set, and availability. The following list is offered to assist all relevant community personnel in selecting appropriate tree species. These trees have been selected because of their aesthetic and functional characteristics and their ability to thrive in the soil and climate conditions throughout Zone 6 on the USDA Plant Hardiness Zone Map.

DECIDUOUS TREES

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer rubrum	red maple	Red Sunset®
Acer saccharum	sugar maple	'Legacy'
*Aesculus flava**	yellow buckeye	
*Betula alleghaniensis**	yellow birch	
*Betula lenta**	sweet birch	
Betula nigra	river birch	Heritage®
Carpinus betulus	European hornbeam	'Franz Fontaine'
*Carya illinoensis**	pecan	
*Carya laciniata**	shellbark hickory	
*Carya ovata**	shagbark hickory	
*Castanea mollissima**	Chinese chestnut	
Celtis laevigata	sugar hackberry	
Celtis occidentalis	common hackberry	'Prairie Pride'
Cercidiphyllum japonicum	katsuratree	'Aureum'
*Diospyros virginiana**	common persimmon	
*Fagus grandifolia**	American beech	
*Fagus sylvatica**	European beech	(Numerous exist)
Ginkgo biloba	ginkgo	(Choose male trees only)
Gleditsia triacanthos inermis	thornless honeylocust	'Shademaster'
Gymnocladus dioica	Kentucky coffeetree	Prairie Titan®
*Juglans nigra**	black walnut	
*Larix decidua**	European larch	
Liquidambar styraciflua	American sweetgum	'Rotundiloba'
*Liriodendron tulipifera**	tuliptree	'Fastigiatum'
*Magnolia acuminata**	cucumbertree magnolia	(Numerous exist)
*Magnolia macrophylla**	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvatica	black tupelo	
*Platanus occidentalis**	American sycamore	
Platanus × acerifolia	London planetree	'Yarwood'
Quercus alba	white oak	

Large Trees: Greater than 45 Feet in Height at Maturity (Continued)

Scientific Name	Common Name	Cultivar
Quercus bicolor	swamp white oak	
Quercus coccinea	scarlet oak	
Quercus lyrata	overcup oak	
Quercus macrocarpa	bur oak	
Quercus montana	chestnut oak	
Quercus muehlenbergii	chinkapin oak	
Quercus palustris	pin oak	
Quercus imbricaria	shingle oak	
Quercus phellos	willow oak	
Quercus robur	English oak	Heritage®
Quercus rubra	northern red oak	'Splendens'
Quercus shumardii	Shumard oak	
Styphnolobium japonicum	Japanese pagodatree	'Regent'
Taxodium distichum	common baldcypress	'Shawnee Brave'
Tilia americana	American linden	'Redmond'
Tilia cordata	littleleaf linden	'Greenspire'
Tilia × euchlora	Crimean linden	
Tilia tomentosa	silver linden	'Sterling'
Ulmus parvifolia	Chinese elm	Allée®
Zelkova serrata	Japanese zelkova	'Green Vase'

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Aesculus × carnea	red horsechestnut	
Alnus cordata	Italian alder	
*Asimina triloba**	pawpaw	
Cladrastis kentukea	American yellowwood	'Rosea'
Corylus colurna	Turkish filbert	
Eucommia ulmoides	hardy rubber tree	
Koelreuteria paniculata	goldenraintree	
Ostrya virginiana	American hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Phellodendron amurense	amur corktree	'Macho'
Pistacia chinensis	Chinese pistache	
Prunus maackii	amur chokecherry	'Amber Beauty'
Prunus sargentii	Sargent cherry	
*Pterocarya fraxinifolia**	Caucasian wingnut	
Quercus acutissima	sawtooth oak	
Quercus cerris	European turkey oak	
*Sassafras albidum**	sassafras	

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer buergerianum	trident maple	Streetwise®
Acer campestre	hedge maple	Queen Elizabeth™
Acer cappadocicum	coliseum maple	'Aureum'
Acer ginnala	amur maple	Red Rhapsody™
Acer griseum	paperbark maple	
Acer nigrum	black maple	
*Acer pensylvanicum**	striped maple	
Acer triflorum	three-flower maple	
*Aesculus pavia**	red buckeye	
Amelanchier arborea	downy serviceberry	(Numerous exist)
Amelanchier laevis	Allegheny serviceberry	
*Carpinus caroliniana**	American hornbeam	
Cercis canadensis	eastern redbud	'Forest Pansy'
Chionanthus virginicus	white fringetree	
Cornus alternifolia	pagoda dogwood	
Cornus kousa	Kousa dogwood	(Numerous exist)
Cornus mas	corneliancherry dogwood	'Spring Sun'
Corylus avellana	European filbert	'Contorta'
*Cotinus coggygria**	common smoketree	'Flame'
*Cotinus obovata**	American smoketree	
*Crataegus phaenopyrum**	Washington hawthorn	Princeton Sentry™
Crataegus viridis	green hawthorn	'Winter King'
*Franklinia alatamaha**	Franklinia	
*Halesia tetraptera**	Carolina silverbell	'Arnold Pink'
Laburnum × watereri	goldenchain tree	
Maackia amurensis	amur maackia	
*Magnolia × soulangiana**	saucer magnolia	'Alexandrina'
*Magnolia stellata**	star magnolia	'Centennial'
*Magnolia tripetala**	umbrella magnolia	
*Magnolia virginiana**	sweetbay magnolia	Moonglow®
Malus spp.	flowering crabapple	(Disease resistant only)
Oxydendrum arboreum	sourwood	'Mt. Charm'
Prunus subhirtella	Higan cherry	'Pendula'
Prunus virginiana	common chokecherry	'Schubert'
*Staphylea trifolia**	American bladdernut	
Stewartia ovata	mountain stewartia	
*Styrax japonicus**	Japanese snowbell	'Emerald Pagoda'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

Note: * denotes species that are **not** recommended for use as street trees.

CONIFEROUS AND EVERGREEN TREES

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Abies balsamea	balsam fir	
Abies concolor	white fir	'Violacea'
Cedrus libani	cedar-of-Lebanon	
Chamaecyparis nootkatensis	Nootka falsecypress	'Pendula'
Cryptomeria japonica	Japanese cryptomeria	'Sekkan-sugi'
× *Cupressocyparis leylandii*	Leyland cypress	
Ilex opaca	American holly	
Picea omorika	Serbian spruce	
Picea orientalis	Oriental spruce	
Pinus densiflora	Japanese red pine	
Pinus strobus	eastern white pine	
Pinus sylvestris	Scotch pine	
Pinus taeda	loblolly pine	
Pinus virginiana	Virginia pine	
Psedotsuga menziesii	Douglas-fir	
Thuja plicata	western arborvitae	(Numerous exist)
Tsuga canadensis	eastern hemlock	

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Chamaecyparis thyoides	atlantic whitecedar	(Numerous exist)
Juniperus virginiana	eastern redcedar	
Pinus bungeana	lacebark pine	
Pinus flexilis	limber pine	
Pinus parviflora	Japanese white pine	
Thuja occidentalis	eastern arborvitae	(Numerous exist)

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Ilex × *attenuata*	Foster's holly	
Pinus aristata	bristlecone pine	
Pinus mugo mugo	mugo pine	

Dirr's Hardy Trees and Shrubs (Dirr 2013) and *Manual of Woody Landscape Plants (5th Edition)* (Dirr 1988) were consulted to compile this suggested species list. Cultivar selections are recommendations only and are based on DRG's experience. Tree availability will vary based on availability in the nursery trade.

Town of Irondequoit

Street Tree Inventory Map