COMMUNITY FOREST MANAGEMENT PLAN

City of Olean, New York

October 2021

Prepared for:

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ACKNOWLEDGMENTS

The City of Olean's vision to promote and enhance tree conservation and forestry management practices of its parks and public street rights-of-way was the primary inspiration for this project. This vision will encourage healthy forest development and enhance the overall tree population, which will improve aesthetic value, air quality, public health, and increase park use. A *Community Forest Management Plan* offers expertise in preserving and expanding urban canopy so the environmental, economic, and social benefits it provides continue for generations.

The City of Olean is thankful for the grant funding it received from the NYS Department of Environmental Conservation (DEC) through its 2019 Urban and Community Forestry (U&CF) Grant Program Round 15. The grants are part of DEC's Urban and Community Forestry Program, which works to increase public awareness of the importance of trees and helps communities develop and implement comprehensive tree management plans to create healthy forests while enhancing quality of life for residents.

The City of Olean also recognizes the support of its Mayor and City Council:

- William J. Aiello, Mayor
- Forester and Supervisor Sue Cooper
- City of Olean Department of Public Works Staff
- City of Olean Tree Board
- Department of Community Development

- *Cover Photo was taken in Oak Hill Park*

EXECUTIVE SUMMARY

The City of Olean *Community Forest 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 Olean in June 2021 and analyzed the inventory data to understand the structure of the City'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 the City of Olean's inventoried tree population provide benefits with an estimated total value of $18,975 annually. The City's annual tree maintenance budget is roughly $15,000, according to the City's Department of Public Works Forester Susan Cooper, making Olean's return on investment over 100% 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 seven-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.

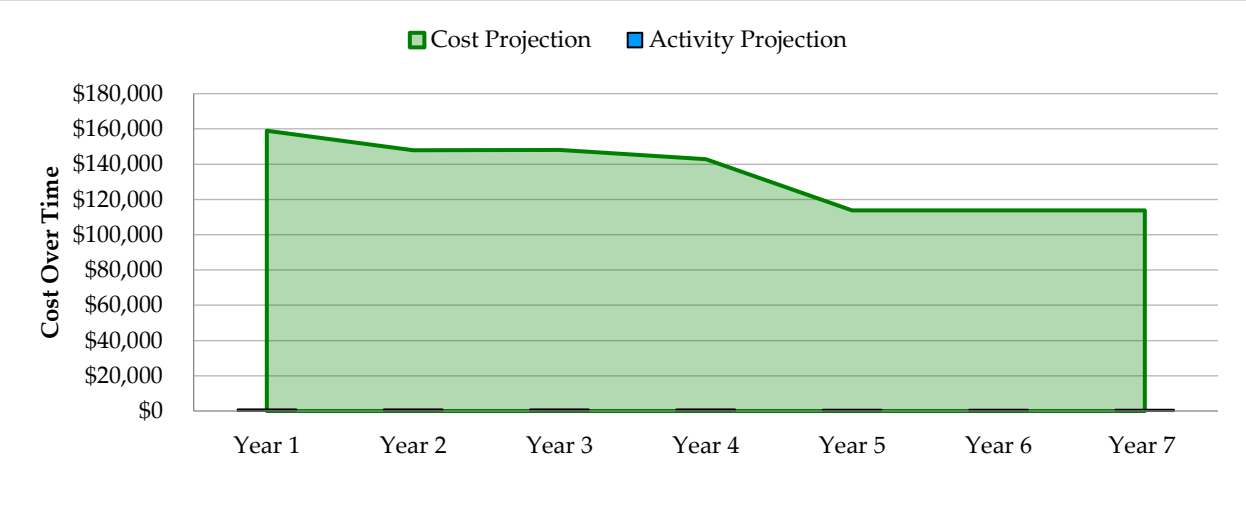

Figure 1. Budget grand totals.

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 = 509 trees
High Priority = 32 trees
Moderate Priority = 350 trees
Low Priority = 127 trees
Stumps = 109

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 = 506 trees
High Priority = 19 trees
Moderate Priority = 487 trees

Routine Pruning Cycle

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

Total = 2,439 trees
Number in cycle each year = at least 488 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 = 758 trees
Number in cycle each year = at least 253 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 new vacant planting sites = 1,036 sites

INTRODUCTION

The City of Olean is home to 13,437 residents (U.S. Census Bureau 2020, retrieved from: https://www.census.gov/quickfacts/fact/table/oleancitynewyork,US/POP010220) benefitting from public trees in their community. The City's Department of Public Works Forester manages all trees, stumps, and planting sites along the street rights-of-way (ROW) and throughout public parks.

Urban Forestry Program budgets are funded by the City's General Fund. Olean has a Tree Board, a tree ordinance, celebrates Arbor Day, and has been a Tree City USA community for 35 years.

Past urban forestry projects have demonstrated Olean's dedicated commitment to sustaining the public tree resource with higher levels of tree care. The City of Olean will soon be able to set goals and perform proactive maintenance using this *Community Forestry Management Plan*. The City'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.

VISION STATEMENT

The City of Olean recognizes that our urban forest is an essential social, economic, and environmental asset and will continue to be a community identified and shaded by a "living umbrella". Relying on the Community Forest Management Plan, the City of Olean aims to create a healthy, diverse, and sustainable urban forest that is properly managed and cared for by selecting and maintaining trees in accordance to the Best Management Practices established by the International Society of Arboriculture. The City will strive to preserve and protect existing trees, increase public safety and tree health, implement cost-effective enhancement and maintenance of the forest, increase public awareness of the value of our community forest, and recognize the positive impacts of the forest as it reduces greenhouse gas emissions and storm water run-off as well as provides shelter to buildings and hardscapes.

HISTORY OF THE CITY OF OLEAN URBAN FOREST

In the years leading up to 1986, John Ash, holding the position of Common Council President, recognized the importance of our tree canopy and community forest and pursued the creation of a tree program. In 1986, Alderman Ash's efforts paid off as he was able to successfully implement a forestry program for the community. During that same year, Mr. Ash became mayor and the City of Olean was awarded its first Tree City USA designation.

On May 1, 1986, the Common Council commemorated their commitment to the new forestry program with the planting of a "Liberty Elm" in historic Lincoln Park.

At that time, this particular tree was one of a hundred Liberty elms made available by the New York State Arbor Day Committee to communities in New York State. The Liberty elm, a disease resistant tree, commemorated the centennial of the Statue of Liberty, unfortunately the tree is no longer thriving.

A Memorial Tree Program also began in 1986. Trees were planted either in memory of or in honor of someone or something of great importance. Throughout the years, approximately 200 trees were planted in City-owned parks or along the street rights-of-way.

The first tree inventory for the City of Olean was conducted and completed in 1986. This inventory was done in book form. Since technology and the science of community forestry management has advanced throughout the years, this current inventory will greatly aid the City in managing its forest for many years to come.

While the activities performed in 1986 proved to be of great importance and dedication, our Forestry Program has demonstrated a colossal evolution since that time. It has shown success in educating the public and elected officials on the importance of trees in our community and their vast benefits. Our Forestry Program prioritizes keeping the public safe from potentially hazardous trees, replanting in order to keep our tree stock healthy, and recognizing the environmental benefits they provide to our residents and visitors. The City of Olean Forester is retiring after 30 years of dedicated service, her parting words are, "*The city of Olean will benefit from this inventory for managing its forest for the future*"

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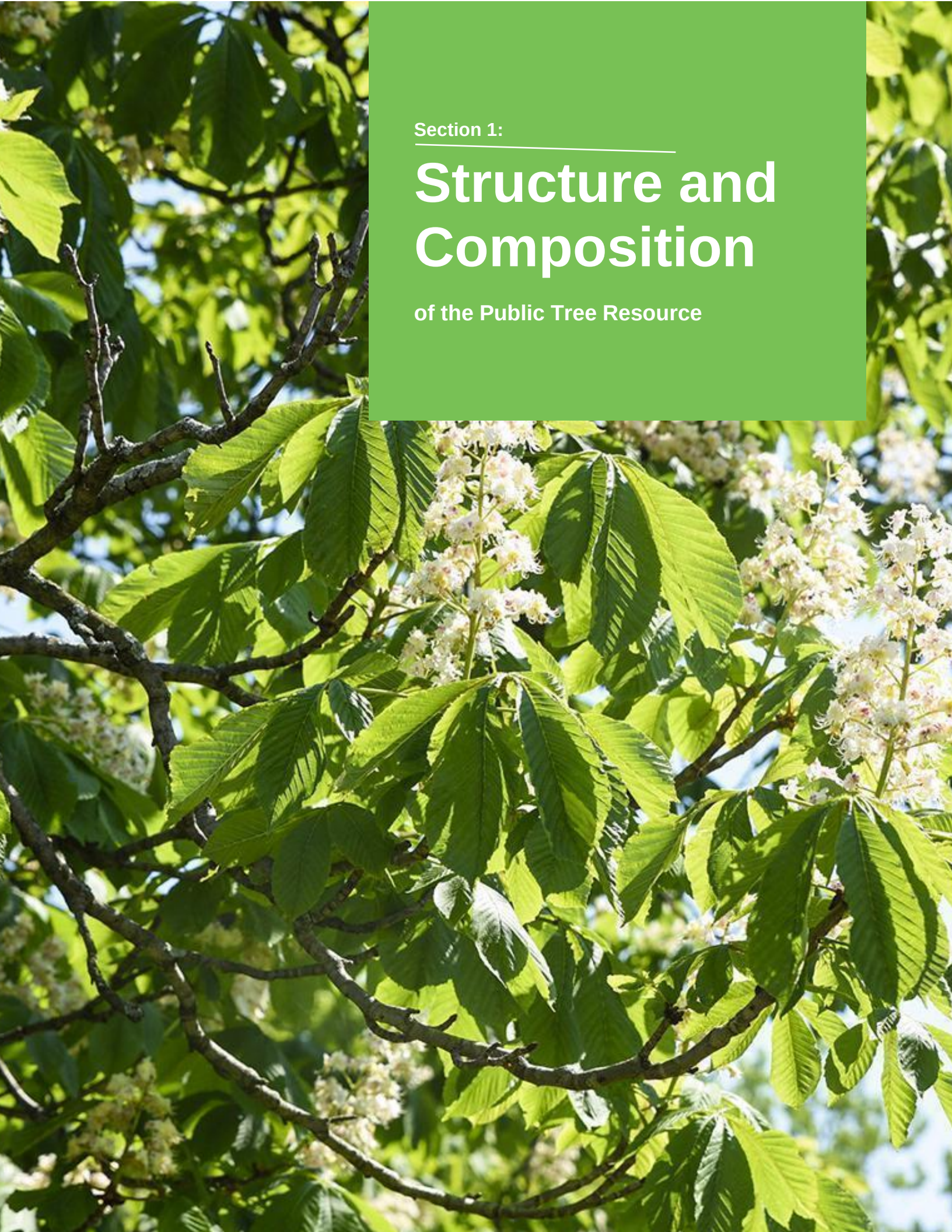
RECOMMENDED APPROACH TO TREE MANAGEMENT

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 June 2021, the City of Olean 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 City'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 seven-year period.



Section 1:

Structure and Composition

of the Public Tree Resource

SECTION 1: STRUCTURE AND COMPOSITION OF THE PUBLIC TREE RESOURCE

In June 2021, DRG arborists collected site data on trees, stumps, and planting sites along the street ROW, trees in public parks and City owned properties for a tree inventory contracted by the City of Olean. Of the total 5,357 sites inventoried, 84% were collected along the street ROW, and the remaining 16% were collected in the maintained areas of parks. Figure 2 breaks down the total sites inventoried in the parks and street ROW by type. See Appendix A for details about DRG's methodology for collecting site data.

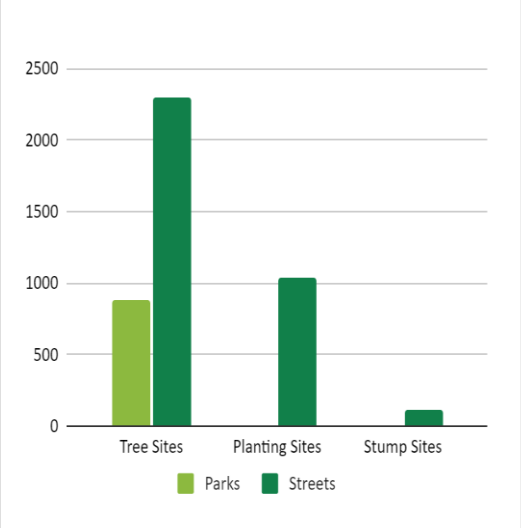


Figure 2. Number of inventoried sites by type.

The City of Olean designated all street ROWs and 18 public parks for DRG to collect site data for the tree inventory. Inventoried parks include: Boardman Park, Bradner Stadium, Chamberlain Park, Fitness Park, Franchot Park, Franklin-Hysol Park, Gargoyle Park, Gerringer-Haggerty Park, Homer Street Park, Irving Street Park, King Street Park, Lincoln Park, Magnano Park, Marcus Park, Oak Hill Park, Polo Field, War Veterans Park, and York/Union (Veterans Memorial Bridge) Park.

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).

Figure 3 shows the City of Olean's distribution of the most abundant tree species inventoried compared to the 10% threshold. Norway maple (*Acer platanoides)*, including the 'Crimson King' cultivar, is the most abundant species at 15% of the population. This percentage surpasses the 10% threshold and should be managed for ideal species diversity. Red maple (*Acer rubrum*) is fairly close to the 10% threshold, comprising 9% of the population, and is not immediately concerning from this data alone.

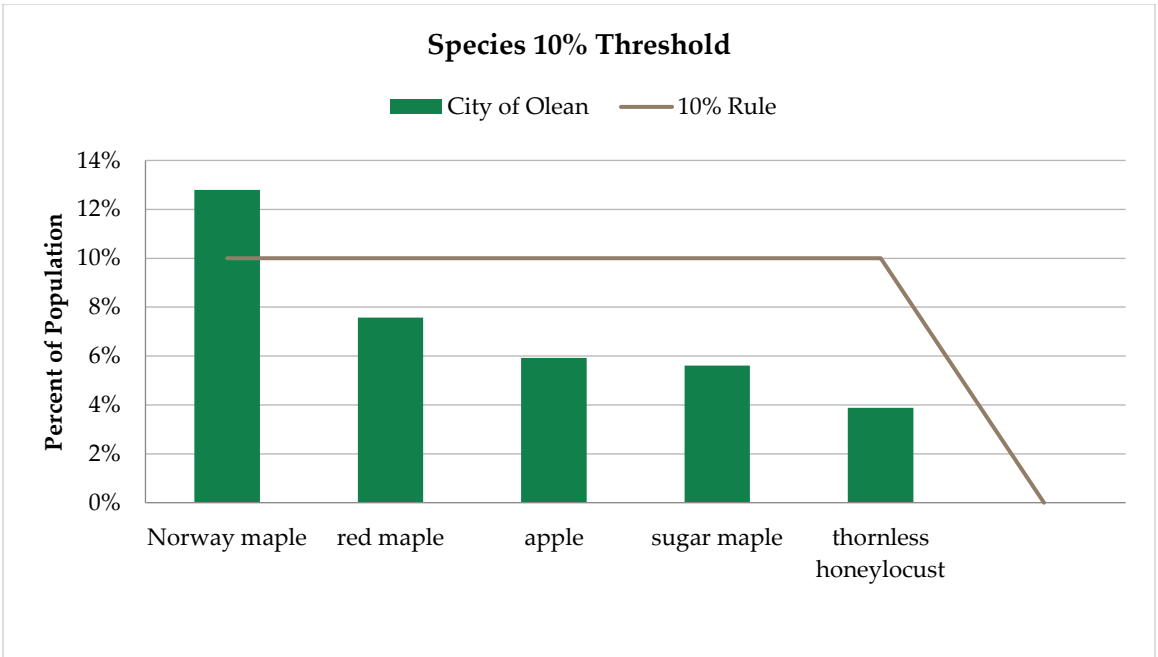


Figure 3. Species distribution of inventoried trees.

However, Figure 4 shows Olean's distribution of the most abundant tree genera inventoried, and maple (*Acer*) is significantly higher than the 20% threshold. This means that red maple is concerning after all, because maple comprise 41% of the inventoried population. For this reason, the City of Olean should not plant red maple or any other maple species until this distribution becomes more ideal.

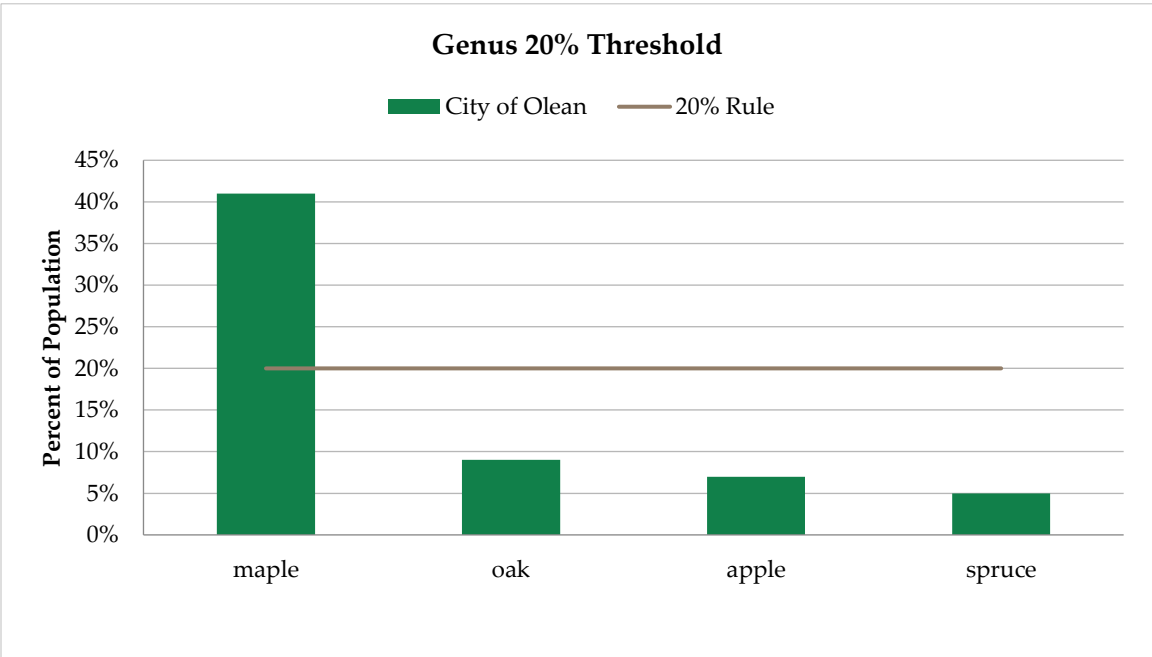


Figure 4. Genus distribution of inventoried trees.

This illustrates how species distribution alone does not completely represent tree population diversity. Genus distribution is an important consideration because some pests, such as Emerald Ash Borer (EAB, *Agrilus planipennis*), target a single genus as its host. Although ash only account for 4% of the population, EAB has had devastating effects on the untreated green ash (*Fraxinus pennsylvanica*) and white ash (*F. americana*) populations in Olean. Out of the 152 green, white, and European ash (*F. excelsior*) trees inventoried, 88 trees have been recommended for removal due to EAB. Maple contributing to 41% of the population can have severe detrimental effects at a genus level when considering pests like Asian Longhorned Beetle (ALB, *Anoplophora glabripennis*) and Spotted Lanternfly (SLF, *Lycorma delicatula*).

PEST SUSCEPTIBILITY

Early diagnosis of disease and infestation is essential to ensuring the health and continuity of Olean's public tree resource. See Appendix B for some information about the pests listed below and websites where additional information can be found.

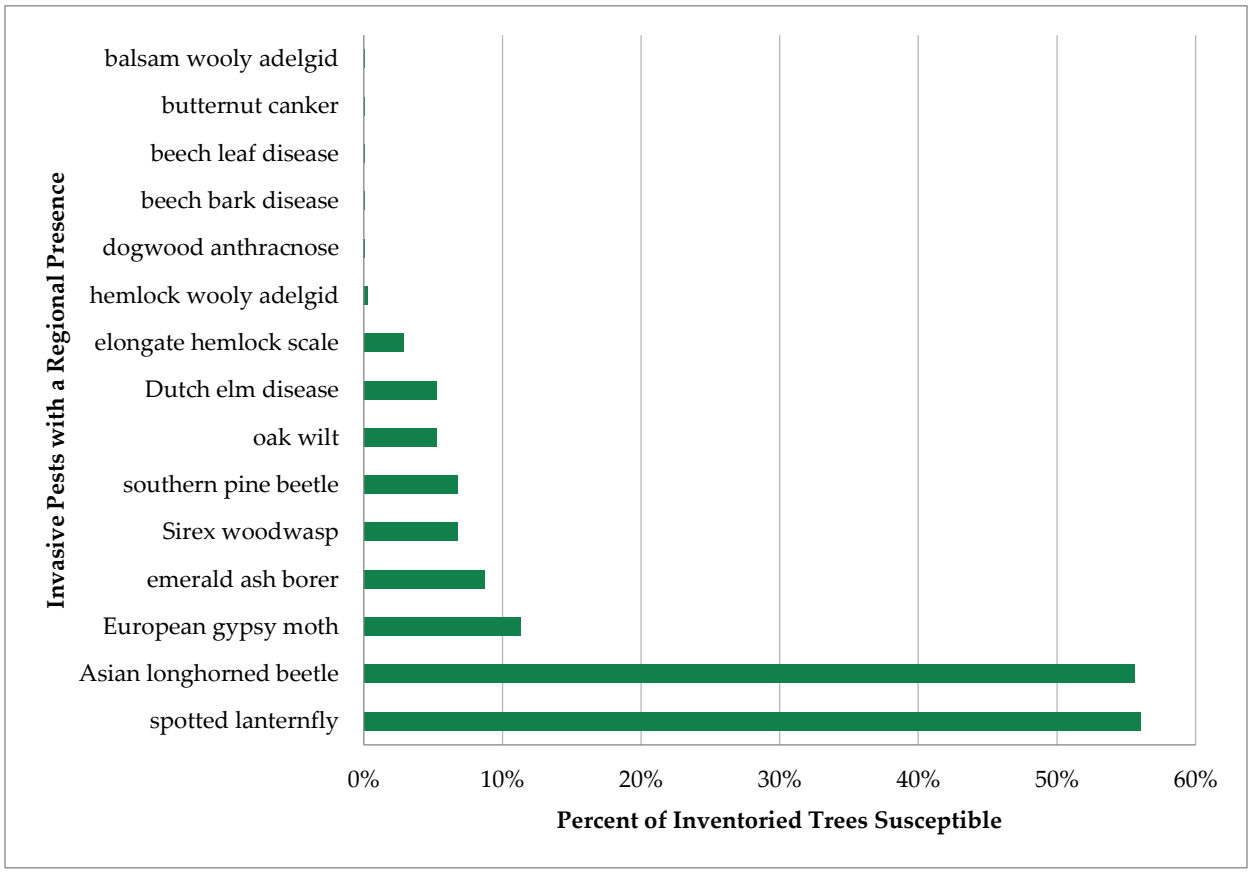


Figure 5. Tree resource susceptibility to invasive pests that have a regional presence.

Figure 5 shows the percent of inventoried trees 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 the City of Olean, especially those on private property and wooded stands, may be susceptible to hosting these invasive pests. SLF and ALB are known threats to a large percentage of the inventoried tree resource, 63% and 50%, respectively.

Photograph 1. Dead ash tree located within public right of way located on North side of City.

Pest Susceptibility Recommendations

The overabundance of maple in Olean's tree resource is a management concern because it creates unnecessary risk in the event of an invasive pest outbreak. This abundance is not only more tree resource to lose but is also 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 Olean's tree resource be resilient in the event of future pest invasions. The EAB has already infected many ash trees around Olean, despite ash being a small percent of the inventoried population, so it is recommended that these trees be removed to help slow the spread of EAB.

The City of Olean should focus efforts to improve diversity at the genus and species level for promoting system resilience. For this reason, The City of Olean should use its resources to inspect trees in the *Acer* and *Fraxinus* genus for signs of infestation from SLF, ALB, and EAB, respectively, on a routine basis, so affected trees can be quarantined to contain the pest before an outbreak starts. Please refer to the Planting Plan for more details on diversification.

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, Critical, or Dead. The general health of the inventoried tree population was characterized by the most prevalent condition assigned during the inventory.

Figure 6 shows most of the inventoried trees were recorded in Good or Fair condition, 32% and 55%, respectively. Based on this data, the general health of the inventoried tree population is rated as Fair. The City of Olean has a low percentage of Dead trees and trees in Critical condition, so the general health of Olean's tree resource is approaching Good.

Condition Recommendations

- Dead trees and trees in Critical and 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.

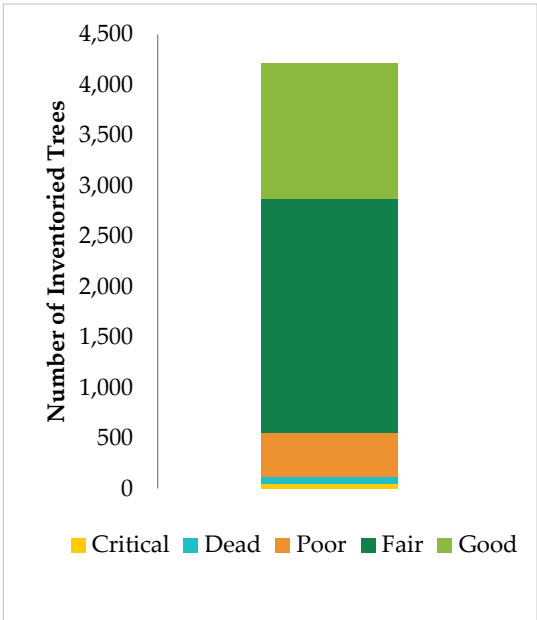


Figure 6. Condition of inventoried trees.

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 Olean'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. As an example a mature apple tree, although small in diameter may be found to be the same age as an oak twice its size.

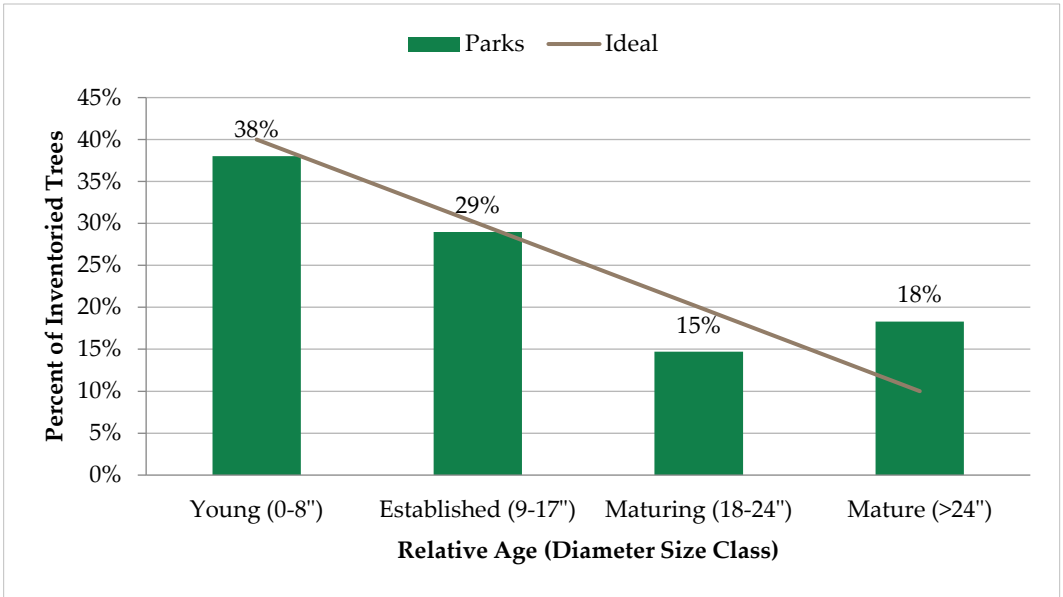


Figure 7. Relative age distribution of inventoried trees.

Figure 7 compares the City of Olean's relative age distribution of the inventoried tree population to the ideal. The City's inventoried tree resource is starting to trend towards the ideal; however, young trees fall short of the ideal by 2%, while mature trees exceed by 8%.

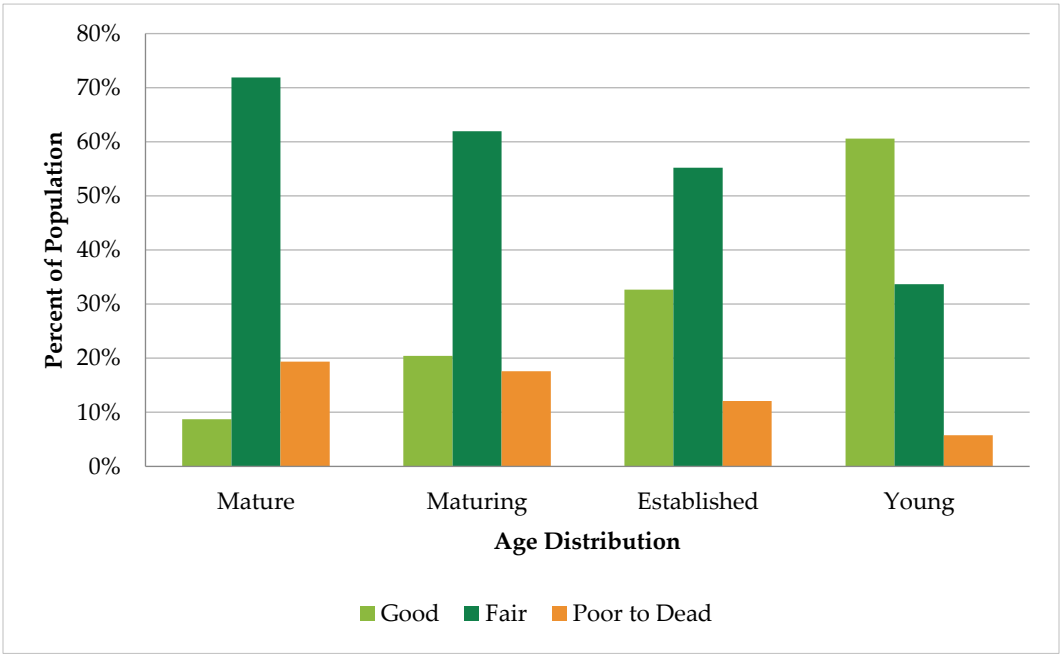


Figure 8. Condition of inventoried trees by relative age class.

Figure 8 cross analyzes the condition of the inventoried tree resource with its relative age distribution, providing insight into the inventoried population's stability. 81% of mature trees and 82% 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.

Relative Age Recommendations

While the City of Olean has a shortage of young trees and an abundance of mature trees, the City has a low percentage of trees that are dead or in Poor or Critical condition, indicating that young trees have the potential of reaching maturity if they are well maintained. Furthermore, replacing the dead and dying trees would further encourage a healthy age distribution. DRG recommends that the City Of Olean implement a robust maintenance program, to conserve the condition of young trees as they age so they replace removed trees and fill canopy gaps in maturity. We 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. Prioritizing proactive maintenance above tree planting will shift the relative age distribution towards the ideal over time.

DEFECT OBSERVATIONS

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

- Dead and dying parts
- Broken and/or hanging branches
- Cracks
- Weakly attached branches and codominant stems
- Missing or decayed wood
- Tree architecture
- Root problems
- Other

Table 1. Tree defect categories recorded during the inventory

Defect	Number of Trees	Percent
Dead and Dying Parts	2,078	49%
None	15	0%
Missing or Decayed Wood	577	14%
Weakly Attached Branches and Codominant Stems	1,259	30%
Tree Architecture	110	3%
Broken and/or Hanging Branches	36	1%
Root Problems	78	2%
Cracks	18	0%
Other	41	1%
Total	4,212	100%

The two most frequently recorded defect categories were Dead & Dying Parts and Weakly Attached Branches/Codominant Stems at 49% and 30% of inventoried trees, respectively (Table 1). Of the 2,078 trees with Dead & Dying Parts, 328 were 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 2021 the City of Olean 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.

Photograph 2. Tree with poor structure. Main leader has been lost, leaving a secondary leader with poor branch attachment

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 primary overhead utility lines above a tree or planting site was noted; it is important to consider this data when planning pruning activities and selecting tree species for planting.

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

Conflict	Presence	Number of Trees	Percent
Overhead Utilities	Present	977	23%
	Not Present	3,235	77%
Total		4,212	100%

Table 2 shows 977 street trees with primary electrical lines directly above, or passing through, the tree canopy. Of those trees, 57% were large or medium size trees.

There were 21 park trees with utilities directly above, or passing through, the tree canopy. Of those trees, 62% were large or medium size trees.

Photograph 3. Large tree planted on power lines.

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.

GROWING SPACE

Information about the type of the growing space was recorded. Growing space types are categorized as follows:

- *Median*—located between opposing lanes of traffic.
- *Planting Strip*—located between the street curb and the public sidewalk.
- *Well/Pit*—at grade level and completely surrounded by sidewalk.
- *Open Space*—open sites with restricted or unrestricted growing space.
- *Wooded Space*—located in areas that do not appear to be regularly maintained.

Most (53%) trees along the street ROW were located in the planting strip. The majority (99%) of vacant planting sites were also located in planting strips.

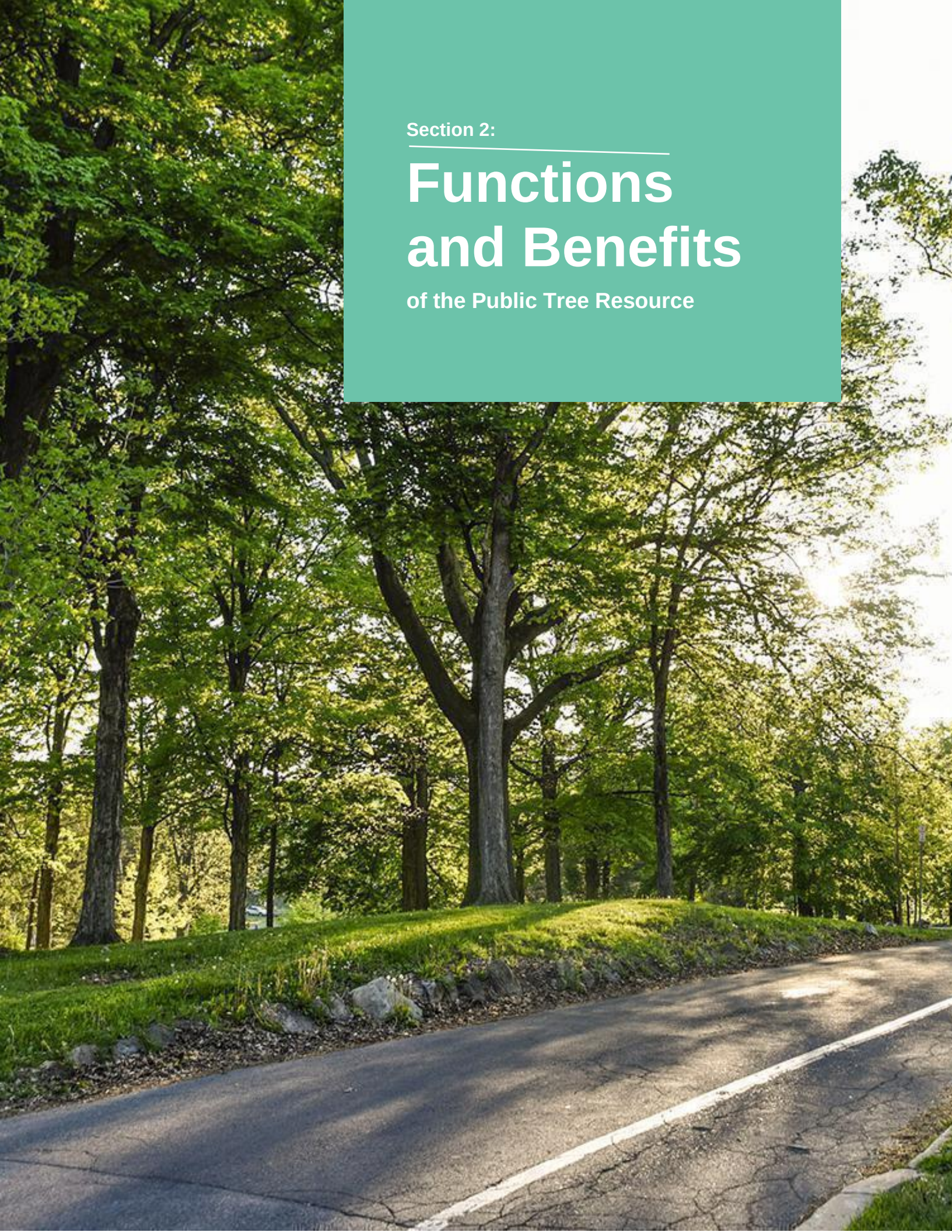
Growing Space Recommendations

To prolong the useful life of street trees, small-growing tree species should be planted in tree lawns 4–6 feet wide, medium-size tree species in tree lawns 6–8 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.

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 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

- 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).
- When surrounded by trees, physical signs of personal stress, such as muscle tension and pulse rate, were measurably reduced within three to four minutes (Ulrich 1991).

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. For more information on i-tree please visit; https://www.itreetools.org/

ANNUAL RETURN ON INVESTMENT FROM THE PUBLIC TREE RESOURCE

The i-Tree Eco analysis of the City of Olean'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 City's annual tree maintenance budget is $165,975.71, making the City of Olean's return on investment almost 11.4% annually.

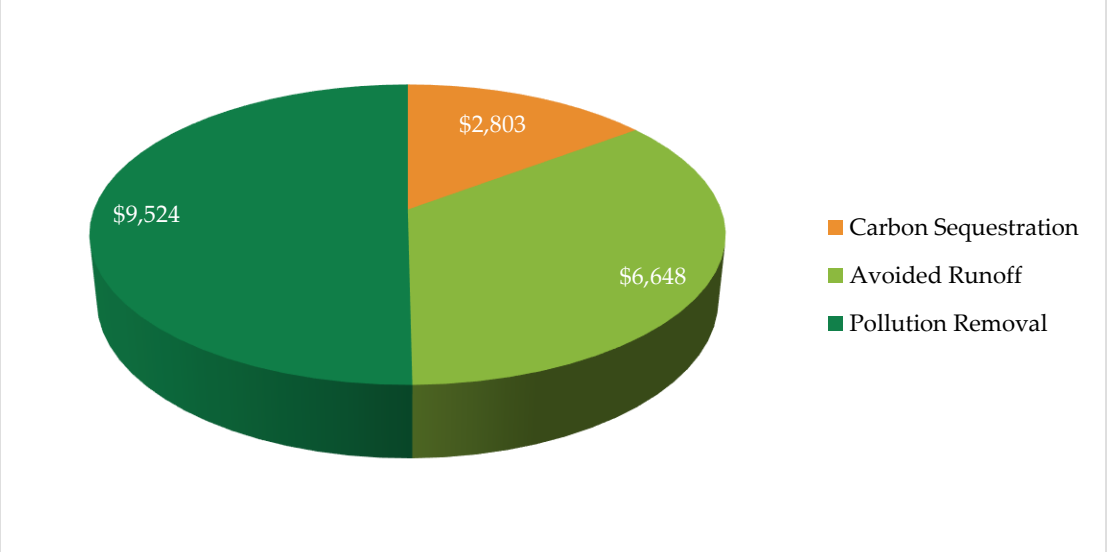


Figure 9. Estimated value of the benefits provided by inventoried trees.

Urban environments have unique challenges that make the estimated $18,975 of functional benefits provided by the City of Olean's inventoried tree population an essential asset to the City (Figure 9). Compared to rural landscapes, urban landscapes are characterized by high emissions in a relatively small area, valuing the 1,940 lbs. of airborne pollutants removed by Olean's tree resource at an estimated $9,524. Avoiding stormwater runoff reduces the risk of flooding and combined sewer overflow, both of which impact people, property, and the environment, valuing the 743,966 gals. of runoff avoided with the City of Olean's tree resource at an estimated $6,648.

Carbon dioxide (CO_2) also impacts people, property, and the environment as the primary greenhouse gas driving climate change, valuing the 32,860 lbs. sequestered by Olean's tree resource at an estimated $2,803.

The replacement value of the City's inventoried tree population is estimated to be $8,389,407. In the City of Olean, only eight species account for almost half of the public tree resource and half of the functional benefits it provides. If any 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 C 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. The City of Olean's inventoried trees have stored 9,314,120 lbs. of carbon, which is all the carbon each tree has amassed throughout their lifetimes and is valued at $794,265.43. White oak (*Quercus alba*) and silver maple (*Acer saccharinum)* store the most carbon: 8,638 lbs. per tree and 6,213 lbs. per tree, respectively. Black cherry (*Prunus serotina*) and eastern white pine (*Pinus strobus*) sequester the most carbon: 21 lbs. per tree per year and 20 lbs. per tree per year, respectively.

Table 3. Summary of benefits provided by inventoried trees

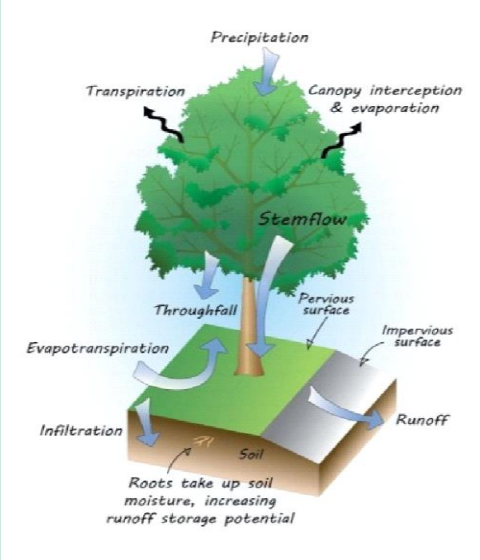
Species	Trees	Carbon Storage		Gross Carbon Sequestration		Avoided Runoff		Pollution Removal		Structural Value
	Number	(ton)	($)	(ton/yr)	($/yr)	(ft^3/yr)	($/yr)	(ton/yr)	($/yr)	($)
Norway maple	415	538.28	$91,803.62	1.53	$261.79	12,463.02	$833.10	0.12	1,194	$868,819.60
red maple	367	592.13	$100,987.71	1.14	$194.05	13,207.45	$882.86	0.13	1,265	$987,902.14
sugar maple	272	662.3	$112,955.65	2.32	$395.44	9,042.36	$604.44	0.09	866	$1,112,279.61
Crimson King Norway maple	207	241.1	$41,120.39	0.34	$58.39	5,623.70	$375.92	0.05	539	$256,707.97
thornless honeylocust	188	105.6	$18,009.68	0.55	$94.02	2,528.21	$169.00	0.02	242	$262,715.24
northern red oak	151	442.11	$75,401.67	1.03	$175.78	5,798.35	$387.60	0.06	555	$868,129.12
Japanese tree lilac	144	20.58	$3,509.83	0.35	$59.22	177.22	$11.85	0.00	17	$66,035.65
Freeman maple	134	148.52	$25,330.00	0.16	$26.61	3,602.76	$240.83	0.04	345	$159,019.02
littleleaf linden	134	36.64	$6,248.75	0.49	$83.46	1,788.89	$119.58	0.02	171	$173,535.11
Callery pear	117	21.9	$3,735.32	0.40	$67.97	693.85	$46.38	0.01	66	$69,261.08
Norway spruce	113	95.77	$16,334.16	0.56	$94.72	4,905.77	$327.93	0.05	470	$323,657.01
silver maple	110	341.71	$58,278.47	1.32	$224.73	8,343.35	$557.72	0.08	799	$339,147.66
hedge maple	98	35.31	$6,021.73	0.01	$1.93	1,770.12	$118.32	0.02	170	$86,233.54
white oak	98	423.25	$72,185.96	0.89	$152.45	5,423.06	$362.51	0.05	519	$722,517.55
green ash	92	42.59	$7,264.33	0.22	$37.77	898.59	$60.07	0.01	86	$92,747.65
elm spp	90	30.32	$5,170.82	0.35	$59.00	583.13	$38.98	0.01	55.8	$42,171.31
Total	4,212	4,657.06	$794,265.42	16.43	$2,802.55	99,453.77	$6,648.07	0.97	9,524	$8,389,406.69

CONTROLLING STORMWATER

Trees intercept rainfall with their leaves and branches, helping lower stormwater management costs by avoiding runoff. The inventoried trees in the City of Olean avoid 743,966 gals. of runoff annually. Avoided runoff accounts for 35% of the annual functional benefits provided by its public tree resource.

Of all species inventoried, red maple (*Acer rubrum*) contributed the most annual stormwater benefits. The red maple population (31% of inventoried trees) avoided 98,799 gals. of runoff. The most abundant species in the inventoried tree population, Norway maple (*A. platanoides*) (35%), avoided approximately 93,230 gals. of runoff. On a per-tree basis, large trees with leafy canopies provided the most functional benefits. Japanese tree lilac (*Syringa reticulata*) and silver maple (*A. saccharinum*) comprised 12% and 9% of the inventoried tree resource, respectively. Silver maple avoided 62,413 gals. of runoff, 98% more than the Japanese tree lilac did, despite having a lower population size. This illustrates how large-statured trees with wide canopies provide significantly greater benefits.

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.

Table 4. Summary of stormwater benefits provided by inventoried trees

Species Name	Number of Trees	Leaf Area	Potential Evapotranspiration	Evaporation	Transpiration	Water Intercepted	Avoided Runoff	Avoided Runoff Value
		(ac)	(ft^3/yr)	(ft^3/yr)	(ft^3/yr)	(ft^3/yr)	(ft^3/yr)	($/yr)
red maple	367	34.2	282,151.95	61,763.78	93,122.82	61,902.01	13,207.45	882.86
Norway maple	415	32.27	266,248.56	58,282.49	87,873.99	58,412.93	12,463.02	833.1
sugar maple	272	23.41	193,172.75	42,286.01	63,755.69	42,380.65	9,042.36	604.44
silver maple	110	21.6	178,239.66	39,017.12	58,827.1	39,104.44	8,343.35	557.72
northern red oak	151	15.01	123,870.57	27,115.59	40,882.86	27,176.27	5,798.35	387.6
Crimson King Norway maple	207	14.56	120,139.48	26,298.84	39,651.43	26,357.7	5,623.7	375.92
white oak	98	14.04	115,853.2	25,360.56	38,236.76	25,417.32	5,423.06	362.51
Norway spruce	113	12.7	104,802.34	22,941.5	34,589.48	22,992.84	4,905.77	327.93
Freeman maple	134	9.33	76,966.12	16,848.08	25,402.28	16,885.79	3,602.76	240.83
pin oak	56	7.92	65,332.06	14,301.36	21,562.52	14,333.36	3,058.18	204.43
thornless honeylocust	188	6.55	54,010.45	11,823.03	17,825.88	11,849.49	2,528.21	169
shagbark hickory	51	5.18	42,757.13	9,359.65	14,111.78	9,380.59	2,001.45	133.79
littleleaf linden	134	4.63	38,216.21	8,365.63	12,613.07	8,384.35	1,788.89	119.58

IMPROVING AIR QUALITY

The inventoried tree population annually removes about 1,940 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 $9,524, which is 50% of the value of all annual benefits. As shown in Figure 10, O_3 has the most lbs. removed in comparison to the other pollutants. The trees that provided the highest annual air quality benefits were silver maple and white oak, which removed 1.45 lbs. of pollutants per tree per year and 1.02 lbs. of pollutants per tree per year, respectively.

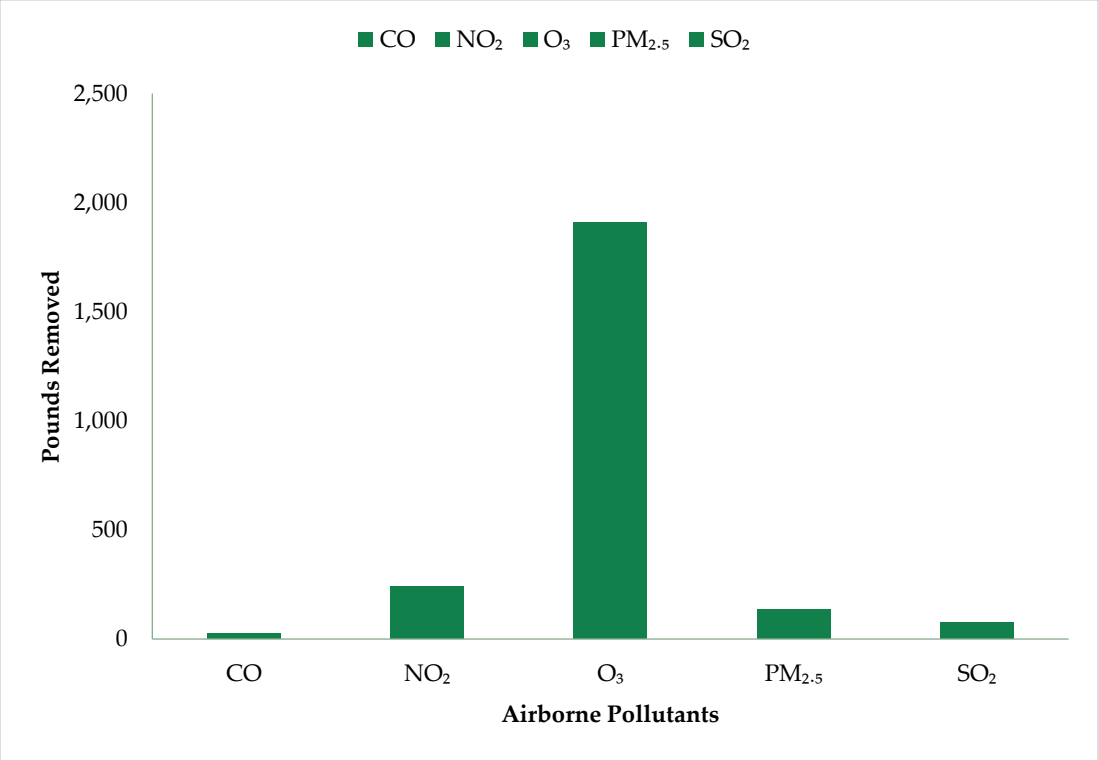


Figure 10. Estimated lbs. of airborne pollution removed.

Section 3:

Recommended Management

of the Public Tree Resource

Pyrus calleryana 'Cleveland select'.Trees located on 16th street

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 seven-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 11 and 12 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.

EXTREME AND HIGH PRIORITY RECOMMENDED MAINTENANCE

Pruning or removing Extreme and 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 Extreme and High Risk trees in a timely and proactive manner often requires significant resources to be secured and allocated. However, performing this work expediently will mitigate risk, improve public safety, and reduce long-term costs.

High Priority Pruning Recommendations

Extreme and 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 missing 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.

The inventory identified 0 Extreme Risk trees and 19 High Risk trees. The diameter size classes for trees with recommended high-priority pruning ranged between 13–18 inches DBH and 37–42 inches DBH. This maintenance should be performed immediately based on assigned risk rating and may be performed concurrently with other Extreme and High Risk removals. Going forward, City Arborists will identify trees that move into thesw categories, update the inventory and plan for timely removal.

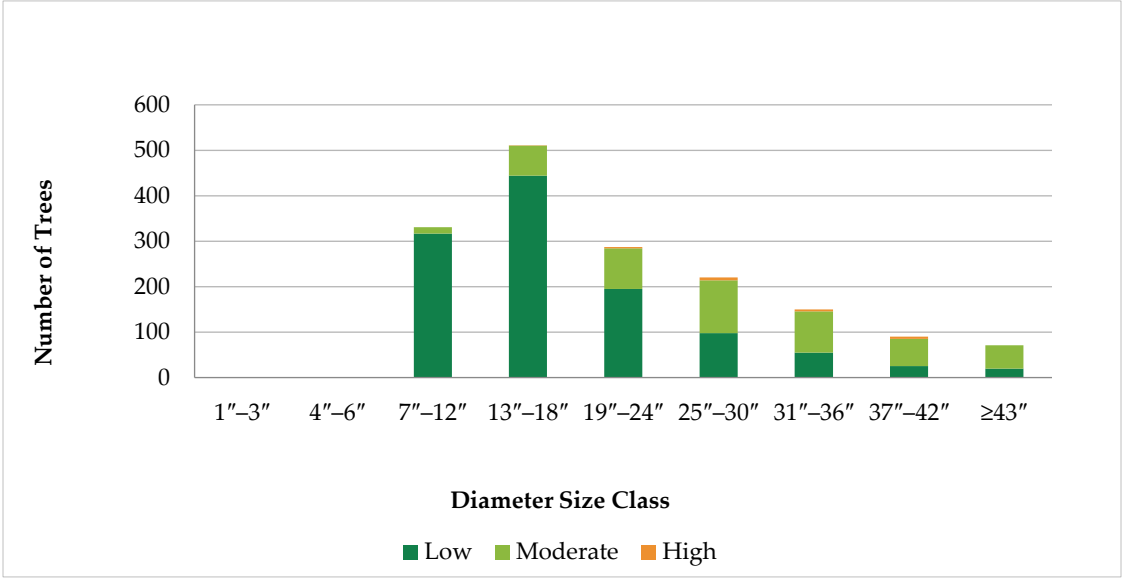


Figure 11. Recommended pruning by risk rating.

High Priority Removal Recommendations

DRG identified 0 Extreme Risk and 32 High Risk trees recommended for removal. The diameter size classes for High Risk trees ranged between 7–12 inches DBH and 37–42 inches DBH.

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.

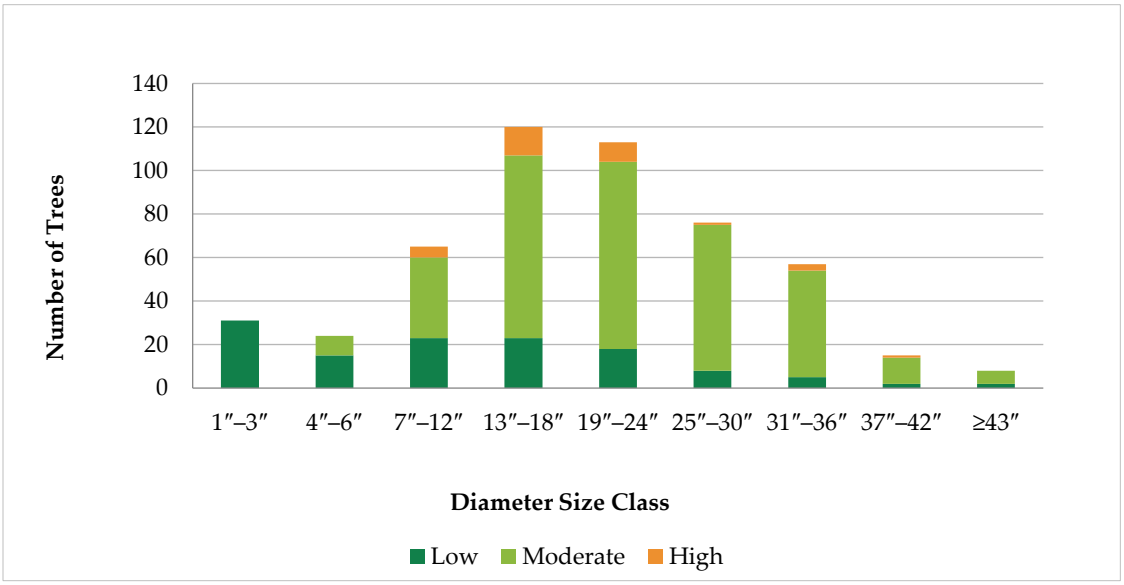


Figure 12. Recommended removal by risk rating.

FURTHER INSPECTION

In the ANSI A300 system, there are three levels of risk assessment. Each level is built on the one before it. The lowest level is designed to be a cost-effective approach to quickly identifying tree risk concerns; whereas, the highest level is intended to provide in-depth information to decide about a tree. These levels are:

- **Level 1** inspection is defined as a Limited Visual assessment, which is often conducted as a walk through or windshield survey designed to identify obvious defects or specified conditions.
- **Level 2** inspection is defined as a Basic assessment and is a detailed, 360-degree visual inspection of a tree and its surrounding site, and a synthesis of the information collected.
- **Level 3** inspection is an Advanced assessment and is performed to provide detailed information about specific tree parts, defects, targets, or site conditions. A Level 3 inspection may use specialized tools or require the input of an expert.

The Further Inspection data field indicates whether a tree requires additional and/or future inspections to assess and/or monitor conditions that may cause it to become a risk to people, property, or other trees. The inventory identified 122 requiring one of three inspection types. Further Inspections are beyond the scope of a standard tree inventory, and can be one of the following:

- **Multi-year Annual Inspection** (e.g., a healthy tree that has been impacted by recent construction, weather, or other damage).
- **Level 3 Risk Assessment** (e.g., a tree with a defect requiring additional or specialized equipment for investigation).
- **Insect/Disease Monitoring** (e.g., a tree that appears to have an emerging insect or disease problem).
- No further inspection required.

A Level 3 inspection was recommended for trees in which a defect was observed during the inventory and it warranted a closer inspection by a TRAQ qualified arborist. These trees were inspected utilizing an aerial bucket to provide the inspector access to the canopy of the tree in which most of the defects are located. Trees with a Further Inspection requirement should be assessed by an ISA certified arborist as soon as possible, because the longer serious defects are left unaddressed, the greater a risk that a tree becomes. For the same reason, the management that the arborist recommends should be performed as soon as possible to minimize risk.

Further Inspection Recommendations

The inventory found 61 trees recommended for an advanced Level 3 Risk Assessment, 32 trees recommended for Annual/Multi-year Inspections, and 29 trees noted for insect and disease monitoring. Unless already designated for removal, the 577 trees noted as having "Missing or Decayed Wood" should be inspected on a regular basis. Corrective action should be taken as soon as possible unless it will not adequately eliminate the defect, in which case tree removal is likely to be the safest and most cost-effective management.

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 487 Moderate Risk trees recommended for pruning. The diameter size classes for Moderate Risk trees ranged between 8–69 inches DBH.

Moderate Risk Removal Recommendations

DRG identified 350 Moderate Risk trees recommended for removal. Most Moderate Risk trees recommended for removal were in between 13–30 inches DBH. If corrective pruning cannot correct a tree's defects and/or adequately mitigate risk, then the tree should be removed. A total of 67 Moderate Risk trees larger than 31 inches DBH were recommended for removal. These trees should be removed as soon as possible after all Extreme High Risk removals and pruning have been completed.

Low Priority Pruning Recommendations

There were 1,154 Low Risk trees recommended for pruning. Of these Low Risk trees, 1,015 were recommended for Prune due to road, sidewalk, or sign clearance issues. Low Risk trees with the assigned maintenance of "Prune" should be included in a proactive Routine Pruning cycle after all the higher risk trees are addressed.

Photograph 4. Example of low priority pruning. Tree is located in Lincoln Park

Low Priority Removal Recommendations

DRG identified 127 Low Risk trees recommended for removal. Low Risk removals pose little threat; these trees are generally small, dead, volunteer, or poorly formed trees that need to be removed. 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. The City of Olean has a large population of trees that are susceptible to pests and diseases, including ash, maple, apple, and oak.

DRG recommends that the City of Olean 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. 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 "Routine Prune" or "Prune" maintenance recommendation. Primary maintenance recommendations for "Prune" are assigned over "Routine Prune" when a tree's canopy is a clearance issue for pedestrian and motor traffic and street sign legibility. 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.

DRG recommends seven-year Routine Pruning cycles to maintain the condition of the inventoried tree resource when assessing for a seven-year budget or a community with a limited maintenance budget. However, not all municipalities are able to remain proactive with a seven-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. Around 10 years or shortly after, tree condition deteriorates significantly without regular pruning. Once-minor defects have worsened, reducing tree health and potentially increasing risk (Miller and Sylvester 1981).

Routine Pruning Cycle Recommendations

DRG's inventory has identified 1,285 trees that should be routinely pruned, and DRG recommends that the City establish a seven-year Routine Pruning cycle. As stated previously, Low Risk Prunes are also recommended to be added to this cycle. Accounting for both maintenance categories in this seven-year cycle means approximately 488 trees should be pruned each year. If this is not feasible for the City of Olean, a ten-year Routine Pruning cycle, but no greater, could be considered due to the limited budget for annual tree maintenance. DRG recommends that the Routine Pruning cycle begins in Year One of the proposed seven-year program, after all Extreme and High Risk Recommended Maintenance is complete.

Approximately 31% of the inventoried tree population would benefit from routine pruning. Figure 11 shows that a variety of size classes recommended for pruning; however, most of the trees were 7"–18" or smaller DBH.

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.

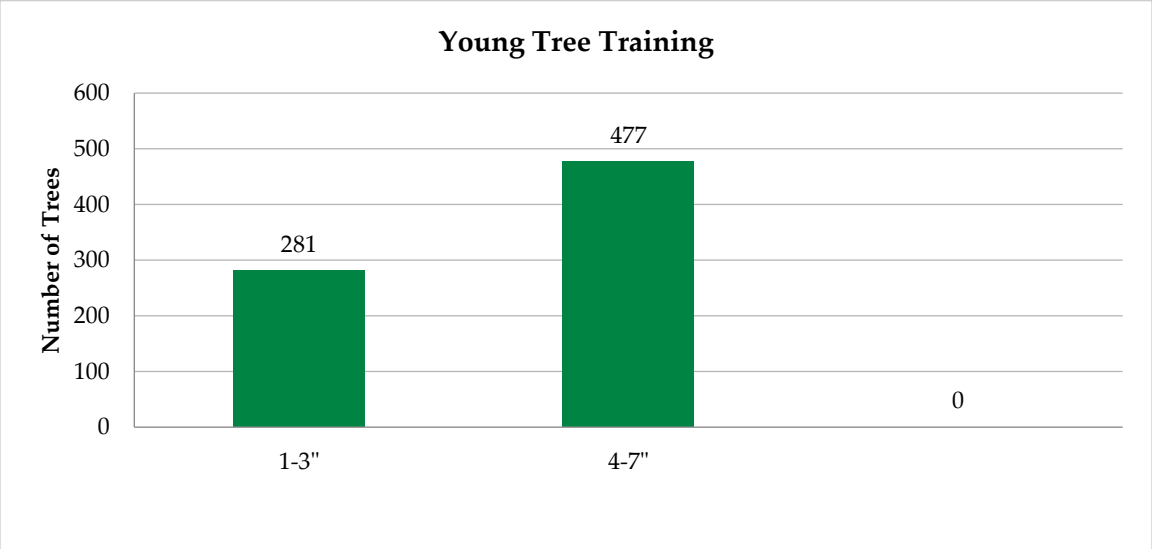


Figure 13. Three-year Young Tree Training cycle by size class.

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 the City of Olean implement a three-year Young Tree Training cycle beginning after the completion of all High Risk Recommended Maintenance activities. During the inventory, 758 trees less than or equal to 7 inches DBH were inventoried and recommended for young tree training. Since the City of Olean has a limited number of young trees to preserve, while attempting to add future plantings, the Young Tree Training cycle is vital for the future condition of the inventoried tree population. DRG recommends that an average of 253 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 City should strive to training 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 the City of Olean as a whole receives value from the ecosystem services provided by the public tree resource, those benefits usually are not distributed evenly across the City.

"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.

Tree Planting and Stump Removal Recommendations

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 or planting strips in existing sidewalks of sufficient width. Ideally, the minimum growing space of a small-sized tree is 32 square feet or 48 feet wide. Where the City of Olean has sidewalks of a sufficient width and length, it 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.
- Installing permeable paving for sidewalks and parking lots allows for water to pass through the hardscape and allows the trees to benefit even in the presence of infrastructure.

The inventory identified 109 stumps recommended for removal, with a wide range of sizes from 2" to 66" in diameter. Stump removals should occur when convenient and be included in 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 C. These tree species are specifically selected for the climate of the City of Olean. 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 2021 City of Olean 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. A complete table of estimated costs for the City of Olean's seven-year tree management program follows.

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

To implement the maintenance schedule, the City of Olean's tree maintenance budget should be:

- No less than $158,953 for the first year of implementation.
- No less than $148,058 for the second and third years.
- No less than $142,781 for the fourth and fifth years.
- No less than $113,731 for the final two years of the maintenance schedule.

Annual budget funds are needed to ensure that Extreme and 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.

When speaking with the City Forester, it was made clear the City has not devoted a budget in the past that would support the proposed budget in this report. It is the intent of the management report to guide the City in supporting the budget necessary to achieve a healthy and robust urban forest. It is recommended the City of Olean pursue future NYSDEC grants for maintenance and plantings. Other suggestions include fundraisers within the community for tree plantings, Arbor Day Grants, and other Federal Grants as they are made available. If the City would like assistance with future endeavors of seeking funding or reviewing how other communities in New York increase their budgets, DRG can provide assistance as well as the local NYSDEC Urban Forester.

Table 5. Estimated budget for recommended seven-year tree resource management program

Estimated Costs for Each Activity			Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		Ten-Year Cost
Activity	Diameter	Cost/Tree	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	
High Risk Removals	1-3	$28	-	-	-	$0	-	-	-	-	-	-	-	-	-	-	$0
	4-6	$58	0	$0	0	$0	-	-	-	-	-	-	-	-	-	-	$0
	7-12	$138	5	$690	0	$0	-	-	-	-	-	-	-	-	-	-	$690
	13-18	$314	13	$4,082	0	$0	-	-	-	-	-	-	-	-	-	-	$4,082
	19-24	$605	9	$5,445	0	$0	-	-	-	-	-	-	-	-	-	-	$5,445
	25-30	$825	1	$825	0	$0	-	-	-	-	-	-	-	-	-	-	$825
	31-36	$1,045	3	$3,135	0	$0	-	-	-	-	-	-	-	-	-	-	$3,135
	37-42	$1,485	1	$1,485	0	$0	-	-	-	-	-	-	-	-	-	-	$1,485
	>43	$2,035	0	$0	0	$0	0	$0	0	$0	0	$0	0				$0
Activity Total(s)			**32**	**$15,662**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$15,662**
Moderate and Low Risk Removals	1-3	$28	4	$112	4	$112	5	$140	4	$112	5	$140	5	$140	5	$140	$896
	4-6	$58	3	$174	4	$232	3	$174	4	$232	3	$174	3	$174	3	$174	$1,334
	7-12	$138	9	$1,242	9	$1,242	8	$1,104	8	$1,104	9	$1,242	9	$1,242	9	$1,242	$8,418
	13-18	$314	15	$4,710	15	$4,710	16	$5,024	15	$4,710	15	$4,710	15	$4,710	15	$4,710	$33,284
	19-24	$605	15	$9,075	15	$9,075	15	$9,075	15	$9,075	15	$9,075	15	$9,075	15	$9,075	$63,525
	25-30	$825	11	$9,075	11	$9,075	10	$8,250	11	$9,075	10	$8,250	10	$8,250	10	$8,250	$60,225
	31-36	$1,045	8	$8,360	8	$8,360	8	$8,360	7	$7,315	8	$8,360	8	$8,360	8	$8,360	$57,475
	37-42	$1,485	2	$2,970	2	$2,970	2	$2,970	2	$2,970	2	$2,970	2	$2,970	2	$2,970	$20,790
	>43	$2,035	2	$4,070	1	$2,035	1	$2,035	1	$2,035	**1**	$2,035	**1**		**1**		**$12,210**
Activity Total(s)			**69**	**$35,718**	**69**	**$35,776**	**68**	**$35,097**	**67**	**$34,593**	**68**	**$34,921**	**67**	**$34,921**	**67**	**$34,921**	**$245,947**
High and Moderate Risk Pruning	1-3	$20	0	-	0	-	0	-	0	-	0	-	0	-	0	-	$0
	4-6	$30	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	0	$0
	7-12	$75	0	$0	5	$375	5	$375	5	$375	0	$0	0	$0	0	0	$1,125
	13-18	$120	10	$1,200	22	$2,640	22	$2,640	12	$1,440	0	$0	0	$0	0	0	$7,920
	19-24	$170	23	$3,910	20	$3,400	30	$5,100	20	$3,400	0	$0	0	$0	0	0	$15,810
	25-30	$225	26	$5,850	29	$6,525	34	$7,650	34	$7,650	0	$0	0	$0	0	0	$27,675
	31-36	$305	24	$7,320	21	$6,405	26	$7,930	26	$7,930	0	$0	0	$0	0	0	$29,585
	37-42	$380	20	$7,600	29	$11,020	20	$7,600	15	$5,700	0	$0	0	$0	0	0	$31,920
	>43	$590	0	$0	17	$10,030	17	$10,030	17	$10,030	**0**	**$0**	**0**	**$0**	**0**	**$0**	
Activity Total(s)			**103**	**$25,880**	**143**	**$30,365**	**137**	**$31,295**	**112**	**$26,495**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$114,035**
Low Risk Pruning	1-3	$20	0	-	0	-	0	-	0	-	0	-	0	-	0	-	$0
	4-6	$30	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12	$75	14	$1,050	14	$1,050	14	$1,050	14	$1,050	14	$1,050	14	$1,050	14	$1,050	$7,350
	13-18	$120	164	$19,680	164	$19,680	164	$19,680	164	$19,680	164	$19,680	164	$19,680	164	$19,680	$137,760
	19-24	$170	85	$14,450	85	$14,450	85	$14,450	85	$14,450	85	$14,450	85	$14,450	85	$14,450	$101,150
	25-30	$225	49	$11,025	49	$11,025	49	$11,025	49	$11,025	49	$11,025	49	$11,025	49	$11,025	$77,175
	31-36	$305	25	$7,625	25	$7,625	25	$7,625	25	$7,625	25	$7,625	25	$7,625	25	$7,625	$53,375
	37-42	$380	9	$3,420	9	$3,420	9	$3,420	9	$3,420	9	$3,420	9	$3,420	9	$3,420	$23,940
	>43	$590	5	$2,950	5	$2,950	5	$2,950	5	$2,950	5	$2,950	5	$2,950	5	$2,950	
Activity Total(s)			**351**	**$57,250**	**346**	**$57,250**	**346**	**$57,250**	**346**	**$57,250**	**346**	**$57,250**	**346**	**$57,250**	**346**	**$57,250**	**$400,750**
Young Tree Training (3-year cycle)	all sizes	$30	252	$7,560	252	$7,560	252	$7,560	252	$7,560	252	$7,560	252	$7,560	252	$7,560	$52,920
Activity Total(s)			**252**	**$7,560**	**252**	**$7,560**	**252**	**$7,560**	**252**	**$7,560**	**252**	**$7,560**	**252**	**$7,560**	**252**	**$7,560**	**$52,920**
Tree Planting	Purchasing and Planting	$280	50	$14,000	50	$14,000	50	$14,000	50	$14,000	50	$14,000	50	$14,000	50	$14,000	$98,000
Activity Total(s)			**50**	**$14,000**	**50**	**$14,000**	**50**	**$14,000**	**50**	**$14,000**	**50**	**$14,000**	**50**	**$14,000**	**50**	**$14,000**	**$98,000**
Stump Removals	1-3	$18	1	$18	1	$18	1	$18	1	$18	0	$0	0	$0	0	$0	$70
	4-6	$28	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12	$44	6	$264	6	$264	6	$264	6	$264	0	$0	0	$0	0	$0	$1,056
	13-18	$72	5	$358	5	$358	5	$358	5	$358	0	$0	0	$0	0	$0	$1,430
	19-24	$94	6	$561	6	$561	6	$561	6	$561	0	$0	0	$0	0	$0	$2,244
	25-30	$110	7	$770	7	$770	7	$770	7	$770	0	$0	0	$0	0	$0	$3,080
	31-36	$138	2	275	2	$275	2	$275	2	$275	0	$0	0	$0	0	$0	$1,100
	37-42	$160	4	638	4	$638	4	$638	4	$638	0	$0	0	$0	0	$0	$2,552
	>43	$182	5	910	5	$910	5	$910	5		0		0				
Activity Total(s)			**36**	**$2,883**	**31**	**$2,883**	**31**	**$2,883**	**31**	**$2,883**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$11,532**
Activity Grand Total			**893**		**891**		**884**		**858**		**716**		**715**		**715**		**0**
Cost Grand Total				**$158,953**		**$147,834**		**$148,085**		**$142,781**		**$113,731**		**$113,731**		**$113,731**	**$938,846**

CONCLUSION

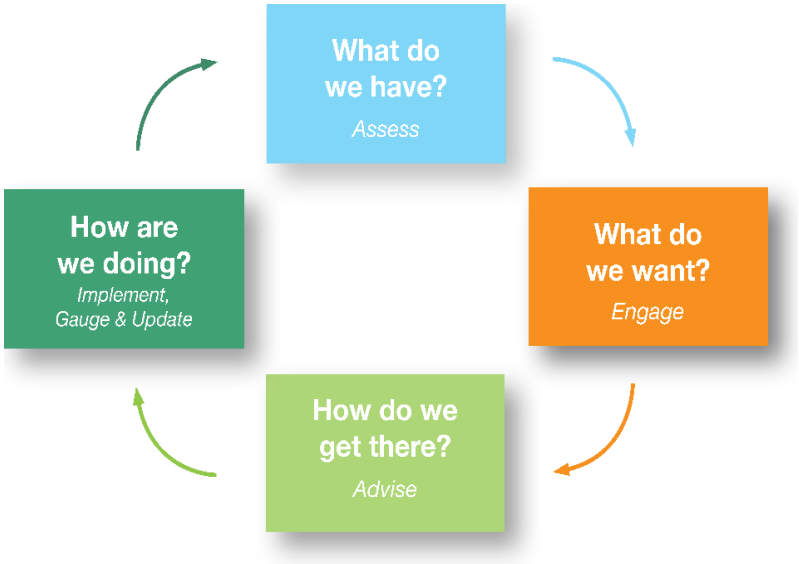
When properly maintained, the valuable benefits trees provide over their lifetime far exceed the time and money invested in planting, pruning, and inevitably removing them. The 4,212 public trees inventoried provide $18,973 in estimated annual economic value. Successfully implementing the seven-year program may increase the City of Olean's Return of Investment over time, or at least maintain it over the years.

The program is ambitious and is a challenge to complete in seven years but becomes easier after all high priority tree maintenance is completed. This *Standard Inventory Analysis and Management Plan* could potentially help the City advocate for an increased urban forestry budget to fund the recommended maintenance activities. 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 City of Olean and its residents will increase as well. Inventoried trees are only a fraction of the total trees in the City of Olean when including private property and wooded stands, which is why it is important to also incentivize private landowners to care for their trees and to plant new ones. The City'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 *Standard Inventory Analysis and Management Plan* provides management priorities for the next seven 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 the City of Olean to self-assess its 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:



- Prepare planting plans well enough in advance to schedule and complete stump removal in the designated area, and to select species best suited to the available sites.
- Annually comparing the number of trees planted to the number of trees removed and the number of vacant planting sites remaining, then adjusting future planting plans accordingly.
- Annually comparing the species distribution of the inventoried tree resource with the previous year after completing planting plans to monitor recommended changes in abundance.
- Schedule and assign high-priority tree work so it can be completed as soon as possible instead of reactively addressing new lower priority work requests as they are received.
- Include data collection such as measuring DBH and assessing condition into standard procedure for tree work and routine inspections, so changes over time can be monitored.

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GLOSSARY

address (data field): The address number was recorded based on parcel data within the GIS data collection program and confirmed with visual observation of the actual address number posted on a building at the inventoried site. In instances where there was no posted address number on a building or sites were located by vacant lots with no GIS parcel addressing data available, the address number assigned was matched as closely as possible to opposite or adjacent addresses by the arborist(s) and the suffix field (assigned address field) was set to "X".

air pollution removal: In i-Tree Eco, air pollution removal refers to the removal of ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and particulate matter less than 2.5 microns ($PM_{2.5}$).

American National Standards Institute (ANSI): ANSI is a private, nonprofit organization that facilitates the standardization work of its members in the United States. ANSI's goals are to promote and facilitate voluntary consensus standards and conformity assessment systems, and to maintain their integrity.

***ANSI A300*:** Tree care performance parameters established by ANSI that can be used to develop specifications for tree maintenance.

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

assigned address (data field): see **suffix**

avoided runoff: In i-Tree Eco, avoided runoff measures the amount of surface runoff avoided when trees intercept rainfall during precipitation events.

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

canopy cover: As seen from above, it is the area of land surface that is covered by tree canopy.

Carbon Monoxide (CO): A colorless, odorless, highly toxic gas formed as a result of the incomplete combustion of a carbon or carbon compound.

carbon sequestration: The capture and storage of carbon from the Earth's atmosphere. In i-Tree Eco, carbon sequestration is calculated as an annual functional benefit of trees.

carbon storage: Storage of carbon in plant tissue. In i-Tree Eco, carbon storage is calculated as a structural benefit over the lifetime of the tree.

clean (secondary maintenance need): The tree has dead or diseased parts greater than 2 inches in diameter which should be removed to improve tree health, appearance, and to reduce associated risk.

comments (data field): Additional comments on the state of the inventoried site. Comments may include additional defects that were significant but not the primary defect, explanations for why further inspection is needed, and other general information considered important by the inventory arborist.

commercial (land use): Land used for the buying and selling of commercial goods. This land use type includes stores, restaurants, hospitals, and other businesses which provide goods or services for a fee. Although churches do not necessarily fit well under this category, they were included under the umbrella of commercial land, since they do not fit better into any other land use category included in the inventory.

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.

critical (condition rating): The tree has a major structural problem that presents an unacceptable risk, has very little vigor, and/or has an insect or disease problem that is fatal.

cycle: Planned length of time between vegetation maintenance activities.

dead (condition rating): A dead tree shows no signs of life.

defect: See **structural defect**.

defect (data field): The primary defect noted by the inventory arborist. Defects include missing or decayed wood, dead or dying parts, broken or hanging branches, weakly attached branches and codominant stems, cracks, root problem, tree architecture, other, and none.

diameter: See **tree size**.

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

excellent (condition rating): A tree in perfect or nearly perfect condition, vigor, and form. This is a rarely used condition category.

extreme-risk tree: Applies in situations where tree failure is imminent, 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 in order to prevent injury.

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.

fair (condition rating): A fair tree has minor problems that may be corrected with time or corrective action.

functional benefit: In i-Tree Eco, a benefit which is due to the physiological processes carried out by trees, calculated on an annual basis.

further inspection (data field): Notes that a specific tree may require an annual inspection for several years to make certain of its maintenance needs. A healthy tree obviously impacted by recent construction serves as a prime example. This tree will need annual evaluations to assess the impact of construction on its root system. Another example would be a tree with a defect requiring additional equipment for investigation.

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 provide 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.

good (condition rating): A tree in good condition shows no major problems.

hardscape damage (data field): Diversion of hardscape by tree roots by at least ½ inch.

high-risk tree: 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.

industrial (land use): Land used to produce goods. Factories, warehouses, and associated parking are included in this land use.

insect/disease monitoring (further inspection): A tree which requires additional inspection by an entomologist or tree disease specialist to determine whether or not there is an emergent pest or disease present.

invasive tree: A tree species that is out of its original biological community. Its introduction into an area causes or is likely to cause economic or environmental harm, or harm to human health. An invasive, exotic tree has the ability to thrive and spread aggressively outside its natural range. An invasive species that colonizes a new area may gain an ecological edge since the insects, diseases, and foraging animals that naturally keep its growth in check in its native range are not present in its new habitat.

inventory: See **tree inventory**.

i-Tree Eco: i-Tree Eco is a street tree management and analysis tool that uses tree inventory data to quantify the dollar value of annual environmental benefits, including runoff reduction, air pollution reduction, and carbon sequestration, as well as life-long structural benefits trees provide, including carbons storage and structural value.

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. While i-Tree Streets was not used for the tree benefits analysis in this management plan, it is still used as the basis for the tree benefits tab in TreeKeeper®.

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.

level 3 assessment (further inspection): A more in-depth assessment than the level 2 assessment conducted during the inventory which requires specialized equipment or training to complete.

low-risk tree: 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.

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

median (grow space type): Strip of landscaped area which divides lanes of traffic. The center of traffic circles is included in this grow space type.

memorial/donated/plaque (data field): indicates whether a tree is designated as a memorial or donated tree based on signifiers visible in the field at the time of the inventory.

moderate-risk tree: 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.

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

multi-stem (data field): Indicates whether a tree has multiple trunks splitting less than 1.5 feet above ground level. For this inventory, multi-stem trees were measured below the trunk split or at ground level in cases where multiple stems originated from a branching point below grade.

multi-year annual (further inspection): Designates a tree which should be inspected annually or biannually to monitor a defect for improvement or degradation.

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.

none (risk rating): Equal to zero. It is used only for planting sites and stumps, or as a residual risk rating when a tree is recommended for removal.

open space (grow space type): Unrestricted, maintained growing space located behind the sidewalk, if sidewalk is present, or behind the curb of a street if sidewalk is not present. Most sites within privately owned lawns fall into this grow space type.

ordinance: See **tree ordinance**.

overhead utilities (data field): Any overhead utility lines including primary and secondary electrical distribution lines, telecommunication lines, service drops, streetlight supply lines, etc.

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.

park (land use): Open land set aside for public recreation.

park name (data field): The park or public grounds on which a site was located. If a site was within the street ROW, the park name field was set to N/A.

Particulate Matter ($PM_{2.5}$): A major class of air pollutants consisting of tiny solid or liquid particles of soot, dust, smoke, fumes, and mists.

planting strip (grow space type): Also known as a **tree lawn**, a strip of landscaped area located between the sidewalk and the road.

plant tree (primary maintenance need): Used only for sites which do not currently host a tree, but which could be viable planting sites. Indicates the need to plant a tree.

poor (condition rating): A tree in poor condition has major problems that are irrecoverable.

primary maintenance need (data field): The type of tree work recommended to reduce immediate risk or fulfill other goals.

prune (primary maintenance need): The tree needs priority pruning to remove dead limbs, provide clearance, remove an obstruction, or thin the canopy.

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

public grounds (land use): Public land used for purposes other than public recreation (see **park**). Includes city offices or publicly owned lots.

raise (secondary maintenance need): The tree has limbs which are obstructing pedestrian or vehicle traffic or obscuring streetlights, signs, or signals. These limbs should be raised to provide appropriate clearance and reduce associated risk.

reduce (secondary maintenance need): The tree has limbs which are interfering with overhead utilities or nearby buildings. These limbs should be reduced to provide appropriate clearance and reduce associated risk.

remove (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.

replacement value: See **structural value**.

residential (land use): Privately owned land used to house people. Includes apartments, condos, and single-family homes.

residual risk (data field): The risk rating of a tree after the recommended primary maintenance has been carried out. Residual risk may be equal to but never greater than the original risk rating.

resilience: The ability of a community to absorb disturbance and reorganize while undergoing change to retain essentially the same function, structure, identity, and feedbacks as prior to the disturbance.

resistance: The ability of a community to remain unchanged when challenged by a disturbance such as pests, severe weather, or climate change.

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

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

risk assessment complete (data field): Indicates whether the arborist was able to complete a Level 2 qualitative risk assessment. Arborists may not be able to fully assess tree risk due to embankments, homeowner conflicts, fences, or other obstacles to getting a 360 degree view of the tree.

risk rating (data fields): Level 2 qualitative risk assessment will be performed on the ANSI A300 (Part 9) and the companion publication *Best Management Practices: Tree Risk Assessment*, published by International Society of Arboriculture (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.

routine prune (primary maintenance need): The tree requires no immediate pruning but should be included in a routine pruning cycle to maintain condition over time.

secondary maintenance need (data field): A further description of the work needed to reduce immediate risk when the primary maintenance need is prune.

side (data field): Each site is assigned a side value to aid in locating the site. Side values include: *front*, *side, median* (includes islands), and *rear* based on the site's location in relation to the assigned address.

site: Any point for which data was recorded during the inventory, including trees, vacant sites, and stumps.

species (data field): 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.

structural benefit: In i-Tree Eco, a benefit which is produced by the physical arrangement and composition of trees and tree parts and which is calculated as an aggregate over the lifetime of a tree.

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

structural value: In i-Tree Eco, the compensatory value calculated based on the local cost of having to replace a tree with a similar tree.

stump removal (Primary Maintenance Need): Indicates a stump that should be removed.

suffix (data field): Data field indicating whether the address was assigned by the arborist.

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.

thin (secondary maintenance need): The tree has very densely spaced limbs in the crown which should be thinned to improve tree health, provide appropriate air flow within the crown, and improve tree aesthetics.

topping: Characterized by reducing tree size using internodal cuts without regard to tree health or structural integrity; this is not an acceptable pruning practice.

train (primary maintenance need): A young or small size tree that requires routine structural pruning to ensure good form as it grows.

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.

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 height (data field): Estimated height of the tree, either more than or less than fifty feet.

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

tree lawn: see **planting strip**.

tree ordinance: Tree ordinances are policy tools used by communities striving to attain a healthy, vigorous, and well-managed urban forest. Tree ordinances simply provide the authorization and standards for management activities.

tree pit: see **well/pit**.

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 well: see **well/pit**.

underground utilities (data field): Any buried utility conduits, including buried electrical distribution or telecommunication lines, water and gas lines, and sewers, among others.

urban forest: All 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.

very good (condition rating): Overall, the tree is healthy in condition, vigor, and form. The tree has no major structural problems, no mechanical damage, and no aesthetic, insect, disease, or structural problems.

volunteer: A tree that was not intentionally planted, but rather grew naturally in a location and has been allowed to remain as part of the maintained landscaping.

well/pit (growing space type): A growing space completely surrounded by hardscape, typically sidewalk, and generally constrained in area in all dimensions.

wooded space (grow space type): An unmaintained area typically located behind the curb or sidewalk and usually hosting volunteer trees.

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. 2021 Imagery was provided for the inventory and TreeKeeper®.

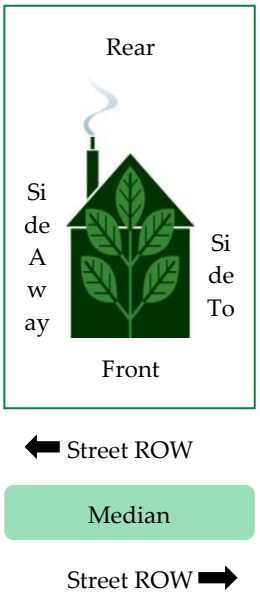
STREET ROW SITE LOCATION

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.

PARK AND PUBLIC SPACE SITE LOCATION

Park 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 "Park Name" data field filled.

Site Location Example

Corner Lot A

Address/Street Name:	205 Hoover St.
Side/Site Number:	Side To / 1
On Street:	Taft St.
From Street:	E Mac Arthur St.
To Street:	Hoover St.
Address/Street Name:	205 Hoover St.
Side/Site Number:	Side To / 2
On Street:	Taft St.
From Street:	E Mac Arthur St.
To Street:	Hoover St.
Address/Street Name:	205 Hoover St.
Side/Site Number:	Side To / 3
On Street:	Taft St.
From Street:	19th St.
To Street:	Hoover St.
Address/Street Name:	205 Hoover St.
Side/Site Number:	Front / 1

Corner Lot B

Address/Street Name:	226 E Mac Arthur St.
Side/Site Number:	Side To / 1
On Street:	Davis St.
From Street:	Hoover St.
To Street:	E Mac Arthur St.
Address/Street Name:	226 E Mac Arthur St.
Side/Site Number:	Front / 1
On Street:	E Mac Arthur St.
From Street:	Davis St.
To Street:	Taft St.
Address/Street Name:	226 E Mac Arthur St.
Side/Site Number:	Front / 2
On Street:	E Mac Arthur St.
From Street:	Davis St.
To Street:	Taft St.

i-TREE ECO METHODOLOGY

Structural value (also called replacement value) is a compensatory value calculated based on the local cost of having to replace a tree with a similar tree. In other words, it is a measurement of the value of the resource itself. The structural value of an urban forest is the sum of the structural values of all the individual trees contained within. Monetary values are assigned based on valuation procedures of the Council of Tree and Landscape Appraisers using information on species, diameter, condition, and location (McPherson 2007) and (Nowak et al. 2008).

Carbon sequestration refers to the capture and storage of carbon from the earth's atmosphere. i-Tree Eco analysis reports on the gross annual amount of carbon sequestered as well as the total amount of carbon stored over the lifetime of the tree. For this analysis, carbon storage and sequestration values are calculated at a rate of $170.55 per ton.

Air pollution removal refers to the removal of ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and particulate matter less than 2.5 microns ($PM_{2.5}$). For this analysis, the pollution removal value is calculated based on the prices of $2.39 per pound of ozone, $0.10 per pound of sulfur dioxide, $0.33 per pound of nitrogen dioxide, $0.66 per pound carbon monoxide, and $93.65 per pound of particulate matter less than 2.5 microns.

Avoided runoff measures the amount of surface runoff avoided when trees intercept rainfall during precipitation events. Surface runoff from rainfall contributes to the contamination of streams, rivers, lakes, and wetlands by washing oils, pesticides, and other pollutants, either directly into waterways or into drainage infrastructure that ultimately empties into waterways. For this analysis, annual avoided runoff is calculated based on the estimated amount of intercepted rainfall and the local weather in Glens Falls, where annual precipitation in 2016 equaled 32.4 inches. The monetary value of avoided runoff is based on the U.S. Forest Service's Community Tree Guide Series at a rate of $0.076 per cubic foot

Treekeeper Search

Searching for specific trees, recommended work or general information can be easily executed in Treekeeper. Located within treekeeper there is a Support Portal, top right corner, this icon will open a new window and allow the user to choose from a variety of formats for tutorials on how to utilize Treekeeper. If the user desires, they can also download all the data into an excel sheet and search for specific data that they need. Instructions can be found in the support portal on how to download the excel sheet. If the City of Olean should invest in an ESRI platform the data collected could be integrated into their system.

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 over winter 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 City, 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.

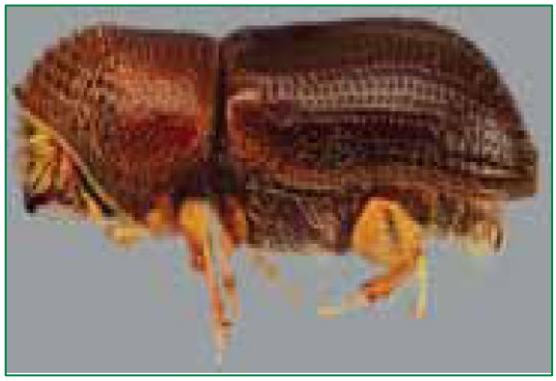
Photograph courtesy of USDA APHIS (2019)

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*) 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.

Hemlock woolly adelgids on a branch.

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

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

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
SUGGESTED TREE SPECIES FOR USDA HARDINESS ZONES 4 AND 5

USDA HARDINESS ZONE 4

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 Zones 5 and 6 on the USDA Plant Hardiness Zone Map.

Deciduous Trees

Large Trees (greater than 50 feet in height when mature)

Scientific Name	Common Name	Cultivar
Acer rubrum	red maple	'Red Sunset'
Betula papyrifera	paper birch	
Catalpa speciosa	northern catalpa	
Celtis occidentalis	common hackberry	'Prairie Pride'
Ginko biloba	ginko	'Autumn Gold'
Gleditsia triacanthos var. *inermis*	thornless honeylocust	'Shademaster' 'Skyline'
Gymnocladus dioicus	Kentucky coffeetree	
Juglans nigra	black walnut	'Laciniata'
Quercus macrocarpa	bur oak	
Quercus rubra	northern red oak	
Tilia americana	American linden	'Redmond'
Tilia cordata	Littleleaf linden	'Greenspire'
Ulmus americana	American elm	'Princeton' 'Valley Forge'

Medium Trees (26 to 50 feet in height when mature)

Scientific Name	Common Name	Cultivar
Aesculus glabra	Ohio buckeye	
Betula pendula	European white birch	
Gleditsia triacanthos var. *inermis*	thornless honeylocust	'Imperial'
Ostrya virginiana	American hophornbeam	
Phellodendron amurense	Amur corktree	
Prunus cerasus	sour cherry	'Montmorency' 'Northstar'
Prunus maackii	Amur chokecherry	
Sorbus aucuparia	European mountainash	'Beissneri'
Sorbus decora	showy mountainash	

Small Trees (10 to 25 feet in height when mature)

Scientific Name	Common Name	Cultivar
Acer ginnala	amur maple	
Acer grandidentatum	bigtooth maple	
Acer tataricum	Tatarian maple	
Aesculus × *carnea*	red horsechestnut	'Briotii'
Crataegus ambigua	Russian hawthorn	
Crataegus crusgalli var. *inermis*	thornless cockspur hawthorn	'Crusader'
Crataegus viridis	green hawthorn	'Winter King'
Malus spp.	crabapple spp.	'Centennial' 'David' 'Harvest Gold' 'Madonna' 'Prairifire' 'Spring Snow'
Prunus cerasifera	cherry plum	'Newport'
Prunus nigra	Canada plum	'Princess Kay'
Prunus padus	European birdcherry	
Prunus virginiana	common chokecherry	'Canada Red'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

Coniferous and Evergreen Trees

Large Trees (greater than 50 feet in height when mature)

Scientific Name	Common Name	Cultivar
Abies concolor	white fir	'Violacea'
Larix deciduas	European larch	
Picea glauca	white spruce	
Picea pungens	Colorado spruce	
Picea pungens var. *glauca*	Colorado blue spruce	'Thompsenii'
Pinus nigra	Austrian pine	
Pinus ponderosa	ponderosa pine	
Pinus sylvestris	Scotch pine	
Pseudotsuga menziesii	Douglas-fir	
Tsuga canadensis	Canadian hemlock	

Medium Trees (26 to 50 feet in height when mature)

Scientific Name	Common Name	Cultivar
Juniperus scopulorum	Rocky mountain juniper	'Blue Heaven' 'Skyrocket'
Juniperus virginiana	eastern redcedar	
Picea glauca var. *densata*	Black Hills spruce	
Pinus flexilis	limber pine	'Glauca'

Small Trees (10 to 25 feet in height when mature)

Scientific Name	Common Name	Cultivar
Pinus aristata	bristlecone pine	
Pinus edulis	Piñon 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.

USDA HARDINESS ZONE 5

Deciduous Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer x freemanii	Freeman maple	
Acer rubrum	red maple	Red Sunset®
Acer nigrum	black maple	
Acer saccharinum	silver maple	
Acer saccharum	sugar maple	'Legacy'
*Aesculus flava**	yellow buckeye	
Betula nigra	river birch	Heritage®
Betula papyrifera	paper birch	
Carpinus betulus	European hornbeam	'Franz Fontaine'
*Castanea mollissima**	Chinese chestnut	
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	(male trees only)
Gleditsia triacanthos inermis	thornless honeylocust	'Shademaster'
Gymnocladus dioica	Kentucky coffeetree	Prairie Titan®
Juglans nigra	walnut	
*Juglans regia**	English walnut	'Hansen'
*Larix decidua**	European larch	
Liquidambar styraciflua	American sweetgum	Cherokee™
Liriodendron tulipifera	tuliptree	'Fastigiatum'
Maclura pomifera	osage-orange	'White Shield','Witchita'
*Magnolia acuminata**	cucumbertree magnolia	(numerous exist)
*Magnolia macrophylla**	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvatica	black tupelo	
Platanus × acerifolia	London planetree	'Yarwood'
*Platanus occidentalis**	American sycamore	
Prunus serotina	black cherry	
Quercus alba	white oak	
Quercus bicolor	swamp white oak	
Quercus coccinea	scarlet oak	

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

Scientific Name	Common Name	Cultivar
Quercus ellipsoidalis	northern pin oak	
Quercus frainetto	Hungarian oak	
Quercus imbricaria	shingle oak	
Quercus lyrata	overcup oak	
Quercus macrocarpa	bur oak	
Quercus montana	chestnut oak	
Quercus muehlenbergii	chinkapin oak	
Quercus palustris	pin oak	
Quercus phellos	willow oak	
Quercus robur	English oak	Heritage®
Quercus rubra	northern red oak	'Splendens'
Quercus shumardii	Shumard oak	
Quercus texana	Texas oak	
Styphnolobium japonicum	Japanese pagodatree	'Regent'
Taxodium distichum	common baldcypress	'Shawnee Brave'
Tilia americana	American linden	'Redmond'
Tilia cordata	littleleaf linden	'Greenspire'
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	
Cladrastis kentukea	American yellowwood	'Rosea'
Eucommia ulmoides	hardy rubbertree	
Koelreuteria paniculata	goldenraintree	
Ostrya virginiana	eastern hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Phellodendron amurense	amur corktree	'Macho'
Prunus maackii	amur chokecherry	'Amber Beauty'
Prunus sargentii	Sargent cherry	
Quercus acutissima	sawtooth oak	
Quercus cerris	European turkey oak	
Sorbus alnifolia	Korean mountainash	'Redbird'

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 pensylvanicum**	striped maple	
Acer truncatum	Shantung maple	
*Aesculus pavia**	red buckeye	
Amelanchier arborea	downy serviceberry	(numerous exist)
Amelanchier laevis	Allegheny serviceberry	
Carpinus caroliniana	American hornbeam	
Cercis canadensis	eastern redbud	(cold-resistant only)
Chionanthus virginicus	white fringetree	
Cornus alternifolia	pagoda dogwood	
Cornus florida	flowering dogwood	(disease resistant only)
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'
*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'
Styrax japonicus	Japanese snowbell	'Emerald Pagoda'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

Note: * denotes species **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'
Chamaecyparis nootkatensis	Nootka falsecypress	'Pendula'
Cryptomeria japonica	Japanese cryptomeria	'Sekkan-sugi'
Ilex opaca	American holly	
Picea glauca	white spruce	
Picea omorika	Serbian spruce	
Picea orientalis	Oriental spruce	
Pinus densiflora	Japanese red pine	
Pinus resinosa	red pine	
Pinus rigida	pitch pine	
Pinus strobus	eastern white pine	
Pinus sylvestris	Scotch pine	
Psedotsuga menziesii	Douglasfir	
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	
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 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.

APPENDIX D
COMPREHENSIVE PLANTING PLAN

IMPORTANCE OF THE URBAN FOREST

Trees are a significant component of the City of Olean, New York's urban environment. The street and public/park space trees are an integral part of the City71 of 167 Context:'s infrastructure, no less so than its streets, utilities, and sidewalks. Unlike other infrastructure components, the public tree population, when properly cared for, will actually increase in value as the trees mature over time. Susan Cooper, City Forester, was interviewed on two separate occasions to help develop this plan. The plan captures how she has been able to replace the City's Tree Canopy when trees had to be removed throughout her career.

Trees return overall benefits and value to the community far in excess of the time and money invested in them for planting, pruning, protection, and removal. Their shade and beauty contribute to the community's quality of life and soften the hard appearance of concrete structures and streets, moderating harsh urban conditions. They help stabilize the soil by controlling wind and water erosion, and provide shade, helping to reduce energy costs in hot climates. Trees also help reduce noise and air pollution, produce oxygen, and absorb carbon dioxide, which is believed to contribute to the "greenhouse effect". Additionally, they provide significant economic value, including increased real estate values and improved settings for business activities.

The residents and officials of The City of Olean recognize urban forest benefits and understand the importance of protecting this investment with a comprehensive Planting Plan. Such a program begins with an inventory of the public trees and potential planting sites and their present condition. This inventory will provide important information used to identify the needs of the City of Olean's urban forest and help direct the establishment of an effective Planting Plan.

STATEMENT OF PURPOSE

The purpose of this Public Tree Planting Plan is to provide guidelines for the implementation of an organized public tree planting effort in the City of Olean. The public tree inventory and subsequent *Community Forestry Management Plan* prepared by DRG in 2021 provides information on suitable planting locations along with general recommendations on the size and species of trees for each site. This Planting Plan, in turn, provides specific and in-depth guidelines for the future plantings, allowing for more effective use of tree care funds and more accurate budget projections. Implementation of this planting plan will aid in increasing canopy cover and prioritizing planting areas where the canopy is lacking.

SCOPE

This document discusses the findings of the viable public street planting sites by DRG and provides a comprehensive action plan for the City of Olean's inventoried planting sites. The Planting Plan includes a brief analysis of the current tree population, the environment in which they grow, and needs of the urban forest. The scope of this discussion includes:

- A brief analysis of the public street tree inventory and species composition.
- Recommendations for the specific planting needs; related to species diversity, site restrictions, functionality of the urban forest, and canopy cover.
- A seven-year budget for the planting program and training pruning program.

GOALS

The Public Tree Planting Program discussed in this document is intended to achieve the following goals:

- To gain an overall understanding of the inventoried tree population in terms of species composition.
- To identify the needs of the urban forest and take action to meet diversity and stocking goals through proper planting protocols.
- To establish a Training Pruning Program and Maintenance Program for all newly planted trees.
- To maximize investments in the purchasing, planting, and maintenance of new trees by meeting industry standards and making practical decisions in species selection.

EVALUATING AND UPDATING THIS PLAN

This Community Forestry Planting Plan is initially intended to provide planting guidelines for the next 7 years. In order to measure the effectiveness of the implementation of the program in achieving the stated goals, a method for evaluation should be followed. Specific accomplishments can be measured in comparison to the Plan's goals and recommendations. These include:

- Annually comparing the number of trees planted to the desired number of plantings and the number of removals per year.
- Beginning in Year 1, establishing a training pruning program and evaluating the number of trees pruned annually to match the goal of a three-year program.
- At the end of each year, comparing the City71 of 167 Context:'s annual urban forestry budget for planting and training pruning to that projected in this Plan.

CHAPTER 1: METHODOLOGY

Summary

This chapter provides a description of the procedures used for potential planting site recommendations during the City of Olean public tree inventory. Definitions and methodology of data collection are provided to give the reader an understanding of the inventory process.

Definition

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. A "street tree" is further defined as a tree growing within the public right-of-way (ROW) that was planted by the City71 of 167 Context: or its residents. A "park/public space tree" is defined as a tree growing in an area designated as a park/public space or growing on city-owned property such as municipal building lots or other facilities. the City71 of 167 Context: provided the park/public space information in addition to the ROW information. At times, when the ROW data and park/public space boundaries seemed incorrect or offset, experience in reading obvious and subtle ROW and property boundary indicators was relied upon.

Potential Planting Sites

Potential planting sites are located by street and address. The sites are defined as areas suitable for tree planting within the existing ROW, as defined above. Typically, the size of each site is determined by the growing space available and the presence of overhead wires, and are spaced accordingly:

- Small (3–5 feet); 20 feet between small sites
    - If overhead wires are present, then the vacant site is automatically designated as Small despite the growing space available
    - Small vacant sites may also not indicate overhead wires despite secondary, communication, and house drop lines being present, as only primary distribution lines are noted
- Medium (6–8 feet); 30 feet between medium sites
- Large (8 feet and greater); 40 feet between large sites

Planting site parameters are determined based on an original agreement utilizing the experience from the City of Olean's personnel and DRG Inventory Urban Foresters. Some of these parameters are:

- No planting of a tree within 25 feet of any intersection or crosswalk
- No planting of a tree within 50 feet of any stop signs
- No planting of a tree within 10 feet of any fire hydrant, streetlight, utility pole, or underground utility (i.e., gas or sewer line)
- No planting of a tree within 10 feet of any driveway or walkway

The overall landscape and existing planting scheme was also taken into account for the spacing and sizes of recommended planting sites. Where any types of overhead utility wires exist, planting sites are recorded as small, regardless of the available growing space.

Growing Space Type

The type of space available for tree growth is noted in the inventory. The common site types include: Median, Planting Strip, Open Space (unrestricted in all directions), Wooded Space, and Well/Pit (a tree pit surrounded by pavement). The growing space type can be a limiting factor of the growth and natural habit of trees and dictates which species are suitable for any given site.

Growing Space Size

The shortest dimension in length and width (in feet) of each growing space type is noted in the vacant site collection. The growing space size can be a limiting factor of the growth and natural habit of trees and dictates which species are suitable for any given site.

Utilities

The presence of all primary distribution lines is noted in the inventory. This does not include secondary, communication (i.e., telephone and cable), and house drop lines. Where any overhead wires exist, the planting site is recorded as small, regardless of the available growing space size and type.

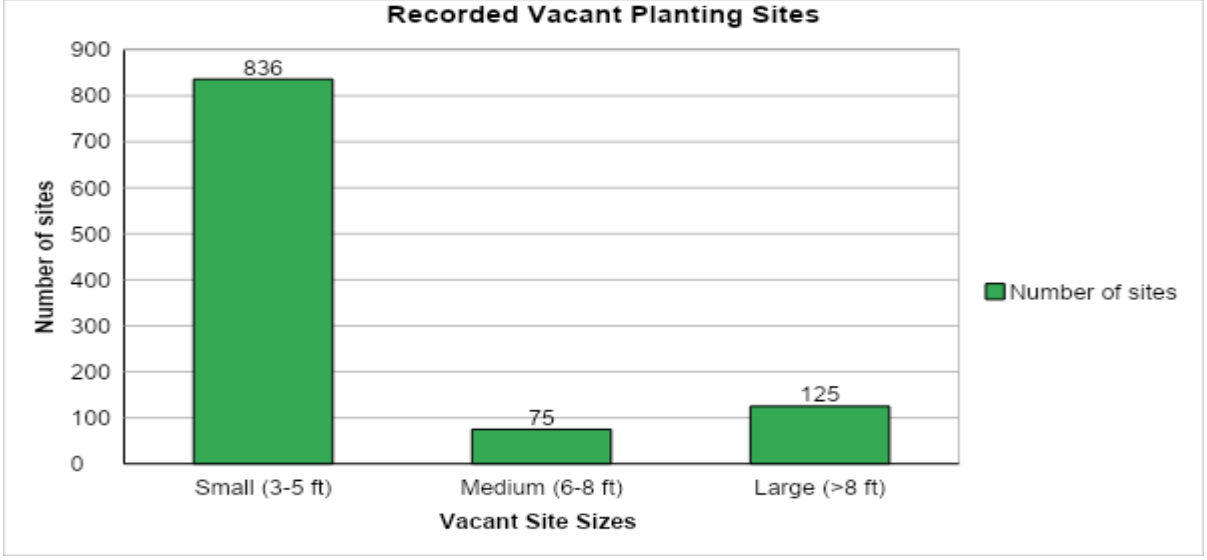
Suggested Species

A list of suggested species is provided in this management plan and is meant to be a guideline for selecting which species to plant during future street tree plantings. The suggested species are alphabetized, with summaries that include the average height to assist in potential planting site size designations. The size of the site refers to the mature size of a tree suitable to be planted in that particular site. Selecting trees from this list will help to ensure that appropriate sized trees are planted in a site suitable to sustain the tree's natural habit. The suggested species list also contains a short summary of other site characteristics important for species success. City of Olean's Suggested Tree Species list can be found in Appendix C.

CHAPTER 2: THE CITY OF OLEAN'S PLANTING SITES AND SPECIES SELECTION

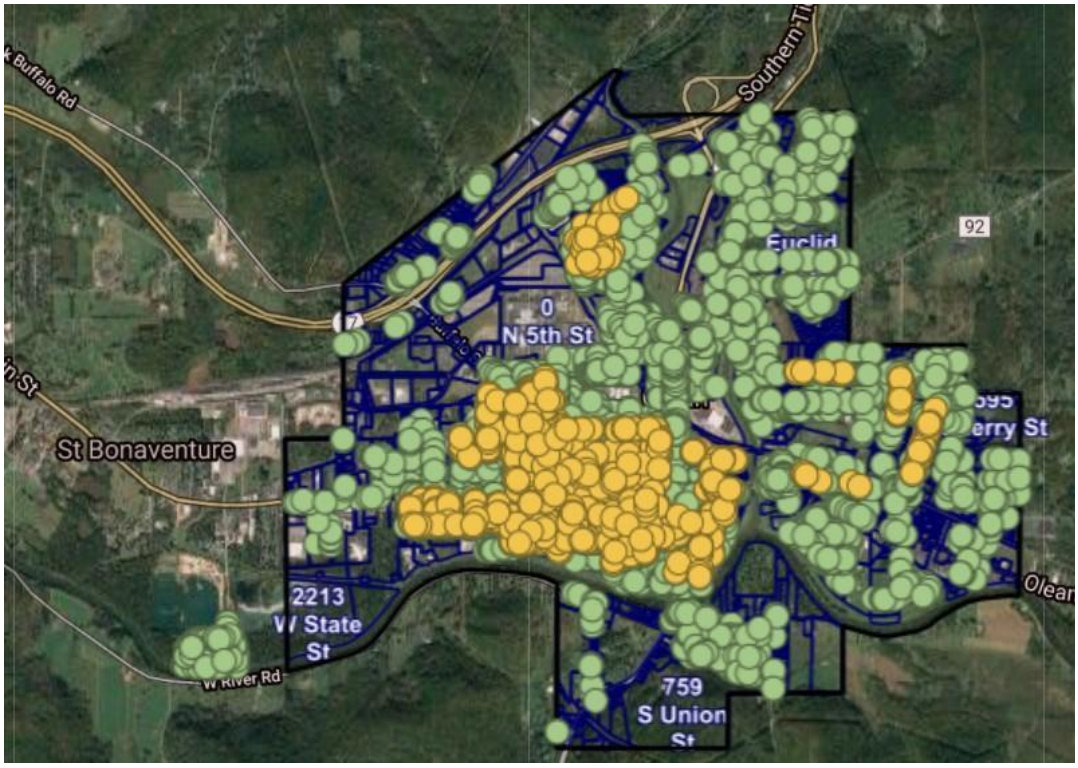
Vacant Planting Sites

Within the public tree inventory, a total of 1,036 potential planting sites have been recorded. The space available for a tree to be planted and thrive is a major factor that dictates the type of species best suited for a given location. Of the available sites, 125 are designated as "large", meaning that they are suitable for large growth habit trees (8 feet wide and greater grow space size). There are 75 "medium" sites (6 to 8 feet wide grow space sizes) and 836 "small" sites (3 to 5 feet wide grow space sizes). This information is highlighted below. In the event that any overhead wires are present, only small potential planting sites were recorded.



Vacant planting sites were prioritized within the low income Census Tracts NY-009961700 and NY-0099617003 CFMP Environmental Justice areas. These areas of the City of Olean are the most likely to benefit from an improved urban tree population. After inventorying the existing tree population excluding these areas, DRG assessed a limited portion of the potential planting sites along the remaining street ROWs. There are additional planting sites in the City of Olean that were not inventoried at this time. Planting sites were then prioritized by the amount of growing space provided by planting strips, while attempting uniform distribution. No vacant sites were recorded on planting strips that provided a width of 3 feet or less. Recording vacant sites with a width of 4 feet or greater promotes a tree population that will reach maturity in Good or Fair condition. Many planting strips along certain street ROWs are less than 3 feet wide, thus not viable for most tree species' growth habits. The total 19.3% of potential planting sites recorded provides the City of Olean, NY with information to prioritize placement and species selection. The size class that is most frequently recommended as a potential planting site is small, followed by large, and then medium. This distribution is typical for a large community like the City of Olean.

The map below shows the distribution of vacant planting sites prioritized by the low income areas and viable planting strip growing spaces.

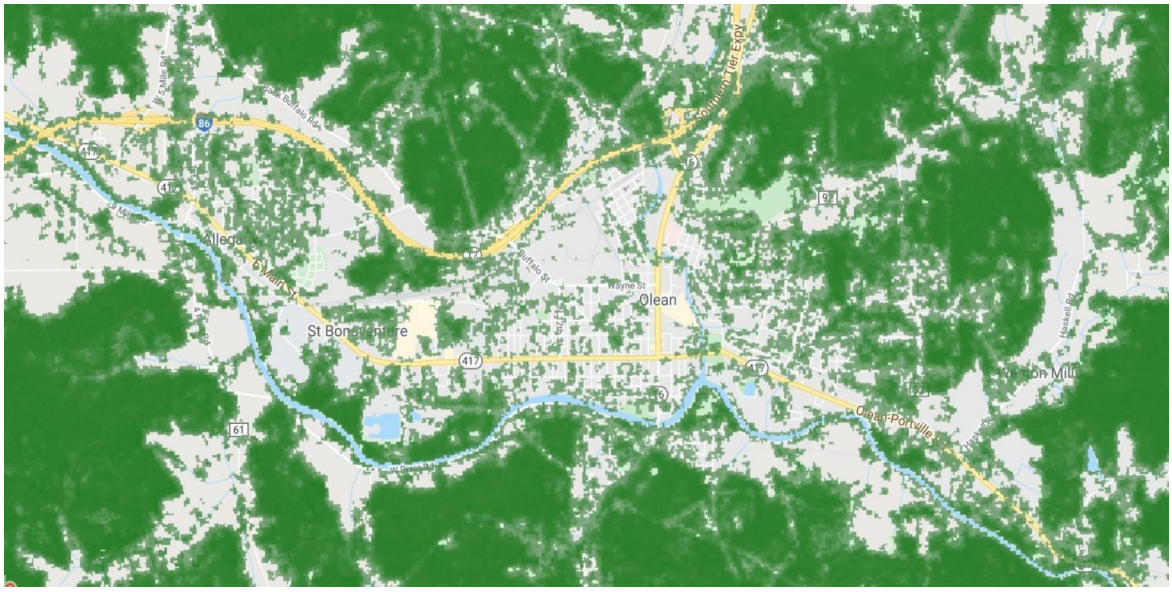


Potential planting sites based on low income census areas and viable growing space

Correct Species Selection

The city must determine which tree species will be planted on a specific site. The phrase "right tree, right place" is the most important concept in planting. All trees have different characteristics suitable for different landscapes. It is recommended that all characteristics be recognized including but not limited to the desired function (e.g., seasonal flowering, shade canopy, wind resistance), mature size and shape for the intended location, soil conditions, maintenance requirements, and potential pest problems. A canopy analysis using i-Tree Landscape revealed the amount of canopy cover in the surrounding areas compared to the City of Olean. The following map detailing the shade canopy analysis to visualize the amount of open planting space theoretically available in the City71 of 167 Context:.

Soil conditions in the City of Olean are described to be poor in many areas according to the experience provided by Sue Cooper, City Forester. Consisting of pulverized tile, gravel, oil, timber, and brick, it is difficult for these areas to be successful planting sites. Several city parks have higher quality soils, depending on their previous use, and may prove to be areas where planted trees successfully mature into part of the urban forest. For the purpose of this inventory; however, planting sites were only recorded on planting strips appearing to have viable soil for vegetative growth in areas defined by the City of Olean to be collected.



City of Olean, NY tree canopy analysis.

Along several streets in the City of Olean, there is a misuse of available planting space. There are large growing trees under power lines, and there are small-growing trees in sites suitable for larger trees. These previous planting decisions, likely made by abutting owners and developers, challenge the most effective use of funds allocated to the improvement of the City of Olean's urban forest. Large trees in small spaces can damage sidewalks and curbs, require severe pruning for overhead utility lines and street clearance, and often have a much shorter service life due to the restricted growing area. Streets including, but not limited to, North and South 3rd Street, North and South Clinton Street, Wayne Street, and West Henley Street, were observed with large trees planted with overhead utilities. Small trees in large spaces limit the use of mature shade trees on public streets. Several streets observed to have small trees sporadically planted in large spaces include Laurens Street, North 8th Street, and York Street. It is well known that larger growing trees provide the most environmental and economic benefits to cities, and appropriate areas to plant them rarely exist in older, well-developed communities. Proactive planning should be made to plant the "right tree, right place" in the vacant sites, considering available growing space, presence of utilities, and traffic and pedestrian clearance issues, while obtaining the desired aesthetic effects and function of the street tree. This Planting Plan should help resolve some of these issues and guide the City of Olean in achieving the most effective and attractive urban forest possible.

The suggested species list in Appendix C considers maintenance requirements, adaptability to specific planting sites, and suitability to the restrictive conditions of the urban environment, among others. The list is categorized by tree heights (small, medium, and large), providing a number of different species that would be suitable for a variety of planting sites. Selecting trees from this list will help to ensure that appropriate sized trees are planted in a site suitable to sustain the tree's natural habit. Careful planning is necessary to introduce a level of variety into the street tree population.

Young Tree Maintenance

A systematic program of maintenance, specifically designed for newly planted trees, is necessary to provide them with the greatest chance of survival. Activities, including watering, fertilization, removal of staking materials, inspections, and training pruning, should be adopted to ensure that proper care is taken to protect the investment of a Tree Planting Program and the trees themselves. Proper planting of the trees is also important. Inadequately dug planting holes, improperly placed support wires, inappropriate staking/bracing materials, etc. can lead to additional stress, and even death, of young trees.

Currently, in the public street tree inventory, there are 758 (14.1%) immature trees in need of a Training Prune. The objective of training pruning is to ensure that newly planted and immature trees have a strong, central leader and good form as they mature, encouraging a wind-resistant urban forest. A training pruning program more focused on the development of trees with strong structure is relatively inexpensive since immature trees (generally less than 20 feet in height and/or 7 inches or less in DBH) can be pruned easily from the ground. Training prunes are not used for conifers; their growth habits do not necessitate this maintenance. Implementing maintenance to newly planted and immature trees is a cost-effective way to avoid excessive and greater pruning costs upon maturity. The City of Olean needs to develop a Training Pruning Program, as this is an inexpensive activity that would be extremely beneficial for the overall health and quality of the City71 of 167 Context:'s urban forest. It is recommended the City of Olean contact the Erie County Cooperative Extension for guidance; they have organized this training for Erie County communities and it can easily be replicated in the City of Olean.

Planting Plan Concerns

During the inventory and analysis of the data, DRG's Inventory Arborists made specific observations that require mention to the City of Olean. Some of these concerns have been detailed above in Correct Species Selection. Concerns including misuse of planting space and lack of adequate planting space were most commonly observed during the inventory. Planting strip width should be considered in future city planning to provide optimal growing space for future tree planting. When possible, underground utilities such as the gas line along Greene Street should also be installed so that potential planting space is not impeded. Considering such limitations will allow for higher quality planting placements and tree longevity in the future. The most optimal present planting locations have been identified and detailed with appropriate vacant site size selections. A limited budget is another concern for future plantings and young tree maintenance. Currently, the City of Olean does not have a specified budget for tree planting. Trees are planted at the homeowner's request or for Memorial Trees from a list of potential species. Additional information for achieving funding for a more robust planting budget will be discussed later in the Plan.

CHAPTER 3: SEVEN-YEAR PLANTING PLAN

Summary

This chapter details the activities that will constitute the Seven-Year Planting Program for the City of Olean. Headings in this chapter include:

- Developing an Effective Planting Program
- Training Pruning Program
- Seven-Year Planting Plan and Budget

Developing an Effective Public Tree Planting Program

Tree species and planting location designations are significant components of a municipal tree care program because of the long-term impact of these decisions. It is important to develop an overall planting strategy, initially concentrating on streets and areas with the greatest need for improvement.

Success of a continuing tree planting program will be judged by the health of the trees after planting and the amount of money spent on planting and maintaining the new trees. With a small amount of planning, healthy trees with greater life expectancy can be established with minimal up-front investment and minor maintenance costs.

The key elements for a successful tree-planting program are covered in this section and are primarily based on the reference, *Principles and Practice of Planting Trees and Shrubs* by Gary Watson and E. B. Himelick (1997).

Tree Species Diversity

Tree plantings greatly add to the aesthetic appeal of neighborhoods, historic districts, commercial areas, and industrial areas alike. Species diversity in new plantings should be of major importance. The City of Olean's inventoried tree population consists of 13% Norway maple (*Acer platanoides*) and 41% maple species in total. The dangers (disease, insects, etc.) of planting monocultures have proven to be devastating throughout the Eastern and Midwestern United States. The goal should be to increase species diversity throughout the City71 of 167 Context:, such that no species represents more than 10% and that no one genus comprises more than 20% of the total population. Consideration should be given to large trees that provide as much shade and are as aesthetically pleasing. The need to plant a wider range of species should include native and non-native, urban-tolerant, and/or wind-resistant species.

Tree Species Selection

The City of Olean occurs in Zones 5a and 5b of the USDA Hardiness Zone Map, which identifies the climatic region where the average annual minimum temperature is between -20 to -15 (F) and -15 to -10 (F). The City of Olean is also described to occur in Zone 4b, according to City Forester Susan Cooper, with annual minimum temperatures between -25 to -20 (F). Precipitation additionally averages 43 inches per year. Tree species selected for planting in the City71 of 167 Context: should be appropriate for these three zones and should consider a mix of native and

non-native tree species. Lists of species based on these three Hardiness Zones are provided and are encouraged to be used and cross referenced to create a thriving and diverse urban forest.

In addition to considering site characteristics, such as climate, precipitation, native vegetation, availability of space, soil pH, and irrigation, tree features must also be scrutinized. Some considerations for street trees are the amount of litter dropped by mature trees, the maintenance required, potential pest species, and public acceptance. Species such as Callery pear (*Pyrus calleryana*), comprising 2.4% of the inventoried population, have weak wood that easily fails during storm seasons. Others, such as American sweetgum (*Liquidambar styraciflua)* at only 0.5% of the population, drop high volumes of syncarps (fleshy aggregate fruits). Thornless honeylocust (*Gleditsia triacanthos inermis*), 3.9% of the population, are another species that typically require more extensive routine pruning of small, dead branches. In certain species, such as ash (Fraxinus species) at 4% of the population, pests such as emerald ash borer (EAB) are present and produce devastating effects. Ash species are not currently being treated for EAB in the City71 of 167 Context: of Olean and may need more extensive maintenance, including removal, based on the individual condition of a site. 88 ash trees, both green and white ash, were recorded for removal due to EAB. Ash species, unless routinely treated, should be avoided in future tree plantings. Additionally, a few tree species, including Prunus species (cherry), 3%, and Acer species (maple), 41%, have fungal diseases including black knot (*Dibotryon morbosum*) and tar spot (*Rhytisma acerinum*) that may be cosmetically displeasing and eventually pose harm to the tree. Seasonal color should also be considered when planning tree plantings. Different varieties of maple, including *Acer* × *freemanii* (Freeman maple), have proven to be a sturdy tree species with vibrant coloration. Flowering varieties, including Japanese tree lilac (*Syringa reticulata*), are particularly welcoming in the spring and can add a great deal of interest to surrounding landscapes.

Above all, tree species should be selected for their durability and low-maintenance requirements. These attributes are highly dependent on site characteristics as well as species characteristics. Matching a species to its favored climatic and soil conditions is the most important task when planning for a low-maintenance landscape. Plants that are well matched to their environmental conditions are much more likely to resist pathogens and insect pests and severe storm damage; therefore, they will require less maintenance overall.

The Tree Planting Process

A frequent cause of new tree failure is poor acclimation to site conditions. This includes not only the planting site, but also the climate conditions at the nursery and the similarity in the new tree location. For example, a tree raised in a nursery farther south than the planting site may have more difficulty in adapting than a tree grown in more similar climate conditions. As trees are purchased through local nurseries, including Schichtel's Nursery in Springville, NY, (where current stock is purchased), the key consideration should be species selection. This will aid in increasing species diversity throughout the City of Olean. Once appropriate trees have been selected for planting, the most important detail to ensure success is the preparation of the planting site. Appendix B explains the proper method of excavating a planting hole. In general, the tree-planting hole should be relatively shallow (typically slightly less deep than the height of the root ball) and quite wide (three times the diameter of the root ball). Care should be taken that the root collar of the new tree is at the same level or slightly higher than the surrounding soil grade. In

most situations, it is not recommended to add soil amendments to the planting hole as this can lead to severe differences between texture and structure of soils inside the planting hole and the surrounding soil. Such differences can lead to water being wicked away from or accumulating in the planting hole.

Staking of the tree should only be done when necessary to keep the tree from leaning (windy sites) or to prevent damage from pedestrians and/or vandals. Stakes should only be attached to the tree with a loose, flexible material, and all staking materials must be removed within one growing season. Avoid metal or confining materials that may choke and damage a young tree, or increased usage of materials that may cause a lack of a taper at the base of a tree.

Tree Mulching

Mulch should be applied to the surface of the soil around each newly planted tree. Mulch should never be piled up around the root collar (mulch "volcanoes"), but rather should be pulled away from the root collar. Mulch that buries the root collar provides shelter for insects, fungi, and mammals that could damage the tree. Mulch should be applied to an area three times the diameter of the root ball to a depth of two to four inches. Mulch not only suppresses competition from grass and weeds, but also provides a zone where mowing is not needed, thereby keeping mowers and string trimmers safely away (thus preventing mechanical damage). Mulch also helps to hold moisture in the surface of the soil where most of the feeder roots are to be established.

Tree Fertilization

Any fertilization process should not be thought of as "feeding" or "energizing" the plant; instead, arboricultural fertilizers should be understood as essentially replacing soil elements or minerals that are lacking or in short supply for a variety of reasons. Nutrients may be in adequate supply, but be unavailable for uptake by the tree because of extreme pH conditions. Application of fertilizer may not improve the situation until measures are taken to alter pH levels or to replace the plant with a species better suited for the existing soil conditions.

Fertilization may not be necessary for the first growing season unless specific nutrient deficiencies exist. At the beginning of the second growing season, fertilizers can be applied to the root zone. Nitrogen is usually the limiting nutrient for plant growth. Soil analysis, particularly when combined with a foliar analysis, can determine when other elements are in short supply. A light application of slow-release fertilizer applied a few months after planting will be delivered. Slow-release fertilizers applied in Autumn will help root growth and will still be available the following spring.

Tree Pruning

Assuming that the proper tree has been selected for the site, pruning a young tree to improve branch structure is the most cost-effective method of reducing maintenance costs as the tree matures. At the time of planting, the only pruning that should be done is the removal of broken or dead branches. In the second growing season, minor pruning can be done to remove branches with poor attachments. In subsequent years, selective pruning should be done to achieve proper spacing of branches. Adopting these proactive approaches for tree maintenance assists in creating an urban forest with lower future maintenance costs for mature trees.

Tree Purchases

Tree prices, of course, vary based on the species selected, but many nurseries offer trees of 1.5- to 2.5-inch caliper for $150 to $250. As the City works at planting more trees annually, obtaining a good price for quality trees will become more important. Saving money on the cost per tree will allow a greater number of trees to be purchased.

DRG feels that a good working relationship with a local nursery, including Schichtel's Nursery, is very beneficial, but it is equally important that high-quality stock, good prices, and wide species availability be considered. It is recommended that the City of Olean continue to explore local and regional sources for trees and discuss the pricing and even contract growing with the current nursery source. Due to the requirement to work towards species diversity, it may be necessary to use several nurseries as sources for trees. Sourcing the preferred bare-root stock from several local nurseries also ensures higher genetic diversity in new plantings, which is crucial for tree populations experiencing various biotic and abiotic stressors.

Tree Planting Designs

Prior to conducting tree inventories, most cities determine available planting sites primarily through resident requests, as is the case for the City of Olean, NY. With the inventory data, City Officials can now know the exact location of available planting sites. Vacant planting sites were prioritized within the low-income Census Tracts NY-009961700 and NY-0099617003 CFMP Environmental Justice areas. These areas would greatly benefit from an increase of tree plantings. After documenting the existing trees in the surrounding areas of the City71 of 167 Context: of Olean, potential planting sites were incorporated along the remaining street ROWs. Planting sites were then prioritized by the amount of provided growing space in each planting strip, while attempting uniform distribution. No vacant sites were recorded on planting strips that provided a width of 3 feet or less. Recording vacant sites with a width of 4 feet or greater promotes a tree population that will reach maturity in Good or Fair condition.

Tree plantings in residential areas can be selected to match the existing types of trees growing on each street and block (such as large growth-habit trees or flowering tree species) or can be selected to begin to develop a uniform look for a given street. To create unity, balance, and beauty on a street, it is advantageous to plant the same species or species of similar form and size on both sides of the street, if possible. Keep species diversity in mind when developing any type of tree planting design. Often, in older neighborhoods, one side of the street has utility lines, which precludes the use of large trees. The primary aesthetic role that street tree plantings can play in a residential neighborhood is to visually link individual homes into a unified landscape. It is this unified quality that makes older neighborhoods with large, mature trees so attractive in many communities. Either formal or informal planting schemes are appropriate for neighborhood streets. In most instances, medium or large trees, spaced so that their canopies overlap, are desirable. As always, a street tree-planting program must have the objective of species diversity in mind at all times.

City-Owned Nursery Operation

One idea is that the City71 of 167 Context: of Olean could have its own nursery operation to supply some of the trees needed to plant the vacant sites and replace trees as they die or are removed. There are many factors that should be considered when evaluating the pros and cons of maintaining a municipal tree nursery.

Is a nursery worth the time and effort involved in maintaining it? Municipal nurseries can be found in many communities throughout the United States. These nurseries can be anything from a well-maintained and productive source for urban trees to a forgotten field of saplings. Two potential locations for a nursery are in Homer Street Park or any vacant lot that could be purchased by the City. The structure of a municipal nursery depends on the time and resources a community is willing to devote.

When evaluating the status of a city tree nursery, the following is a list of questions that should be considered:

- Do city personnel have the time and tree related knowledge to manage the nursery?
- Are there resources available for the required pruning, root pruning, watering, fertilizing, weed control, and insect and disease monitoring and treatment that are all a necessary part of running a successful nursery operation and to produce quality trees?
- If volunteers will be used, who will lead and furnish them with training and materials?
- Are desirable tree species available to the nursery?

After these and other questions are explored and answered, it may be apparent that buying trees from local nurseries will still be the most cost-effective way to acquire the high number of trees needed for the City71 of 167 Context: tree plantings.

It is DRG's opinion that the City71 of 167 Context: will benefit most if the nursery does not take away resources needed to manage the other needs of the urban forestry program, especially high priority pruning and removals. A city nursery can best be utilized for the following purposes:

- To grow unique, hard-to-find, or otherwise desirable species
- To nurture free, inexpensive, or donated tree saplings
- A source of trees when funds for purchasing trees are low
- A source for trees needed on short notice

Training Pruning Program

Training, or pruning to shape, consists of the removal of dead, dying, diseased, interfering, conflicting, and weak branches, as well as selective trimming to direct future branch growth. These maintenance categories apply to all trees less than 20 feet in height, or ≤7 inch DBH, and are usually young and newly planted. Trees in this group are of such a size that they can be pruned from the ground using a pole pruner. This work can be performed by the City DPW or a Training Program could be developed by the City71 of 167 Context: to have citizens assist with the care of young trees in the City71 of 167 Context:.

Three-Year Cycle

Although this type of trimming is called Training Pruning, the word "training" truly pertains to young or recently planted trees. For these trees, training pruning is used to develop a strong structural architecture of branches so that future growth will create a healthy tree. Many young trees may have branch structure that can lead to potential problems as the tree grows, such as double leaders, many limbs attached at the same point on the trunk, or crossing limbs. These problems can be remedied easily and inexpensively while trees are small and immature. Pruning can be accomplished from the ground with a minimum of equipment. If not alleviated while trees are young, these potential problems can lead to instances where branches are poorly attached and decay may develop at the crossing points of interfering limbs. Trees with poor branching may become potential safety risks as they grow larger and may create potential liability for the City71 of 167 Context: of Olean in the future.

All newly planted trees should receive their first training prune three years following planting. No training pruning should be done when a tree is planted since it is already under stress from transplanting and needs as much of its leaf canopy as possible in order to manufacture food for proper establishment in its new site. Only dead or broken branches should be removed at the time of planting. With the initiation of the many recommendations involved in this Planting Plan, it is also recommended that the City of Olean develop a strong Training Pruning Program starting in the first year of the Plan and budget.

As mentioned above, newly planted trees should receive their first training prune three years after planting and continue on a three-year cyclical basis. Performing this work every three years until the trees require more sophisticated safety and equipment requirements will help reduce the need for the more expensive maintenance requirements of mature trees. Also, the preventative efforts associated with developing a tree with a strong structure can improve survival in severe storms. The practice of proper pruning techniques and elimination of codominant stems, keeping trees as healthy as possible, all assists in the creation of a more wind resistant urban forest. This work can be accomplished throughout the year and since no bucket truck is required, city employees can perform this work at any time. This type of work is also highly suitable for properly trained summer interns, part-time employees, and/or volunteers.

Work Estimates

A three-year pruning cycle would require the training pruning of approximately 758 public street trees per year beginning in the first year of the Seven-Year Urban Forestry Management Program. All new trees planted in accordance to this Public Tree Planting Plan should be pruned 3 years after planting. Training pruning can begin immediately for all new street tree plantings that have taken place before and during this inventory and Planting Plan Project. A good example of an area where training prunes will need to occur soon is North and South Union Streets, where roughly 100 new trees have been planted in a high traffic area. Experience demonstrates that, based on the generally small size of the trees in this category, a crew of two properly trained city personnel would be capable of accomplishing all of the work.

Training of Personnel

Proper training in young tree structural pruning should be required for all tree crew personnel. Additionally, these workers would require an understanding of the growth habits of the various species being planted, as well as an understanding of basic tree anatomy and physiology. This training can be received through local urban forestry consultants and/or International Society of Arboriculture Certified Arborists. The tremendous benefits to be gained in the years to come due to proper structural pruning of young trees are a strong incentive for educating tree crew personnel. Additionally, knowledge gained by these individuals could prove to be an incentive in raising the sense of professionalism in their jobs and enhancing appropriate care for future tree plantings. The local Region 9 Releaf Committee offers training sessions throughout the year. The City of Olean is encouraged to have their DPW attend the sessions for additional training.

Seven-Year Planting Plan and Budget

The inventory has indicated approximately 1,036 vacant planting sites are suitable for new trees. Planting sites have been identified specifically by address number, street, side, and site number in the inventory. By setting a goal to plant trees in all of these sites, the City71 of 167 Context: will be headed toward improving the amount of canopy cover provided by the street tree population. The first table that follows represents the costs associated with a planting program over the course of seven years when adding a minimum of 50 yearly plantings. At the rate of estimation of 50 plantings per year given a limited budget, it will take the City71 of 167 Context: of Olean roughly 20 years to plant all 1,036 identified vacant sites. Although this is a much longer time frame than is ideal, it attempts to account for the lack of budget for current tree plantings. Less than $1,000 annually is spent for tree plantings. The second table represents the costs associated with a planting program over the course of seven years when adding the ideal 148 yearly plantings. Although this planting program is much more costly, it may be more applicable, if future budgets experience improvement.

Seven-Year Tree Planting Program for Minimum Plantings

Year	Planting Cost (Purchasing and Planting)	Number of Trees	Total Cost
1	$280	50	$14,000
2	$280	50	$14,000
3	$280	50	$14,000
4	$280	50	$14,000
5	$280	50	$14,000
6	$280	50	$14,000
7	$280	50	$14,000
Totals	$1,960	350	$98,000

Seven-Year Tree Planting Program for Ideal Plantings

Year	Planting Cost (Purchasing and Planting)	Number of Trees	Total Cost
1	$280	148	$41,440
2	$280	148	$41,440
3	$280	148	$41,440
4	$280	148	$41,440
5	$280	148	$41,440
6	$280	148	$41,440
7	$280	148	$41,440
Totals	$1,960	1,036	$290,080

Proper planting of new trees is an essential part of a successful planting plan. The steps taken to properly plant trees must be clearly outlined for city crews and/or contractors performing the work. Post planting inspections must be performed to ensure that the work meets the guidelines set forth by the City71 of 167 Context: and this plan.

After a tree is planted properly, some additional maintenance activities are highly recommended in order to ensure the health of the young tree. Maintenance activities include watering (the most important activity), weed control, mulch application, fertilizing, and pruning. Post-planting care of trees is important and necessary for a successful planting plan that can be accomplished inexpensively. A New Tree Maintenance Task List is provided under the Tree Planting Tips section. The costs associated in this list are not provided, although it is recommended that the City71 of 167 Context: foresee costs of new tree maintenance are attended to in the yearly budget.

Tree Planting Program Funding Assistance and Public Relations

The new objective of the Planting Program should be directed at filling the identified sites in addition to fulfilling resident requests for trees. This, of course, will increase the budget for tree purchases by the City71 of 167 Context: unless creative means are found to solicit contributions and help from the community-at-large.

In any tree planting program, funding and participation can often be achieved by soliciting certain sectors of the community. Businesses, institutions, and corporations in the City71 of 167 Context: are often willing to donate funds for tree plantings in exchange for recognition in some way (either through the media or during Arbor Day ceremonies).

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 Zones 4 and 5 on the USDA Plant Hardiness Zone Map.

Zone 4 Species List

Deciduous Trees

Large Trees (greater than 50 feet in height when mature)

Scientific Name	Common Name	Cultivar
Acer platanoides	Norway maple	'Cleveland' 'Emerald Queen' 'Summershade'
Acer rubrum	red maple	'Red Sunset'
Betula papyrifera	paper birch	
Catalpa speciosa	northern catalpa	
Celtis occidentalis	common hackberry	'Prairie Pride'
Ginko biloba	ginko	'Autumn Gold'
Gleditsia triacanthos var. *inermis*	thornless honeylocust	'Shademaster' 'Skyline'
Gymnocladus dioicus	Kentucky coffeetree	
Juglans nigra	black walnut	'Laciniata'
Quercus macrocarpa	bur oak	
Quercus rubra	northern red oak	
Tilia americana	American linden	'Redmond'
Tilia cordata	littleleaf linden	'Greenspire'
Ulmus americana	American elm	'Princeton' 'Valley Forge'

Medium Trees (26 to 50 feet in height when mature)

Scientific Name	Common Name	Cultivar
Aesculus glabra	Ohio buckeye	
Betula pendula	European white birch	
Gleditsia triacanthos var. *inermis*	thornless honeylocust	'Imperial'
Ostrya virginiana	American hophornbeam	
Phellodendron amurense	Amur corktree	
Prunus cerasus	sour cherry	'Montmorency' 'Northstar'
Prunus maackii	Amur chokecherry	
Sorbus aucuparia	European mountainash	'Beissneri'
Sorbus decora	showy mountainash	

Small Trees (10 to 25 feet in height when mature)

Scientific Name	Common Name	Cultivar
Acer ginnala	amur maple	
Acer grandidentatum	bigtooth maple	
Acer tataricum	Tatarian maple	
Aesculus × *carnea*	red horsechestnut	'Briotii'
Crataegus ambigua	Russian hawthorn	
Crataegus crusgalli var. *inermis*	thornless cockspur hawthorn	'Crusader'
Crataegus viridis	green hawthorn	'Winter King'
Malus spp.	crabapple spp.	'Centennial' 'David' 'Harvest Gold' 'Madonna' 'Prairifire' 'Spring Snow'
Prunus cerasifera	cherry plum	'Newport'
Prunus nigra	Canada plum	'Princess Kay'
Prunus padus	European birdcherry	
Prunus virginiana	common chokecherry	'Canada Red'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

Coniferous and Evergreen Trees

Large Trees (greater than 50 feet in height when mature)

Scientific Name	Common Name	Cultivar
Abies concolor	white fir	'Violacea'
Larix deciduas	European larch	
Picea glauca	white spruce	
Picea pungens	Colorado spruce	
Picea pungens var. *glauca*	Colorado blue spruce	'Thompsenii'
Pinus nigra	Austrian pine	
Pinus ponderosa	ponderosa pine	
Pinus sylvestris	Scotch pine	
Pseudotsuga menziesii	Douglas-fir	
Tsuga canadensis	Canadian hemlock	

Medium Trees (26 to 50 feet in height when mature)

Scientific Name	Common Name	Cultivar
Juniperus scopulorum	Rocky mountain juniper	'Blue Heaven' 'Skyrocket'
Juniperus virginiana	eastern redcedar	
Picea glauca var. *densata*	Black Hills spruce	
Pinus flexilis	limber pine	'Glauca'

Small Trees (10 to 25 feet in height when mature)

Scientific Name	Common Name	Cultivar
Pinus aristata	bristlecone pine	
Pinus edulis	Piñon pine	

Zone 5 Species List

Deciduous Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer x freemanii	Freeman maple	
Acer rubrum	red maple	Red Sunset®
Acer nigrum	black maple	
Acer saccharinum	silver maple	
Acer saccharum	sugar maple	'Legacy'
*Aesculus flava**	yellow buckeye	
Betula nigra	river birch	Heritage®
Betula papyrifera	paper birch	
Carpinus betulus	European hornbeam	'Franz Fontaine'
*Castanea mollissima**	Chinese chestnut	
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	(male trees only)
Gleditsia triacanthos inermis	thornless honeylocust	'Shademaster'
Gymnocladus dioica	Kentucky coffeetree	Prairie Titan®
Juglans nigra	walnut	
*Juglans regia**	English walnut	'Hansen'
*Larix decidua**	European larch	
Liquidambar styraciflua	American sweetgum	Cherokee™
Liriodendron tulipifera	tuliptree	'Fastigiatum'
Maclura pomifera	osage-orange	'White Shield','Witchita'
*Magnolia acuminata**	cucumbertree magnolia	(numerous exist)
*Magnolia macrophylla**	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvatica	black tupelo	
Platanus × acerifolia	London planetree	'Yarwood'
*Platanus occidentalis**	American sycamore	
Prunus serotina	black cherry	
Quercus alba	white oak	
Quercus bicolor	swamp white oak	
Quercus coccinea	scarlet oak	
Quercus ellipsoidalis	northern pin oak	
Quercus frainetto	Hungarian oak	
Quercus imbricaria	shingle oak	
Quercus lyrata	overcup oak	
Quercus macrocarpa	bur oak	

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

Scientific Name	Common Name	Cultivar
Quercus montana	chestnut oak	
Quercus muehlenbergii	chinkapin oak	
Quercus palustris	pin oak	
Quercus phellos	willow oak	
Quercus robur	English oak	Heritage®
Quercus rubra	northern red oak	'Splendens'
Quercus shumardii	Shumard oak	
Quercus texana	Texas oak	
Styphnolobium japonicum	Japanese pagodatree	'Regent'
Taxodium distichum	common baldcypress	'Shawnee Brave'
Tilia americana	American linden	'Redmond'
Tilia cordata	littleleaf linden	'Greenspire'
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	
Cladrastis kentukea	American yellowwood	'Rosea'
Eucommia ulmoides	hardy rubbertree	
Koelreuteria paniculata	goldenraintree	
Ostrya virginiana	eastern hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Prunus maackii	amur chokecherry	'Amber Beauty'
Prunus sargentii	Sargent cherry	
Quercus acutissima	sawtooth oak	
Quercus cerris	European turkey oak	
Sorbus alnifolia	Korean mountainash	'Redbird'

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 pensylvanicum**	striped maple	
Acer truncatum	Shantung maple	
*Aesculus pavia**	red buckeye	
Amelanchier arborea	downy serviceberry	(numerous exist)
Amelanchier laevis	Allegheny serviceberry	
Carpinus caroliniana	American hornbeam	
Cercis canadensis	eastern redbud	(cold-resistant only)
Chionanthus virginicus	white fringetree	
Cornus alternifolia	pagoda dogwood	
Cornus florida	flowering dogwood	(disease resistant only)
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'
*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'
Styrax japonicus	Japanese snowbell	'Emerald Pagoda'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

Note: * denotes species **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'
Chamaecyparis nootkatensis	Nootka falsecypress	'Pendula'
Cryptomeria japonica	Japanese cryptomeria	'Sekkan-sugi'
Ilex opaca	American holly	
Picea glauca	white spruce	
Picea omorika	Serbian spruce	
Picea orientalis	Oriental spruce	
Pinus densiflora	Japanese red pine	
Pinus resinosa	red pine	
Pinus rigida	pitch pine	
Pinus strobus	eastern white pine	
Pinus sylvestris	Scotch pine	
Psedotsuga menziesii	Douglasfir	
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	
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 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.

TREE PLANTING TIPS

The following tips will help to ensure a successful tree planting experience.

Time of Year

Keep in mind that spring and fall are the best times of the year to plant trees, but some trees do better when transplanted in spring rather than fall, and vice versa. Check with your nursery or an expert to make sure you are planting the tree at the right time of year.

Tree Selection

- Pick trees that are the right size for your site when fully grown.
- Select trees that show normal growth and are free of serious insect and disease problems. The trees should exhibit good vitality, appearing undamaged, have good leaf color, and bud appearance.
- Single-stemmed trees should not have clumped foliage arising from the same point on the stem. Such a condition, while providing an initial tree form, will ultimately cause branching problems, such as weak crotches, and should be avoided.

Balled-And-Burlapped and Containerized Tree

When buying a tree, it will typically be a balled-and-burlapped tree, with soil surrounding the root system or a containerized tree, generally grown in the container in which they are sold.

Balled-and-burlapped tree roots are slower to dry out than bare-root trees, as the roots are inside a soil ball. However, the burlap may cover dead or poorly pruned roots and should be inspected before planting. The type of soil surrounding the roots should not be too different from the soil on the site or the tree roots may not extend sufficiently into the surrounding soil from the root ball. In such a case, the backfill soil should be amended to provide a transition between the two types of soil.

Container-grown trees have an undisturbed root system and can be planted with the intact root system. If the tree has been in the container for too long; however, the tree may be pot-bound with the roots encircling the inside perimeter of the pot. The roots should be sliced or partially separated in order to improve the ability of the tree to extend the roots into the surrounding soil.

Transport

Handle trees with care. Trees are living organisms and, thus, are perishable. During transport and when loading and unloading, protect trees from damage. Use care and don't break branches or lift by the trunk. If trees are stored prior to planting, keep the roots moist.

The Planting Hole

The size of the hole you dig is very important. The planting hole is wider (two to three times) than the root ball and not quite as deep as the root ball. The hole should be dug shallow and wide. It should not be any deeper than the root ball. The root flair (which is the area at the base of a tree where the trunk transitions from trunk into the root system tissues) should be at or just above ground level. Loosen heavy clay soils around the perimeter of the hole, if present, to allow for root penetration.

Placing the Tree

The tree should be planted to the same depth or slightly higher than it was growing at the nursery. A high mound should be avoided as the soil can dry out quickly in the summer and freeze in the winter.

Backfilling the Soil

The backfill soil should be added gradually and watered carefully to settle the soil but not to saturate it. Balled-and-burlapped trees should have any untreated burlap pulled away from the top of the root ball and cut away, not buried, so that none of the burlap is exposed at the soil surface. Otherwise, the burlap can wick moisture away from the roots of the freshly planted tree.

Staking the Tree

Stakes should only be used to support trees on windy sites or for smaller trees with weak trunks. The stakes should be placed before the backfill is added to avoid damaging any large roots. A stake is meant to provide a temporary support and should be removed within a year to allow the tree to develop trunk strength and to limit the potential for physical damage from the stakes and support ties.

Wooden stakes, metal pipe, fence stakes, and metal reinforcing bars may all be used for support. Anything used for a tie should have a flat, smooth surface and be somewhat elastic to allow for slight movement for the tree. Suitable materials include rubber strips or webbing and belting. Wire covered with hose or tubing should not be used.

Watering

Because a newly transplanted tree may have lost much of its root system, watering is critical for successful establishment.

- Water at the time of planting.
- Water weekly, or bi-weekly particularly during dry periods.
- A newly planted tree will benefit from at least an inch of water a week.

Mulching

Newly planted trees respond well to mulch placed around the tree. This reduces initial root competition with turf and limits the possibility of physical damage by mowers.

The mulch should not be piled (mulch 'volcanoes') around the tree and should not actually touch the tree trunk.

Apply no more than a 2- to 3-inch depth of mulch, with it being no more than ½ inch deep closest to the tree.

Pruning

When planting a tree, only dead or broken branches should be removed. All living branches should be left on the tree to help promote tree establishment. Once the tree has been established on the site, training pruning can be done to promote good branching patterns, but no more than 1/4 of the branches should be removed at any one time.

Fertilizing

Fertilizer is not generally necessary at the time of planting and, indeed, if placed improperly in the planting hole can injure roots. The addition of nitrogen, in a slow-release form, however, can benefit a newly planted tree, and it may be efficient to apply at the time of planting.

Poster Design by: Dr. Bonnie Appleton, Virginia Tech University, Illustrations/Layout by

S.K. Kane; Funds provided by the Urban and Community Forestry Assistance Grants Program of the U.S Forest Service in cooperation with the Virginia Department of Forestry, 1995.

APPENDIX E
STORM PREPAREDNESS PLAN

INTRODUCTION

The purpose of preparing an emergency storm preparedness plan is to mitigate, respond, and recover from an emergency or natural disaster in a timely manner. This section will focus on establishing protocols to outline the steps needed to have an effective strategy in place. Advance planning will go a long way toward minimizing the impacts of natural disasters on the urban forest. Susan Cooper, City Forester was interviewed to aid in the development of the plan. She shared what she has developed for a plan during her career and how she has effectively responded to events in the City of Olean. The intent of this document is to provide a guide for the City of Olean in the event of an emergency.

Keys of an Effective Emergency Storm Preparedness Plan

The Plan will address the following:

- Mitigation: activities to reduce the effects of disasters
- Preparedness: plan a response prior to disaster
- Response: activities performed during a disaster to minimize hazards in effective, efficient, and equitable ways
- Recovery: returning to normal following a disaster

The City of Olean, New York lies in a climate zone that exhibits four distinct seasons. This creates the potential for rapid changes in temperature, humidity, and barometric pressure, and sets the stage for severe weather events, such as tornadoes, thunderstorms, hail, high winds, ice, and snow. Also, flooding from severe storms are ever-present threats.

The Köppen climate classification rates Olean as Dfb which is characterized as a humid, continental region with a warm summer. The coldest month averages below 32 °F and no month's average temperature is above 71.6 °F. Olean receives above national averages in rainfall at 43", snowfall at 76", and precipitation days at 166 days of some kind of precipitation. The increased precipitation seen in the area can raise the likelihood of damage being done to trees, particularly in severe storms.

Severe weather can cause catastrophic damage and create significant volumes of vegetative debris that requires processing. To prepare, proactive cities have developed emergency response and recovery plans. Traditionally, these plans address serious public safety and health issues, but commonly overlook the necessity of addressing trees and woody debris in the mitigation efforts.

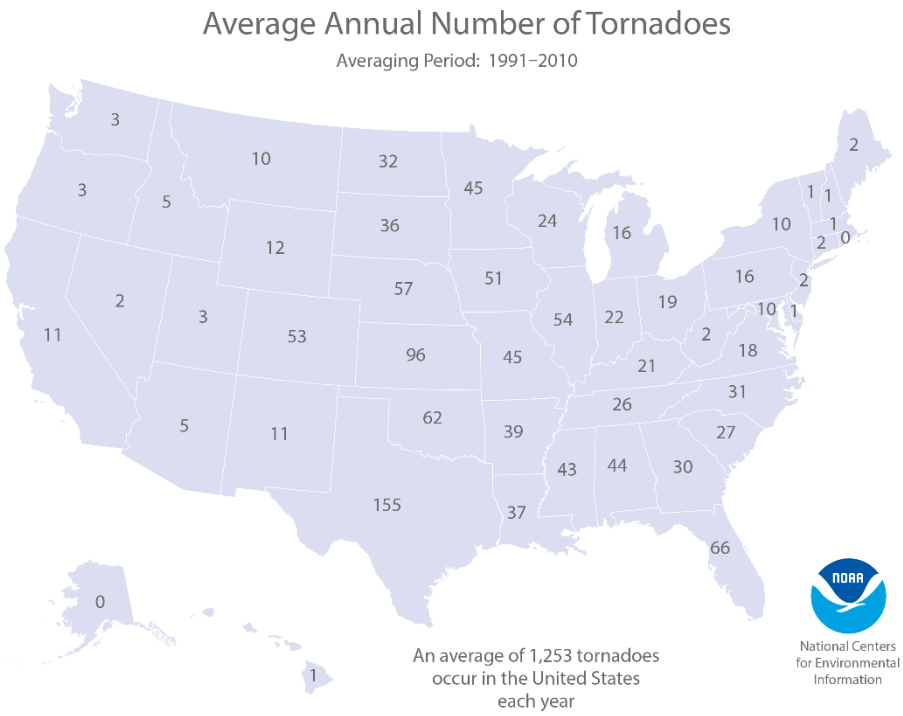
When catastrophic disasters, such as tornadoes, ice storms, and severe straight-line winds strike a metropolitan center, thousands to millions of cubic yards of debris are produced. Trees and vegetation can account for approximately 30% of this debris volume. Beyond the task of collecting and disposing of this debris are additional urban forest management considerations, including increased threat to life, hindrance to life-saving efforts, power outages, and personal and public property damage. The impacts of these additional tree-related considerations are not always quantifiable but can overwhelm the city's storm response services and slow down the recovery process.

Severe Weather Events in Olean

The severe weather events most commonly experienced in New York include winter storms (snow and ice) and thunderstorms. These types of events generally include high winds and potent flooding that can cause partial or whole tree failure, particularly in trees with pre-existing defects. Full canopies on trees during late spring to summer, when severe thunderstorms are most common, and the accumulation of ice and snow on branches during winter storms can increase the dynamic loading experienced by trees and their parts during severe weather events, increasing the chances of failure.

Even relatively low wind speeds can cause tree damage in trees that are fully leafed out. Wind speeds from 45 to 57 miles per hour can cause small, healthy limbs to break as well as damage larger dead or weakened branches. At 58 to 74 miles per hour, large, healthy branches will break and shallowly rooted trees may be uprooted. Widespread tree damage with trees snapped or uprooted can occur at wind speeds from 75 to 89 miles per hour, and above 90 miles per hour even large and healthy trees may be snapped or uprooted. Full tree failure may occur at wind speeds as low as 30 miles per hour if the soil is heavily saturated, while much higher wind speeds may be required to cause damage when trees are not leafed out.

The National Oceanic and Atmospheric Administration reports that on average, about 10 tornadoes are confirmed in the state of New York each year. However, the threat of tornadoes, and the resulting damage that occurs, is relatively low in Olean but have occurred in the past.



Average number of tornadoes by state, 1991-2010

Other high wind events are also common in New York. Between 2011 and 2021, 17 high wind events were recorded by the National Center for Environmental Information in Cattaraugus County, with a minimum wind speed of 58 miles per hour and a maximum wind speed of 67 miles per hour. A further 187 thunderstorm events were recorded during the same time period, which produced gusts of at least 46 miles per hour.

A total of 73 winter storms and winter weather events, including a blizzard in 2014 and 2020, have been recorded in Cattaraugus County from 2011 to 2021. These types of storms, in addition to producing strong wind gusts, frequently produce large quantities of ice and snow which may build up on trees, exacerbating wind loading and leading to tree damage.

While any individual type of severe weather event may seem uncommon, when considered together, severe weather is not a rarity for the City of Olean. Many types of weather events can produce the high winds required to cause significant damage to Olean's urban forest. Proactive maintenance is the best form of preparation a community can take for the potential damage brought by severe weather.

Impact of Climate Change

The climate is changing both globally and in New York State, causing an increase in storms and flooding. In the United States, 2019 was the second warmest year on record, and nine of the ten warmest recorded years have occurred since 2005. The average temperature across New York has risen 2.4° F since 1970. Annual precipitation and heavy precipitation events have gone up throughout the state, particularly during winter and spring; however, there has been less rain during summer and fall, leading to an increase in drought conditions during the hot season. Global climate change has sparked a sense of urgency for urban forestry professionals, as weather and climate are integrally tied to urban forest health. As a result of climatic changes, increases in the frequency and severity of storms are occurring throughout the East Coast. This impacts urban forest in several ways:

- Increased drought conditions lead to more stress on urban trees, weakening natural resistance to extreme weather events.
- More storm damage and subsequent loss of trees.
- Poorly or infrequently managed trees are more susceptible to breakage in storms.
- Premature post-storm tree removals on private land tend to occur, often as a result of fear and lack of professional assessment.
- More frequent power outages from trees situated next to power lines.
- High volumes of stormwater runoff due to extensive impervious surfaces and shrinking amounts of green land cover, exacerbating existing issues of erosion and pollution.

A Comprehensive Community Forest Management Plan greatly reduces storm hazards through proper planting and preventative maintenance. However, when disasters occur, an Emergency Storm Plan as an addendum to this plan can provide solid data, facts, and protocols to ensure service continuity and timely recovery and restoration.

Funding and Budget for Urban Forest Emergencies

While the scope of this Plan does not permit detailed budgeting estimates, Olean is strongly encouraged to analyze past catastrophic storm events (snow/ice storms, tornadoes, flooding) and provide for enough regular funding and contingency funding to support an adequate response for various levels of storm damage. Information on storm emergency categories can be found in Appendix A. Storm and emergency response will require funding for staff overtime, contractual services, and equipment rental.

Removal of debris from public property is eligible for reimbursement from the Federal Emergency Management Agency (FEMA) under most cases when a Federal disaster has been declared and when it constitutes an immediate threat to life, public safety, or improved property. This includes the removal of tree debris (downed limbs, trees) and the pruning or removal of trees to remove imminent hazards (hanging limbs or trees so damaged that they are structurally unstable). Any tree debris located on public rights-of-way are eligible. This includes material that originated on private property that is dragged to the right-of-way by residents during a specified period.

In order to receive FEMA funding, it is critical to be prepared and fully document all losses and money spent. Most damage assessments through FEMA must be done immediately after the disaster event. The calculated dollar amount is then sent to the County Emergency Management Director. FEMA has a public assistance program that is open to municipal departments and nonprofit hospitals. These grants can be applied for to assist with a variety of damages, including debris removal and emergency protective measures.

Additionally, National Grid can assist in any tree work or cleanup when it is related to the electrical lines and utilities. The City of Olean can do brush cleanup; however, the City does not currently have a woodchipper and brush is dumped whole in a vacant lot during storm events. Contractors in the past have occasionally been hired to remove brush after storm events in which they have the capability to manage the debris. To help be prepared for future events the City of Olean should develop a list of current contractors approved for storm response and note which contractors can assist with the removal and disposal of tree debris.

Storm-Related Training

It is recommended the City DPW and forestry staff receive safety and technical training through in-the-field and classroom methods. To ensure safe and effective work, staff should receive regular and updated training sessions for first-aid, CPR, chainsaw use, tree risk assessment, and minimum approach distances for energized electric lines. These topics should be considered as basic minimum training opportunities.

Additional training should be provided to key the City of Olean personnel in topics that include electric hazard assessment (EHAP), aerial lift training, advanced climbing, crane operations, and aerial rescue. Consider having key staff members receive training to become ISA Certified Arborists. Develop annual "scenario training" with tree emergency response topics and situations. TCIA, Tree Care Industry Association offers additional safety training that should be considered.

TREE POPULATION CHARACTERISTICS RELATED TO STORM DAMAGE

With the 2021 public tree inventory data, the vulnerability of the City of Olean's urban forest to severe weather events can be assessed more accurately. Of course, certain tree species are more prone to breaking and splitting in storms and high winds than others (i.e., silver maple and Callery pear). Trees growing under utility lines that have been poorly pruned in the past are more susceptible to storm damage, so it is important to plant smaller species, when necessary. Trees under stress from insect and disease pressures, or generally poor condition with crown, trunk, or root defects, are also more likely to fail in a storm. Therefore, it is beneficial to examine the urban forest data to do a generalized vulnerability assessment of the City of Olean in terms of its urban forest resource.

Timing of a storm event can have a major effect on the overall damage sustained by the tree. This is the case when a tree is leafed out and can act as a sail, or catch, and an early or late snow storm in Olean causes excess snow and ice to build up in the canopy. Combining this with supersaturated soil conditions the issue only worsens.

Tree Condition, Defects, and Size

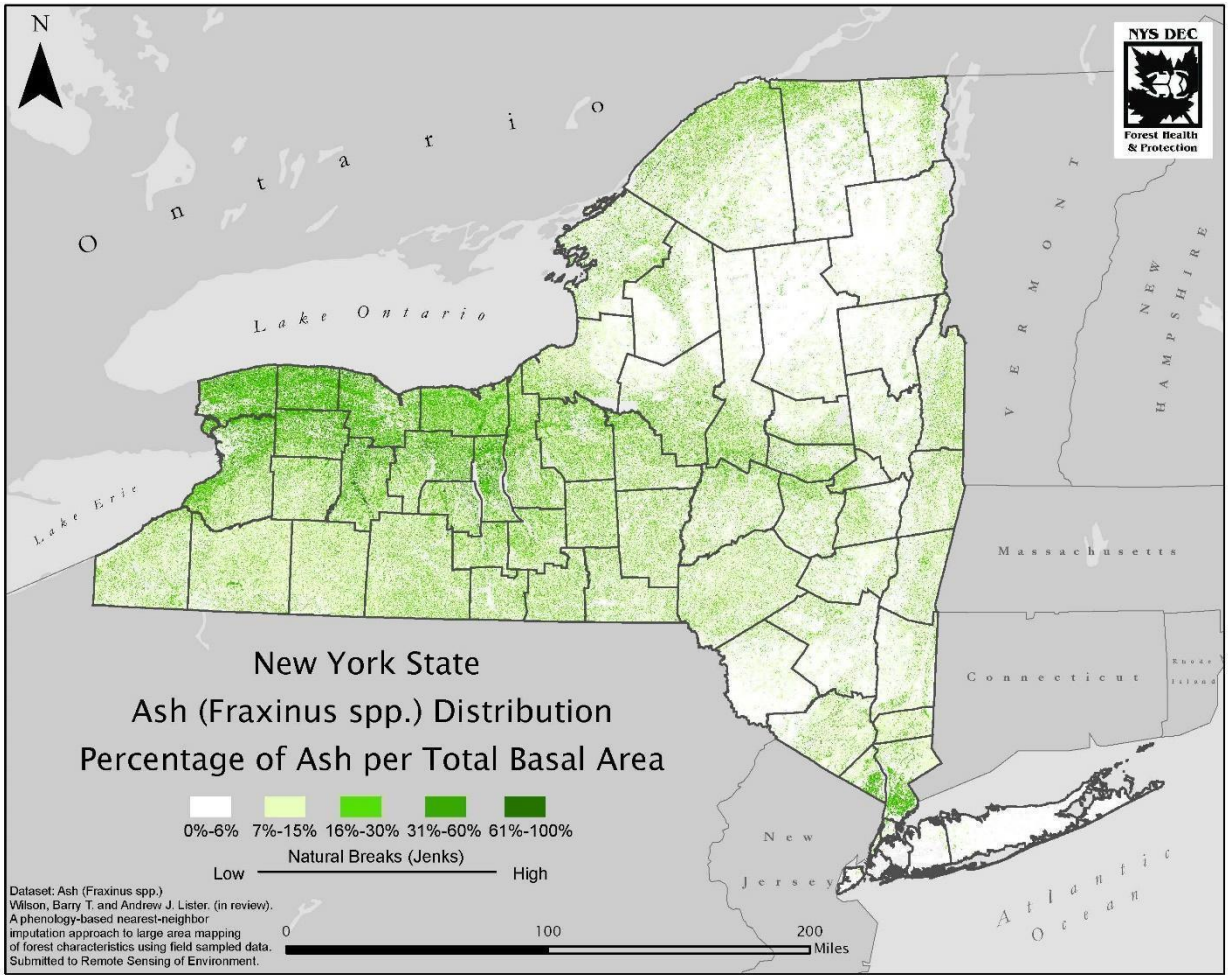
Extreme, High, and Moderate Risk removals and pruning should be completed immediately to mitigate risk. Olean's proactive storm preparedness maintenance activities should prioritize mitigation of the defects on Poor and Dead condition trees with an existing defect (especially dead and dying parts or missing or decayed wood), particularly along their major streets.

Our city-wide 2021 Tree Inventory identified 509 trees with a condition rating of Poor, Critical, or Dead, a defect other than None, and a primary maintenance need of Prune or Remove in order to mitigate the defect. 402 (79%) of these storm-susceptible trees are in Poor condition, 41 (8%) are in Critical condition, and 66 (13%) are Dead. Among the trees in Poor and Critical condition, 276 (54%) are noted with dead and dying parts and 156 (31%) are noted with missing or decayed wood. These trees can be considered at an elevated risk of failure during storm events and should be pruned, removed, or otherwise maintained to decrease the chance that they will fail in storm events.

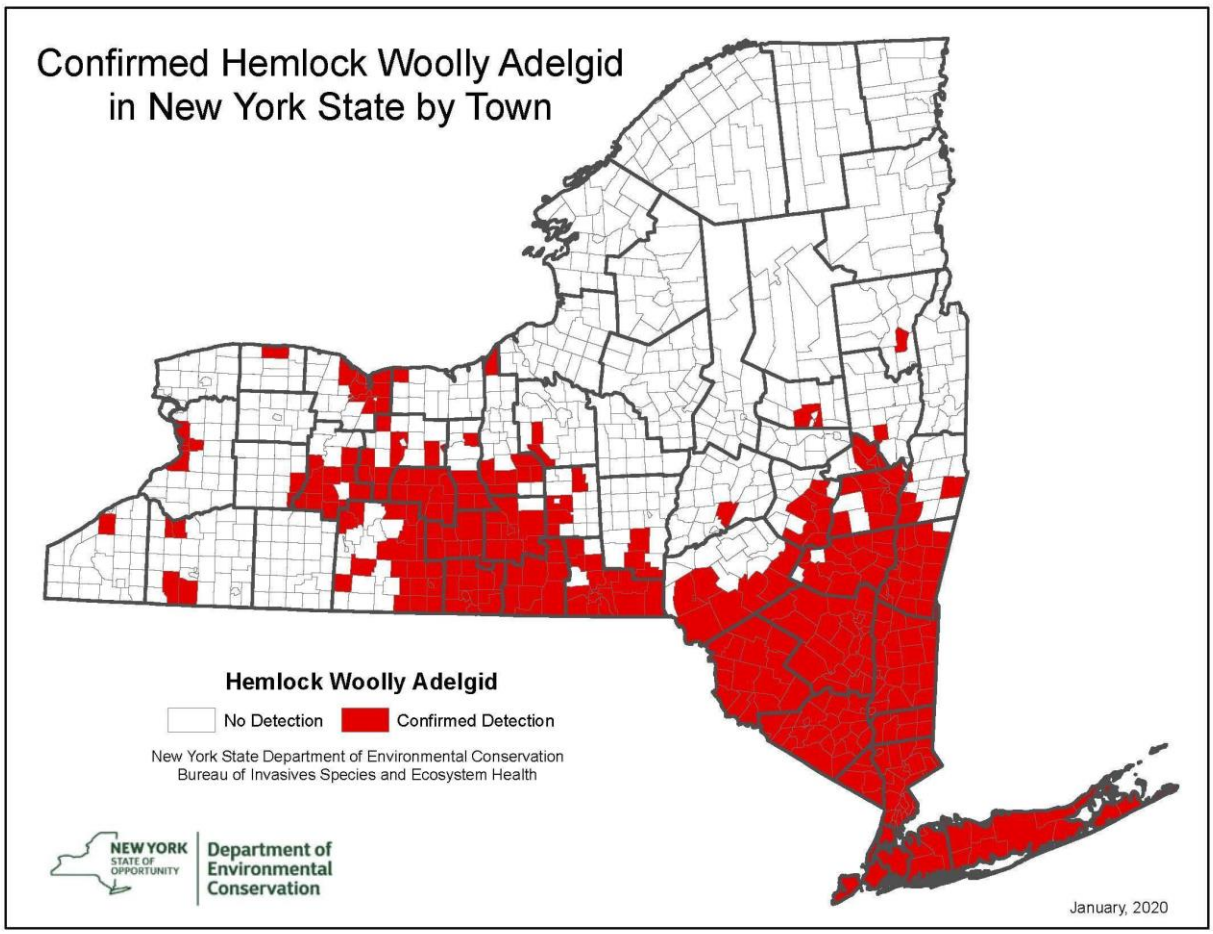
Of the 509 storm-susceptible trees, 101 (20%) are located near primary electrical lines. These trees are likely to have been utility pruned to provide clearance for aerial electrical lines. Utility pruning, while important to prevent tree interference with important electric utilities, often creates unbalanced crowns which can predispose trees near utility lines to failure under increased loading from wind or ice. Topping cuts, which are common in utility pruning, can promote the growth of poorly attached branches which may become large enough to cause damage if they fail. Partial or complete failure of these trees could result in electrical hazards or power interruptions to City residents.

Maturity has also shown to be a factor during storms. Mature trees tend to be larger in size, creating a higher risk for causing damage and creating excessive debris. Storm preparedness management for the urban forest should prioritize maintenance work by emphasizing mature trees, using tree DBH as a proxy for age. Any mature trees that have been around recent construction pose an increased risk due to potential for stress and damage to root zones. Of the 509 storm-susceptible trees, 187 (37%) are 24" DBH and larger. The largest storm susceptible tree in Fair condition is 64" DBH.

Urban forests are consistently under pressure from exotic and invasive insects and diseases. The frequency and severity of pests and disease are likely to worsen throughout the U.S. as the climate warms; therefore, the best solution for local communities lies in proper proactive care (budgeting, monitoring, smart management) as well as planting of more resistant tree species. When pests cause severe damage to trees, we can see a sudden surge in storm susceptible trees and damage done. This is currently being expressed with the emerald ash borer (EAB; Figure 2) and hemlock wooly adelgid (HWA; Figure 3), as they spread throughout New York and attack native species of ash and hemlock, respectively. Within our urban forest, there were 152 ash trees and 11 hemlock trees that should be inspected on a regular schedule to identify diseases and insects early and prevent the threat from destabilizing large portions of the urban forest. It is possible to treat for EAB, but it is costly and most ash trees in the City have already been infected. Unlike EAB, HWA has not yet been detected in the City of Olean, but it has nearby in Allegheny State Park. This further illustrates the importance of planting diverse, pest resistant species to mitigate cost, and maintenance.



Map of EAB in NYS



Map of HWA in NYS

TREE SPECIES PRONE TO STORM DAMAGE

Fast-growing, weak-wooded species have the highest potential to create large amounts of debris after storms. However, wood characteristics alone cannot accurately predict which trees or which species will be vulnerable to storm damage. Tree habit also plays an important role. Pin oak (*Quercus palustris)* branches tend to fail easily due to their horizontal growth, unlike other oak which are typically very strong trees. Research has shown that preexisting characteristics, including weak branch junctures, fine branching, dead and decaying branches, root damage, broad crowns, and horizontal branching habit, can increase a tree's susceptibility to wind and ice damage. Callery pear (*Pyrus calleryana*) are prone to forming weak branch connections with included bark, while Siberian elm (*Ulmus pumila*) have many fine branches, providing greater surface area for ice buildup. The following tables provide a list of tree species and their resistance to wind and ice damage.

Wind Susceptible Trees

High	Medium-High	Medium-Low	Low
Species			
Callery pear (*Pyrus calleryana*)	hybrid elm (*Ulmus* x)	hophornbeam (*Ostrya virginiana*)	American holly (*Ilex opaca*)
Chinese elm (*Ulmus parvifolia*)	black cherry (*Prunus serotina*)	blackgum (*Nyssa sylvatica*)	Baldcypress (*Taxodium distichum*)
Leyland cypress (*Cupressocyparis leylandii*)	boxelder (*Acer negundo*)	redbud (*Cercis canadensis*)	dogwood (*Cornus* spp.)
tuliptree (*Liriodendron tulipifera*)	Hackberry (*Celtis occidentalis*)	sweetgum (*Liquidambar styraciflua*)	magnolia (*Magnolia* spp.)
	red maple (*Acer rubrum*)	river birch (*Betula nigra*)	
	mulberry (*Morus* spp.)	hornbeam (*Carpinus* spp.)	
	silver maple (*Acer saccharinum*)	Japanese maple (*Acer palmatum*)	
	sycamore/planetree (*Platanus* spp.)	pignut hickory (*Carya glabra*)	
	white oak (*Quercus alba*)	sugar maple (*Acer saccharum*)	

Ice Susceptible Trees

High	Moderate	Low
American linden (*Tilia americana*)	American beech (*Fagus grandifolia*)	Amur maple (*Acer tataricum ginnala*)
bigtooth aspen (*Populus grandidentata*)	boxelder (*Acer negundo*)	baldcypress (*Taxodium distichum*)
black cherry (*Prunus serotina*)	chestnut oak (*Quercus prinus*)	bitternut hickory (*Carya cordiformis*)
black locust (*Robinia pseudoacacia*)	common chokecherry (*Prunus virginiana*)	black walnut (*Juglans nigra*)
black oak (*Quercus velutina*)	douglas-fir (*Pseudotsuga menziesii*)	blackgum (*Nyssa sylvatica*)
butternut (*Juglans cinerea*)	eastern white pine (*Pinus strobus*)	bur oak (*Quercus macrocarpa*)
Callery pear (*Pyrus calleryana*)	gray birch (*Betula populifolia*)	Colorado blue spruce (*Picea pungens*)
eastern cottonwood (*Populus deltoides*)	green ash (*Fraxinus pennsylvanica*)	crabapple (*Malus* spp.)
hackberry (*Celtis occidentalis*)	northern red oak (*Quercus rubra*)	eastern arborvitae (*Thuja occidentalis*)

Ice Susceptible Trees (Continued)

High	Moderate	Low
honeylocust (*Gleditsia triacanthos*)	paper birch (*Betula papyrifera*)	eastern hemlock (*Tsuga candensis*)
hybrid elm (*Ulmus* x)	pin oak (*Quercus palustris*)	eastern redcedar (*Juniperus virginiana*)
Jack pine (*Pinus banksiana*)	red maple (*Acer rubrum*)	European mountainash (*Sorbus aucuparia*)
pin cherry (*Prunus pensylvanica*)	red pine (*Pinus resinosa*)	ginkgo (*Ginkgo biloba*)
pitch pine (*Pinus rigida*)	scarlet oak (*Quercus coccinea*)	hedge maple (*Acer campestre*)
quaking aspen (*Populus tremuloides*)	Scotch pine (*Pinus sylvestris*)	hophornbeam (*Ostrya virginiana*)
river birch (*Betula nigra*)	sugar maple (*Acer saccharum*)	hornbeam (*Carpinus* spp.)
Siberian elm (*Ulmus pumila*)	sycamore/planetree (*Platanus* spp.)	horschestnut (*Aesculus hippocastanum*)
silver maple (*Acer saccharinum*)	tamarack (*Larix laricina*)	Kentucky coffeetree (*Gymnocladus dioicus*)
slippery elm (*Ulmus rubra*)	tuliptree (*Liriodendron tulipifera*)	littleleaf linden (*Tilia cordata*)*
Virginia pine (*Pinus virginiana*)	white ash (*Fraxinus americana*)	northern catalpa (*Catalpa speciosa*)
willow (*Salix* spp.)	yellow birch (*Betula alleghaniensis*)	Norway maple (*Acer platanoides*)
		Norway spruce (*Picea abies*)
		pignut hickory (*Carya glabra*)
		red buckeye (*Aesculus pavia*)
		red horsechestnut (*Aesculus* x *carnea*)
		shagbark hickory (*Carya ovata*)
		swamp white oak (*Quercus bicolor*)
		sweetgum (*Liquidambar styraciflua*)
		white oak (*Quercus alba*)
		white spruce (*Picea glauca*)

The species composition of the City of Olean tree population translates to vulnerability to storm-related damage. 21% of the inventoried trees have high or medium-high susceptibility to wind damage, and a further 16% and 27% are highly and moderately susceptible to ice damage, respectively. These lists of storm-susceptible species should be considered when prioritizing maintenance activities for storm preparedness and future planting plans should incorporate storm-resistant species listed in the following tables. Tree loss during storm events can be an opportunity to replant and increase species diversity and urban forest resilience in the face of climate-driven pests and severe weather.

Wind Susceptible Trees in Olean

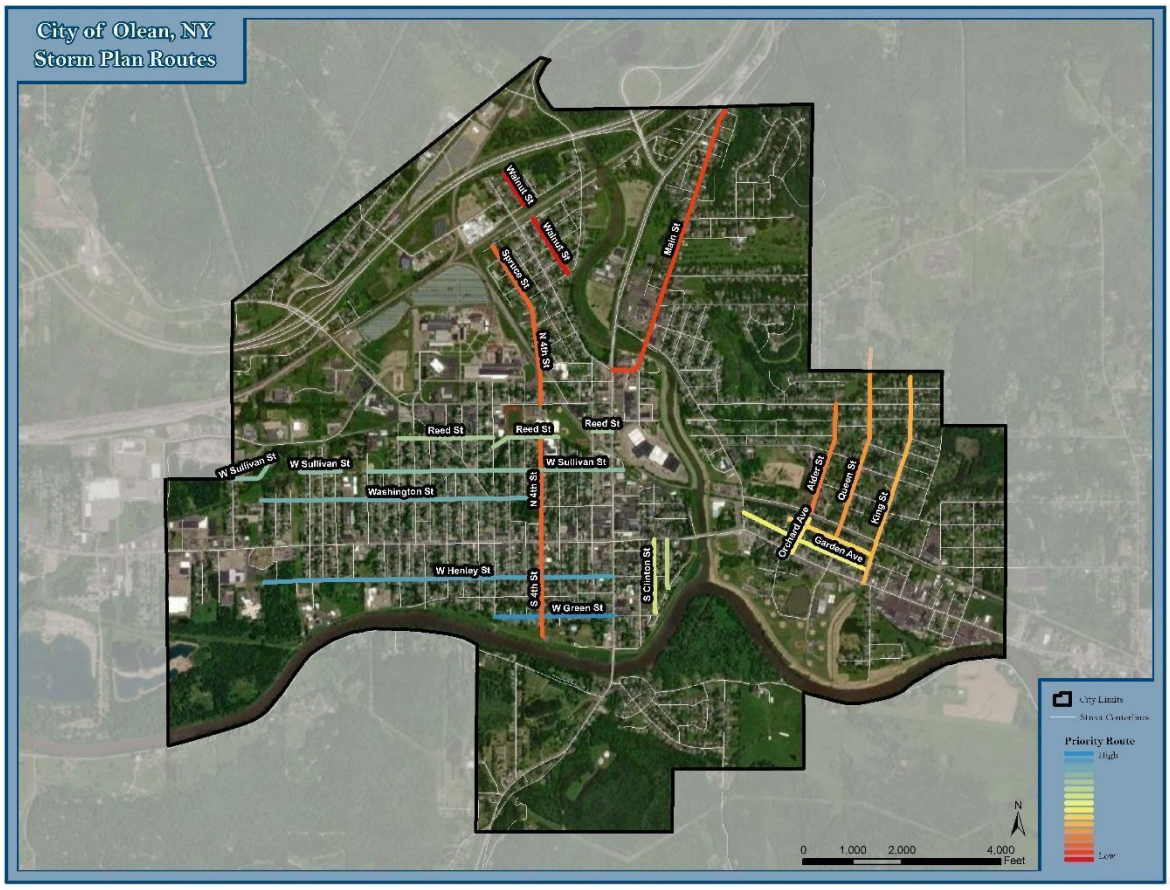
Species	Susceptibility	Count	Percent
Callery pear (*Pyrus calleryana*)	High	117	2.78
Chinese elm (*Ulmus parvifolia*)	High	3	0.07
tuliptree (*Liriodendron tulipifera*)	High	8	0.19
hybrid elm (*Ulmus* x)	Medium-High	90	2.14
black cherry (*Prunus serotina*)	Medium-High	60	1.42
boxelder (*Acer negundo*)	Medium-High	39	0.93
hackberry (*Celtis occidentalis*)	Medium-High	46	1.09
red maple (*Acer rubrum*)	Medium-High	367	8.71
mulberry (*Morus* spp.)	Medium-High	3	0.07
silver maple (*Acer saccharinum*)	Medium-High	110	2.61
sycamore/planetree (*Platanus* spp.)	Medium-High	24	0.57
white oak (*Quercus alba*)	Medium-High	98	2.33

Ice Susceptible Trees in Olean

Species	Susceptibility	Count	Percent
American linden (*Tilia americana*)	High	3	0.07
bigtooth aspen (*Populus grandidentata*)	High	1	0.02
black cherry (*Prunus serotina*)	High	60	1.42
black locust (*Robinia pseudoacacia*)	High	21	0.50
butternut (*Juglans cinerea*)	High	3	0.07
Callery pear (*Pyrus calleryana*)	High	117	2.78
hackberry (*Celtis occidentalis*)	High	46	1.09
honeylocust (*Gleditsia triacanthos*)	High	188	4.46
hybrid elm (*Ulmus* x)	High	90	2.14
quaking aspen (*Populus tremuloides*)	High	8	0.19
river birch (*Betula nigra*)	High	9	0.21
Siberian elm (*Ulmus pumila*)	High	11	0.26
silver maple (*Acer saccharinum*)	High	110	2.61
willow (*Salix* spp.)	High	6	0.14
American beech (*Fagus grandifolia*)	Moderate	2	0.05
boxelder (*Acer negundo*)	Moderate	39	0.93
douglas-fir (*Pseudotsuga menziesii*)	Moderate	6	0.14
eastern white pine (*Pinus strobus*)	Moderate	23	0.55
gray birch (*Betula populifolia*)	Moderate	1	0.02
green ash (*Fraxinus pennsylvanica*)	Moderate	92	2.18
northern red oak (*Quercus rubra*)	Moderate	151	3.58
paper birch (*Betula papyrifera*)	Moderate	18	0.43
pin oak (*Quercus palustris*)	Moderate	56	1.33
red maple (*Acer rubrum*)	Moderate	367	8.71
red pine (*Pinus resinosa*)	Moderate	8	0.19
Scotch pine (*Pinus sylvestris*)	Moderate	38	0.90
sugar maple (*Acer saccharum*)	Moderate	272	6.46
sycamore/planetree (*Platanus* spp.)	Moderate	24	0.57
tuliptree (*Liriodendron tulipifera*)	Moderate	8	0.19
white ash (*Fraxinus americana*)	Moderate	48	1.14
Total		1,826	43.35

Debris Removal Priorities

Severe weather events can cause large amounts of woody debris to be deposited on and around public roadways. The same weather events also tend to increase the need for emergency vehicles, including fire trucks and ambulances, utility workers, and Department of Public Works staff to travel public roadways. Both during and after extreme weather events, clearing of major roadways is essential to allow emergency vehicles to travel unimpeded. In the event of an emergency evacuation, major routes of ingress and egress from the City or areas of the City need to be navigable and is based on the advice of Susan Cooper of the street that should be cleared and the order they should be cleared.



DISCUSSION

The City of Olean has many trees that are at an elevated risk of failure during severe weather events. All Extreme, High, and Moderate Risk trees recommended for pruning or removal should be attended to right away to mitigate the risk associated with these trees. However, in order to lessen the damage associated with major storms, Low Risk trees with poorer condition ratings, pre-existing defects, and pruning recommendations should also be considered a maintenance priority after elevated risk trees have been dealt with. Special attention should be paid to trees which have the potential to impact aerial electrical lines, as the failure of these trees may result in power interruptions or electrical hazards. Future planting efforts should take storm damage susceptibility into consideration when choosing which species to plant.

Tree species with an elevated chance of failure during storms are not evenly distributed throughout the City. Neighborhoods with large numbers or high proportions of highly susceptible trees should be prioritized for proactive storm preparedness maintenance to mitigate the potentially devastating impacts of a storm on these parts of the City. These neighborhoods should also be considered priorities for debris removal after storms, as they are likely to have more downed woody debris than neighborhoods with smaller populations of storm-vulnerable species. A quick filter is supplied in Treekeeper® to aid the City of Olean in identifying large diameter trees in poor condition. Special attention should be paid to trees along the City's busiest roadways. Proactive pruning and other maintenance can help prevent trees along vital roadways from becoming hazards or dropping significant woody debris into important routes during storms. High-volume roads should be considered priorities for clearing after storms to enable emergency vehicles to traverse the City71 of 167 Context: efficiently.

The occurrence of severe weather cannot be controlled, but the severity of a storm's impact on the urban forest can be mitigated with the creation and implementation of an effective storm preparedness plan. A comprehensive plan that explicitly considers the urban forest will equip the City of Olean to effectively manage future severe weather events from both an operational and financial perspective.

Partners

Successful creation, implementation, and execution of a Storm Preparedness Plan will require the resources and expertise of a variety of external partners. Multiple partnerships are a reality in storm response given the variety of legal, jurisdictional, and operational missions within a municipal boundary. Partnerships can present challenges but can also result in an effective and efficient response when the expertise and resources of each partner are acknowledged, and roles are properly delineated.

The following is a brief description of the City of Olean's major partners in a storm emergency and during recovery efforts.

1. **Utility Agencies**

   Electric distribution lines in the City of Olean are controlled by National Grid, who is a key partner during a storm emergency. Only Electrical Hazards Awareness Program (EHAP) trained staff are qualified to work around energized lines. They have the resources to mobilize quick and appropriate responses to emergency situations involving trees and utilities. During a widespread storm event, we will likely also need to communicate and coordinate with the New York Public Service Commission. Where whole trees or limbs are down or resting on energized lines, rescue and clean-up efforts cannot proceed until power lines have been addressed by the trained personnel of these agencies. Prioritization of where utility agencies respond first generally are: three-phase aerial electric lines; single-phase aerial electric lines; secondary electric lines; and then service (or residential) drops.

2. **New York State Department of Transportation (NYSDOT)**

   The NYSDOT is responsible for the safety and maintenance of interstate and state routes within and around the City of Olean. During a storm emergency, they can respond with staff and equipment to clear state-owned rights-of-way and assist with city streets if authorized. The NYSDOT will likely have a priority of clearing routes which may affect debris staging or removal patterns for Olean. Check with the local district DOT authority to determine their responsibilities and the municipal expectations for each storm category.

3. **Contractors**

   Labor and equipment for debris clearance, removal, and disposal should be available from local contractors. It is advisable to have contractors, such as tree service companies, debris processing companies, and equipment and tool rentals, already under contractual agreements with the municipality before a storm event occurs. During an emergency, the City can enter into new emergency contracts and modify existing contracts to supply the personnel and equipment necessary to efficiently deal with storm mitigation efforts.

4. **State of New York**

   When the response efforts appear to be beyond the capability of the City of Olean, the State can normally provide the next level of assistance by declaring a state of emergency. The New York State Division of Emergency Management and Homeland Security (DEMHS) aids local emergency response leaders for major or complex emergencies or disasters. The division also assists local jurisdictions with recovery from natural or man-made disasters, in addition to coordinating mitigation programs designed to reduce the impact of future disasters on a community. The division typically evaluates the disaster situation and provides advice to the Governor on the availability of State resources to assist local efforts. The City of Olean falls within DEMHS Region 5.

   The DEMHS website (dhses.ny.gov/) offers a toolbox of information to assist with the process of requesting aid and making claims for reimbursement. It offers several guide sheets and forms that provide excellent information about the application process and how to maintain adequate records of debris cleanup costs and contracting procedures.

5. **Federal Government**

   The U.S. Army Corps of Engineers may be able to respond for up to 10 days without a Presidential Declaration; the Federal Highway Administration may provide grant assistance to states for debris clearing, tree removal, and repair of roads; and the Federal Emergency Management Agency (FEMA) provides financial and administrative assistance after storms that are declared a federal emergency.

   FEMA is the major Federal agency that will be a partner of the City of Olean in the event of a severe storm emergency. FEMA recommends that communities have an *Emergency Operation Plan* and, since debris removal is reported as the most significant storm-related problem, communities should have a *Debris Management Plan*.

   FEMA will reimburse the City Olean for debris removal costs if a federal disaster is declared. FEMA will also reimburse the City71 of 167 Context: of Olean for removing certain trees during a federal disaster. Trees which sustain greater than 50% crown loss and are on the public right-of-way are eligible for removal cost reimbursement. However, trees that are completely on the ground after a storm and can be moved away with other debris are usually included in the debris estimates. FEMA often does not cover stump removal unless a hazard situation is present.

   FEMA will also reimburse the City of Olean for hazard reduction pruning immediately following a storm during a federal disaster. In general, broken or hanging branches that are 2 inches or greater in diameter and that are still in the crown of a tree can be pruned under the hazard reduction reimbursement policy. The pruning cost is not extended to the entire tree but is limited only to the removal of branches contributing directly to the hazard.

   Final reimbursement of storm-related damages from FEMA is dependent on accurate record keeping and documentation of storm-related cleanup work.

Summary of Recommendations

- Be sure all staff are signed up for the New York Emergency Alert System through (alert.ny.gov/) .
- Establish communication protocol for storm events. Both during and after a storm emergency, the City of Olean may be relying on and working with multiple departments and levels of government. Effective communication is key to effective and expedient action. An effective plan ensures that all potentially involved or relevant departments understand their roles in the storm response effort.
- Routinely update the tree inventory as maintenance activities occur or as otherwise warranted. The most effective storm preparedness and management plans rely on current data to prioritize work and ultimately reduce future storm damage.
- Annually review the Storm Preparedness and Response Plan and update as necessary.

- Utilize the Homeland Security office to provide quick notification to the New York State Division of Emergency Management and Homeland Security (DEMHS) and FEMA if reimbursement from disaster funds is anticipated. Understand in advance the FEMA system for reimbursement and develop a clear system of record keeping in order to streamline and expedite reimbursement.
- Promptly address elevated risk trees to remove them from the population or otherwise mitigate risk in order to reduce potential storm damage.
- Prioritize proactive tree maintenance activities by considering tree condition, the presence and type of defect, age of tree, and tree location.
- Remove Low Risk but storm damage-prone species from the population when their service lives are over and replace them with more resilient species.
- Provide staff training, particularly on tree risk and working in environments with potential electrical hazards.
- Commit to providing the citizens timely messaging about the City71 of 167 Context: of Olean's response and recovery activities and about tree damage and correction topics. Prepare public relations materials ahead of time so that they are easily accessible when storms strike.
- Re-access all the trees in impacted areas to determine if remedial work is needed.
- Review FEMA Debris Monitoring Guide (March 2021) for further guidance.

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STORM RESPONSE CATEGORIES FOR THE URBAN FOREST

Storm Emergency Categories in the Urban Forest

Storm severity and resulting damage in the urban forest will vary; the degrees of response and resources need to respond will vary as well. For planning purposes, severe weather can generally be classified into three classes: Class I, II, and III. The following descriptions of these classes and the responses are offered for the City71 of 167 Context:'s consideration and adoption as part of an official emergency response plan.

Class I – Minor Storm Event

Class I storms are those that are moderate in severity municipality-wide and/or those which are more severe, but damage is restricted to very few locations or a small geographic area.

Damage reports and service requests are made to the government department directly by citizens and from staff inspections. Damage is corrected, and debris is disposed of, by municipal staff and contractors on site or following customary procedures.

Generally, Class I storms require no outside assistance for parks or streets personnel, and only limited (if any) assistance from contractors or others. Storm damage remediation and clean-up are achieved by municipal staff and/or contractors, requires no additional funding or special equipment, and is completed quickly.

Class I – Storm Mitigation Procedures

- Municipal urban forestry staff receive calls/reports from citizens and partnering agencies.
- Municipal urban forestry staff inspect and determine appropriate mitigation; utility company is called as required.
- Municipal urban forestry staff and/or contractors immediately resolve damage and dispose of debris.
- Municipal urban forestry staff perform a final inspection, complete a work order, and/or otherwise note the occurrence in the tree inventory database.

Class II – Large Storm Event

Class II storms are those that are long in duration or are severe enough to cause widespread damage. Damage mitigation may also include trees on private property that fall into or threaten the public right-of-way or other property. Mitigation priority areas will be major roads, public health and services facilities, and areas or sites where public safety is at risk.

Class II storms exceed the normal staff and resources of the municipality and/or contractors alone. Damage mitigation for these storms will usually require the assistance of outside contractors and from other government departments. The assistance will come in the forms of additional staff and equipment, communication assistance, public safety measures, electrical hazard reduction, and customer service.

Class II Storm Mitigation Procedures

- Municipal urban forestry staff assess damage and immediately communicate with police and fire to determine the extent of the damage.
- The informal Emergency Operations Center should be convened to receive calls/reports and to coordinate mitigation response.
- Municipal urban forestry staff inspect damage, determine mitigation levels and needs, and set work priorities.
- Municipal urban forestry staff designate personnel and equipment resources under the guidance of the EOC leader.
- Municipal urban forestry staff and contractual staff resolve damage, process debris on site where appropriate, or transport debris to storage sites.
- Municipal urban forestry staff will make the final inspection and update the tree inventory database.
- Debris is processed appropriately.
- Municipal urban forestry staff should communicate with the citizens about its response activities and status using the City71 of 167 Context:'s website and social media platforms.

Class III – Catastrophic Storm Event

Class III storms will be rare but can occur. Generally, these will result from hurricanes or snowstorms and widespread ice storms. Damage will be severe and widespread on both public and private property.

A "State of Emergency" will likely be called during and after a Class III storm event. A full EOC should be convened by municipality officials. Other local, state, and federal emergency management agencies will become involved, as well as department of transportation and natural gas and electric utility providers. It will become necessary to identify municipal funding that can be used to finance additional contractual services, equipment, and staff overtime for the mitigation efforts.

Mitigation priorities will be first determined by public safety, health, and welfare needs. Primary streets and highways that provide for evacuation and/or access to hospitals, shelters, police, fire and rescue stations, and other facilities providing vital public services should be the first priorities when clearing roads.

The second priority of streets and highways to be cleared of debris are those that provide access to components of the public and private utility systems that are vital to the restoration of essential utility services, such as electrical power stations and substations, municipal water and sanitary sewer pumping stations, and communication stations and towers. The last priority of roadways to be cleared are residential streets and alleys/access ways.

No debris is intended to be removed during the initial emergency road-clearing operations. Rather, debris is to be moved to the side of the roadway that will allow for a minimum of one lane of traffic in each direction and not create conflict with future utility restoration efforts by others.

Class III - Storm Mitigation Procedures

- Municipal urban forestry staff assess damage and immediately communicate with the EOC and the designated municipal staff leader to determine the extent of the damage. County and State Emergency Management agencies may also be in the communication channels.
- Municipal urban forestry staff secure an additional regional tree debris disposal site(s) as needed.
- Municipal urban forestry staff inspect tree related damage, determine mitigation levels and needs, and set work priorities.
- Municipal, county, DOT, and other agencies combine sufficient and appropriate personnel and equipment resources under the guidance of the municipality to mitigate tree related situations.
- Municipality, allied agencies, and contractual staff resolve damage, process debris on site where appropriate, or transport debris to a storage site.
- Municipal urban forestry staff make a final inspection and update the tree inventory database.
- Debris is processed appropriately.
- Municipal urban forestry staff assist EOC team members and municipal leaders with completion of required state and Federal Emergency Management Agency (FEMA) forms.
- Municipal urban forestry staff should communicate with the citizens about its response activities and status and provide advice for the treatment of private trees that have been damaged using the municipal website and social media platforms.

Tree Emergency Plan Worksheet

For: Urban and Community Foresters, Community Leaders, Public Works and Parks Departments, Planners, Councils, and other Public Officials

1. Early Warning System/Weather Forecasting Service — Use an early warning procedure to enhance mitigation: communicate with the National Weather Service, a consulting meteorological firm, a designated television weather channel, or the local police department. With a procedure in place, you should have at least three hours of lead time before most tree damaging weather strikes.

Staff Lead: _____

Contact Name: _____
Address: _____
Phone: _____
Mobile: _____
FAX: _____
Email: _____ **Web Site** _____

Description of services provided:

2. Local Emergency Manager – Lead contact for a community and responsible for emergency planning and response activities.

Name: _____ **Phone:** _____
Mobile: _____

Role(s):

3. Public Relations Coordinator — This is the individual responsible for primary public relations, media contacts, citizen information and communications about the natural disaster. (Must have full knowledge of damage, community issues and capabilities, and be able to make decisions.)

Name: _____ **Phone:** _____
Mobile: _____

Alternate(s):
Name: _____ **Phone:** _____
Mobile: _____
Name: _____ **Phone:** _____
Mobile: _____

4. Disaster Planning and Response Team Members: Your team should include: mayor, selected department heads including specialists in public relations and purchasing, public works specialists (streets, wood utilization and disposal, fleet manager), utilities, parks department, other local government heads, meteorologist, local emergency managers. Include creative people on your team that can think beyond barriers that may be up. Get media involved in planning so they understand what your cleanup priorities are after a storm. Someone involved with public tree management should be part of the community emergency management team. It is critical to include individuals who can make fiscal and administrative decisions because this team will most likely serve in the storm operations command center.

Name:	Role/Responsibility:
1.	**Mayor**
2.	**Fire Chief**
3.	**Director of Public Works**
4.	**Utility Representative**
5.	**Public Relations Representative**
6.	**City Council**
7.	**County Emergency Management**
8.	**Police Chief**
9.	**Director of Parks**
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	

5. Available Disaster Response Staff and Crews: Identify and list all municipal staff and crews available for disaster response work. Consider forestry and parks departments, public works, engineering, streets and sanitation, etc. Where possible, establish teams that can be responsible for specific disaster response activities (primary route clearing, assistance to utility crews, manage debris staging sites, distribute equipment, etc.)

Staff Name:	Role/Responsibility:
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
21.	

6. Emergency Call Out Procedure — phone contact tree for staff.

Name: ______________________ Will Contact — Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________ Will Contact — Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________ Will Contact — Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________ Will Contact — Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________
Phone: ______________________
Mobile: ______________________

Name: ______________________
Phone: ______________________
Mobile: ______________________

7. Primary transportation and evacuation corridors and routes for emergency vehicles. Identify and map for reference. Have map available and accessible, and review and update annually.

8. Critical power transmission corridor restoration sites (medical treatment centers). Identify and map for reference. Have map available and accessible, and review and update annually.

9. Identify who is responsible for decision making and priority response setting for multiple life threatening situations.

Name:_____ Phone:
Pager:_____ Mobile:_____

10. Tree Damage Clean-up Priorities — List areas that need attention after life threatening situations are abated. Share this information with key staff the will be answering phone calls from residents, businesses, etc. Create a work order form for use when receiving calls.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11. Procedure for Debris Staging and Removal — Identify several areas for staging and processing debris. Establish a contract or agreement securing each site. Choose a processing site that is large, flat, well-drained and accessible to roads that can support truck weights of at least 9 tons per axle. Identify ways to protect significant trees or cultural resources during processing. Potential sites include undeveloped park, industrial, cemetery, fairgrounds, agency and state land. Large parking lots (even paved lots) work well. Remember to consider noise implications near residential areas. Identify multiple sites. Annually reconfirm access and availability to these sites. Make sure the site is large enough for safety considerations (flying debris from tub grinders), if possible, identify sites that can be secured (fencing).

Site 1 – Location: _____

Contact Name/Role:

Phone: Mobile:

Site 2 – Location: _____

Contact Name/Role:

Phone: Mobile:

Site 3 – Location: _____

Contact Name/Role:

Phone: Mobile:

12. Debris and Brush Removal from Private Property — Identify how you will address this issue. A major storm makes it difficult for private property owners to remove brush and debris. Make a decision at the municipal level allowing for debris collection. Determine if your city has adequate equipment and staff available to accomplish this often enormous task. It is critical that you provide guidelines for residents. Specify the types, amounts and piling arrangement of the materials that you will accept. Cities can also assist private homeowners who must contract with private companies for trimming and removal by preparing a list of companies that are licensed, professionally trained and insured.

Person Responsible: _____
Phone: _____ **Mobile:**_____

Minor Storm Policy:

Major Storm Policy:

Listing of available tree care companies:

13. Identify Wood Utilization Options – Develop a list of companies and resources that can process the wood material generated from storm damage. When possible, establish a contract for utilization services.

Wood Utilization Contract: **Company/Organization:**

Phone: Mobile:
Utilization Service Contract: Yes / No
Description of Service:

Wood Utilization Contract: **Company/Organization:**

Phone: Mobile:
Utilization Service Contract: Yes / No
Description of Service:

14. Equipment Listing (available in-house) — Develop a list of public works and parks department equipment and vehicles available for tree clean up work. Keep it current. Include wood chippers, aerial bucket trucks, refuse packers, loaders, supervisory vehicles, chain saws, barricade and lighting equipment, hand saws and pole pruners on the list.

Person Responsible: _____
Phone:_____ **Mobile:**_____

Equipment Available	Quantity	Department/Contact
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

15. Additional Equipment and Assistance Sources — In an emergency, your city administrator may authorize the lease or rental of additional equipment for storm clean-up work. Make a list of potential vendors and keep it current. For certain equipment and assistance needs, it is critical to establish an emergency contract. Guaranteed access to large tub grinders and multiple additional tree trimming crews would be services to guarantee via an emergency contract. The city administrator may also authorize tree contractors to supplement city crews. Assemble a list of licensed and insured potential tree service contractors. Your neighbor cities may be unaffected by a storm that strikes your city. Establish a system to contact neighbor cities that could send staff and equipment to assist you in cleaning up your city.

Person Responsible: _____
Phone:_____ **Mobile:**_____

Equipment Available	Quantity	Department/Contact
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Emergency Contract:

Organization: Contact Name:
Phone: Mobile:

Emergency Contract:

Organization: Contact Name:
Phone: Mobile:

Emergency Contract:

Organization: Contact Name:
Phone: Mobile:

16. Staff, Crew Organization and Equipment Needs – In an emergency, staff members may need to lead crews from other departments or of private contractors. Determine staff who can function in this manner.

Name	Crew#	Equipment Needed

17. Individual(s) Responsible for Record Keeping — This person does documentation and cost accounting during and after disasters. Note – define a specific accounting code for each storm event. If you define a specific code for each storm event, it will allow for effective accounting.

Name: Phone:
Mobile:

Name: Phone:
Mobile:

Storm Accounting Code:

18. Individual(s) Responsible for Damage Assessment and Damage Survey Reports — This person is familiar with FEMA and Division of Emergency Management procedures and prepares the reports needed for public assistance.

Name: Phone:
Mobile:

Name: Phone:
Mobile:

19. Disaster Budget (identify potential activities to anticipate costs)

Personnel Regular Time:

Overtime:

Equipment Owned:

Equipment Contracted:

Contracted Work:

Operational Supplies:

Disposal/Recycling:

Administrative Costs (Overhead):

20. Funding Information from Past Storms — review costs from past storms to anticipate costs for future storms and establish funding needs.

Storm: _____ **Date:** _____

Activity	**Cost**
Personnel Regular Time	
Overtime	
Equipment Owned	
Equipment Contracted	
Contracted Work	
Operational Supplies	
Disposal/Recycling	
Administrative Costs (Overhead)	
TOTAL	

Storm: **Date:** _____ _____

Activity	**Cost**
Personnel Regular Time	
Overtime	
Equipment Owned	
Equipment Contracted	
Contracted Work	
Operational Supplies	
Disposal/Recycling	
Administrative Costs (Overhead)	
TOTAL	

21. Individual(s) and/or Organization(s) responsible for community regreening efforts: Develop a list of contacts for use in efforts to regreen the community after storm events.

Name/Organization: Phone:
Mobile:
Organization Role:

Name/Organization: Phone:
Mobile:
Organization Role:

Name/Organization: Phone:
Mobile:
Organization Role:

Name/Organization: Phone:
Mobile:
Organization Role:

22. Listing of community and neighborhood groups that promote and support community regreening efforts

Group:	Representative:	Phone: Mobile:
Group:	Representative:	Phone: Mobile:
Group:	Representative:	Phone: Mobile:
Group:	Representative:	Phone: Mobile:
Group:	Representative:	Phone: Mobile:
Group:	Representative:	Phone: Mobile:

23. Community urban forestry comprehensive management plan —

Comprehensive forest management is your best defense against storms. Well planted and cared for trees stand up to weather better than neglected trees. Develop or modify a forest management plan to include information related to disaster preparedness. Identify critical activities such as hazard tree removal, tree pruning cycles, annual tree care needs, etc.

Name: Completed:

24. Community tree risk management plan — A tree risk management plan will provide the community with a systematic approach to accurately identify moderate to high risk trees, an initiate the timely removal or corrective treatment of hazardous trees. Communities that carry out tree risk management strategies will likely see reductions in damage after storms. Go to: http://www.na.fs.fed.us/spfo/pubs/uf/utrmm/index.htm

Name: Completed:

25. Storm Damage Assessment – If a storm is significant enough to receive a formal disaster declaration, state and/or federal funding may be available. To assist communities in the process of applying for reimbursement for storm associated costs, it is important to be able to quickly develop an estimate of damage. Consider using the Storm Damage Assessment Protocol as a tool prior to a storm. This protocol allows a community to provide an assessment of damage in a simple, credible and efficient manner. Go to: http://www.itreetools.org/applications.html

Name: Completed:

26. Contacts for additional assistance in natural disaster planning, response and recovery:

Name	Phone
Area or District Forester	
University Extension Agent	
Consulting Foresters	
City Foresters of Neighboring Cities:	
Other	

(Worksheet Prepared by: Lisa Burban (USDA Forest Service), Jim Hermann (Minneapolis Park and Recreation Board), and Katie Himanga (Heartwood Forestry) – Updated May, 2006. Worksheet available on-line at: http://www.na.fs.fed.us/urban/inforesources - under "Urban Forest Management")