

DAVEY Resource Group

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Tree Inventory Summary Report

Jersey City, NJ

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Acknowledgments

This project supports Jersey City's vision to promote and enhance community well-being through public tree conservation and improved forestry management practices. This *Tree Inventory Summary Report* offers expertise in preserving and expanding urban canopy so the environmental, economic, and social benefits it provides continue for generations.

Notice of Disclaimer

Inventory data provided by Davey Resource Group, Inc. "DRG" are based on visual recording at the time of inspection. Visual records do not include individual testing or analysis and do not include aerial or subterranean inspection. DRG is not responsible for the discovery or identification of hidden or otherwise non-observable hazards. Records may not remain accurate after inspection due to the variable deterioration of inventoried material. DRG provides no warranty with respect to the fitness of the urban forest for any use or purpose whatsoever. Clients may choose to accept or disregard DRG's recommendations, or to seek additional advice. Important: know and understand that visual inspection is confined to the designated subject tree(s) and that the inspections for this project are performed in the interest of facts of the tree(s) without prejudice to or for any other service or any interested party.

Executive Summary

The City of Jersey City (Jersey City) contracted Davey Resource Group (DRG) to conduct a comprehensive inventory and assessment of the trees, stumps, and planting sites located in the street rights-of-way (ROW) in Jersey City. Understanding an urban forest's structure, function, and value can promote management decisions that will improve the urban forest as well as human health and environmental quality. DRG collected and analyzed the inventory data to understand species composition and tree condition and to generate maintenance recommendations. Tree values and benefits have been quantified using the i-Tree Eco benefits model (developed by the United States Department of Agriculture Forest Service in partnership with The Davey Tree Expert Company). This report will discuss the health and benefits of the inventoried tree population throughout Jersey City.

Key Findings

- The appraised value of Jersey City's inventoried tree population is $30.6 million.
- The overall condition of the tree population is Fair.
- Most common species: P*latanus hybrida* (London planetree), 18%; *Pyrus calleryana* (callery pear),12%; *Prunus spp.* (cherry species), 11%; *Acer rubrum* (red maple), 9%; *Gleditsia triacanthos* (honey locust), 8%; and *Zelkova serrata* (Japanese zelkova), 5%.
- The majority (49%) of the urban forest is rated as Young, having a diameter of 0-8 inches.
- 37% of the population is recommended for a Routine Prune, 36% is recommended for a Young Tree Training Prune, 20% is recommended for Pruning, and 6% is recommended for removal.
- Jersey City's trees provide approximately $205,600 annually in the following environmental benefits:
    - *Air Quality*: valued at $149,000 per year.
    - *Carbon Sequestration*: 3 tons valued at $29,000 per year.
    - *Avoided runoff:* 44,034 gallons valued at $27,600 per year.

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A. Methodology

Section 1: Tree Inventory Assessment

Project Area

Between December 2020 and Spring 2023, DRG arborists assessed and inventoried trees, stumps, and planting sites along the street ROW in Jersey City. Additional information about the inventory can be found in Appendix A.

Species Diversity

Throughout Jersey City's ROW, 20,029 sites were inventoried, including 17,510 trees, 562 stumps, and 1,957 proposed planting sites. Figure 1 shows the composition of the most populous species compared to all inventoried species. The composition of a tree population should follow the 10-20-30 Rule for species diversity: a single species should represent no more than 10% of the urban forest, a single genus no more than 20%, and a single family no more than 30%. Currently, Jersey City has three species, P*latanus hybrida* (London planetree) comprising 18% of the inventoried population, *Pyrus calleryana* (callery pear), 12%, and *Prunus spp.* (cherry species), 11% that surpasses the 10% rule for species. Red maple (*Acer rubrum)* is approaching the 10% threshold at 9% of the inventoried population.

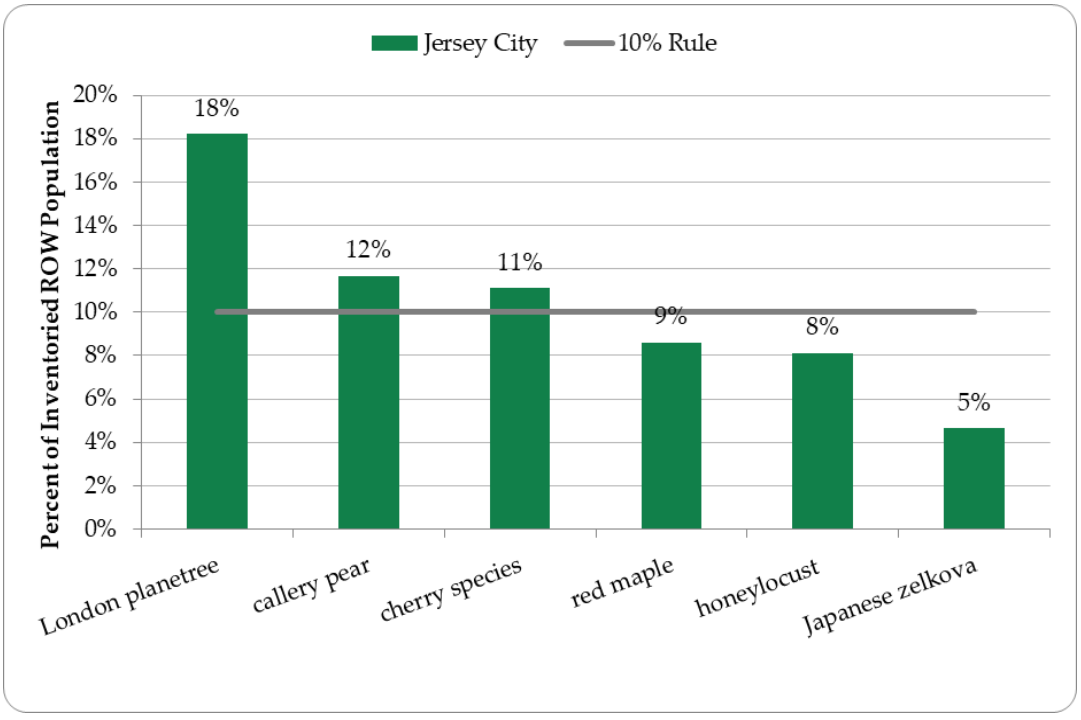


Figure 1. Tree species composition in Jersey City, NJ.

Figure 2 represents the top five most common genera identified during the inventory in comparison to the 20% Rule. No species exceed the 20% threshold, however, *Platanus hybrida* is approaching the 20% threshold at 19% of the inventoried population.

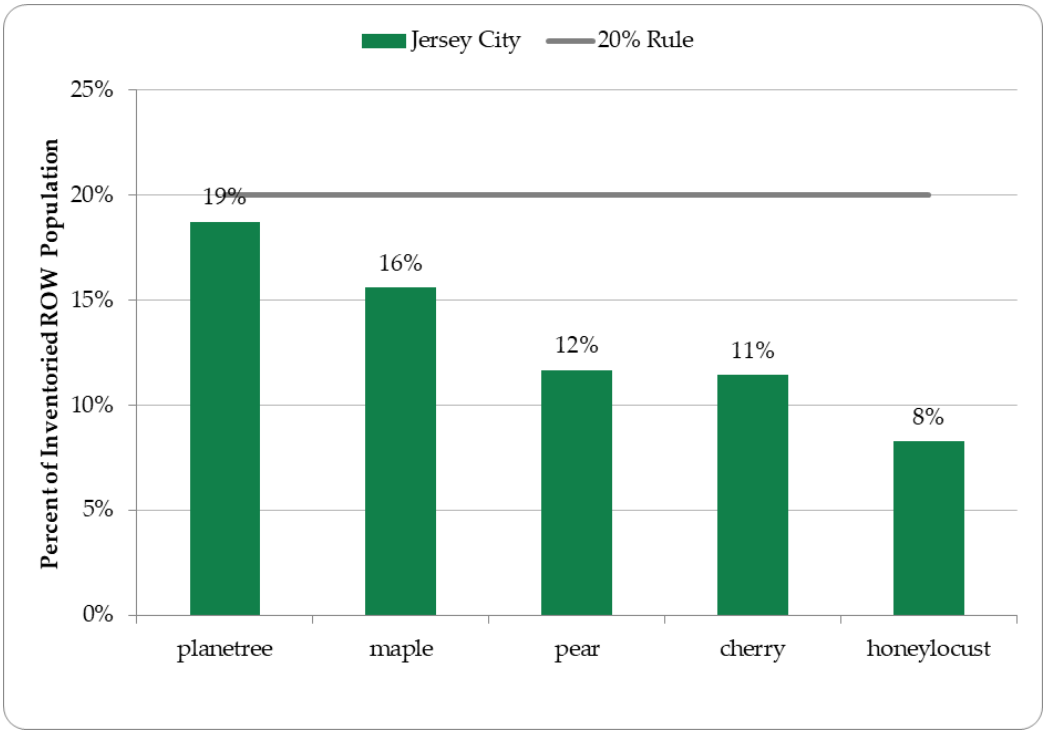


Figure 2. Top five genera in Jersey City, NJ in relation to the 20% Rule.

An urban forest with low species, genera, or family diversity is more likely to be damaged by pests, disease, weather, and climate disruptions due to the presence of large populations of susceptible trees. It is also likely to be less resilient, or less capable of recovering from such disturbances, since large portions of the urban forest may be eliminated or damaged by these disturbances. Cultivating and maintaining diversity on the species, genus, and family levels can help mitigate the effects of disturbances and ensure a thriving urban forest for generations to come.

Diameter Size Class Distribution

Analyzing the diameter size class distribution (measured as diameter at breast height [DBH]) provides an estimate of the relative age of a tree population and insight into maintenance practices and needs.

The inventoried trees were categorized into the following diameter size classes: young trees (0–8 inches DBH), established (9–17 inches DBH), maturing (18–24 inches DBH), and mature

trees (>24 inches DBH). These categories were chosen so that the population could be analyzed following Richards' ideal distribution (1983). Richards proposed an ideal diameter size class distribution for street trees based on observations of well-adapted trees in Syracuse, New York. Richards' ideal distribution suggests that the largest fraction of trees (approximately 40% of the population) should be young (<8 inches DBH) with a smaller fraction (approximately 10%) in the large-diameter size class (>24 inches DBH). A tree population with the ideal distribution would have an abundance of newly planted and young trees, with established, maturing, and mature trees present in lower numbers.

Figure 3 compares Jersey City's inventoried street ROW tree diameter size class distribution to the ideal proposed by Richards (1983). Jersey City's urban forest is trending toward the ideal with a large proportion of young and established trees, which will replace older trees as they approach senescence. Jersey City has a low proportion of Maturing trees, falling below the ideal distribution at 12%. Maintaining an uneven age distribution will allow Jersey City to allocate annual maintenance costs uniformly over many years and assure continuity in overall tree canopy coverage.

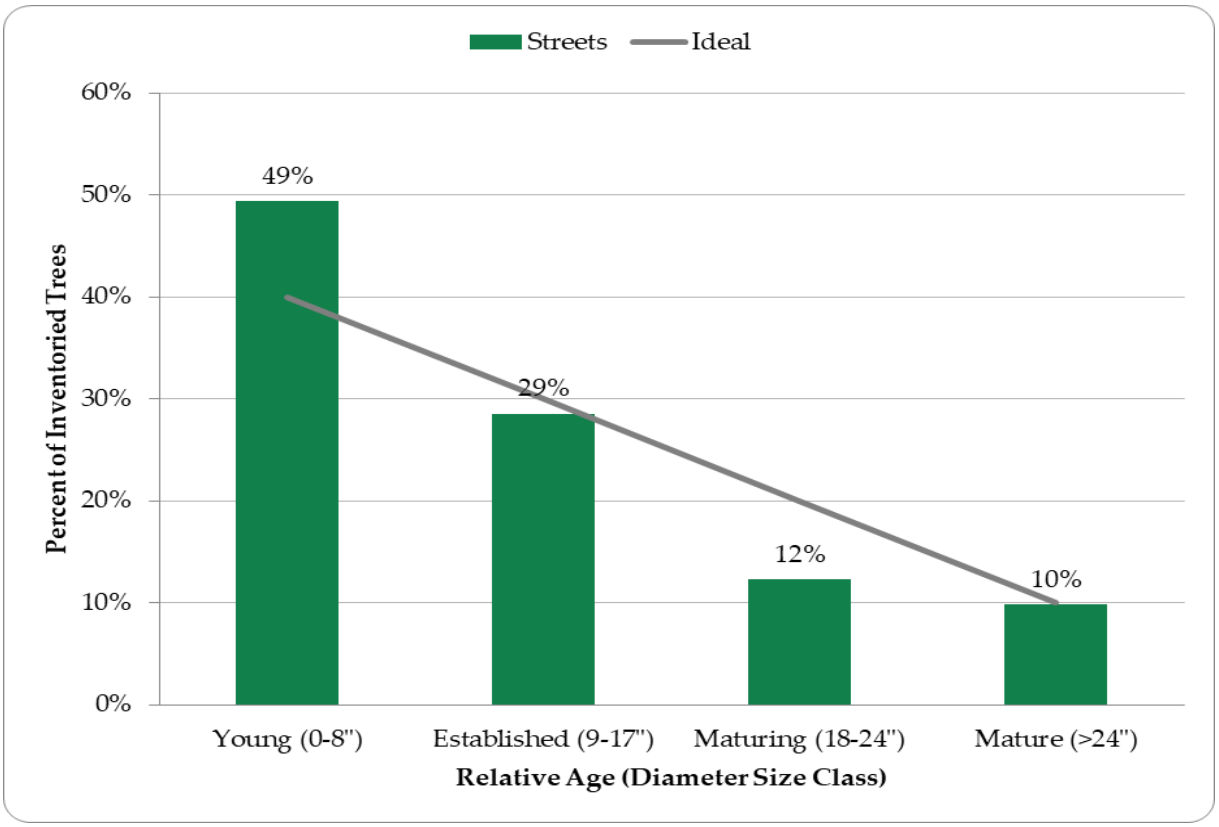


Figure 3. Relative age distribution of inventoried trees.

Condition

Several factors were considered for the condition of each tree, including root characteristics; branch structure; trunk, canopy, and foliage condition; as well as the presence of pests. The condition of each inventoried tree was rated Good, Fair, Poor, or Dead.

Most of the inventoried ROW trees were recorded to be in Fair or Good condition, 58% and 29%, respectively (Figure 4). Based on these data, the general health of the overall inventoried tree population is rated Fair.

Figure 5 illustrates the condition of the urban forest in relation to the relative age classes. The majority of the young, established, maturing, and mature trees were rated to be in Fair condition; however, there was an increase in Poor to Dead trees and a decrease in Good conditioned trees as the population reached maturity. With an established maintenance schedule and proactive care, this trend can be improved to have a healthier urban forest.

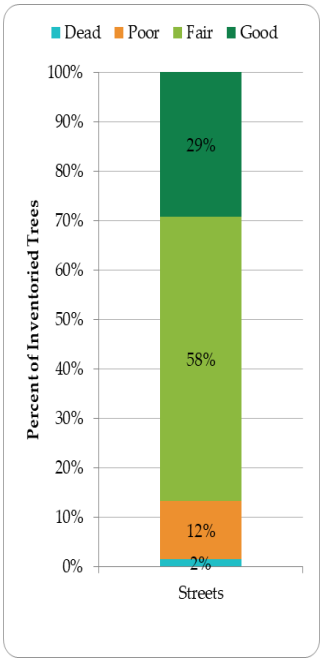


Figure 4. Condition of inventoried trees.

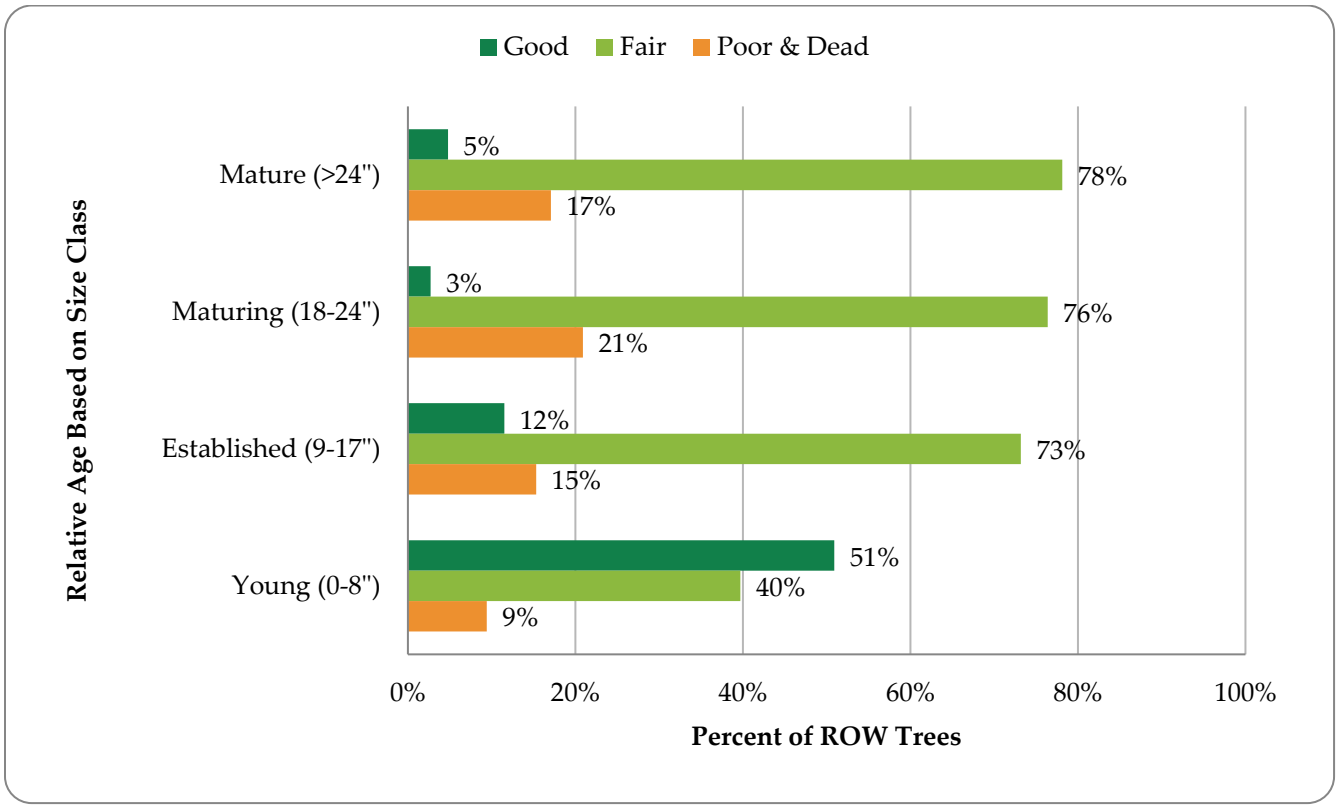
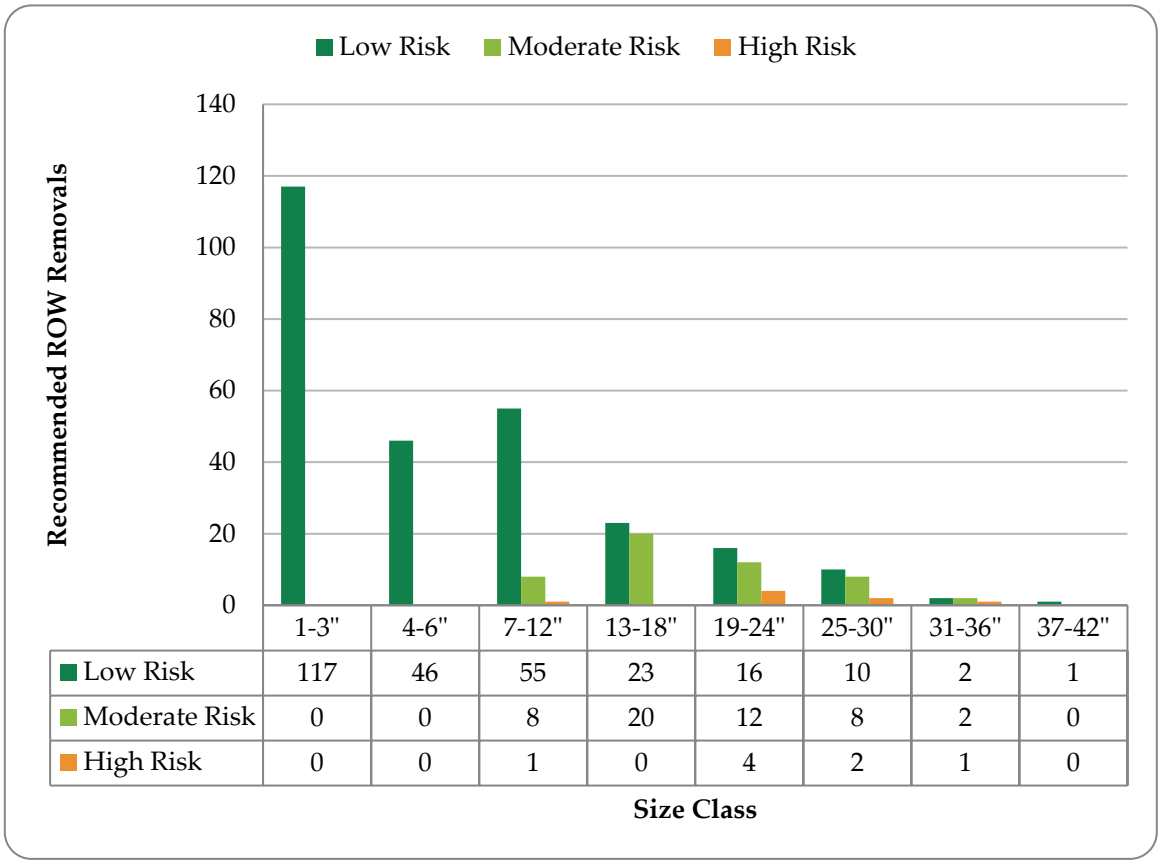


Figure 5. Condition of inventoried trees by relative age class.

Primary Maintenance and Risk

Every tree, regardless of condition, has an inherent risk of whole or partial tree failure. During the inventory, DRG performed a modified Level 2 qualitative risk assessment for each tree and assigned a risk rating based on ANSI A300 (*Part 9*) and the companion publication *Best Management Practices: Tree Risk Assessment* (ISA 2011). Trees can have multiple potential modes of failure, each with its own risk rating. The potential mode of failure with the highest risk rating was recorded for each tree during the tree inventory. Figures 6, 7 and 8 represent the data collected in the 2023 tree inventory. The specified time frame for the risk assessment was one year.

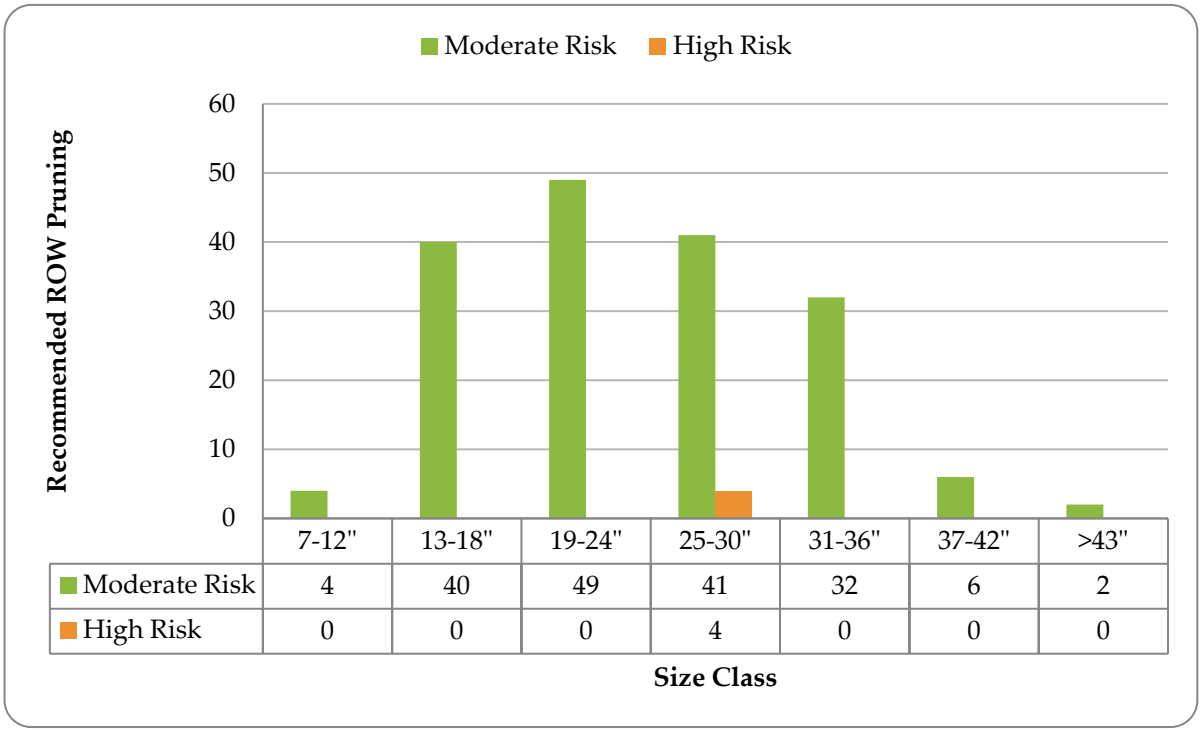
DRG recommends that tree maintenance activities are prioritized and completed based on the risk rating that was assigned to each tree during the inventory. Trees with high-risk ratings should be attended to first, followed by trees with a moderate risk rating, and trees with a low-risk rating should be maintained once higher-risk trees have been pruned or removed. The following graphs describe the recommended maintenance activities for each risk rating category by size class.



	1-3"	4-6"	7-12"	13-18"	19-24"	25-30"	31-36"	37-42"
Low Risk	117	46	55	23	16	10	2	1
Moderate Risk	0	0	8	20	12	8	2	0
High Risk	0	0	1	0	4	2	1	0

Figure 6: ROW priority removals for inventoried trees.

Figures 6 and 7 present recommended tree removals and tree pruning by risk rating and diameter size class for the trees included in the 2023 inventory. There are 328 trees recommended for removal. There are 178 trees recommended for priority pruning.



	7-12"	13-18"	19-24"	25-30"	31-36"	37-42"	>43"
Moderate Risk	4	40	49	41	32	6	2
High Risk	0	0	0	4	0	0	0

Figure 7: ROW priority pruning for inventoried trees.

Routine Pruning Cycle

The Routine Pruning cycle includes all Low-Risk trees that received a "Prune "or "Routine Prune" 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. Jersey City's 2023 inventory identified 4,885 trees that should be routinely pruned.



Figure 8: ROW routine pruning cycle for inventoried trees.

Section 2: i-Tree Streets Benefits

The i-Tree Eco application was used to assess the trees inventoried. Trees provide a wide array of economic, environmental, and social benefits, which often exceed the cost associated with 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. The i-Tree Eco Software and other models in the i-Tree software suite calculate the monetary value associated with the ecological services of the urban forest.

The inventoried urban forest of Jersey City has a recorded benefit savings of $205,600 annually from carbon sequestration, stormwater reduction, and overall air quality improvements. Figure 9 provides a breakdown of the annual benefits provided to Jersey City.

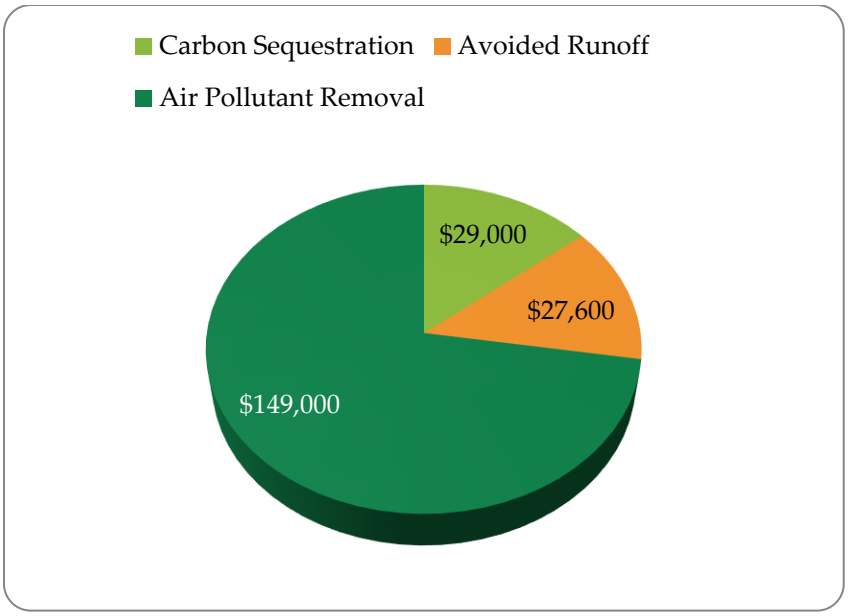


Figure 9: Distribution of the annual benefits provided by the inventoried trees.

Sequestering and Storing Carbon

The i-Tree Eco model estimates both the carbon sequestered each year and total carbon stored. Jersey City's inventoried trees have stored 6,688 tons of carbon, which is all the carbon each tree has amassed throughout their lifetimes and is valued at $1.14 million. London planetree stores and sequesters the most carbon, with approximately 47.6% of the total carbon stored and 32% of all sequestered.

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
London planetree	*Platanus x acerifolia*	3,191	18.6%	3,183.3	54.4	10,809,850	4,940	$14,289,631
Callery pear	*Pyrus calleryana*	2,045	11.9%	764.2	21.9	1,840,185	840	$2,699,257
Plum spp	*Prunus spp.*	1,946	11.3%	288.9	13.5	1,075,425	500	$1,396,783
Red maple	*Acer rubrum*	1,534	8.9%	231.0	13.3	910,323	420	$1,536,756
Thornless honeylocust	*Gleditsia triacanthos*	1,424	8.3%	433.2	13.7	1,415,472	640	$2,086,243
Japanese zelkova	*Zelkova serrata*	814	4.7%	104.7	3.3	887,016	400	$936,331
Littleleaf linden	*Tilia cordata*	723	4.2%	139.1	4.7	648,334	300	$1,031,011
Ginkgo	*Ginkgo biloba*	510	3.0%	32.9	0.9	328,827	160	$537,114
Freeman maple	*Acer x freemanii*	443	2.6%	48.4	3.3	346,481	160	$289,356
Pin oak	*Quercus palustris*	439	2.6%	355.3	8.1	1,376,236	620	$1,314,015
Norway maple	*Acer platanoides*	391	2.3%	184.3	5.5	336,621	160	$746,497
Japanese tree lilac	*Syringa reticulata*	312	1.8%	6.9	1.0	30,470	20	$72,779
Pagoda tree	*Styphnolobium japonicum*	234	1.4%	171.8	4.6	251,431	120	$411,747
Northern red oak	*Quercus rubra*	225	1.3%	58.9	1.9	269,324	120	$330,849
Green ash	*Fraxinus pennsylvanica*	184	1.1%	51.1	1.4	286,758	140	$316,238
All Other Trees Inventoried		2,956	17.2%	787	19.6	2,313,624	940	$2,762,169
Total		**17,199**	**101%**	**6,688**	**170.0**	**23,110,721**	**10,580**	**$30,558,241**

Table 10. Summary of benefits provided by inventoried trees ranked by species importance value.

Improving Air Quality

The inventoried tree population annually removed 10,572 pounds of air pollutants, including sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and particulate matter ($PM_{2.5}$). Particulate matter ($PM_{2.5}$) removal (309 lbs. removed) is valued highest at $95,364 annually.

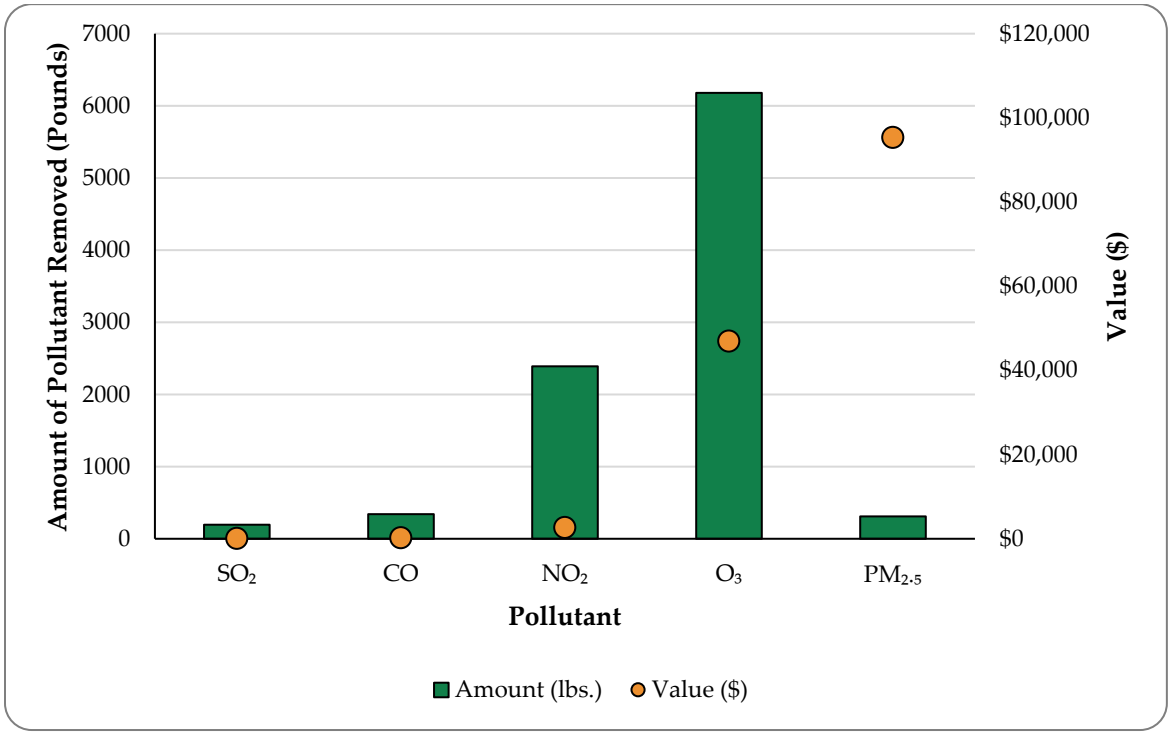


Figure 11. Quality and value of annual airborne pollutant removal by inventoried trees

Conclusion and Recommendations

Managing trees in urban areas is often complicated. Dealing with the recommendations of experts, the needs of residents, the pressures of local economics and politics, the concerns for public safety and liability issues, the physical aspects of trees, the forces of nature and severe weather events, and the expectation for all these issues to be resolved simultaneously is a considerable challenge. Jersey City must carefully consider each specific issue and balance these pressures with a knowledgeable understanding of trees and their needs. By completing a tree inventory, Jersey City has shown interest in not only preserving the urban forest but maintaining it for future generations. Maintaining an established planting program, routine pruning operation, and public outreach program will aid in maintaining the many benefits the urban forest provides to the community.

Glossary

Aesthetic/Other Report: The i-Tree Streets Aesthetic/Other Report presents the tangible and intangible benefits of trees reflected in increases in property values in dollars ($).

Air Quality Report: The i-Tree Streets Air Quality Report quantifies the air pollutants (ozone [O_3], nitrogen dioxide [NO_2], sulfur dioxide [SO_2], coarse particulate matter less than 10 micrometers in diameter [PM_{10}]) deposited on tree surfaces, and reduced emissions from power plants (NO_2, PM_{10}, Volatile Oxygen Compounds [VOCs], SO_2) due to reduced electricity use measured in pounds (lbs.). Also reported are the potential negative effects of trees on air quality due to Biogenic Volatile Organic Compounds (BVOC) emissions.

arboriculture: The art, science, technology, and business of commercial, public, and utility tree care.

canopy: Branches and foliage that make up a tree's crown.

Carbon Dioxide Report: The i-Tree Streets Carbon Dioxide Report presents annual reductions in atmospheric CO_2 due to sequestration by trees and reduced emissions from power plants due to reduced energy use in pounds. The model accounts for CO_{2+} released as trees die and decompose and CO_2 released during the care and maintenance of trees.

clean (primary maintenance need): Based on *ANSI A300 (Part 1)* standards, selective removal of dead, dying, broken, and/or diseased wood to minimize potential risk.

community forest: see **urban forest**.

condition (data field): The general condition of each tree rated during the inventory according to the following categories adapted from the International Society of Arboriculture's rating system: Excellent (100%), Very Good (90%), Good (80%), Fair (60%), Poor, (40%), Critical (20%), Dead (0%).

diameter at breast height (DBH): See **tree size**.

diameter: See **tree size**.

Energy Report: The i-Tree Streets Energy Report presents the contribution of the urban forest toward conserving energy in terms of reduced natural gas use in winter measured in therms [th] and reduced electricity use for air conditioning in summer measured in megawatt-hours (MWh).

failure: In terms of tree management, failure is the breakage of stem or branches, or loss of mechanical support of the tree's root system.

genus: A taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics. In taxonomic nomenclature, the genus name is used, either alone or followed by a Latin adjective or epithet, to form the name of a species.

geographic information system (GIS): A technology that is used to view and analyze data from a geographic perspective. The technology is a piece of an organization's overall information system framework. GIS links location to information (such as people to addresses, buildings to parcels, or streets within a network) and layers that information to give you a better understanding of how it all interrelates.

global positioning system (GPS): GPS is a system of earth-orbiting satellites that make it possible for people with ground receivers to pinpoint their geographic location.

High Risk tree: Tree that cannot be cost-effectively or practically treated. Most High Risk trees have multiple or significant defects affecting less than 40% of the trunk, crown, or critical root zone. Defective trees and/or tree parts are most likely between 4–20 inches in diameter and can be found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.

Importance Values: A calculation in i-Tree Streets. Importance Values (IV) are displayed in table form for all species that make up more than 1% of the population. The Streets IV is the mean of three relative values (percentage of total trees, percentage of total leaf area, and percentage of canopy cover) and can range from 0 to 100 with an IV of 100 suggesting total reliance on one species. IVs offer valuable information about a community's reliance on certain species to provide functional benefits. For example, a species might represent 10% of a population, but have an IV of 25% because of its great size, indicating that the loss of those trees due to pests or disease would be more significant than their numbers suggest.

inventory: See **tree inventory**.

i-Tree Streets: i-Tree Streets is a street tree management and analysis tool that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, CO_2 reduction, stormwater control, and property value increase.

i-Tree Tools: State-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban forestry analysis and benefits assessment tools. The i-Tree Tools help communities of all sizes to strengthen their urban forest management and advocacy efforts by quantifying the structure of community trees and the environmental services that trees provide.

Low Risk tree: Tree with minor visible structural defects or wounds in areas with moderate to low public access.

mapping coordinate (data field): Helps to locate a tree; X and Y coordinates were generated for each tree using GPS.

Moderate Risk tree: Tree with defects that may be cost-effectively or practically treated. Most of the trees in this category exhibit several moderate defects affecting more than 40% of a tree's trunk, crown, or critical root zone.

monoculture: A population dominated by one single species or very few species.

Net Annual Benefits: Specific data field for i-Tree Streets. Citywide benefits and costs are calculated according to category and summed. Net benefits are calculated as benefits minus costs.

Nitrogen Dioxide (NO_2): Nitrogen dioxide is a compound typically created during the combustion processes and is a major contributor to smog formation and acid deposition.

Ozone (O_3): A strong-smelling, pale blue, reactive toxic chemical gas with molecules of three oxygen atoms. It is a product of the photochemical process involving the Sun's energy. Ozone exists in the upper layer of the atmosphere as well as at the Earth's surface. Ozone at the Earth's surface can cause numerous adverse human health effects. It is a major component of smog.

Particulate Matter (PM_{10}): A major class of air pollutants consisting of tiny solid or liquid particles of soot, dust, smoke, fumes, and mists.

primary maintenance need (data field): The type of tree work needed to reduce immediate risk.

pruning: The selective removal of plant parts to meet specific goals and objectives.

removal (primary maintenance need): Data field collected during the inventory identifying the need to remove a tree. Trees designated for removal have defects that cannot be cost-effectively or practically treated. Most of the trees in this category have a large percentage of dead crown.

right-of-way (ROW): See **street right-of-way**.

risk: Combination of the probability of an event occurring and its consequence.

risk assessment (data fields): The risk assessment is a point-based assessment of each tree by an arborist using a protocol based on the US Forest Service Community Tree Risk Rating System. In the field, the probability of tree or tree part failure is assigned 1–4 points (identifies the most likely failure and rates the likelihood that the structural defect(s) will result in failure based on observed, current conditions), the size of defective tree part is assigned 1–3 points (rates the size of the part most likely to fail), the probability of target impact by the tree or tree part is assigned 1–3 points (rates the use and occupancy of the area that would be struck by the defective part), and other risk factors are assigned 0–2 points (used if professional judgment suggests the need to increase the risk rating). The data from the risk assessment is used to calculate the risk rating that is ultimately assigned to the tree.

risk rating: Calculated from the field risk assessment data (see **risk assessment**), this is the sum of total risk assessment values. Risk ratings range from 3–10, with 3 being the lowest risk and 10 being the highest risk. In this Plan, the risk rating was used to identify the severity of risk assigned to a tree and to prioritize tree maintenance needs. The following categories were used:

- risk rating of 9 or 10 = Severe Risk tree
- risk rating of 7 or 8 = High Risk tree
- risk rating of 5 or 6 = Moderate Risk tree
- risk rating of 3 or 4 = Low Risk tree
- risk rating of 0 = no risk (used only for planting sites and stumps)

secondary maintenance need (data field): Recommended maintenance for a tree, which may be risk oriented, such as raising the crown for clearance, but generally was geared toward improving the structure of the tree and enhancing aesthetics.

Severe Risk tree: Tree rated to be Severe Risk cannot be cost-effectively or practically treated. Most Severe Risk trees have multiple and significant defects present in the trunk, crown, or critical root zone. Defective trees and/or tree parts are most likely larger than 20 inches in diameter and can be found in areas of frequent occupation, such as a main thoroughfare, congested streets, and/or near schools.

species: Fundamental category of taxonomic classification, ranking below a genus or subgenus, and consisting of related organisms capable of interbreeding.

stem: A woody structure bearing buds and foliage and giving rise to other stems.

stems (data field): Identifies the number of stems or trunks splitting less than one foot above ground level.

Stored Carbon Report: Whereas, the i-Tree Streets Carbon Dioxide Report quantifies annual CO_2 reductions, and the i-Tree Streets Stored Carbon Report tallies all of the Carbon (C) stored in the urban forest over the life of the trees as a result of sequestration measured in pounds as the CO_2 equivalent.

Stormwater Report: A report generated by i-Tree Streets that presents the reductions in annual stormwater runoff due to rainfall interception by trees measured in gallons (gals.).

street name (data field): The name of a street right-of-way or road identified using posted signage or parcel information.

street right-of-way (ROW): A strip of land generally owned by a public entity over which facilities, such as highways, railroads, or power lines, are built.

street tree: A street tree is defined as a tree within the right-of-way.

structural defect: A feature, condition, or deformity of a tree or tree part that indicates weak structure and contributes to the likelihood of failure.

stump removal (primary maintenance need): Indicates a stump that should be removed.

Sulfur Dioxide (SO_2): A strong-smelling, colorless gas that is formed by the combustion of fossil fuels. Sulfur oxides contribute to the problem of acid rain.

Summary Report: The i-Tree Streets Summary report presents the annual total of energy, stormwater, air quality, carbon dioxide, and aesthetic/other benefits. Values are dollars per tree or total dollars.

tree benefit: An economic, environmental, or social improvement that benefits the community and results mainly from the presence of a tree. The benefit received has real or intrinsic value associated with it.

tree inventory: Comprehensive database containing information or records about individual trees typically collected by an arborist.

tree size (data field): A tree's diameter measured to the nearest inch in 1-inch size classes at 4.5 feet above ground, also known as diameter at breast height (DBH) or diameter.

tree: A tree is defined as a perennial woody plant that may grow more than 20 feet tall. Characteristically, it has one main stem, although many species may grow as multi-stemmed forms.

urban forest: All of the trees within a municipality or a community. This can include the trees along streets or rights-of-way, in parks and greenspaces, in forests, and on private property.

Volatile Organic Compounds (VOCs): Hydrocarbon compounds that exist in the ambient air and are by-products of energy used to heat and cool buildings. Volatile organic compounds contribute to the formation of smog and/or are toxic. Examples of VOCs are gasoline, alcohol, and solvents used in paints.

Young Tree Train (primary maintenance need): Data field based on *ANSI A300 (Part 1)* standards, pruning of young trees to correct or eliminate weak, interfering, or objectionable branches to improve structure. These trees, up to 20 feet in height, can be worked with a pole pruner by a person standing on the ground.

References

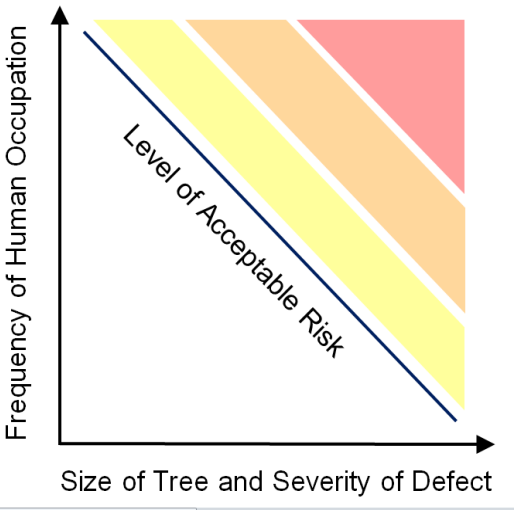
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APPENDIX A
RISK ASSESSMENT/PRIORITY AND PROACTIVE MAINTENANCE

Risk Assessment

Every tree has an inherent risk of tree failure or defective tree part failure. During the inventory, DRG performed a modified Level 2 qualitative risk assessment for each tree and assigned a risk rating based on the ANSI A300 (Part 9), and the companion publication *Best Management Practices: Tree Risk Assessment* (ISA 2011). Trees can have multiple failure modes with various risk ratings. One risk rating per tree will be assigned during the inventory. The failure mode having the greatest risk will serve as the overall tree risk rating. The specified time period for the risk assessment is one year.



- **Likelihood of Failure**—Identifies the most likely failure and rates the likelihood that the structural defect(s) will result in failure based on observed, current conditions.
  - Improbable—The tree or branch is not likely to fail during normal weather conditions and may not fail in many severe weather conditions within the specified time period.
  - Possible—Failure could occur but is unlikely during normal weather conditions within the specified time period.
  - Probable—Failure may be expected under normal weather conditions within the specified time period.
- **Likelihood of Impacting a Target**—The rate of occupancy of targets within the target zone and any factors that could affect the failed tree as it falls towards the target.
  - Very low—The chance of the failed tree or branch impacting the target is remote.
    - Rarely used sites
    - Examples include rarely used trails or trailheads
    - Instances where target areas provide protection
  - Low—It is not likely that the failed tree or branch will impact the target.
    - Occasional use area fully exposed to tree
    - Frequently used area partially exposed to tree
    - Constant use area that is well protected
  - Medium—The failed tree or branch may or may not impact the target.

- Frequently used areas that are partially exposed to the tree on one side
- Constantly occupied area partially protected from the tree

- High—The failed tree or branch will most likely impact the target.
  - Fixed target is fully exposed to the tree or tree part

- **Categorizing Likelihood of Tree Failure Impacting a Target**—The likelihood for failure and the likelihood of impacting a target are combined in the matrix below to determine the likelihood of tree failure impacting a target.

Likelihood of Failure	Likelihood of Impacting Target			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very Likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

- **Consequence of Failure**—The consequences of tree failure are based on the categorization of target and potential harm that may occur. Consequences can vary depending upon size of defect, distance of fall for tree or limb, and any other factors that may protect a target from harm. Target values are subjective and should be assessed from the client's perspective.
  - Negligible—Consequences involve low value damage and do not involve personal injury.
    - Small branch striking a fence
    - Medium-sized branch striking a shrub bed
    - Large tree part striking structure and causing monetary damage
    - Disruption of power to landscape lights
  - Minor—Consequences involve low to moderate property damage, small disruptions to traffic or communication utility, or very minor injury.
    - Small branch striking a house roof from a high height
    - Medium-sized branch striking a deck from a moderate height
    - Large tree part striking a structure, causing moderate monetary damage
    - Short-term disruption of power at service drop to house
    - Temporary disruption of traffic on neighborhood street
  - Significant—Consequences involve property damage of moderate to high value, considerable disruption, or personal injury.
    - Medium-sized part striking a vehicle from a moderate or high height
    - Large tree part striking a structure resulting in high monetary damage
    - Disruption of distribution of primary or secondary voltage power lines, including individual services and street-lighting circuits

- Disruption of traffic on a secondary street

- Severe—Consequences involve serious potential injury or death, damage to high-value property, or disruption of important activities.
  - Injury to a person that may result in hospitalization
  - Medium-sized part striking an occupied vehicle
  - Large tree part striking an occupied house
  - Serious disruption of high-voltage distribution and transmission power line disruption of arterial traffic or motorways

- **Risk Rating**—The overall risk rating of the tree will be determined based on combining the likelihood of tree failure impacting a target and the consequence of failure in the matrix below.

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

Trees have the potential to fail in more than one way and can affect multiple targets.

Tree risk assessors will identify the tree failure mode having the greatest risk, and report that as the tree risk rating. Generally, trees with the highest qualitative risk ratings should receive corrective treatment first. The following risk ratings will be assigned:

- None—Used for planting and stump sites only.
- Low—The Low-Risk category applies when consequences are "negligible" and likelihood is "unlikely"; or consequences are "minor" and likelihood is "somewhat likely." Some trees with this level of risk may benefit from mitigation or maintenance measures, but immediate action is not usually required.
- Moderate—The Moderate Risk category applies when consequences are "minor" and likelihood is "very likely" or "likely"; or likelihood is "somewhat likely" and consequences are "significant" or "severe." In populations of trees, Moderate Risk trees represent a lower priority than High or Extreme Risk trees.
- High—The High-Risk category applies when consequences are "significant" and likelihood is "very likely" or "likely," or consequences are "severe" and likelihood is "likely." In a population of trees, the priority of High-Risk trees is second only to Extreme Risk trees.

- Extreme—The Extreme Risk category applies in situations where tree failure is imminent and there is a high likelihood of impacting the target, and the consequences of the failure are "severe." In some cases, this may mean immediate restriction of access to the target zone area to avoid injury to people.

Trees with elevated (Extreme or High) risk levels are usually recommended for removal or pruning to eliminate the defects that warranted their risk rating. However, in some situations, risk may be reduced by adding support (cabling or bracing) or by moving the target away from the tree. DRG recommends only removal or pruning to alleviate risk. But in special situations, such as a memorial tree or a tree in a historic area, BBG may decide that cabling, bracing, or moving the target may be the best option for reducing risk.

Priority Maintenance

Identifying and ranking the maintenance needs of a tree population enables tree work to be assigned priority based on observed risk. Once prioritized, tree work can be systematically addressed to eliminate the greatest risk and liability first (Stamen 2011).

Risk is a graduated scale that measures potential tree-related hazardous conditions. A tree is considered hazardous when its potential risks exceed an acceptable level. Managing trees for risk reduction provides many benefits, including:

- Lower frequency and severity of accidents, damage, and injury
- Less expenditure for claims and legal expenses
- Healthier, long-lived trees
- Fewer tree removals over time
- Lower tree maintenance costs over time

Regularly inspecting trees and establishing tree maintenance cycles generally reduce the risk of failure, as problems can be found and addressed before they escalate.

In this plan, all tree removals and Extreme and High Risk prunes are included in the priority maintenance program.

Proactive Maintenance

Proactive tree maintenance requires that trees are managed and maintained under the responsibility of an individual, department, or agency. Tree work is typically performed during a cycle. Individual tree health and form are routinely addressed during the cycle. When trees are planted, they are planted selectively and with purpose. Ultimately,

proactive tree maintenance should reduce crisis situations in the urban forest, as every tree in the inventoried population is regularly visited, assessed, and maintained. DRG recommends proactive tree maintenance that includes pruning cycles, inspections, and planned tree planting.