Tree Inventory

and

Management Plan

for the

City of

Berea
OHIO

Tree Inventory

and

Management Plan

For the

City of Berea, Ohio

October, 2024

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Notice of Disclaimer

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Table of Contents

Executive Summary

Berea, named by a coin toss in 1836, evolved from an agricultural area into a quarry town thanks to John Baldwin's discovery of rich sandstone veins. The Berea quarries thrived from around 1840 to 1940, producing premium grindstones from Berea sandstone. Berea boasts impressive architecture in its churches, homes, and businesses dating back to as early as 1834.

Though progress has brought many changes over the years, residents still take pride in preserving the city's history and natural beauty. While the nearby Metroparks system offers opportunities for outdoor recreation and preserves the tranquility and beauty of nature, the City owned trees are in decline. A 2017 Cuyahoga County Planning Commission tree canopy study revealed that Berea, along with five other inner-ring suburbs, experienced a decline of more than 10 percent in tree canopy from 2011 to 2017.

The economic health of Berea, as with many communities, is closely related to the ability of the municipal government to supply its citizens with efficient services, safe public spaces, and properly maintained infrastructure. Trees are an integral component of this urban environment. Their shade and beauty contribute to the community's quality of life and soften the hard appearance of concrete structures and streets. They help stabilize the soil by controlling wind and water erosion. Trees also help reduce noise levels, cleanse pollutants from the air, produce oxygen and absorb carbon dioxide, and provide habitat for wildlife.

Trees also provide significant economic benefits, including increased real estate values. Trees provide shade and act as windbreaks, helping to decrease residential energy consumption. Unlike other components of the City's infrastructure, the tree population, with proper care, will actually continue to increase in value with each passing year. When properly maintained, 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.

Managing natural resources in urban areas is challenging in the very least. For many communities, finding suitable space for trees among streets, buildings, sewers, and utility lines is difficult. Frequently, a greater concern is providing adequate maintenance within budget constraints. A successful urban forestry program requires a combination of organized leadership, comprehensive information about the tree population, dedicated personnel, and effective public relations.

The Berea Street Tree Population

In the spring of 2024, Knowles Municipal Forestry, LLC performed an inventory of 8,149 trees, stumps and planting sites in Berea. This street tree data has now been evaluated to provide management strategies for the City. The major findings of the *Tree Inventory and Management Plan for the City of Berea* include the following:

- Knowles Municipal Forestry, LLC inventoried 8,149 total sites. Of these, 7,783 are City street trees and sites and 366 are trees within five park sites.
- Only the City owned street trees and sites were evaluated as the inventoried tree population.
- 44 genera and 80 species are represented in the 4,198 inventoried trees.
- *Acer spp.* (maple) comprises 46% of the inventoried tree population, with *Pyrus calleryana* (pear) 13.2%, *Syringa reticulata* (tree lilac) 6.4%, and *Gleditsias spp.* (honeylocust) at 6.4%.

- Small trees, which are twelve inches and less in diameter, represent 68.6% of the total tree population, 23.8% of the trees are medium-sized (13 to 24 inches in diameter), and 7.6% of the trees are large-sized (25 inches and greater in diameter). This is a very young urban forest.
- The majority of street tree conditions were rated good in both structural condition (90.6%) and functional conditions (98%)
- There are 4,057 trees recommended for pruning in the total street tree population. Of these, 1,534 (37.8%) are recommended for Training, 965 (23.8%) are recommended for Thinning, 894 (22%) are recommended for Raising, and 664 (16.3%) are recommended for Cleaning.
- Removal is recommended for 140 (3%) of the inventoried trees.
- Pruning and removal maintenances were prioritized as 1,530 (36.5%) Young, 2,026 (48.3%) Routine, 525 (12.5%) Immediate, and 115 (2.7%) Critical.
- Twenty-seven stumps were recorded on City streets.
- There are 3,558 planting sites currently inventoried as available for trees.
- The total value of Berea's street tree population is estimated to be **$7,887,531.00**. This number is based on the tree valuation methodology found in the Council of Tree and Landscape Appraisers' publication, *Guide for Plant Appraisal (Tenth Edition).*
- $1,946,380 is required to properly maintain the current street tree population. The annual cost to implement this program into a six-year cycle would be $87,197 for pruning and removals, and $75,000 for planting for a total of $162,197 a year.
- The annual value of environmental benefits for the current street tree population is $35,050.
- For every $1.00 spent on public street trees, the City would receive $0.40 in environmental benefits.

Purpose

The City of Berea has recognized the need for proactive tree maintenance and commissioned a study of the public tree population through the Healthy Urban Tree Canopy Grant. This grant is jointly coordinated by the Cuyahoga County Department of Sustainability, the Cuyahoga County Planning Commission, and the Cuyahoga Soil & Water Conservation District. The intent of this study is to inventory and evaluate the current condition of this asset. The purpose of this *Tree Inventory Management Plan* is to provide a plan of action for the inventoried tree and site population of Berea. The inventory draws attention to immediate risk and provides the basis for designing a long-term management plan. The management plan, in turn, provides guidelines for the future, allows for more effective use of tree care funds, and allows for more accurate budget projections.

Methodology

This chapter provides a description of the procedures used by Knowles Municipal Forestry, LLC in conducting the Berea tree inventory. Definitions and methodology of data collection are provided to give a total understanding of the inventory process.

Definitions and References

American National Standards Institute (ANSI) – A private organization that oversees the development of voluntary standards for products, services, processes, systems and personnel in the United States.

Council of Tree and Landscape Appraisers (CTLA) – authors of tree appraisal standards (CTLA, 2000. *Guide for Plant Appraisal*, 9th Ed. Savoy, IL: ISA 143pp.)

Diameter at Breast Height (DBH) – The diameter (inches) of a trunk cross-section measured at 4-1/2 feet above the ground.

International Society of Arboriculture (ISA) – A worldwide professional organization dedicated to fostering a greater appreciation for trees and to promoting research, technology, and the professional practice of arboriculture.

i-Tree Eco – a street tree management tool for urban forest managers developed by researchers at the USDA Forest Service. i-Tree Streets is a computer application that uses tree inventory data to quantify the structure, function, value and management needs of any street tree resource.

Risk (in trees) – The likelihood of all or part of a tree to fail and the severity of the potential consequences of that failure.

Tree – a perennial woody plant that may grow more than 20 feet tall. Characteristically, it has one main stem, although many species may grow multi-stemmed forms.

Inventory

An inventory of all the trees along the public streets of Berea was conducted. Data definitions and methodology are described to give an understanding of the inventory process.

Data Collection

All Berea public street tree sites were individually examined, identified, measured, and recorded. Data were entered on hand-held data collection units and available online for review and processing. Data collection protocols were specifically designed to incorporate both ANSI standards for tree maintenance and i-Tree data analysis. Tree and site data were recorded for the following street tree variables, which are described in further detail below:

- Tree Address
- Managed By
- Land Use
- Tree Location
- Tree Species
- Tree Diameter
- Tree Condition
- Tree Maintenance Requirements
- Maintenance Priority
- Failure Size
- Root Space
- Sidewalk Damage
- Wires
- Observations
- Identification Number

Address

Every tree site is identified with information based on its physical location within the City. This location information will ensure all maintenance personnel and contractors will be able to identify the appropriate tree in the field. The **address** information was determined during inventory data collection by pulling data from the Cuyahoga County GIS data. Each street tree address includes a *street name* and *address number* as provided by the County.

Managed

This field indicates who is responsible for the maintenance of the tree based on its physical location. The management types include *City, Private, and Shared*. Because this is an inventory of trees on the public right-of-way, most of the trees will be managed by the City. Only private trees that pose an immediate and obvious risk to the public right-of-way are collected. Special attention should also be paid towards trees with portions of the trunk growing simultaneously on both private and public property, as these trees may legally be the responsibility of both property owners. These trees marked as being managed by *Shared* may also be known as border trees.

Land Use

Trees may be affected by or conversely have an effect on the area in which they are growing. This is based in part on the type of land use in that area. In order to track these influences, land use is recorded in the general types of *Industrial, Park, Residential, School* and *Shopping*.

Location

The type of space available for tree growth is noted. The location types include: *Yard*, *Tree Lawn, Well/Pit, Median/Island, Other Un-maintained,* and *Other Maintained.*

Root Space

Root space is the narrowest distance (in feet) that will restrict the natural spread of the root system. In most cases this is the distance between the curb and the sidewalk, or the tree lawn width.

Species

Trees are identified by genus and species using both botanical and common names and by cultivars where appropriate.

Diameter

Diameter is measured to the nearest inch in one-inch size classes at 4-1/2 feet above the ground, or diameter-breast-height (DBH).

Condition

Condition indicates the current state of a tree's health, structural soundness, overall shape, and growth rate. Condition ratings are collected in two separate plant health fields for all trees. The condition of the wood (structural condition) and the condition of the leaves (functional condition) was collected. To some extent, condition class is also a reflection of the life expectancy of the tree. Crown development, trunk condition, major branch structure, twig growth rate, insects/diseases, and root condition, among others, are considered. In general, the condition of each tree's structural health and functional health is recorded as one of the following categories adapted from the rating system established by the Council of Tree and Landscape Appraisers (CTLA) tree appraisal standards (CTLA, 2018. *Guide for Plant Appraisal*, 10th Ed.):

Structural Condition

Good
The tree has no major structural problems, no visible root damage, no significant damage due to diseases or pests, no significant mechanical damage, and a full balanced crown.

Fair
The tree may exhibit minor structural problems and/or mechanical damage, signs of root stress, or minor structural imbalance.

Poor
The tree appears unhealthy and may have structural defects. Trees in this category may also have severe mechanical damage, decay, or root damage.

Dead
This category refers to dead or dying trees.

Functional Condition

Good
The tree has no major significant damage due to diseases or pests, a full balanced crown, and normal twig condition and vigor for its species.

Fair
The tree may exhibit significant damage from non-fatal or disfiguring diseases minor crown imbalance or thin crown or stunted growth compared to adjacent trees.

Poor
The tree appears unhealthy and severe crown dieback or poor vigor/failure to thrive.

Dead
This category refers to dead or dying trees.

Maintenance

Maintenance recommendation information is collected to provide a basis for determining and prioritizing the primary maintenance needs of the inventoried tree population. This information is useful for preparing accurate budgets and for developing maintenance schedules, whether the work is performed by in-house crews or contracted out to local tree care companies. These maintenance categories have been derived from the ANSI A300 pruning standards.

Train
A pruning recommendation to improve structure, health and vigor of a young tree. This will correct structural flaws and make a tree more aesthetically pleasing.

Thin
A selective removal of live branches to evenly distribute crown weight and to reduce density. The intention of this pruning is to reduce wind resistance, reduce snow and ice loads, and to increase light penetration.

Raise
The removal of lower branches from the crown to eliminate obstructions or clearance issues. The majority of these cuts will be made at the tree trunk.

Clean
A crown cleaning to remove dead, diseased, damaged, poorly attached, or crossing branches to increase longevity and reduce failures.

Remove
The complete removal of a dead or dying tree that has no potential of improving with maintenance.

Maintenance Priority

All of the described maintenances are prioritized as to the severity of the recommendation. The following descriptions were used.

Young
This describes a young or newly planted tree that will probably not need immediate attention to increase longevity.

Routine
This maintenance recommendation should be part of a cyclical pruning program.

Immediate
Recommended maintenance should be conducted as soon as possible to ensure the health of this tree and to reduce risk.

Critical
Maintenance needs to be conducted without delay. This tree is a concern to public safety.

Failure Size

The size of the part most likely to fail was recorded. This will help to prioritize the recommended maintenances. This category my make a large branch removal a greater priority than the removal of an entire tree. This is assuming the branch has a larger diameter than the tree trunk diameter. Diameters of parts will be recorded in 12 inch increments.

Hardscape Damage

Hardscape damage was recorded when the inventoried tree has a root system that is conflicting with public sidewalks, curbs, or other infrastructure.

Wires

Noting the presence of utility lines is necessary when planning pruning activities and can be used to identify which sites are more suitable for small growth habit tree species that will not interfere with utility lines when they mature.

Observations

These are common issues which warrant documentation because managing them is essential to any tree management program:

Remove Hardware
Poor Location
Mulched Improperly
Planted Improperly
Pruned Improperly
Pest Problem
Mechanical Damage
Cavity/Decay
Root Problem
Serious Decline
Poor Structure
Memorial Tree
Reinspect
Other – See notes

Identification Number

Each site is given a unique number to easily identify it on future listings and reports.

Inventoried Street Tree Population

Tree Population Characteristics

The characteristics of the urban forest include species, diameter, condition, and other related tree and site factors. By identifying the species, diameter, and condition of trees in the urban forest, one can learn much about the forest's composition, relative age, and health. It is important to know the kinds of trees as well as the number of trees present in the City. Species composition data are essential because tree species vary considerably in life expectancy and maintenance needs. The types of trees present in a community greatly affect tree maintenance activities and budgets. Similarly, tree diameter and size class data help to define the general age and size distribution of the total tree population.

Figure 1. Family Distribution

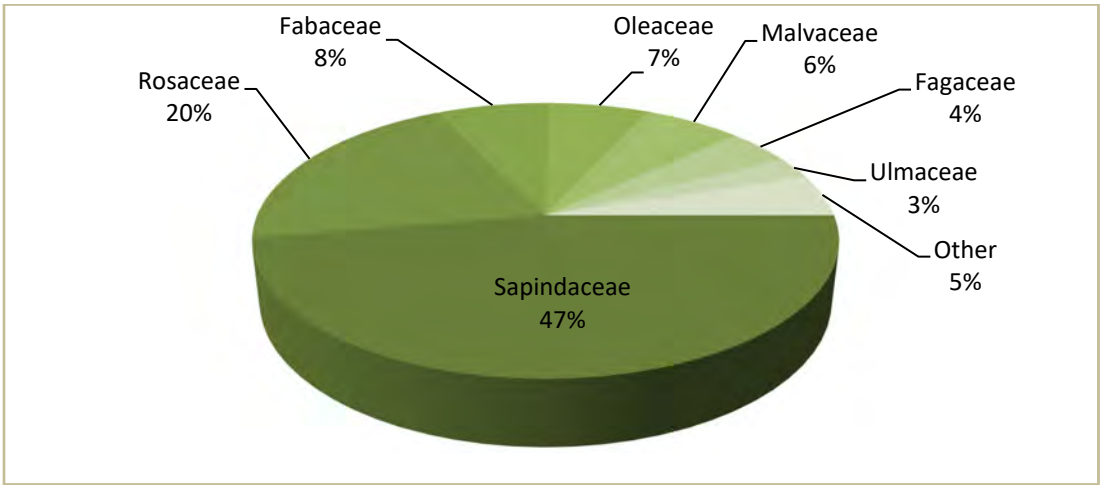
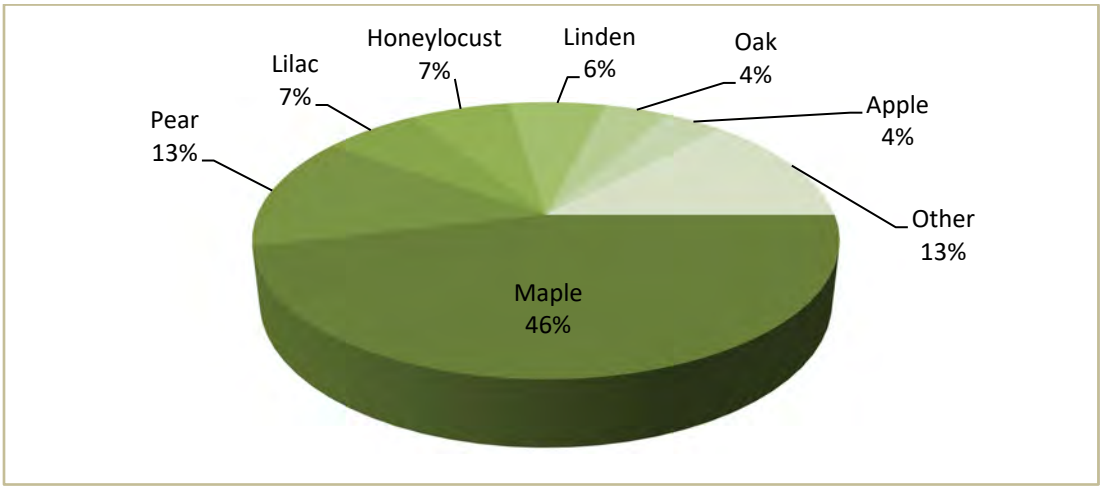


Figure 2. Genus Distribution



The inventoried street tree population is comprised of 4,198 trees distributed among 44 genera and over 80 species. Table 1 illustrates that four species account for 56% of the street tree population.

Table 1. Species Distribution

Common Name	Scientific Name	Number of Trees	Percentage
Red Maple	*Acer rubrum*	1269	30.2%
Callery Pear	*Pyrus calleryana*	554	13.2%
Japanese Tree Lilac	*Syringa reticulata*	270	6.4%
Honeylocust	*Gleditsia spp*	276	6.4%
All Other	*Other spp*	1,829	43.8%
	Total	**4,198**	**100%**

Generally, in the field of urban forestry, it is recommended that no single family (a family is a group of closely related genera) should comprise more than 30% of the total population and no one genus (a genus is a group of closely related species) should comprise more than 20% of the total population. Furthermore, no one species should account for 10% of the total population. This is commonly referred to as the 10-20-30 rule. Table 1 shows that the top two inventoried species exceed this recommendation. Furthermore, Figures 1 and 2 shows that the family *Sapindaceae* and genus *Acer* (maple) accounts for 46% of the City's total street tree population and exceeds the recommended percentages.

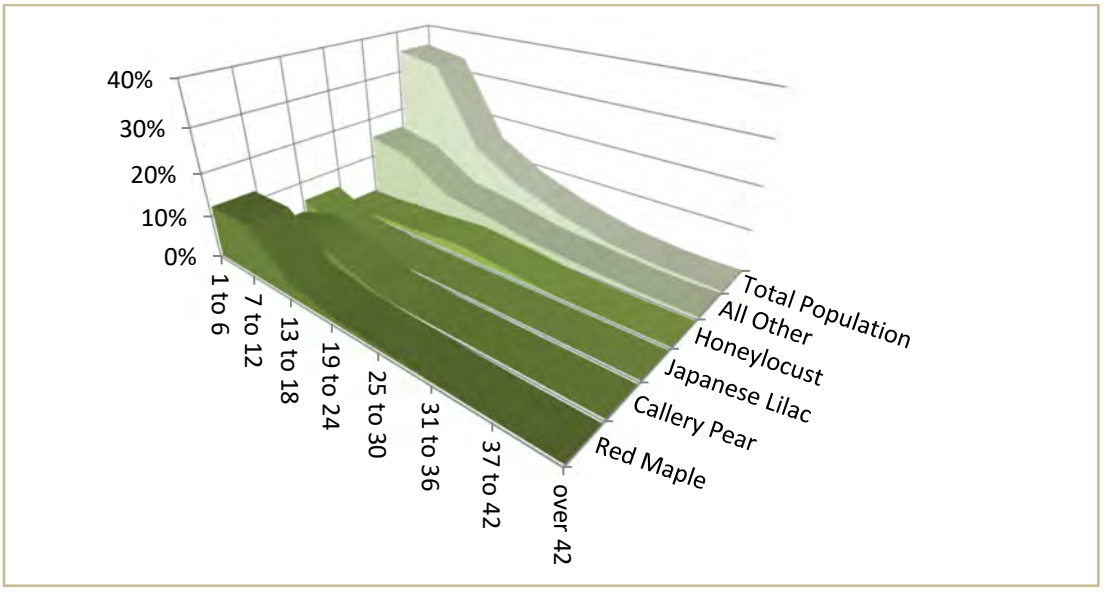
The inventory shows that the diversity of Berea's street tree population is very good but not quite at recommended levels. Planting a large number of trees of the same species (monoculture) can lead to catastrophic results. A good example of this situation was the dominance of American elm (*Ulmus americana*) in American cities in the 20th century. When Dutch elm disease (*Ceratocystis ulmi*) arrived in the United States in the 1930s, the resulting tree losses were devastating. Similar scenarios are now foreseeable for the Spotted Lanternfly and spotted Beech Leaf Disease(Appendix E).

The City should limit the number of Maple's (*Sapindaceae*-family/*Acer*-genus) being planted on public streets. Based on the current tree inventory, if all (3,558) of the available planting sites were to be replaced with a non-maple species, the total number of maples would drop to 25% which is within the threshold of the 10-20-30 rule. At a minimum, the City should eliminate Red maple (*Acer rubrum*) from future plantings until more diversity is obtained.

Size Distribution

Species diversity alone is insufficient in maintaining a stable urban forest. Tree species have different life spans and mature at different diameters, heights, and crown spreads. This means that actual tree ages cannot be assumed from the diameters of trees. However, general classifications of size, such as small, medium, and large, can be used to describe the general characteristics of the urban forest. This is not a substitute for age classes, which can give the actual age and maturity of trees, but it can provide a general idea of the variability in the Berea's tree population (Figure 3).

Figure 3. Diameter Class by Species

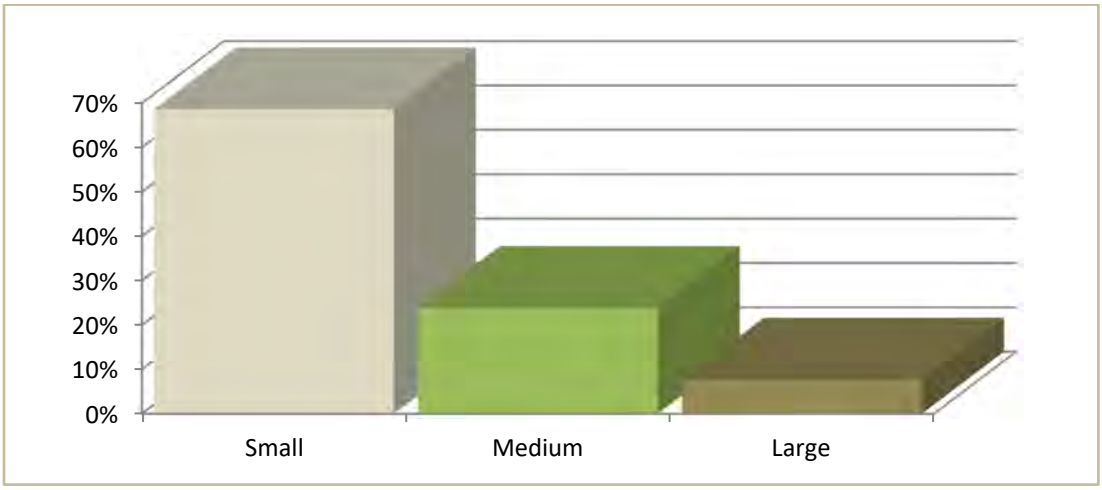


Most (69%) of the total tree population is in the young tree class (1-12 inches). This size class is made up of a diverse population of tree species however Red maple, Callery pear, and Japanese tree lilac make up nearly 40%. Planting efforts should concentrate on planting large more diverse large growing species. The species will eventually grow large enough to provide the type of leaf area and canopy cover that benefits the urban environment the most.

Roughly 24% of the inventoried urban forest falls under the medium-sized classification with a diameter range of 13 to 24 inches. This is a diverse selection of species with no one species making up more than five percent of the total population of this size range. These trees are considered mid-aged and have not yet reached their full potential. This large group of established, diverse, mid aged tree population is a very good sign for the future of the Berea forestry program.

Large trees, which are 25 inches and greater in diameter, comprise only 8% of the City's inventoried tree population. This equates to only 320 total large trees. Trees of this size class are contributing the maximum long term benefits to Berea's urban tree population both aesthetically and in ecological services. With careful preservation and maintenance, this population will grow as younger trees mature. This should be a primary long term goal for the City.

Figure 4. Diameter Distribution of Entire Population

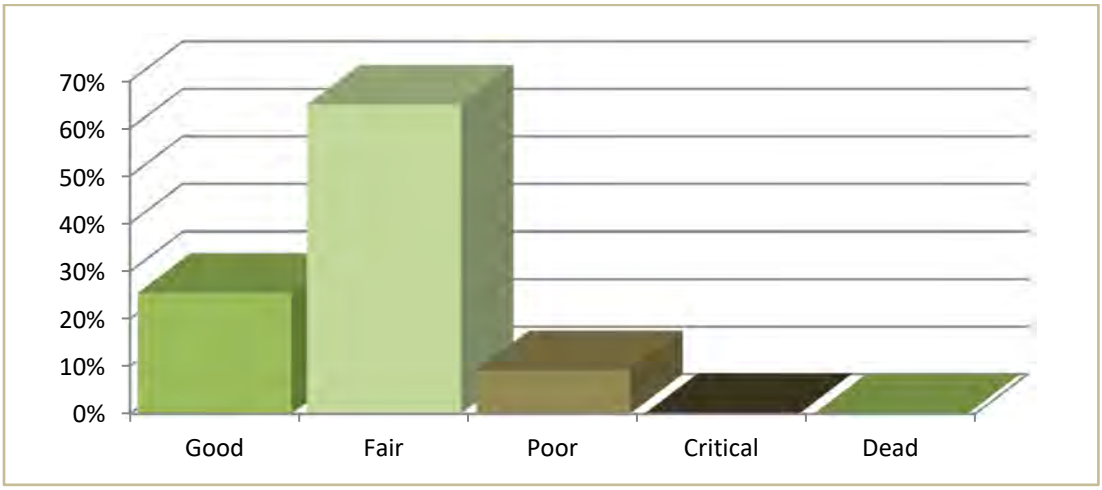


Normal recommendations in urban forestry management call for achieving, over time, an appropriate age mixture by removing and replanting a certain percentage of trees each year. A good ratio for an urban tree population is a 20:60:20 mix of small, medium, and large trees, reflecting the percentage of trees in each size group and representing a uniform spread of tree ages from young to mature to over-mature. By comparison, Berea's current urban forest is a 69:24:7 mix of small, medium, and large trees. This ratio indicates the City currently has incredibly young urban forest. However, this ratio will soon be changed as young trees mature. The City of Berea should establish a tree maintenance program to develop this young population into a healthy and diverse urban forest.

Condition

Condition indicates the current state of a tree's health, structural soundness, overall shape, and growth rate. In order to get a more complete understanding on the health of a tree, condition ratings have been split into two categories. The first is the *structural* health or the condition of the wood and the second is the *functional* health or the leaf condition. The overall health of the tree is a combination of both conditions.

Figure 5. Structural Condition



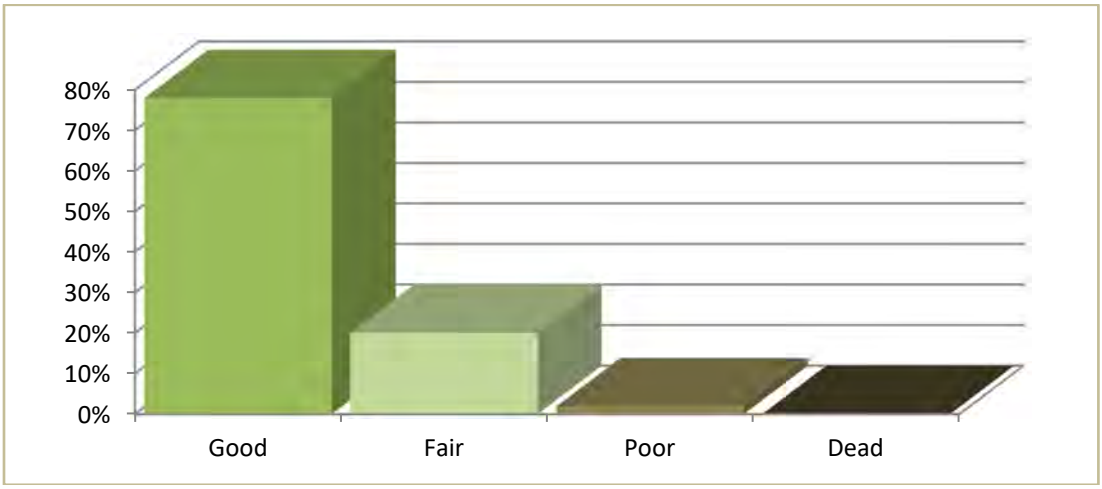
The structural condition of a tree is an evaluation of the trees ability to support its own weight in addition to any loads that it may routinely be subject to. Common loading factors include wind, snow, ice, rain, and

even leaf and fruit weight. A tree with good structural health should have no problem supporting these typical stresses.

It is important to understand that a tree that appears healthy, because it is in full leaf or growing rapidly, may still have a poor structural condition. The structural integrity of a tree is determined by many factors. Each tree is evaluated from root to crown for root problems, cavities, decay, pests, cracks, dead wood, and branch structure.

The majority (91%) of Berea's street trees have *fair* to *good* structural condition. This high percentage of structurally sound trees is most likely due to the young age of the City's street tree population. The portion of the population that has *poor* structure (9%) is comprised mostly of trees that are developing poor branch attachments, co-dominate stems, or significant amounts of dead wood. These structural defects will be greatly improved as high risk trees are removed and trees are pruned on a routine cyclical basis.

Figure 6. Functional Condition



To evaluate functional condition, each tree must be inspected for characteristics common for the particular species and cultivar. Tree characteristics may include shoot growth, crown shape, leaf and bud size, shape and color. Irregularities in any of these characteristics or the presence of twig dieback, insect frass, or fungus may decrease this condition rating.

Insects, disease, chemicals, mechanical damage, pollutants, and environmental conditions are all likely factors in a trees functional health. Any one or any combination of these causal agents must be identified and assessed for their impact on the health of each individual species. Some of these problems may be unsightly, but have little impact on the individual tree species. An example of this may be tar spot (*Rhytisma acerinum*) on Norway maple. This disease is highly visible and may concern the general public, but it does very little damage to the tree.

The City has very few trees (2%) on the street with poor or dead functional health (Figure 6). To improve the level of functional health, dead and over mature trees will need to be removed and future planting efforts should focus on planting a diverse population of urban tolerant trees.

Maintenance

The primary objective of this inventory is to determine the maintenance needs of the City of Berea's street tree population. These maintenance recommendations have been determined from observations of each tree, potential tree site, or stump. The trunk, scaffold branches, and canopy of each tree, as well as the site's

location relative to streets, sidewalks, utilities, signs, buildings, and traffic control devices was considered for each maintenance recommendation.

Table 2. Maintenance Recommendations

Maintenance Type	Trees/Sites	Percentage
Train	1,534	19.7%
Thin	965	12.4%
Raise	894	11.5%
Clean	663	8.5%
Remove	140	1.8%
Plant	3,559	45.7%
Stump	27	0.4%
	7,783	**100%**

The inventory identified four general types of maintenance. Each site was recorded as a tree that requires pruning, a tree that needs removed, a tree site that needs planted, or a stump that should be ground out. Pruning maintenances are further divided into specific pruning types.

Approximately one half (52%) of the recorded sites were trees that require some sort of maintenance prune. Unlike woodland or natural environments, all trees in an urban environment require some sort of pruning. This is because of the unnatural urban stresses, a higher likelihood of doing damage to persons or property, and conflicts with buildings, vehicles and people. These trees need pruned to maintain health, improve structure, increase aesthetics, and to reduce risk.

Training prunes are recommended for 1,534 (20%) of the inventoried trees. These are all young or newly transplanted trees. Structural flaws such as, multiple stems, co-dominant leaders, and poor branch structure should be removed now. Pruning young trees may be the most cost-effective way to increase the value of the street tree population. This is because the work can be done from the ground with hand tools at a relatively low cost. Structural improvements made now will reduce the need for large pruning cuts or branch failures that cause more stress to the tree. Most of the trees in this category are less than 6 inches DBH.

Photo 1 Young newly planted trees require training prunes to help develop good structure and to raise lower branches for clearance.

A tree that has no obvious structural defects or dead wood in the crown will need a routine **thinning prune**. This type of pruning is recommended for 965 (12%) of the trees and should be performed on around a six-year cycle. The trees in the other pruning categories should be scheduled for a thinning prune after they receive the pruning currently recommended in the inventory. A thinning prune will remove live branches in order to reduce crown density and improve crown balance.

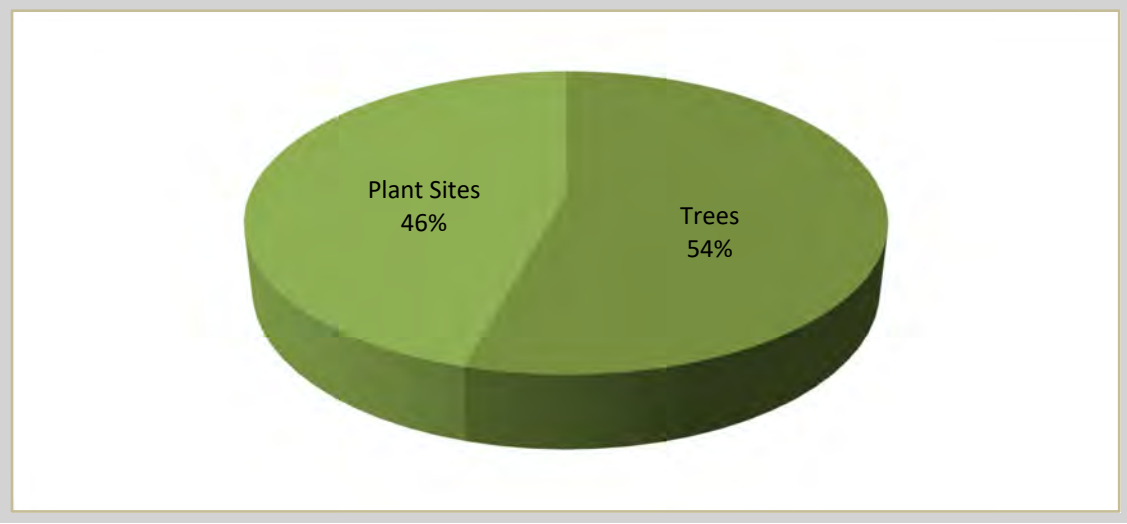
The **raising prune** category includes 894 (12%) trees. This is not surprising since most of the inventoried trees are young trees with lower branching. The low spreading crown of these trees should be maintained to not interfere with pedestrian and vehicular traffic. Special attention should be given to trees near intersections and traffic control devices.

When trees show a high likelihood of branch failure, a **cleaning prune** was assigned. About 9% (663 trees) of the inventoried trees need to have a crown cleaning. This percentage is high considering the small number of mature trees. A routine pruning program will keep the number of cleaning prunes low and reduce the amount of risk of harming persons or property in the City.

The number of **removals** in the City of Berea is currently 140 trees. This number is over 3% of the inventoried street trees. These removals should be quickly performed and replacement trees scheduled.

The reduction of tree failures is a primary goal of City tree management. Trees fail from natural causes such as disease, insects, and weather conditions and from physical injury due to vehicles, vandalism, poisoning, and root disturbances, among others. There are three main reasons why trees with an elevated risk of failure should be removed: (1) to reduce potential harm to persons and property; (2) to reduce breeding sites for insects and diseases; and (3) for aesthetics.

Figure 7. City Street Tree Site Descriptions



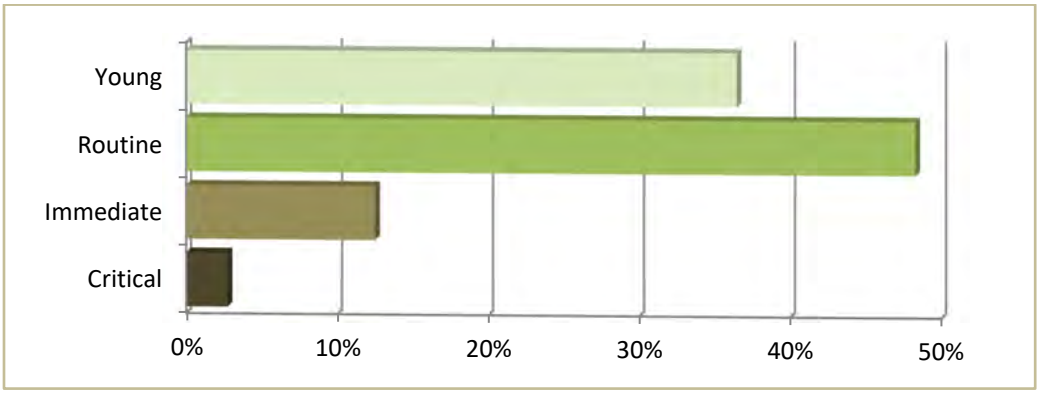
A primary reason this study was commissioned by the City of Berea, was to address the concerns of low stocking level. Of all the available tree sites in the City, 46% of them are vacant **planting sites**. This leaves the City of Berea with a low 54% stocking level. A community with the resources of Berea should have no problem attaining an admirable stocking level of 80% or greater. Increasing the stocking level should be a primary goal for the City on order to maximize the value of the urban forest.

There were twenty-seven stumps throughout the City's streets. Generally, stumps are removed as part of the tree removal process. Stumps are unsightly and give City streets an unkempt look. They also present a tripping hazard to pedestrians.

Maintenance Priority

Maintenance priority information is collected to provide a basis for determining and prioritizing the primary maintenance recommendations of the inventoried tree population. This information is used in part to determine an appropriate maintenance schedule for the City of Berea. Trees identified with a *critical* priority pose the greatest risk of failure while *young* trees pose very little risk.

Figure 8. Maintenance Priority



Most (85%) of the current tree population requires **routine** or **young** tree maintenance. Pruning and removal activities prioritized as **critical** or **immediate** make up only 15% of the inventoried trees. This indicates a well-maintained tree population. The goal of the City's maintenance program should be to quickly eliminate all the critical and immediate concerns within the next year and maintain the entire street tree population with routine maintenance and training of young trees.

Failure Size

To further prioritize the level of risk for a tree to damage persons or property, the size of the part most likely to fail was recorded. Failure size may be recorded for the trunk, a branch, or a co-dominant stem. A tree with a large diameter branch that needs to be removed may pose a greater risk than a smaller diameter tree that needs completely removed.

Observations

These are common issues which were documented to help explain specific maintenance requirements for individual trees:

Cavity/Decay is noted on 397 trees and *Poor Structure* on 912. This is primarily noted to inform maintenance crews of the reason for the recommended maintenance where it may not be obvious.

Some type of *Mechanical Damage* was identified on 423 trees. This type of damage can be caused by vehicular accidents or careless equipment operation.

A tree trunk with more than one stem originating at or near ground level is recorded as having *Multiple Stems*. The sum of all stems that contribute to the total canopy are measured for diameter at breast height.

Pest Problem was collected on 14 trees. The specific pest is listed in the Notes field if it is identified. Although no signs were currently found, one of the more serious pest to look for is the Spotted Lanternfly. More information can be found in Appendix E.

66 trees were *Planted Improperly*. These trees have been planted too high, too low, and/or had mulch or soil piled too high at the base of the tree. Trees that are planted improperly may also have packing material such as wire baskets and burlap left in place too.

Poor Location is recorded on trees that should not be growing in their current location. These 350 trees are either in a poor location or the wrong species for the location.

A *Reinspect* observation is noted for trees that may need some additional inspection. This is most likely due to a potential defect that is not adequately inspected from the ground at this time. The use of a climber, aerial truck or lift may be necessary. The tree may also be showing signs of decline that may be seasonal and need to be looked at in a year or two. These 35 trees should be scheduled for additional inspection.

Photo 2 Mechanical damage on tree can indicated damage from construction equipment or damage from whitetail deer buck rub.

Photo 3 Staking and guying materials should be removed after one growing season to prevent trunk damage from girdling.

Remove Hardware was recorded for 277 trees. Most of the hardware is staking material used on young trees. All staking should be removed from a tree after one year in order to prevent damage by girdling the stem.

Root Problems are often overlooked when maintenance crews work on or near trees. The 272 trees marked as having poor roots may have girdling roots, fungal infection, damage from construction activity, or just inadequate structure.

Over mature, pest infested, stressed, or damaged trees which are not expected to recover were noted as *Serious Decline*. There are only 37 of these trees in the inventory.

Site Characteristics

In addition to the tree data, information about the site was collected. This information will help the City make decisions on what trees are appropriate for which sites and how trees may impact the area they are growing in.

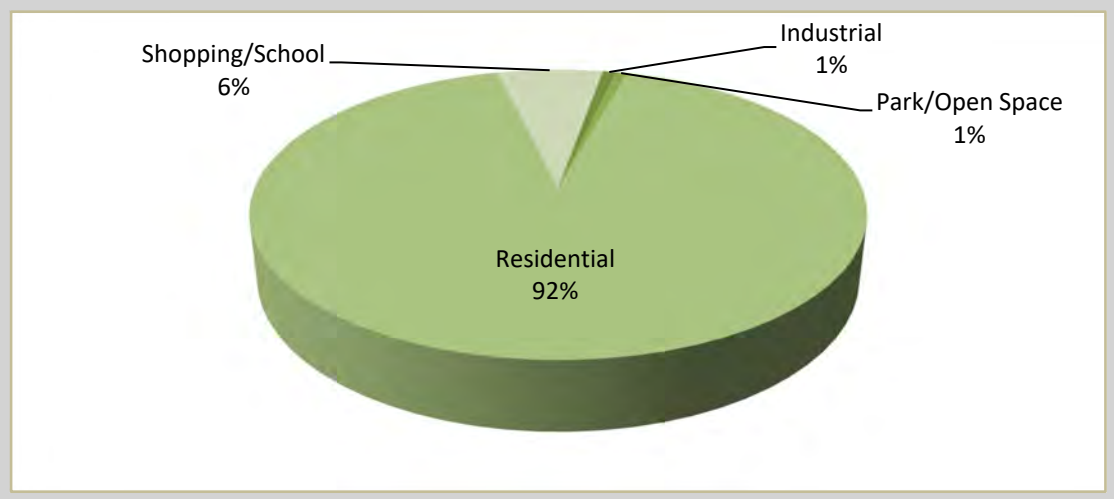
Managed

This field indicates who is responsible for the maintenance of the tree based on its physical location. Because this is an inventory of trees on the public right-of-way, most of the inventoried trees are managed by the *City*. There were two trees noted with other management. One was on private property and the other was in the right of way by being managed by Baldwin Wallace.

Land Use

Trees may be affected by or conversely have an effect on the area in which they are growing. This is based in part on the type of land use in that area. The most significant impact of land use in Berea is the frequency of traffic, both pedestrian and vehicular. Since an important factor in calculating risk is the frequency of potential targets, street trees near commercial shopping areas and schools are evaluated with increased risk. Most of the City's tree sites (7,151) are in **Residential** areas. The highest risk factors in the City are the **Shopping/School** areas that 516 of the existing tree sites are located in.

Figure 9. Land Use



Location

The type of space available for tree growth was recorded. The location types include: *Yard*, *Tree Lawn*, *Well/Pit*, *Median/Island*, *Other Un-maintained*, and *Other Maintained*. The majority (92%) of the inventoried trees and sites are located in tree lawn areas. This is the lawn area within the right-of-way between a curb and a sidewalk. Yard sites are sites within the right-of-way on privately maintained parcels with no tree lawn and account for only 2% of the inventoried locations. Other maintained areas are locations that are being maintained by the City in public landscaped areas or parks and account for 3% of the locations. The remaining 2.7% are growing in medians and wells or pits primarily in the shopping areas.

Root Space

Root space is the narrowest distance (in feet) that will restrict the natural spread of the root system. This field is used to further define the available space for root growth within each *location*. The amount of root space available is a major determining factor as to the appropriate species selected for a site. Areas with unrestricted root space were recorded as *99*. A root space of at least four feet is required for a site to be considered a reasonable planting space.

Hardscape Damage

Sidewalk or curb damage was recorded when the inventoried tree had a root system that was causing damage. Damage to sidewalks by trees causes tripping hazards for pedestrians and can be the source of many conflicts between the City trees and residents. This type of hazard may be avoided by planting the right tree in the right place. Only sites with a significant amount of damage on an otherwise undamaged tract of sidewalk were recorded. Less than 5% of the tree sites in Berea had a notable degree of hardscape damage. This is not surprising considering the young age of the urban forest and the well-maintained City infrastructure.

Wires

Of the 4,198 street trees that were collected in the inventory, 978 (23%) are identified as having utilities above or immediately adjacent to them. Noting the presence of utility lines is necessary when planning pruning activities and can be used to identify which sites are more suitable for small growth habit tree species that will not interfere with utility lines when they mature.

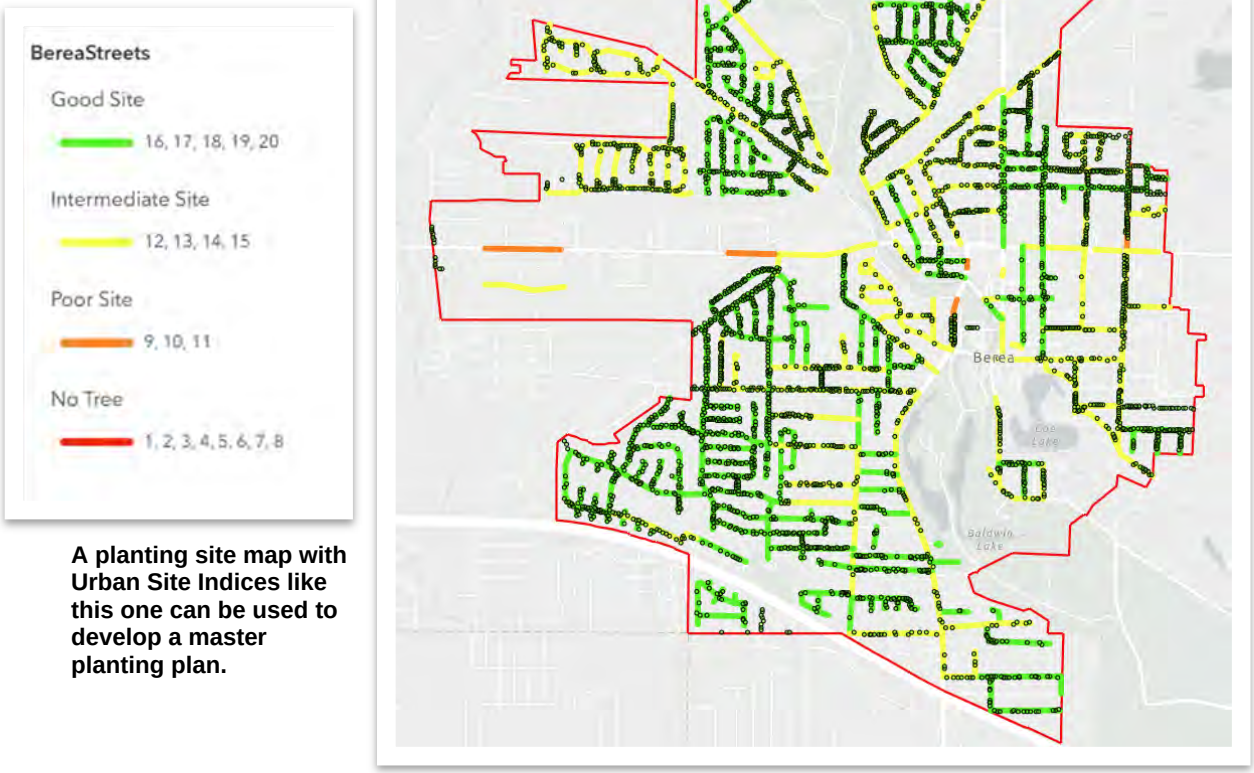
Table 3. Planting Site Considerations

Recommended Planting Size	Root Space						Total
	4-5 feet		*6-8 feet*		>8 feet		
	No Wires	*Wires*	*No Wires*	*Wires*	*No Wires*	Wires	
Small	*167*	*70*	*14*	*256*	*7*	459	973
Medium			*848*	*338*	*4*	3	1,193
Large					*1,393*		1,393
City Wide	237		1,456		1,866		**3,559**

Urban Site Index

The success of any urban forestry program is largely determined by the community's ability to plant the right tree in the right place. Unfortunately, local site conditions are often overlooked as they are highly variable and difficult to define in a cost-effective manner. A new urban site assessment method called the Urban Site Index (USI) has been developed by State of Ohio Urban Foresters (Siewert and Miller 2011). The USI is a rapid, field-based assessment process to quantify the quality of urban planting sites. The USI uses eight field observations to determine a site value between 1 and 20. This value is then used to determine the street tree species best suited for this site. The City of Berea' s USI will help determine proper plant selection in future street tree planting efforts.

Figure 10. Urban Site Index Ratings



A planting site map with Urban Site Indices like this one can be used to develop a master planting plan.

The figure above indicates that most the City's tree sites are in the Good to Intermediate (USI 12-20) range. The species planted on these sites should selected for their inability of growing on lesser quality sites. The sites that fall within the Poor range, are not necessarily sites that should not be planted, they are however sites that should be planted with a species of tree that can withstand a harsher growing environment. A list of Ohio's urban trees and the corresponding USI tolerances is maintained and updated by the Ohio Department of Forestry. The Regional Urban Forester for your area should be able to provide an updated list upon request.

The species planted for each site must consider the recommended mature size as well as a species that best suits the USI number. All the sites recommended for planting should be considered viable sites for trees, however, if funds are limited, a prioritized planting list may be needed. In this case, the large/good sites should be planted first. Large trees provide many more benefits in ecosystem services and will serve the community best.

The data provided in this report is appropriate to complete a successful municipal planting. A recommended next step however may be to develop a Master Planting Plan. This plan would combine the planting site size, recommended age diversity, recommended species diversity, urban site index, budget, canopy goals, species availability, community priorities, and public input into a cohesive plan. If a funding source to develop such a plan is not available, the ODNR has a program that can train municipal personnel. Information on the Tree Commission Academy can be found on their website. (https://ohiodnr.gov/wps/portal/gov/odnr/business-and-industry/municipalities-and-public-entities/urban-forestry/)

Street Tree Maintenance Budget

This section consists of program projections for all tree maintenance activities and is intended to provide an example of the relative costs that could be incurred by the recommended activities. However, Berea must understand that the budgeting recommendations below are only estimates and are based on the application of sound urban forestry management principles to municipal forestry operations.

This program budget is designed to address the highest priority removal and maintenance recommendations first. Maintenance activities have been prioritized by tree site in Appendix D. This is intended to reduce potential high risk situations for the public and all associated liabilities. By doing so, the City will greatly lessen the potential of injury to citizens, damage to property, and possible liability litigation.

Tree maintenance costs in Table 4 are based on quotes from reputable tree care companies and are averages extracted from bids received by communities in similar economic regions during the past few years. These costs are an average and are used to estimate the budget projections in this plan.

Table 4.Total Estimated Maintenance Budget

	Tree Removal			Tree Pruning						Tree Planting		
DBH	Remove	Cost/ Tree	Total Cost	Clean	Raise	Thin	Train	Cost/ Tree	Total Cost	Plant	Cost/ Tree	Total Cost
1-3"	9	$25	$225	1	1	13	548	$30	$16,890	3558	$400	$1,423,200
4-6"	7	$105	$735	9	97	114	677	$60	$53,820			
7-12"	51	$220	$11,220	68	554	425	309	$105	$142,380			
13-18"	31	$355	$11,005	151	162	280	0	$150	$88,950			
19-24"	27	$525	$14,175	202	55	85	0	$210	$71,820			
25-30"	11	$845	$9,295	136	22	29	0	$275	$51,425			
31-36"	2	$1,140	$2,280	64	1	12	0	$340	$26,180			
37-42"	1	$1,470	$1,470	22	0	6	0	$400	$11,200			
43"+	1	$1,850	$1,850	11	2	1	0	$590	$8,260			
Activity Total	**140**		**$52,255**	**664**	**894**	**965**	**1534**		**$470,925**	**3558**		**$1,423,200**
							Maintenance		**Planting**			**Total**
						Total Cost:	$523,180		$1,423,200			**$1,946,380**

The main objective of this budget is to provide maintenance goals for the City of Berea. Based on the current inventory data and cost estimates, the City could maximize the safety and benefits of the street tree population for $1,946,380.00. While it probably is not financially feasible to meet this need immediately, to budget these costs over the course of several years may be.

Table 5.Example Annual Management Goals

Maintenance	Years to Complete	Trees	Annual Cost
Removals	1	140	$52,255
Prunes	6	676	$78,488
Plantings	12	297	$118,800
			$249,343

The City may also consider a hybrid of the recommended tree management strategies based on available budget. This strategy should prioritize the reduction of risk and routine maint enance. Planting could be scaled down but should be included and may be adjusted as funding becomes available. An example of a hybrid annual budget for year one is presented in Table 5.

Table 6.Annual Planting Goals

Trees Planted per Year	75% Stocking Level	80% Stocking Level	90% Stocking Level
50	32 years	40 Years	56 Years
100	16 Years	20 Years	28 Years
200	8 Years	10 Years*	14 Years
300	6 Years	7 Years	10 Years
600	3 Years	4 Years	5 Years
		**Recommended*	

Seventy-three percent of this budget is to stock the street tree population. The remainder of the budget is to maintain what already exists. While reducing risk and maintaining the current tree population should be a priority, it is important to understand that without a planting program, the street tree resource is not sustainable. Even if the full recommended planting budget is not available, some sort of planting program must be established to improve the stocking level. The following chapter explains the increased benefits attained by improving the stocking level.

Benefit Cost Analysis

Most communities appreciate trees and believe that they are important. They may however, not understand the full spectrum of benefits provided by trees. This often leads to inadequate funding for street tree programs. In order to justify the cost of management, this report uses the City of Berea's inventory data and i-Tree's Eco model to quantify the benefits provided by this resource. I-Tree Streets output reports are provided in Appendix C.

Replacement Value

The legal value of the City's inventoried street tree population is **$7,887,531.00**. This value assumes the cost to replace every tree with a tree of similar size, species, condition, and location as defined by the CTLA. With this number, it is easy to see what a value trees are to the City's infrastructure. With proper maintenance, the value of the street tree population will actually increase with age. This is unlike other components of the infrastructure like street, sidewalks, sewers, and streetlights.

Benefit Value

An often-overlooked value of street trees is what they give back to the community in environmental benefits. Trees reduce energy use, carbon dioxide levels, air pollution, and stormwater runoff. Trees also provide an environment that benefits a community socially, psychologically, and economically.

These benefits have value and should be considered when making budget decisions on a street tree management program.

Table 7. Annual Environmental Benefits

Benefits	Total	Per Tree	Per Capita*
CO_2	$5,595	$1.34	$0.29
Air Quality	$22,111	$5.30	$1.16
Stormwater	$7,344	$1.76	$0.38
Total Benefits	**$35,050**	**$8.41**	**$1.84**

*Based on a population of 19,093

A community's carbon footprint is becoming more of a concern as environmental awareness continues to rise. Carbon taxes and carbon credits are now accepted as financial commodities. Berea's street trees can **reduce atmospheric carbon dioxide (CO_2)** by sequestering carbon in plant tissues and by reducing energy use. Conversely, tree maintenance activities release CO2 into the atmosphere by running chainsaws, chippers, and trucks. Dead trees also release the carbon they were holding as they decompose. These factors are evaluated to estimate the value of sequestered and avoided pounds of carbon dioxide.

Trees improve **air quality** by intercepting pollutants such as dust, pollen and smoke. Air is also improved by the absorption of ozone and nitrogen dioxide while at the same time releasing oxygen. The benefits that cause reduced energy use also improve air quality by reducing pollutants associated with energy production.

Stormwater runoff reduction is also a quantifiable benefit of the street tree population. Tree canopies intercept rainfall to reduce the volume of runoff and protect against soil erosion. Root systems absorb water and increase soil infiltration. This benefit should be of interest to all municipalities as stormwater overflow has been a problem in the past.

Benefit-Cost Ratio

In order to justify the cost of maintaining Berea's street trees, the annual benefits need to be compared to the annual costs. By using the budget recommendations in Table 4 of this report and assuming a six-year cycle, the annual maintenance costs are estimated to be $87,197. The annual benefits that the inventoried public street trees provide as determined by i-Tree Streets analysis are $35,050. **This means that the City of Berea would receive $0.40 in benefits for every $1.00 spent on the street tree program.** It is important to acknowledge that the City is most likely receiving a much higher cost benefit based on the current lower maintenance budget. However, the recommended maintenance budget should be implemented as closely as possible to increase the value of this important asset to the community.

Ecological benefits of urban trees are directly related to canopy health and size. The more large healthy trees in a community, the more benefits. With 69% of the City's street trees under 12 inch diameter and of these, 35% under 6 inches, the potential benefits are not yet being achieved. It is essential that the City invest in this young urban forest with appropriate care in order to gain the ecological benefits that will outgrow the cost of maintenance.

Park Trees

In addition to the trees along the City streets, several park properties were made a part of the tree inventory. Trees in the maintained areas of parks and public properties were identified as well as trees that have a high risk of harming visitors to these properties. Although park trees are an important part of a community's urban forest, the maintenance priorities are not the same. For this reason, park trees were not included in the composition, budget, or benefits information previously provided in this report.

Table 8. Sites by Area

Area	Trees	Plant Sites	Stumps	Total Sites
City Street Trees	*4,198*	*3,559*	*27*	7,783
Park Trees	*363*		*3*	366
City Wide	4,561	3,559	30	**8,150**

The primary concern within the City parks is the potential risk associated with the trees. For this reason, only the trees in maintained areas were inventoried. The exception to this is the areas of Coe Lake Park that are not actively maintained but are frequently used by visitors. The table below lists the number of recommended removals in each park to reduce risk. Trees near playgrounds, paths, and benches are examples of higher risk trees that were included.

Table 9. Park tree Summary

Park name	Trees	Removals
Adams Street Cemetery	*22*	*3*
Coe Lake Park	*284*	*44*
Dora Lee Payne Park	*3*	*1*
Jason Malone Park	*30*	*6*
Parknoll Park	*27*	*1*
Total	366	55

Conclusions

Berea has a young public tree population in good condition that adds to the beauty and livability of the City. Although the urban forest is in good condition at present, this is not a situation that should be taken for granted. As trees get older, they become increasingly inefficient in withstanding the inherent stresses of an urban environment and are subject to decline without professional and regular management.

The City is not currently benefiting from the full potential of its street tree population. Nearly one half of the City's tree sites are vacant. The trees that do exist are mostly young and have not started contributing meaningful benefits. The community may benefit greatly in property values, environmental benefits, and aesthetics by implementing a program to fill these sites with the right tree in the right place.

The management of public trees is challenging, to say the least. Balancing the recommendations of experts, the wishes of public officials, the needs of citizens, the pressures of local economics, the concerns for liability issues, the physical aspects of trees, and the desires for all of these factors to be met simultaneously can be a daunting task. All City personnel making decisions about the urban forest must carefully consider each specific issue and balance these pressures with a knowledgeable understanding of trees and their needs. If balance is achieved, the City's tree population will flourish, and the health and safety of the urban forest will be maintained.

Appendix A: Recommended Street Trees

Deciduous Trees

The tree species listed are considered for such factors as: size, disease resistance, pest problems, location suitability, seed or fruit set, and visual appearance. Another factor that can be considered in species selection is which trees are presently doing well and are relatively free from insects and disease. While efforts have been made to make appropriate recommendations, nurseries may have further information as to specific cultivars or varieties, which may be more suitable for your location or climate.

Large Trees: Greater than 50 Feet in Height When Mature
(Root Space > 6ft & no Wires)

Scientific Name	Common Name	Cultivar
Acer miyabei	Miyabe Maple	'State Street'
Acer rubru m	Red maple	'Autumn Flame' 'Bowhall' 'Karpick' 'Northwood' 'October Glory' 'Redpointe' 'Red Sunset'
Acer saccharum	Sugar maple	'Commemoration' 'Green Mountain' 'Oregon Trail' 'Legacy'
Acer x *freemanii*	Freeman maple	'Armstrong' 'Celebration' 'Scarlet Sentinel'
Celtis laevigata	Sugarberry	'All Seasons'
Celtis occidentalis	Hackberry	'Prairie Pride'
Eucommia ulmoides	Hardy rubber tree	
Ginkgo biloba	Ginkgo	(Choose male trees only)
Gleditsia triacanthos inermis	Thornless honeylocust	'Shademaster' 'Skyline'
Gymnocladus dioicus	Kentucky coffeetree	'Espresso'
Liquidambar styraciflua	American sweetgum	
Metasequoia glyptostroboides	Dawn redwood	'Emerald Feathers'
Nyssa sylvatica	Black gum	
Platanus x *acerifolia*	London planetree	'Bloodgood' 'Exclamation'
Quercus acutissima	Sawtooth oak	
Quercus bicolor	Swamp white oak	
Quercus ellipsoidalis	Northern pin oak	
Quercus imbricaria	Shingle oak	
Quercus macrocarpa	Bur oak	
Quercus muehlenbergii	Chinkapin oak	

Large Trees: Greater than 50 Feet in Height When Mature (Continued)

Scientific Name	Common Name	Cultivar
Quercus palustris	Pin oak	
Quercus rubra	Northern red oak	'Splendens'
Quercus shumardii	Shumard oak	
Taxodium distichum	Baldcypress	'Shawnee Brave'
Tilia cordata	Littleleaf linden	'Chancole' 'Corzam' 'Fairview' 'Glenleven' 'Greenspire'
Tilia americana	American linden	'Redmond'
Tilia tomentosa	Silver linden	'Sterling'
Tilia x *euchlora*	Crimean linden	
Ulmus x	Hybrid elm	'Frontier' 'Homestead' 'Pioneer' 'Regal' 'Urban'
Zelkova serrata	Japanese zelkova	'Green Vase' 'Halka' 'City Green'

Medium Trees: 26 to 49 Feet in Height When Mature
(Root Space 5ft – 6ft & no Wires)

Scientific Name	Common Name	Cultivar
Acer grandidentatum	Highland Park maple	'Hipzam'
Acer grandidentatum	Rocky Mountain Glow maple	'Schmidt'
Acer miyabei	Miyabei maple	'State Street'
Acer rubrum	Red maple	'Brandywine'
Acer truncatum x	Norwegian Sunset maple	'Keithsform'
Acer truncatum x	Pacific Sunset maple	'Warrenred'
Aesculus x *carnea*	Red horsechesnut	'Briotii' 'Fort McNair'
Betula nigra	Paperbark Birch	'Heritage'
Carpinus betulus	European hornbeam	
Carpinus caroliniana	American hornbeam	
Cercidiphyllum japonicum	Katsuratree	
Cladrastis kentukea	American yellowwood	
Corylus colurna	Turkish filbert	
Gleditsia triacanthos inermis	Thornless honeylocust	'Imperial'
Halesia tetraptera	Carolina silverbell	
Ostrya virginiana	American hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Ulmus parvifolia	Chinese elm	'Allee' 'Dynasty' 'Ohio'

Small Trees: 10 to 25 Feet in Height When Mature

(Root Space 3ft – 4ft or any site with Wires)

Scientific Name	Common Name	Cultivar
Acer buergerianum	Trident maple	
Acer griseum	Paperbark maple	
Acer pensylvanicum	Striped maple	
Amelanchier spp.	Serviceberry spp.	'Autumn Brilliance' 'Lustre'
Cercis canadensis	Eastern redbud	'Forest Pansy'
Chionanthus retusus	Chinese fringetree	
Cornus kousa	Kousa dogwood	'Galzam' 'Milky Way' 'Propzam' 'Samzam' 'Satomi'
Cornus racemosa	Gray dogwood	'Cuyzam' 'Ottzam'
Crataegus crus-galli.	Thornless Cockspur hawthorn.	inermis
Maackia amurensis	Amur maackia	
Malus spp.	Flowering crabapple	(Disease resistant only)
Prunus x	Flowering Cherry	'Accolade'
Syringa pekinensis	Peking lilac	'China Snow'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

Park and Natural Areas Trees

When selecting trees for parks and natural areas, this list of trees should be considered. These are native trees that will support wildlife and thrive in more natural soil types and site conditions. Care should be taken to avoid planting trees with heavy or messy fruit near high traffic areas.

Scientific Name	Common Name	Native Site Type
Acer rubrum	Red maple	Upland Woods
Acer saccharinum	Silver maple	Floodplain, Upland Woods
Aesculus flava	Yellow buckeye	Upland Woods
Aesculus glabra	Ohio buckeye	Floodplain
Amelanchier arborea	Downy serviceberry	Upland Woods
Asimina triloba	Paw	Floodplain, Upland Woods
Betula nigra	River birch	Floodplain
Carpinus caroliniana	Hornbeam, Musclewood	Upland Woods
Carya cordiformis	Bitternut	Upland Woods
Carya glabra	Pignut hickory	Upland Woods
Carya illinoinensis	Pecan	Upland Woods
Carya laciniosa	Shellbark hickory	Upland Woods
Carya ovalis	Sweet pignut hickory	Upland Woods
Carya ovata	Shagbark hickory	Upland Woods
Carya tomentosa	Mockernut hickory	Upland Woods
Celtis occidentalis	Hackberry	Upland Woods
Cercis canadensis	Redbud	Upland Woods
Cornus florida	Flowering dogwood	Upland Woods
Crataegus mollis	Downy hawthorn	Floodplain
Diospyros virginiana	Persimmon	Fields and Prairie

Gleditsia triacanthos	Honey locust	Floodplains
Gymnocladus dioica	Kentucky coffee tree	Upland Woods
Juglans cinerea	Butternut	Upland Woods
Juglans nigra	Black walnut	Floodplain, Upland Woods
Liquidambar styraciflua	Sweet gum	Floodplain
Liriodendron tulipifera	Tulip tree	Upland Woods
Magnolia acuminata	Cucumber tree	Upland Woods
Magnolia tripetala	Umbrella magnolia	Upland Woods
Morus rubra	Red mulberry	Upland Woods
Nyssa sylvatica	Black gum	Upland Woods
Ostrya virginiana	Hop hornbeam	Upland Woods
Oxydendrum arboreum	Sourwood	Upland Woods
Platanus occidentalis	Sycamore	Floodplain
Prunus americana	Wild plum	Fields and Prairie
Prunus serotina	Black cherry	Upland Woods
Quercus alba	White oak	Upland Woods
Quercus coccinea	Scarlet oak	Upland Woods
Quercus imbricaria	Shingle oak	Fields and Prairie
Quercus macrocarpa	Bur oak	Fields and Prairie
Quercus muehlenbergii	Chinquapin oak	Upland Woods
Quercus prinus	Chestnut oak	Upland Woods
Quercus rubra	Red oak	Upland Woods
Quercus shumardii	Shumard oak	Upland Woods
Quercus velutina	Black oak	Upland Woods
Sassafras albidum	Sassafras	Upland Woods
Tilia americana	American basswood	Upland Woods

Special Use Trees

In certain areas of the City, such as the downtown business district or in areas of restricted aboveground space, the best tree choice may be those varieties that grow more upright in what is termed a fastigiate, or columnar, manner. This form achieves two purposes: (1) because of their tighter, upright habit, there is minimal storefront blockage; and (2) they will not be wide branching, thus avoiding sidewalk clearance concerns. The following tree species and varieties offer the described characteristics and should be considered for tight space situations:

Scientific Name	Common Name	Cultivar
Acer rubrum	Red maple	'Bowhall' 'Karpick'
Amelanchier arborea	Downy serviceberry	'Cumulus' 'Robin Hill'
Carpinus betulus	European hornbeam	'Fastigiata'
Ginkgo biloba	Ginkgo	'Lakeview' Princeton Sentry®
Liquidanbar styraciflua	Sweetgum	'Slender Silhouette'
Malus spp.	Flowering crabapple	'Adirondack' 'Harvest Gold' Madonna™ 'Sentinel'
Prunus sargentii	Sargent cherry	'Columnaris'

Prunus serrulata	Japanese flowering cherry	'Amanogawa'
Quercus robur	English oak	'Attention' 'Skymaster' 'Skyrocket'
Zelkova serrata	Zelkova	'Musashino'

The suggested species lists were compiled through the use of the excellent references, *Dirr's Hardy Trees and Shrubs* (Dirr, 2003), *Manual of Woody Landscape Plants (5th Edition)* (Dirr, 1998), *Street Tree Factsheets* (Pennsylvania State University, 1993), and ODNR Division of Natural Areas and Preserves online publications. Cultivar selections are only recommendations and are based on personal experience and tree availability in the nursery trade.

Appendix B: Urban Site Index Tree List

Ohio Trees by Size and Site Hardiness

Family	Genus	Species	Common name	Hardiness Zone	USI	Size	Notes
Aceraceae	*Acer* (Maple)	*nigrum*	black	3	G	L	
Aceraceae	*Acer* (Maple)	*rubrum*	red	3	G	L	
Aceraceae	*Acer* (Maple)	*saccharum*	sugar	3	G	L	
Ericaceae	*Oxydendrum*	*arboreum*	sourwood, sorrel tree	5b	G	L	Acid
Fagaceae	*Fagus* (Beech)	*grandifolia*	American	4	G	L	
Fagaceae	*Fagus* (Beech)	*sylvatica*	European, common	4	G	L	
Fagaceae	*Quercus* (Oak)	*alba*	white	4	G	L	
Fagaceae	*Quercus* (Oak)	*coccinea*	scarlet	5a	G	L	
Fagaceae	*Quercus* (Oak)	*lyrata*	overcup	6a	G	L	
Fagaceae	*Quercus* (Oak)	*muehlenbergii*	chinkapin, yellow, chinquapin	5a	G	L	
Fagaceae	*Quercus* (Oak)	*palustris*	pin	4	G	L	
Fagaceae	*Quercus* (Oak)	*prinus*	chestnut	5a	G	L	
Fagaceae	*Quercus* (Oak)	*rubra*	red	3	G	L	
Juglandaceae	*Juglans* (Walnut)	*cinerea*	butternut	3	G	L	Edible, large seed
Juglandaceae	*Juglans* (Walnut)	*nigra*	black	4	G	L	Edible, large seed
Juglandaceae	*Juglans* (Walnut)	*regia*	English walnut	5b	G	L	Edible, large seed
Juglandaceae	*Pterocarya*	*fraxinifolia*	wingnut	6a	G	L	
Magnoliaceae	*Liriodendron*	*tulipifera*	tuliptree, tulip poplar, yellow poplar	5a	G	L	
Magnoliaceae	*Magnolia* (Magnolia)	*acuimata*	cucumbertree	4	G	L	
Oleaceae	*Fraxinus* (Ash)	*nigra*	black	3	G	L	EAB
Oleaceae	*Fraxinus* (Ash)	*quadrangulata*	blue	4	G	L	EAB
Pinaceae	*Tsuga* (Hemlock)	*canadensis*	Canadian, Canada	3	G	L	
Pinaceae	*Tsuga* (Hemlock)	*caroliniana*	Carolina	5b	G	L	

Ohio Trees by Size and Site Hardiness

Family	Genus	Species	Common name	Hardiness Zone	USI	Size	Notes
Aceraceae	*Acer* (Maple)	x *freemanii*	freeman	4	I	L	
Betulaceae	*Betula* (Birch)	*nigra*	river, red	4a	I	L	
Fabaceae	*Gymnocladus*	*dioicus*	Kentucky coffeetree	4	I	L	Male
Fagaceae	*Castanea* (Chestnut)	*dentata*	American	4	I	L	Edible, spiny seed, Cblight
Fagaceae	*Quercus* (Oak)	*bicolor*	swamp white	4	I	L	
Fagaceae	*Quercus* (Oak)	*imbricara*	shingle	5a	I	L	
Fagaceae	*Quercus* (Oak)	*macrocarpa*	bur	3	I	L	Large seed
Fagaceae	*Quercus* (Oak)	*shumardii*	shumard	6a	I	L	
Hamamelidaceae	*Liquidambar* (Sweetgum)	*styraciflua*	sweetgum	5b	I	L	Spiny seed
Hippocastanaceae	*Aescculus* (Horsechestnut/Buckeye)	*chinensis*	Chinese HC	5a	I	L	Spiny seed
Hippocastanaceae	*Aescculus* (Horsechestnut/Buckeye)	*flava aka octandra*	yellow buckeye	5a	I	L	Spiny seed
Hippocastanaceae	*Aescculus* (Horsechestnut/Buckeye)	*hippocastanum*	common HC	4	I	L	Spiny seed
Juglandaceae	*Carya* (Hickory)	*cordiformis*	bitternut	4	I	L	Large seed
Juglandaceae	*Carya* (Hickory)	*illinoinensis*	pecan	6a	I	L	Large seed
Juglandaceae	*Carya* (Hickory)	*laciniosa*	shellbark	5b	I	L	Large seed
Juglandaceae	*Carya* (Hickory)	*ovata*	shagbark	4	I	L	Large seed
Lauraceae	*Sassafras*	*albidum*	sassafras	5b	I	L	
Nyssaceae	*Nyssa*	*sylvatica*	blackgum, sourgum	5a	I	L	Acid
Oleaceae	*Fraxinus* (Ash)	*americana*	white	4	I	L	EAB
Oleaceae	*Fraxinus* (Ash)	*pennsylvancia*	green	2	I	L	EAB
Oleaceae	*Fraxinus* (Ash)	*excelsior*	common, European	4	I	L	EAB
Oleaceae	*Fraxinus* (Ash)	*mandshurica*	Manchurian	4	I	L	EAB
Pinaceae	*Larix* (Larch)	*decidua*	European, common	4	I	L	
Pinaceae	*Larix* (Larch)	*kaempferi*	Japanese	4	I	L	
Pinaceae	*Larix* (Larch)	*laricina*	tamarack, eastern, American	2	I	L	
Pinaceae	*Picea* (Spruce)	*abies*	Norway	3a	I	L	
Platanaceae	*Platanus* (Sycamore/Planetree)	*x acerifolia*	London planetree	5a	I	L	
Platanaceae	*Platanus* (Sycamore/Planetree)	*occidentalis*	American sycamore	5a	I	L	
Taxodiaceae	*Metasequoia*	*glyptostroboides*	dawn redwood	5b	I	L	
Taxodiaceae	*Taxodium* (Cypress)	*ascendens*	pond	5b	I	L	
Tiliaceae	*Tilia* (Linden)	*americana*	American linden, basswood	3	I	L	

Ohio Trees by Size and Site Hardiness

Family	Genus	Species	Common name	Hardiness Zone	USI	Size	Notes
Tiliaceae	*Tilia* (Linden)	*tomentosa*	silver	5a	I	L	
Ulmaceae	*Ulmus* (Elm)	*carpinifolia*	smoothleaf	5b	I	L	
Aceraceae	*Acer* (Maple)	*saccharinum*	silver	3	P	L	
Betulaceae	*Alnus* (Alder)	*glutinosa*	black, European	4a	P	L-M	
Bignoniaceae	*Catalpa* (Catalpa)	*bignonioides*	eastern, cigar tree	5a	P	L	
Bignoniaceae	*Catalpa* (Catalpa)	*speciosa*	northern, hardy	4a	P	L	
Betulaceae	*Corylus* (Filbert)	*colurna*	Turkish	2b	P	L	Edible
Fabaceae	*Gleditisa* (Honeylocust)	*triacanthos*	*inermis'* (thornless)	4	P	L	
Fabaceae	*Robinia* (Black Locust)	*pseudoacacia*	black, yellow, white	4	P	L	Short lived
Ginkgoaceae	*Ginkgo*	*biloba*	maidenhair tree, ginkgo	4	P	L	
Juglandaceae	*Carya*(Hickory)	*glabra*	pignut	5b	P	L	Large seed
Taxodiaceae	*Taxodium* (Cypress)	*distichum*	bald	5a	P	L	
Ulmaceae	*Celtis* (Hackberry)	*occidentalis*	hackberry	2	P	L	
Ulmaceae	*Ulmus* (Elm)	*americana*	American	2	P	L	DED
Ulmaceae	*Zelkova*	*serrata*	Japanese zelkova	5a	P	L-M	

Ohio Trees by Size and Site Hardiness

Family	Genus	Species	Common name	Hardiness Zone	USI	Size	Notes
Aceraceae	*Acer* (Maple)	*pensylvanicum*	striped	4b	G	M	
Aceraceae	*Acer* (Maple)	*pseudoplatanus*	sycamore	5	G	M	
Aceraceae	*Acer* (Maple)	*triflorim*	three flower	5a	G	M	
Betulaceae	*Betula* (Birch)	*alleghaniensis*	yellow	3b	G	M	
Betulaceae	*Carpinus* (Hornbeam)	*cordata*	heartleaf	5a	G	M	
Betulaceae	*Carpinus* (Hornbeam)	*caroliniana*	musclewood, American	3b	G	M-S	
Betulaceae	*Carpinus* (Hornbeam)	*japonica*	Japanese	5b	G	M	
Cornaceae	*Cornus* (Dogwood)	*controversa*	giant	6a	G	M	
Hamamelidaceae	*Parrotia*	*persica*	persian ironwood, irontree	6a	G	M	
Magnoliaceae	*Magnolia* (Magnolia)	*tripetala*	umbrella	5a	G	M	
Roseaceae	*Prunus* (Cherry)	*avium*	mazzard or sweet cherry	6a	G	M	
Roseaceae	*Prunus* (Cherry)	*maacki*	amur chokecherry	3	G	M	
Roseaceae	*Prunus* (Cherry)	*sargentii*	sargent cherry	5a	G	M-L	
Roseaceae	*Prunus* (Cherry)	*serrulata*	paperbark cherry	6a-b	G	M	
Roseaceae	*Prunus* (Cherry)	*virginiana*	common chokcherry	3	G	M	Tent Caterpillar
Roseaceae	*Sorbus* (Mountain Ash)	*alnifolia*	Korean	4	G	M	
Roseaceae	*Sorbus* (Mountain Ash)	*aucuparia*	European	3	G	M	
Styracaceae	*Pterostyrax* (Epaulettetree)	*hispida*	fragrant	6a	G	M	
Theaceae	*Stewartia* (Stewartia)	*pseudocamellia*	Japanese	6a	G	M	Acid
Aceraceae	*Acer* (Maple)	*buergerianum*	trident	6a	I	M	
Aceraceae	*Acer* (Maple)	*campestre*	hedge	5a	I	M	
Aceraceae	*Acer* (Maple)	*griseum*	paperbark	5a	I	M	
Aceraceae	*Acer* (Maple)	*miyabei*	miyabei	4	I	M	
Aceraceae	*Acer* (Maple)	*platanoides 'Crimson King'*	Crimson King Norway	4b	I	M	
Anacardiaceae	Cotinus (Smoketree)	*obovatus*	American	6	I	M	
Aquifoliaceae	*Ilex* (Holly)	*opaca*	American	6a	I	M	
Betulaceae	*Betula* (Birch)	*lenta*	sweet, black, cherry	4a	I	M	
Betulaceae	*Carpinus* (Hornbeam)	*betulus*	European	5a	I	M	
Betulaceae	*Ostrya* (Hophornbeam)	*virginiana*	ironwood, American	3b	I	M	
Cercidiphyllaceae	*Cercidiphyllum*	*japonicum*	katsuratree	5a	I	M	

Ohio Trees by Size and Site Hardiness

Family	Genus	Species	Common name	Hardiness Zone	USI	Size	Notes
Cupressaceae	C*hamaecyparis* (Falsecypress)	*lawsoniana*	lawson	6b	I	M	
Cupressaceae	C*hamaecyparis* (Falsecypress)	*nootkatensis*	Alaska-cedar	5b	I	M	
Cupressaceae	C*hamaecyparis* (Falsecypress)	*pisifera*	sawara, Japanese	5a	I	M	
Cupressaceae	C*hamaecyparis* (Falsecypress)	*thyoides*	Altantic whitecedar	5a	I	M	
Fabaceae	*Cladratis*	*kentukea*	yellowwood	4	I	M	
Fabaceae	*Maackia*	*amurensis*	amur maackia	4	I	M	
Fagaceae	*Castanea* (Chestnut)	*mollissima*	Chinese	5b	I	M	Spiny seed
Fagaceae	*Quercus* (Oak)	*acutissima*	sawtooth	6a	I	M	
Fagaceae	*Quercus* (Oak)	*phellos*	willow	6a	I	M	
Fagaceae	*Quercus* (Oak)	*robur*	English	5b	I	M	
Fagaceae	*Quercus* (Oak)	*stellata*	post	6a	I	M	
Hippocastanaceae	*Aescculus* (Horsechestnut/Buckeye)	*glabra*	Ohio buckeye	3	I	M	Spiny seed
Hippocastanaceae	*Aescculus* (Horsechestnut/Buckeye)	x *carnea*	red HC	5	I	M	Spiny seed
Magnoliaceae	*Magnolia* (Magnolia)	*grandifolia*	southern	6a	I	M	
Roseaceae	*Malus* (Crabapple)	*baccata*	Siberian	3	I	M	
Roseaceae	*Prunus* (Cherry)	*subhirtella*	spring, rosebud or higan	6a	I	M	
Roseaceae	*Prunus* (Cherry)	x *incamp*	okame	6b	I	M	
Roseaceae	*Prunus* (Cherry)	x *yedoensis*	yoshino	5b	I	M	
Rutaceae	*Phellodendron*	*amurense*	amur corktree	4	I	M	male only
Sapindaceae	*Koelreuteria*	*paniculata*	goldenraintree	5b	I	M	
Styracaceae	*Halesia* (Silverbell)	*diptera*	two winged	6	I	M	
Styracaceae	*Halesia* (Silverbell)	*carolina*	carolina	5	I	M	
Styracaceae	*Halesia* (Silverbell)	*tetraptera*	Carolina	5a	I	M	
Tiliaceae	*Tilia* (Linden)	*cordata*	little leaf	3	I	M	
Tiliaceae	*Tilia* (Linden)	x *euchlora*	crimean	3	I	M	

Ohio Trees by Size and Site Hardiness

Family	Genus	Species	Common name	Hardiness Zone	USI	Size	Notes
Betulaceae	*Alnus (Alder)*	*incana*	speckled	3a	P	M	
Eucommiaceae	*Eucommia*	*ulmoides*	hardy rubber tree	6a	P	M	
Fabaceae	*Sophora*	*japonica*	Japanese pagodatree	6a	P	M	
Roseaceae	*Crataegus* (Hawthorn)	*viridis*	green	5a	P	M	
Ulmaceae	*Ulmus* (Elm)	*hybrids*	hybrid	4	P	M-L	Lots: do homework
Ulmaceae	*Ulmus* (Elm)	*parviflolia*	lacebark	5b	P	M-L	
Araliaceae	*Aralia*	*spinosa*	devils walking stick	4a	G	S	Spiny stem
Araliaceae	*Aralia*	*elata*	Japanese angelica tree	5	G	S	
Cornaceae	*Cornus* (Dogwood)	*alternifolia*	pagoda	4a	G	S	
Cornaceae	*Cornus* (Dogwood)	*florida*	white flowering	5b	G	S	
Cornaceae	*Cornus* (Dogwood)	*officianalis*	Japanese. cornal	5a	G	S	
Fabaceae	*Albizia*	*julibrissin*	mimosa, silk tree	6a	G	S	
Magnoliaceae	*Magnolia* (Magnolia)	*virginiana*	sweetbay	5b	G	S	
Oleaceae	*Chionanthus* (Fringe Tree)	*virginicus*	fringe tree	5a	G	S	
Roseaceae	*Prunus* (Cherry)	*americana*	american red plum	3	G	S	
Roseaceae	*Prunus* (Cherry)	*cerasifera*	cherry plum	4	G	S	
Roseaceae	*Prunus* (Cherry)	*tomentosa*	manchu or nanking	3	G	S	
Staphyleaceae	*Staphylea*	*trifolia*	bladdernut	4	G	S	
Styracaceae	*Styrax* (Snowbell)	*japonicus*	Japanese	6b	G	S	
Styracaceae	*Styrax* (Snowbell)	*obassia*	fragrant	6b	G	S	
Theaceae	*Stewartia* (Stewartia)	*ovata*	mountain	6b	G	S	Acid
Magnoliaceae	*Magnolia* (Magnolia)	x *soulangiana*	saucer	5a	I-G	S	
Aceraceae	*Acer* (Maple)	*tataricum*	Tatarian	3	I	S	
Anacardiaceae	Cotinus (Smoketree)	*coggygria*	common	5a	I	S	
Betulaceae	*Carpinus* (Hornbeam)	*orientalis*	oriental	5a	I	S	
Betulaceae	*Corylus* (Filbert/hazelnut)	*maxima*	purple giant	5b	I	S	edible
Caprifoliaceae	*Heptacodium*	*miconioidies*	seven-son flower	5b	I	S	
Cornaceae	*Cornus* (Dogwood)	*amomum*	silky	4b	I	S	
Cornaceae	*Cornus* (Dogwood)	*drummondii*	giant, roughleaf	4b	I	S	
Cornaceae	*Cornus* (Dogwood)	*kousa*	kousa	5a	I	S	
Cornaceae	*Cornus* (Dogwood)	*mas*	corneliancherry	5a	I	S	
Fabaceae	*Cercis*	*canadensis*	redbud	5b	I	S	

Ohio Trees by Size and Site Hardiness

Family	Genus	Species	Common name	Hardiness Zone	USI	Size	Notes
Fagaceae	*Castanea* (Chestnut)	*pumila*	Allegheny, chinquapin	5a	I	S	Spiny seed
Hippocastanaceae	*Aescculus* (Horsechestnut/Buckeye)	*pavia*	red buckeye	6a	I	S	Spiny seed
Magnoliaceae	*Magnolia* (Magnolia)	*stellata*	star	5a	I	S	
Rutaceae	*Evodia*	*daniellii*	Korean evodia	5b	I	S	

Ohio Trees by Size and Site Hardiness

Family	Genus	Species	Common name	Hardiness Zone	USI	Size	Notes
Roseaceae	*Amelanchier* (Serviceberry)	*arborea*	downy	3	I-P	S	Edible
Roseaceae	*Amelanchier* (Serviceberry)	*canadensis*	shadblow	3	I-P	S	Edible
Roseaceae	*Amelanchier* (Serviceberry)	*laevis*	Allegheny	3	I-P	S	Edible
Roseaceae	*Amelanchier* (Serviceberry)	x *grandiflora*	apple	3	I-P	S	Edible
Aceraceae	*Acer* (Maple)	*ginnala*	amur	3	P	S	
Aceraceae	*Acer* (Maple)	*truncatum*	shantung	5	P	S	
Betulaceae	*Alnus* (Alder)	*incana*	white	3a	P	S	
Betulaceae	*Alnus* (Alder)	*rugosa*	smooth	3b	P	S	
Betulaceae	*Corylus* (Filbert/hazelnut)	*americana*	American	3	P	S	Edible
Betulaceae	*Corylus* (Filbert/hazelnut)	*avellana*	European	4b	P	S	Edible
Fabaceae	*Caragana*	*arborescens*	pea tree	2	P	S	
Oleaceae	*Syringa* (Lilac)	*pekinensis*	Pekin	4	P	S	
Oleaceae	*Syringa* (Lilac)	*reticulata*	Japanese tree	3	P	S	
Roseaceae	*Crataegus* (Hawthorn)	*crus-galli*	*inermis'* (cockspur)	4	P	S	
Roseaceae	*Crataegus* (Hawthorn)	*laevigata*	English	5a	P	S	
Roseaceae	*Crataegus* (Hawthorn)	*mollis*	downy	3	P	S	
Roseaceae	*Crataegus* (Hawthorn)	*phaenopyrum*	Washington	4	P	S	
Roseaceae	*Crataegus* (Hawthorn)	*punctata*	Ohio pioneer	5	P	S	
Roseaceae	*Crataegus* (Hawthorn)	x *lavallei*	Lavalle	5	P	S	
Roseaceae	*Malus* (Crabapple)	*sargentii*	sargents	4	P	S	
Roseaceae	*Malus* (Crabapple)	*transitoria*	Golden Raindrops	3	P	S	
Roseaceae	*Malus* (Crabapple)	*tschonoski*	tschonoski	3	P	S	
Roseaceae	*Malus* (Crabapple)	*zumi*	calocarpa	4	P	S	

Appendix C: iTree Eco Reports

Net Annual Benefits for all Trees

Location: Berea, Cuyahoga, Ohio, United States of America
Project: Berea iTree, Series: 1, Year: 2024
Generated: 10/10/2024

Benefits	Total $ (USD)	$ (USD)/tree	$ (USD)/capita
Energy	0.00	0.00	0.00
Gross Carbon Sequestration	5,594.72	1.34	0.29
Pollution Removal	22,111.35	5.30	1.16
Avoided Runoff	7,343.99	1.76	0.38
Total Benefits	**35,050.07**	**8.41**	**1.84**
Costs			
Purchasing trees and planting	0.00	0.00	0.00
Contract pruning	87,197.00	20.92	4.57
Pest management	0.00	0.00	0.00
Irrigation	0.00	0.00	0.00
Removal	0.00	0.00	0.00
Administration	0.00	0.00	0.00
Inspection/service	0.00	0.00	0.00
Infrastructure repairs	0.00	0.00	0.00
Litter clean-up	0.00	0.00	0.00
Liability/claims	0.00	0.00	0.00
Other costs	0.00	0.00	0.00
Total Costs	**87,197.00**	**20.92**	**4.57**
Net Benefits	**-52,146.93**	**-12.51**	**-2.73**
Benefit-cost ratio	**0.40**		

Energy saving value is calculated based on the prices of $122.50 per MWH and $9.47 per MBTU. Trees less than or equal to 10ft/3m tall or further than 60ft/18m away from buildings do not provide energy benefits to nearby buildings.
Gross carbon sequestration value is calculated based on the price of $170.55 per ton.
Avoided runoff value is calculated by the price $0.009/gal. The user-designated weather station reported 45.8 inches of total annual precipitation. Eco will always use the hourly measurements that have the greatest total rainfall or user-submitted rainfall if provided.
Values per capita are based on a population of 19,093.

Benefits Summary of Trees by Species

Location: Berea, Cuyahoga, Ohio, United States of America
Project: Berea iTree, Series: 1, Year: 2024
Generated: 10/10/2024

Species	Trees	Carbon Storage		Gross Carbon Sequestration		Avoided Runoff		Pollution Removal		Replacement Value
	Number	(ton)	($)	(ton/yr)	($/yr)	(gal/yr)	($/yr)	(ton/yr)	($/yr)	($)
Maple spp	1,947	806.45	137,540.59	14.63	2,494.54	443,035.11	3,958.96	0.81	11,919.68	2,898,382.05
Buckeye spp	41	9.30	1,585.60	0.17	29.71	3,998.74	35.73	0.01	107.58	27,608.21
Serviceberry spp	70	2.16	368.68	0.14	24.16	971.42	8.68	0.00	26.14	12,264.78
Birch spp	7	5.51	940.20	0.07	11.54	1,402.34	12.53	0.00	37.73	16,415.17
Hickory spp	2	1.57	267.84	0.04	6.14	666.06	5.95	0.00	17.92	6,024.15
Catalpa spp	16	7.00	1,194.42	0.12	19.65	3,155.70	28.20	0.01	84.90	26,740.51
Hornbeam spp	8	0.06	10.27	0.01	1.56	91.11	0.81	0.00	2.45	385.38
Redbud spp	24	1.76	300.70	0.07	11.96	1,230.68	11.00	0.00	33.11	11,709.22
Hackberry spp	1	0.00	0.51	0.00	0.07	8.03	0.07	0.00	0.22	58.73
Dogwood spp	13	0.33	56.38	0.02	3.55	150.10	1.34	0.00	4.04	2,371.90
Hawthorn spp	36	15.01	2,560.55	0.21	36.53	3,637.43	32.50	0.01	97.86	66,463.43
Beech spp	2	0.36	61.12	0.01	1.96	427.20	3.82	0.00	11.49	1,925.15
Ash spp	6	2.18	371.02	0.05	8.76	1,509.00	13.48	0.00	40.60	10,455.43
Ginkgo spp	16	0.50	85.68	0.02	2.71	701.01	6.26	0.00	18.86	7,638.08
Locust spp	270	293.81	50,109.20	4.63	789.40	74,387.69	664.73	0.14	2,001.37	1,411,643.76
Coffeetree spp	5	0.02	3.27	0.00	0.57	53.06	0.47	0.00	1.43	313.20
Rosemallow spp	3	0.15	24.79	0.01	1.43	111.11	0.99	0.00	2.99	750.69
Juniper spp	1	0.06	10.74	0.00	0.57	34.12	0.30	0.00	0.92	308.31
Tuliptree spp	18	20.21	3,446.85	0.30	51.83	11,809.19	105.53	0.02	317.72	67,314.74
Sweetgum spp	37	15.43	2,631.72	0.32	55.43	14,408.05	128.75	0.03	387.64	129,541.33
Magnolia spp	10	2.06	351.89	0.05	9.23	878.58	7.85	0.00	23.64	8,484.91
Apple spp	159	19.49	3,324.12	0.76	129.78	6,096.53	54.48	0.01	164.02	101,321.84
Dawn Redwood spp	1	0.15	25.84	0.00	0.70	242.12	2.16	0.00	6.51	2,118.83
Mulberry spp	3	0.39	66.85	0.02	3.19	246.57	2.20	0.00	6.63	2,055.89
Tupelo spp	19	0.07	11.77	0.01	2.49	89.91	0.80	0.00	2.42	1,190.16
Hophornbean spp	1	0.03	4.79	0.00	0.38	48.07	0.43	0.00	1.29	219.54
Spruce spp	9	1.92	327.20	0.05	8.19	1,052.55	9.41	0.00	28.32	10,911.81
Pine spp	4	1.70	290.54	0.03	4.78	733.61	6.56	0.00	19.74	10,952.36

Benefits Summary of Trees by Species

Location: Berea, Cuyahoga, Ohio, United States of America
Project: Berea iTree, Series: 1, Year: 2024
Generated: 10/10/2024

Species	Trees	Carbon Storage		Gross Carbon Sequestration		Avoided Runoff		Pollution Removal		Replacement Value
	Number	(ton)	($)	(ton/yr)	($/yr)	(gal/yr)	($/yr)	(ton/yr)	($/yr)	($)
Sycamore spp	23	18.74	3,196.38	0.28	48.09	12,172.58	108.77	0.02	327.50	114,388.21
Cottonwood spp	2	3.02	514.22	0.04	7.05	871.16	7.78	0.00	23.44	8,320.10
Plum spp	16	6.38	1,088.94	0.09	16.11	1,972.72	17.63	0.00	53.08	17,466.28
Douglas-fir spp	1	0.12	20.43	0.00	0.53	139.88	1.25	0.00	3.76	1,717.06
Pear spp	557	178.79	30,492.01	3.71	632.39	63,636.78	568.66	0.12	1,712.12	803,984.90
Oak spp	176	320.23	54,614.71	3.36	573.67	93,028.70	831.30	0.17	2,502.90	1,326,743.60
Sumac spp	2	0.00	0.25	0.00	0.10	6.23	0.06	0.00	0.17	96.35
Robinia spp	14	29.32	5,000.05	0.21	35.20	4,877.18	43.58	0.01	131.22	61,005.90
Willow spp	3	4.15	708.28	0.03	4.63	1,116.70	9.98	0.00	30.04	13,708.32
Lilac spp	272	18.59	3,169.94	1.06	180.47	5,953.51	53.20	0.01	160.18	77,334.59
Red Cedar spp	2	0.04	6.52	0.00	0.47	20.62	0.18	0.00	0.55	319.73
Basswood spp	267	82.12	14,006.27	1.71	291.28	51,506.21	460.26	0.09	1,385.75	494,746.66
Elm spp	48	9.11	1,554.01	0.21	36.55	3,647.08	32.59	0.01	98.12	34,876.31
Zelkova spp	57	13.99	2,385.64	0.34	57.39	11,718.95	104.72	0.02	315.29	97,253.75
Total	**4,169**	**1,892.28**	**322,730.78**	**32.80**	**5,594.72**	**821,843.37**	**7,343.99**	**1.51**	**22,111.35**	**7,887,531.30**

Carbon storage and gross carbon sequestration value is calculated based on the price of $170.55 per ton.
Due to limits of available models, i-Tree Eco will limit carbon storage to a maximum of 7,500 kg (16,534.7 lbs) and not estimate additional storage for any tree beyond a diameter of 254 cm (100 in). Whichever limit results in lower carbon storage is used.
Avoided runoff value is calculated by the price $0.009/gal. The user-designated weather station reported 45.8 inches of total annual precipitation. Eco will always use the hourly measurements that have the greatest total rainfall or user-submitted rainfall if provided.
Pollution removal value is calculated based on the prices of $1,488.30 per ton (CO), $4,773.33 per ton (O3), $709.70 per ton (NO2), $162.39 per ton (SO2), $237,950.58 per ton (PM2.5), $6,996.09 per ton (PM10*).
Replacement value is the estimated local cost of having to replace a tree with a similar tree.
A value of zero may indicate that ancillary data (pollution, weather, energy, etc.) is not available for this location or that the reported amounts are too small to be shown.

Appendix D: Tree Maintenance Risk Priorities

OBJECTID	ADDRESS	STREET	COMMONNAME	MT_PRIORTY	MT_TYPE	COND	DBH	FAIL_SIZE	WIRES	OBSERVE_1	OBSERVE_2	NOTES
8123	0	Coe Lake Park	Oak, Pin	Critical	Remove	Dead	26	25 to 36	No	None	None	
7969	0	Coe Lake Park	Black Locust	Critical	Remove	Dead	17	13 to 24	No	None	None	
8177	0	Dora Lee Payne Park	Cottonwood, Eastern	Critical	Remove	Dead	16	13 to 24	No	None	None	
8142	0	Coe Lake Park	Cottonwood, Eastern	Immediate	Remove	Dead	29	25 to 36	No	None	None	
8160	0	Adams Street Cemetery	Pine, Austrian Black	Immediate	Remove	Dead	26	25 to 36	No	None	None	
8167	0	Adams Street Cemetery	Pine, Austrian Black	Immediate	Remove	Dead	26	25 to 36	No	None	None	
5948	334	BAKER ST	Pear, Callery	Critical	Remove	Critical	24	13 to 24	Yes	Cavity or Decay	Poor Structure	
7552	428	ADRIAN DR	Honeylocust, Thornless	Critical	Remove	Poor	26	25 to 36	No	Cavity or Decay	Serious Decline	
148	205	ELLEN DR	Oak, Pin	Critical	Remove	Critical	25	13 to 24	No	Poor Structure	None	
7972	0	Coe Lake Park	Black Locust	Critical	Remove	Dead	11	04 to 12	No	None	None	
8130	0	Coe Lake Park	Cottonwood, Eastern	Critical	Remove	Dead	11	04 to 12	No	None	None	
8126	0	Coe Lake Park	Black Locust	Critical	Remove	Dead	8	04 to 12	No	None	None	
8129	0	Coe Lake Park	Black Locust	Critical	Remove	Dead	8	04 to 12	No	None	None	
8154	0	Adams Street Cemetery	Pine, Austrian Black	Immediate	Remove	Dead	21	13 to 24	No	None	None	
8071	0	Coe Lake Park	Tree Of Heaven	Critical	Remove	Critical	20	13 to 24	No	None	None	
8144	0	Coe Lake Park	Black Locust	Immediate	Remove	Dead	19	13 to 24	No	None	None	Broken
8153	0	Coe Lake Park	Oak, White	Immediate	Remove	Dead	19	13 to 24	No	None	None	Leaning
8150	0	Coe Lake Park	Cherry, Black	Immediate	Remove	Dead	18	13 to 24	No	None	None	
8143	0	Coe Lake Park	Black Locust	Immediate	Remove	Dead	17	13 to 24	No	None	None	Leaning
8149	0	Coe Lake Park	Cherry, Black	Immediate	Remove	Dead	16	13 to 24	No	None	None	
8133	0	Coe Lake Park	Blackgum	Immediate	Remove	Dead	13	13 to 24	No	None	None	
8148	0	Coe Lake Park	Cherry, Black	Immediate	Remove	Dead	13	13 to 24	No	None	None	
8151	0	Coe Lake Park	Cherry, Black	Immediate	Remove	Dead	13	13 to 24	No	None	None	
8152	0	Coe Lake Park	Cherry, Black	Immediate	Remove	Dead	13	13 to 24	No	None	None	
8094	0	Coe Lake Park	Black Locust	Critical	Remove	Poor	29	25 to 36	No	Poor Structure	None	
5592	137	WESTBRIDGE DR	Maple, Red	Critical	Remove	Critical	23	04 to 12	No	Cavity or Decay	Serious Decline	
4209	204	ADAMS ST	Black Locust	Critical	Remove	Poor	36	13 to 24	Yes	Cavity or Decay	Reinspect	
1761	451	HAZEL DR	Maple, Red	Critical	Remove	Poor	26	13 to 24	No	Cavity or Decay	Reinspect	
4731	73	HARNAGY ST	Linden, American	Critical	Remove	Poor	17	13 to 24	No	Cavity or Decay	None	
4800	18	CROCKER ST	Maple, Silver	Critical	Clean	Poor	48	25 to 36	No	Cavity or Decay	Reinspect	Level 3 inspection recommended
3268	122	WELLINGTON ST	Crabapple	Immediate	Remove	Dead	10	04 to 12	No	Multiple Stems	None	
3430	130	FIFTH AVE	Maple, Norway	Immediate	Remove	Dead	5	04 to 12	No	None	None	
4782	94	HARTMAN ST	Maple, Silver	Critical	Remove	Poor	30	13 to 24	Yes	None	None	
3580	0	BAGLEY RD	Pear, Callery	Critical	Remove	Critical	12	04 to 12	Yes	Poor Structure	Poor Location	active trunk crack
8125	0	Coe Lake Park	Black Locust	Immediate	Remove	Dead	10	04 to 12	No	Multiple Stems	None	
8140	0	Coe Lake Park	Black Locust	Immediate	Remove	Dead	10	04 to 12	No	Multiple Stems	None	
8131	0	Coe Lake Park	Black Locust	Immediate	Remove	Dead	7	04 to 12	No	Multiple Stems	None	
8146	0	Coe Lake Park	Cottonwood, Eastern	Immediate	Remove	Dead	12	04 to 12	No	None	None	Broken
8124	0	Coe Lake Park	Maple, Red	Immediate	Remove	Dead	11	04 to 12	No	None	None	
8132	0	Coe Lake Park	Blackgum	Immediate	Remove	Dead	11	04 to 12	No	None	None	
8136	0	Coe Lake Park	Black Locust	Immediate	Remove	Dead	11	04 to 12	No	None	None	
8138	0	Coe Lake Park	Cherry, Black	Immediate	Remove	Dead	11	04 to 12	No	None	None	
8134	0	Coe Lake Park	Cherry, Black	Immediate	Remove	Dead	9	04 to 12	No	None	None	
8141	0	Coe Lake Park	Maple, Red	Immediate	Remove	Dead	8	04 to 12	No	None	None	
8127	0	Coe Lake Park	Black Locust	Immediate	Remove	Dead	7	04 to 12	No	None	None	
8128	0	Coe Lake Park	Black Locust	Immediate	Remove	Dead	7	04 to 12	No	None	None	
8135	0	Coe Lake Park	Ash, Green	Immediate	Remove	Dead	6	04 to 12	No	None	None	
8137	0	Coe Lake Park	Black Locust	Immediate	Remove	Dead	6	04 to 12	No	None	None	
6288	200	FAIR ST	Maple, Silver	Critical	Remove	Poor	18	04 to 12	No	Cavity or Decay	Serious Decline	

3581	0	BAGLEY RD	Pear, Callery	Critical	Remove	Poor	12	04 to 12	Yes	Cavity or Decay	Poor Structure	active trunk crack
3283	145	DEPOT ST	Maple, Red	Critical	Clean	Poor	39	13 to 24	No	Cavity or Decay	Reinspect	
1814	463	PECAN DR	Maple, Red	Critical	Clean	Poor	25	13 to 24	No	Cavity or Decay	None	
7300	366	ADRIAN DR	Honeylocust, Thornless	Critical	Remove	Fair	25	13 to 24	No	Cavity or Decay	Poor Structure	
3101	440	FRONT ST	Maple, Norway	Immediate	Remove	Poor	23	13 to 24	Yes	Cavity or Decay	Serious Decline	
3120	807	FRONT ST	Zelkova	Immediate	Remove	Poor	20	13 to 24	No	Cavity or Decay	Serious Decline	
4774	252	PROSPECT RD	Maple, Red	Immediate	Remove	Poor	20	13 to 24	Yes	Cavity or Decay	Root Problem	
4936	282	WALLACE DR	Maple, Silver	Immediate	Remove	Poor	18	13 to 24	No	Mechanical Damage	Cavity or Decay	
3154	399	FRONT ST	Linden, American	Immediate	Remove	Poor	47	13 to 24	No	Multiple Stems	Cavity or Decay	reinspect
4741	70	HARNAGY ST	Maple, Sugar	Critical	Remove	Poor	23	04 to 12	Yes	None	None	
4606	48	JACQUELINE DR	Maple, Red	Critical	Remove	Poor	15	04 to 12	No	None	None	
4602	32	JACQUELINE DR	Maple, Norway Crimson King	Critical	Remove	Poor	12	04 to 12	No	None	None	
7028	435	WOODRIDGE CIR	Oak, Pin	Critical	Clean	Poor	31	13 to 24	No	None	None	
4786	417	FAIR ST	Maple, Silver	Immediate	Remove	Poor	29	13 to 24	Yes	None	None	
4722	115	HARNAGY ST	Pear, Callery	Immediate	Remove	Poor	25	13 to 24	No	None	None	
4783	96	HARTMAN ST	Maple, Red	Immediate	Remove	Poor	25	13 to 24	Yes	None	None	
2598	131	WHITEHALL DR	Honeylocust, Thornless	Immediate	Remove	Poor	23	13 to 24	No	None	None	
4696	328	PROSPECT RD	Maple, Red	Immediate	Remove	Poor	23	13 to 24	Yes	None	None	
4763	93	HARTMAN ST	Maple, Silver	Immediate	Remove	Poor	21	13 to 24	No	None	None	
1330	480	PARK PLACE	Pear, Callery	Immediate	Remove	Critical	12	04 to 12	No	Poor Structure	Cavity or Decay	
1345	440	PARK PLACE	Pear, Callery	Immediate	Remove	Critical	12	04 to 12	No	Poor Structure	Cavity or Decay	
5297	302	WYLESWOOD DR	Maple, Silver	Immediate	Remove	Poor	22	13 to 24	Yes	Root Problem	None	Leaning
4228	178	MEADOW CIR	Maple, Silver	Immediate	Remove	Poor	19	13 to 24	No	Root Problem	None	
2806	735	FAIR ST	Honeylocust, Thornless	Immediate	Remove	Poor	18	13 to 24	Yes	Root Problem	None	
8147	0	Coe Lake Park	Maple, Red	Immediate	Remove	Dead	22	00 to 03	No	None	None	
8145	0	Coe Lake Park	Cottonwood, Eastern	Immediate	Remove	Dead	17	00 to 03	No	None	None	
8139	0	Coe Lake Park	Black Locust	Immediate	Remove	Dead	8	00 to 03	No	None	None	
7973	0	Coe Lake Park	Black Locust	Critical	Remove	Poor	12	04 to 12	No	None	None	
5407	173	SEMINARY ST	Maple, Silver	Critical	Clean	Poor	37	04 to 12	No	Cavity or Decay	Reinspect	
2175	740	GRAYTON RD	Willow, Corkscrew	Critical	Clean	Poor	35	04 to 12	No	Cavity or Decay	Poor Structure	reinspect, remove?
6703	279	WAYNE DR	Boxelder	Critical	Clean	Poor	32	04 to 12	No	Cavity or Decay	Serious Decline	
3797	422	WAVERLY ST	Elm, Other	Critical	Clean	Poor	24	04 to 12	No	Cavity or Decay	Poor Structure	fairgrounds?
5229	160	BEECH ST	Maple, Silver	Immediate	Remove	Poor	22	04 to 12	Yes	Cavity or Decay	None	
5462	142	NORTH ROCKY RIVER DR	Zelkova	Immediate	Remove	Poor	19	04 to 12	No	Cavity or Decay	Serious Decline	
3591	177	PULASKI ST	Linden, American	Critical	Clean	Poor	18	04 to 12	Yes	Cavity or Decay	Poor Structure	active trunk crack
2571	59	THIRD AVE	Zelkova	Critical	Clean	Poor	16	04 to 12	No	Cavity or Decay	Serious Decline	
3600	305	RUNN ST	Linden, American	Critical	Clean	Poor	16	04 to 12	No	Cavity or Decay	Poor Structure	
3019	388	BEECH ST	Maple, Norway	Immediate	Remove	Poor	16	04 to 12	No	Cavity or Decay	Poor Structure	basal decay fungi present
1165	400	LAUREL DR	Maple, Red	Critical	Clean	Poor	15	04 to 12	No	Cavity or Decay	Reinspect	
6663	174	EDGEWOOD DR	Hawthorn, Laevigata	Immediate	Remove	Poor	10	04 to 12	No	Cavity or Decay	None	
1812	381	SAVAGE ST	Maple, Red	Critical	Clean	Fair	31	13 to 24	No	Cavity or Decay	None	
3323	303	BEREA ST	Maple, Red	Critical	Clean	Fair	30	13 to 24	No	Cavity or Decay	Serious Decline	
5296	290	WYLESWOOD RD	Maple, Silver	Immediate	Remove	Poor	41	04 to 12	No	None	None	
4583	71	JACQUELINE DR	Maple, Silver	Immediate	Remove	Poor	24	04 to 12	Yes	None	None	
4805	58	CROCKER ST	Maple, Norway	Critical	Clean	Poor	23	04 to 12	No	None	None	
4611	82	JACQUELINE DR	Boxelder	Immediate	Remove	Poor	22	04 to 12	No	None	None	
4693	15	HAMILTON ST	Zelkova	Immediate	Remove	Poor	21	04 to 12	No	None	None	
3912	768	STARLITE DR	Maple, Silver	Immediate	Remove	Poor	18	04 to 12	No	None	None	
4575	105	JACQUELINE DR	Maple, Silver	Immediate	Remove	Poor	17	04 to 12	Yes	None	None	
4581	79	JACQUELINE DR	Maple, Silver	Immediate	Remove	Poor	17	04 to 12	Yes	None	None	

4607	48	JACQUELINE DR	Maple, Red	Immediate	Remove	Poor	13	04 to 12	No	None	None	
5324	456	WYLESWOOD DR	Maple, Norway	Immediate	Remove	Poor	11	04 to 12	No	None	None	
4705	80	HAMILTON ST	Crabapple	Immediate	Remove	Poor	9	04 to 12	Yes	None	None	
5101	411	BALDWIN DR	Crabapple	Immediate	Remove	Poor	8	04 to 12	No	None	None	
4395	330	ROCKY RIVER DR	Unknown Species	Critical	Clean	Fair	60	13 to 24	No	None	None	
7845	640	Jason Malone Park	Ash, Green	Immediate	Remove	Poor	19	04 to 12	No	Pest Problem	None	
6986	303	RACE ST	Maple, Sugar	Immediate	Remove	Poor	15	04 to 12	No	Poor Location	Cavity or Decay	
1407	260	NOBOTTOM RD	Black Locust	Immediate	Remove	Poor	18	04 to 12	No	Poor Structure	Cavity or Decay	
7439	446	WYLESWOOD DR	Linden, American	Immediate	Remove	Poor	15	04 to 12	No	Poor Structure	Cavity or Decay	
4766	85	HARTMAN ST	Maple, Silver	Immediate	Remove	Poor	23	04 to 12	No	Root Problem	Cavity or Decay	
2857	262	VIVIAN DR	Maple, Red	Immediate	Remove	Poor	14	04 to 12	No	Root Problem	None	
2671	717	FAIR ST	Honeylocust, Thornless	Immediate	Remove	Fair	17	13 to 24	No	Root Problem	None	Falling and recent digging
8074	0	Coe Lake Park	Black Locust	Immediate	Remove	Poor	16	04 to 12	No	Multiple Stems	None	
8095	0	Coe Lake Park	Black Locust	Immediate	Remove	Poor	24	04 to 12	No	None	None	
8091	0	Coe Lake Park	Boxelder	Critical	Clean	Poor	21	04 to 12	No	None	None	
6886	289	KEMPTON DR	Oak, Northern Red	Critical	Clean	Fair	33	04 to 12	No	Cavity or Decay	None	
7151	245	FAIRPARK DR	Honeylocust, Thornless	Critical	Clean	Fair	30	04 to 12	No	Cavity or Decay	Poor Structure	
7406	410	ADRIAN DR	Honeylocust, Thornless	Critical	Clean	Fair	29	04 to 12	Yes	Cavity or Decay	Root Problem	root decay
6529	145	PARKWOOD DR	London Planetree	Critical	Clean	Fair	28	04 to 12	No	Cavity or Decay	Pest Problem	
6340	170	TAMARACK DR	Honeylocust, Thornless	Critical	Clean	Fair	27	04 to 12	No	Cavity or Decay	None	
2314	660	WESLEY DR	Black Locust	Critical	Clean	Fair	26	04 to 12	No	Cavity or Decay	Serious Decline	
7178	165	FAIRPARK DR	Honeylocust, Thornless	Critical	Clean	Fair	26	04 to 12	No	Cavity or Decay	None	
7417	424	ANNE DR	Honeylocust, Thornless	Critical	Clean	Fair	26	04 to 12	No	Cavity or Decay	None	
5992	33	BAKER ST	Maple, Silver	Critical	Clean	Fair	25	04 to 12	No	Cavity or Decay	Reinspect	
5883	60	PROSPECT ST	Maple, Sugar	Critical	Clean	Fair	24	04 to 12	No	Cavity or Decay	Serious Decline	
7398	405	RACE ST	Honeylocust, Thornless	Critical	Clean	Fair	23	04 to 12	No	Cavity or Decay	None	
7428	440	BEELER DR	Honeylocust, Thornless	Critical	Clean	Fair	23	04 to 12	No	Cavity or Decay	None	
6357	225	SUNSET DR	Honeylocust, Thornless	Critical	Clean	Fair	22	04 to 12	No	Cavity or Decay	None	
2055	735	ROCKY RIVER DR	Oak, Northern Red	Critical	Clean	Fair	20	04 to 12	No	Cavity or Decay	Serious Decline	
2977	17	FOURTH AVE	Maple, Red	Critical	Clean	Fair	20	04 to 12	No	Cavity or Decay	None	
5014	275	BALDWIN DR	Maple, Silver	Immediate	Remove	Poor	20	00 to 03	No	None	None	
4400	342	ROCKY RIVER DR	Oak, Northern Red	Critical	Clean	Fair	42	04 to 12	No	None	None	
250	170	PROSPECT RD	Oak, Pin	Critical	Clean	Fair	40	04 to 12	Yes	None	None	
4441	84	MONROE ST	Maple, Silver	Critical	Clean	Fair	40	04 to 12	No	None	None	
6006	217	FOURNIER ST	Oak, Northern Red	Critical	Clean	Fair	40	04 to 12	No	None	None	
4430	221	SOUTH ROCKY RIVER DR	Maple, Silver	Critical	Clean	Fair	36	04 to 12	No	None	None	
6306	183	FAIR ST	Maple, Silver	Critical	Clean	Fair	36	04 to 12	No	None	None	
1038	376	HOLLY DR	Oak, Pin	Critical	Clean	Fair	32	04 to 12	No	None	None	
1252	350	NOBOTTOM RD	Oak, Northern Red	Critical	Clean	Fair	32	04 to 12	No	None	None	hanger over sidewalk
7171	185	FAIRPARK DR	Honeylocust, Thornless	Critical	Clean	Fair	31	04 to 12	No	None	None	
5027	197	BALDWIN DR	Honeylocust, Thornless	Critical	Clean	Fair	30	04 to 12	No	None	None	
4160	68	EASTLAND RD	Maple, Silver	Critical	Clean	Fair	29	04 to 12	No	None	None	
6507	354	CRESCENT DR	Maple, Silver	Critical	Clean	Fair	28	04 to 12	No	None	None	
4458	247	BEVANS ST	Tulip Tree	Critical	Clean	Fair	27	04 to 12	No	None	None	
6011	105	BAKER ST	Honeylocust, Thornless	Critical	Clean	Fair	27	04 to 12	No	None	None	
7396	419	RACE ST	Honeylocust, Thornless	Critical	Clean	Fair	27	04 to 12	No	None	None	
7543	413	ANNE DR	Honeylocust, Thornless	Critical	Clean	Fair	27	04 to 12	No	None	None	
5026	203	BALDWIN DR	Honeylocust, Thornless	Critical	Clean	Fair	26	04 to 12	No	None	None	
7175	175	FAIRPARK DR	Honeylocust, Thornless	Critical	Clean	Fair	26	04 to 12	No	None	None	
7402	361	RACE ST	Honeylocust, Thornless	Critical	Clean	Fair	26	04 to 12	No	None	None	

6500	226 SUNSET DR	Honeylocust, Thornless	Critical	Clean	Fair	24 04 to 12	No	None	None	
7209	202 FAIRPARK DR	Honeylocust, Thornless	Critical	Clean	Fair	24 04 to 12	No	None	None	
7312	384 RACE ST	Honeylocust, Thornless	Critical	Clean	Fair	24 04 to 12	No	None	None	
6147	257 FOURNIER ST	Maple, Silver	Critical	Clean	Fair	23 04 to 12	No	None	None	
6356	231 SUNSET DR	Honeylocust, Thornless	Critical	Clean	Fair	22 04 to 12	No	None	None	
6688	320 WEST ST	Maple, Silver	Critical	Clean	Fair	22 04 to 12	No	None	None	
7149	251 FAIRPARK DR	Honeylocust, Thornless	Critical	Clean	Fair	22 04 to 12	No	None	None	
6364	183 SUNSET DR	Honeylocust, Thornless	Critical	Clean	Fair	21 04 to 12	No	None	None	
7203	170 FAIRPARK DR	Honeylocust, Thornless	Critical	Clean	Fair	21 04 to 12	No	None	None	
7425	414 BEELER DR	Honeylocust, Thornless	Critical	Clean	Fair	21 04 to 12	No	None	None	
7213	222 FAIRPARK DR	Honeylocust, Thornless	Critical	Clean	Fair	20 04 to 12	No	None	None	
7807	499 Parknol Park	Honeylocust, Thornless	Critical	Clean	Fair	19 04 to 12	No	None	None	
7497	404 PATTIE DR	Honeylocust, Thornless	Critical	Clean	Fair	16 04 to 12	No	None	None	
2171	720 GRAYTON RD	Elm, American	Immediate	Remove	Poor	14 00 to 03	No	Poor Location	None	next to light pole, needs removed
7317	424 RACE ST	Honeylocust, Thornless	Critical	Clean	Fair	32 04 to 12	No	Poor Structure	None	
6497	202 SUNSET DR	Honeylocust, Thornless	Critical	Clean	Fair	28 04 to 12	No	Poor Structure	None	
7399	397 RACE ST	Honeylocust, Thornless	Critical	Clean	Fair	28 04 to 12	No	Poor Structure	Cavity or Decay	
7221	266 FAIRPARK DR	Honeylocust, Thornless	Critical	Clean	Fair	27 04 to 12	No	Poor Structure	None	
7431	466 BEELER DR	Honeylocust, Thornless	Critical	Clean	Fair	26 04 to 12	No	Poor Structure	Cavity or Decay	
7514	353 PATTIE DR	Honeylocust, Thornless	Critical	Clean	Fair	25 04 to 12	No	Poor Structure	None	
7525	398 GIRARD DR	Honeylocust, Thornless	Critical	Clean	Fair	25 04 to 12	No	Poor Structure	Cavity or Decay	reinspect
7202	164 FAIRPARK DR	Honeylocust, Thornless	Critical	Clean	Fair	24 04 to 12	No	Poor Structure	None	
7307	350 ADRIAN DR	Honeylocust, Thornless	Critical	Clean	Fair	24 04 to 12	Yes	Poor Structure	Cavity or Decay	
7313	392 RACE ST	Honeylocust, Thornless	Critical	Clean	Fair	24 04 to 12	No	Poor Structure	None	
7430	456 BEELER DR	Honeylocust, Thornless	Critical	Clean	Fair	24 04 to 12	No	Poor Structure	Cavity or Decay	
6695	356 WEST ST	Maple, Red	Critical	Clean	Fair	23 04 to 12	No	Poor Structure	Cavity or Decay	
7530	440 GIRARD DR	Honeylocust, Thornless	Critical	Clean	Fair	23 04 to 12	No	Poor Structure	None	
7623	460 RACE ST	Honeylocust, Thornless	Critical	Clean	Fair	23 04 to 12	No	Poor Structure	None	
6509	360 CRESCENT DR	Maple, Silver	Critical	Clean	Fair	22 04 to 12	No	Poor Structure	None	
7308	358 RACE ST	Honeylocust, Thornless	Critical	Clean	Fair	22 04 to 12	No	Poor Structure	Cavity or Decay	
7473	467 ADRIAN DR	Honeylocust, Thornless	Critical	Clean	Fair	22 04 to 12	No	Poor Structure	None	
7550	367 ANNE DR	Honeylocust, Thornless	Critical	Clean	Fair	22 04 to 12	No	Poor Structure	Cavity or Decay	
4329	189 EAST BRIDGE ST	Pear, Callery	Critical	Clean	Fair	21 04 to 12	No	Poor Structure	Cavity or Decay	
4381	228 SOUTH ROCKY RIVER DR	Buckeye, Other	Critical	Clean	Fair	21 04 to 12	No	Poor Structure	Cavity or Decay	
7415	406 ANNE DR	Honeylocust, Thornless	Critical	Clean	Fair	21 04 to 12	No	Poor Structure	None	
7432	470 BEELER DR	Honeylocust, Thornless	Critical	Clean	Fair	21 04 to 12	No	Poor Structure	None	
6013	192 FOURNIER ST	Tulip Tree	Immediate	Remove	Fair	21 04 to 12	Yes	Poor Structure	Poor Location	
7542	419 ANNE DR	Honeylocust, Thornless	Critical	Clean	Fair	20 04 to 12	No	Poor Structure	None	
7433	478 BEELER DR	Honeylocust, Thornless	Critical	Clean	Fair	19 04 to 12	No	Poor Structure	None	
5685	189 STANFORD RD	Oak, Northern Pin	Critical	Clean	Fair	16 04 to 12	No	Poor Structure	Cavity or Decay	
4455	263 BEVANS ST	Maple, Red	Critical	Clean	Fair	15 04 to 12	No	Poor Structure	Root Problem	
6510	360 CRESCENT DR	Maple, Silver	Critical	Clean	Fair	14 04 to 12	No	Poor Structure	None	
5675	249 STANFORD RD	Oak, Northern Red	Critical	Clean	Fair	46 04 to 12	No	Root Problem	Cavity or Decay	
7011	265 RACE ST	Oak, Northern Red	Critical	Clean	Fair	45 04 to 12	No	Serious Decline	Reinspect	
2170	714 GRAYTON RD	Oak, Northern Red	Critical	Clean	Fair	40 04 to 12	No	Serious Decline	None	cable embedded in trunk
7996	0 Coe Lake Park	Sweetgum	Critical	Clean	Fair	38 04 to 12	No	Cavity or Decay	None	
8090	0 Coe Lake Park	Boxelder	Critical	Clean	Fair	24 04 to 12	No	Multiple Stems	None	
7992	0 Coe Lake Park	Oak, Pin	Critical	Clean	Fair	38 04 to 12	No	None	None	
7477	439 ADRIAN DR	Honeylocust, Thornless	Critical	Clean	Fair	22 00 to 03	No	None	None	
6145	267 FOURNIER ST	Oak, Northern Red	Critical	Clean	Good	37 04 to 12	No	None	None	

6884	295 KEMPTON DR	Oak, Northern Red	Critical	Clean	Good	35 04 to 12	No	None	None	
4203	138 ADAMS ST	Oak, Northern Red	Critical	Clean	Good	28 04 to 12	No	None	Root Problem	concrete and steel cable around base

Appendix E: Significant Pests

THE OHIO STATE UNIVERSITY EXTENSION

Central State University EXTENSION
1890 LAND-GRANT INSTITUTION

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Be Alert for Spotted Lanternfly

ANR-83

Agriculture and Natural Resources

Date: 04/22/2020

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The spotted lanternfly (SLF) (*Lycorma delicatula*) is a new non-native invasive insect pest to the United States. Spotted lanternfly is thought to be native to China, Japan, Vietnam, and Taiwan. However, it has been reported as a serious non-native, invasive pest in Korea. In the United States, it was discovered in 2014 in southeastern Pennsylvania, Berks County. Spotted lanternfly has the potential to cause harm to the tree fruit, grape, and hops industries.

Though quarantined by the United States Department of Agriculture (USDA) Animal Plant Health Inspection Service (APHIS) and the Pennsylvania Department of Agriculture, the insect spread to additional counties within Pennsylvania and to Virginia, Delaware, Maryland, Massachusetts, New York, New Jersey, and West Virginia. For more information on its spread, please see the references at the end of this fact sheet.

As with any new invasive species, early prevention and detection are crucial to manage spread and impact of these non-native pests. Spotted lanternfly was first detected in Ohio in October 2021 in Jefferson County. The Ohio Department of Agriculture issued a quarantine for SLF in Ohio on October 28, 2021 (ODA 2021). It has since been sited and reported in other counties. For an updated map of confirmed populations, visit the Ohio Department of Agriculture website at **agri.ohio.gov/divisions/plant-health/invasive-pests/slf**. Residents are asked to be vigilant and report any suspected finds by calling a local

Ohio State University Extension office or by using the **Ohio Department of Agriculture website**. Residents can also report suspected finds via the **Great Lakes Early Detection Network (GLEDN) mobile app**.

Host Range

The preferred host of SLF is Tree of Heaven (Ailanthus altissima) another introduced invasive species. SLF, however, feeds on a wide variety of plants throughout its life cycle, with nymphs reported as having a more diverse palate than their adult counterparts. Spotted lanternfly nymphs and adults have been reported feeding on wild and domestic grapes, hops, fruit trees, willow, various hardwood trees, pines, shrubs, and vines.

Identification

Spotted lanternfly is not a fly, but a type of planthopper (order Hemiptera, family Fulgoridae). These insects have four wings and a piercing-sucking mouthpart that is used to pierce their food source and suck out nutritive fluids. Spotted lanternfly is a large, sap-feeding planthopper that feeds from the phloem tissue of host plants. Adults measure approximately 1 inch long and ½ inch wide at rest, and 1½ to 2 inches wide with wings spread. The front wings are a translucent gray with black spots, transitioning to a black tiled pattern at the tips. The hind wings are red with patches of black and white.

When at rest, the forewings lay tent-like over the body. The red coloration of the hindwing shows through, resulting in a pinkish appearance with black spots.

Figure 1. Spotted lanternfly with wings fully extended. Source: Pennsylvania Department of Agriculture, bugwood.org.

Figure 2. Spotted lanternfly, Lycorma delicatula. Source: Lawrence Barringer, Pennsylvania Department of Agriculture, bugwood.org.

Life Cycle/Life History

Based on what has been observed in Pennsylvania, the spotted lanternfly has a one-year lifecycle. Adults lay eggs in late fall through the first freeze. Eggs are laid on host plants

or any flat surface in clusters of 30–50 eggs arranged in 4–7 columns of aligned seed-like eggs. These columns of eggs, measuring approximately 1 inch in length, are covered in a mud-like substance by the female. This coating begins as a light gray but darkens and cracks with age. In general, first hatch begins in late April to early May in Pennsylvania, but emergence may vary by state and by location (personal correspondence, Maria Smith, 2020). Data is still being collected to determine the number of growing degree days (GDD) for egg hatch. This may vary in different states and regions as SLF spreads.

Figure 3. Spotted lanternfly egg mass. Source: Lawrence Barringer, Pennsylvania Department of Agriculture, bugwood.org.

Figure 4. Spotted lanternfly nymph, first instar. Source: Emilie Swackhamer, Penn State University, bugwood.org.

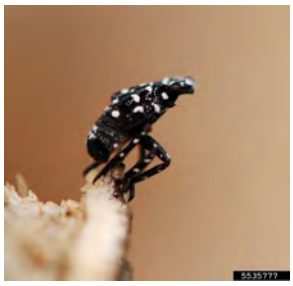

Figure 5. Spotted lanternfly nymph, instar stages 1–3 appear black with white spots. Source: Lawrence Barringer, Pennsylvania Department of Agriculture, bugwood.org.

Figure 6. Spotted lanternfly nymph, fourth and final instar develops red spots. Source: Lawrence Barringer, Pennsylvania Department of Agriculture, bugwood.org.

While nymphs are flightless, they are strong jumpers and use this ability to disperse to a wide variety of host plants to feed. Adults typically emerge beginning in mid-July. As

winged adults, they are weak flyers but can and do fly, in addition to jumping, to disperse. Adults also feed on several host plants; however, they do show a strong preference for Tree of Heaven (*Ailanthus altissima*) and grapevine (*Vitis sp.*). Adults mate in early fall to continue the cycle.

Signs, Symptoms, and Damage of Spotted Lanternfly

The spotted lanternfly is a plant-feeder, using its piercing mouthparts like a straw to suck plant sap from the phloem tissue of tree trunks and on the branches of trees, shrubs, and vines. Feeding creates wounds that weep sweet sap (Figure 7). The sap is attractive to other insects, including hornets, yellow jackets, flies, and ants.

In areas of infestation, adults and nymphs can congregate and feed in mass. This feeding has the potential to reduce vigor of the host plant with potential for long-term consequences to overall health (Figure 8).

Figure 7. Sap running from spotted lanternfly feeding injury. Source: Pennsylvania Department of Agriculture, bugwood.org.

Figure 8. Congregation of spotted lanternfly. Source: Lawrence Barringer, Pennsylvania Department of Agriculture, bugwood.org.

Grapevine is considered the most vulnerable crop to economic losses from SLF (Harper et al. 2019). In grapevine, SLF feeding has been shown to reduce vine vigor, possibly leading to increased susceptibility to winter injury, reduced fruit set, and in some cases, vine death (Figure 9).

The feeding action also results in honeydew production. Honeydew is a concentrated sugar waste from the insects themselves. The sugary secretions promote the growth of

fungus, including black sooty molds that can impact aesthetic value in landscapes and attract other insects that feed on honeydew (Figure 10).

Figure 9. Spotted lanternfly adults feeding on commercial grape vine. Source: Heather Leach, Penn State University.

Figure 10. Ant feeding on honeydew from spotted lanternfly. Source: Lawrence Barringer, Pennsylvania Department of Agriculture, bugwood.org.

Figure 11. Mold growing around base of tree where sap has accumulated from feeding wounds. Source: Lawrence Barringer, Pennsylvania Department of Agriculture, bugwood.org.

Signs

- adult insects
- nymphs
- egg masses on ANY hard surface, such as trees, branches, logs, rocks, lawn furniture, tires, cars, houses, equipment, firewood, toys, recreational vehicles, and more

Symptoms

- weeping sap from feeding wound
- honeydew build up
- black sooty mold or other fungal growth on sap
- swarming yellow jackets or hornets attracted to the sugary sap

Note: These symptoms also can result from other insects and causes.

Prevent the Spread

Any suspected detection should be reported immediately to the **Ohio Department of Agriculture** for confirmation.

To prevent the spread, be aware of egg masses. SLF lay eggs on a main host, Tree of Heaven, but also lay eggs on any tree, log, plant, or smooth surface such as stones, vehicles, campers, yard furniture, farm equipment, and other vertical surfaces including metal, signposts, train tracks and more (Dara et al. 2015; from Moylett and Molet 2018). It is imperative that people traveling into infested areas check vehicles and objects carefully before leaving a quarantine zone. To prevent the spread of SLF and other known or unknown invasive insects, never move firewood.

Please see references below for more information on spotted lanternfly.

This fact sheet was created in April 2020 and updated in April 2022. Please continue to check for updates as we learn more.

References

Harper, Jayson K., William Stone, Timothy W. Kelsey, and Lynn F. Kime. 2019. “Potential Economic Impact of the Spotted Lanternfly on Agriculture and Forestry in Pennsylvania.” Harrisburg, Pennsylvania: The Center for Rural Pennsylvania, a legislative agency of the Pennsylvania General Assembly. PDF.
rural.palegislature.us/documents/reports/Spotted-Lanternfly-2019.pdf

Leach, Heather, Dave Biddinger, Grzegorz Krawczyk, and Michela Centinari. 2019. “Spotted Lanternfly Management in Vineyards.” Penn State Extension.
extension.psu.edu/spotted-lanternfly-management-in-vineyards

Moylett, H. and T. Molet. 2018. "*Lycorma delicatula*." USDA-APHIS-PPQ-CPHST.PDF.

Ohio Department of Agriculture. 2021. "Spotted Lanternfly."
agri.ohio.gov/divisions/plant-health/invasive-pests/slf

Penn State Extension. 2021. "Spotted Lanternfly Management Guide."
extension.psu.edu/spotted-lanternfly-management-for-homeowners

Pennsylvania Department of Agriculture. n.d. "Spotted Lanternfly." Entomology. Accessed April 4, 2022.
agriculture.pa.gov/Plants_Land_Water/PlantIndustry/Entomology/spotted_lanternfly/Pages/default.aspx

United States Department of Agriculture. 2019. "Pest Alert: Spotted Lanternfly (*Lycorma delicatula*)." PDF.
aphis.usda.gov/publications/plant_health/alert-spotted-lanternfly.pdf

Urban, Julie M., Erica Smyers, Lawrence Barringer, and Sven-Erik Spichiger. n.d. "Spotted Lanternfly." USDA, National Institute of Food and Agriculture, North Central IPM Centers. Accessed April 7, 2022.
ncipmc.org/projects/pest-alerts/spotted-lanternfly-lycorma-delicatula/

Originally posted Apr 22, 2020.

Forest Health Pest Alert

Beech Leaf Disease

July 2016

Hosts and Distribution

Beech leaf disease (BLD) affects American beech (*Fagus grandifolia*) and possibly European beech (*Fagus sylvatica*) and no causal agent has yet been identified. BLD was discovered in Lake County, Ohio in 2012. It seems to have spread quickly, especially to the east, and has been documented in the northeastern Ohio counties of Lake, Ashtabula, Geauga, Cuyahoga, Portage, and Trumbull as well as Crawford County Pennsylvania. BLD has also been reported from other areas of Ohio, NW Pennsylvania, and SW New York.

Symptoms

Symptoms of BLD have only been noted on leaves and buds. Striping or banding on several leaves on an otherwise healthy-appearing tree is the first noticeable symptom. The striping is formed by a darkening between leaf veins giving the leaf a distinctive striped appearance. This striping is often most apparent when viewing from below, looking upwards into the canopy. The darkened leaf area is raised and slightly thicker than the rest of the leaf tissue. Eventually, lighter, chlorotic striping may also occur. This striping is present upon leaf-out in the spring. Most leaves will remain on the tree until autumn. Very little premature leaf drop occurs.

Later stages result in heavily shriveled, discolored, deformed leaves clustered near the branch tips as well as reduced leaf and bud production. Buds that are produced are small and weakly attached to the twig. Mortality has been noted, mainly in saplings.

Disease progression varies with tree size. In sapling-sized trees, the progression from a few striped leaves to severe decline is rapid and may only take one to two years. In larger overstory trees, disease progression has been slower, usually moving from lower branches upwards. Some foliage and branches that appear to be unaffected may persist on an otherwise heavily affected tree.

Top photo: early leaf striping symptoms of BLD
Bottom photo: later stages of BLD resulting in leathery, curled leaves

Biology and Spread

BLD appears to spread rapidly. Incidence of BLD does not appear to be influenced by slope, aspect, or soil conditions. In established areas, the proportion of American beech showing symptoms has been nearly 100%.

Symptomatic trees may show a wide variety of other insects and pathogens, including beech blight aphid (*Grylloprociphilus imbricator*), European beech scale (*Cryptococcus fagisuga*), erineum patches produced by eriophyid mites (*Acalitus fagerinea*), and leaf fungi such as anthracnose (*Discula umbrinella*). All appear to be independent of BLD.

Clockwise from top left: advanced stages of BLD showing deformed leaves, loss of leaves and lack of bud production, and branch dieback resulting in a more open understory

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Knowles Municipal Forestry

Fact Sheet

Bagworms

(Thyridopteryx ephemeraeformis)

Identification: The identification of bagworms can be tricky. This is due to the fact that they are camouflaged by a silk bag covered with portions of plant material. The cone shaped bag can be up to 2 inches long and is constructed from bits of foliage and debris from whatever plant the caterpillar chooses. Infestations often go unnoticed because the protective bags are mistaken for pine cones or other plant structures. Although the camouflaged bags may be difficult to spot, once noticed, it is easy to identify this insect pest as bagworm.

Bagworm on Ohio Buckeye

Life: The bagworm is the larval stage of a moth native to North America. The male develops into a rarely seen clear-winged moth while the female will never take flight. She will remain inside the bag until laying eggs and die shortly after. The eggs will remain inside this bag throughout the winter. In mid to late May the eggs hatch and the tiny larvae crawl out from the end of the bag in search of food. These larvae soon start the construction of their own bag while they carry it on their back like a tiny upside down ice cream cone. The larvae will increase their bag size as they grow to protect themselves from predators such as birds. In early August, after pupation, the males will emerge as moths. The females will remain in the bag and emit powerful pheromones to attract the male moths. After fertilization, the female will lay between 500 to 1000 eggs in a single mass within the bag. These eggs will then hatch in mid to late May to start the cycle once again.

Bagworm on Arborvitae

Concerns: Bagworms are only a concern when found in high numbers on a plant. Because of the limited movement of the caterpillar, individual plants or rows of host plants can be heavily infested. New infestations away from the original may be possible if the larvae are able to balloon to a new host plant. Ballooning is the act of the larvae hanging down on a long silk strand that is caught in wind currents.

Trees and shrubs are harmed by the caterpillars feeding on foliage. When infestations are high, defoliation may stress or destroy the host plant. Bagworms attack over 120 species of broadleaf and evergreen trees and shrubs. Some of these hosts include juniper, arborvitae, cedar, spruce, honeylocust, maple, linden, oak, buckeye, willow, birch, elm and poplar.

Bagworm on Blue Spruce

Control: The preferred method of control is the manual removal and destruction of the bags before the eggs hatch. This can be done by hand picking the bags in the fall, winter or early spring and destroying them in soapy water or sealing them in plastic.

When manual removal is not practical, insecticides should be applied soon after the eggs have hatched. Another application after 2 weeks may be necessary for heavy infestations. Biorational materials should be used whenever possible in order to kill caterpillars but not harm beneficial insects. The following chart shows insecticides for use on bagworms:

Knowles Municipal Forestry

Fact Sheet

Insecticide	Formulation	Amount per gallon	Suggested Use	General Use Restriction H=Homeowner C=Commercial
Acephate (Orthene)	75% S 15.6% EC	1/3 tsp. 1 1/2 Tbsp.	Later Stage Rescue	H, C
Bacillus thuringiensis (Kurstaki) (Dipel, Biotrol, others)	See label	See label	Early Stage Biorational*	H, C
Bifenthrin (Talstar L&T and other site specific products	0.7 F	1/3 - 2/3 tsp.	Later Stage Rescue	H, C
Carbaryl (Sevin and others)	4 F 2 F	2 tsp. 4 tsp.	Later Stage Rescue	H, C
Cyfluthrin (Tempo, Decathalon) (Bayer Lawn & Garden)	20 WP 0.75 EC	- 5 Tbsp.	Later Stage Rescue	C H (Bayer)
Deltamethrin (Deltagard T&O) (Suspend SC)	4.75% EC	1/4 - 1/2 tsp.	Later Stage Rescue	H, C
Fluvalinate (Mavrik)	2 F	1/4 - 1/2 tsp.	Later Stage Rescue	H, C
Lambda-cyhalothrin (Scimitar CS)	9.7% EC	-	Later Stage Rescue	H, C
Malathion	57% EC	2 tsp.	Later Stage Rescue	H, C
Permethrin (Astro EC) (Spectracide Bug Stop) (Eight)	36.8% EC 2.5% EC	1/4 - 1/2 tsp. 2 Tbsp.	Later Stage Rescue	C H
Spinosad (Conserve) Bulls-Eye Bioinsecticide Fertilome Borer, Bagworm, Leafminer & Tent Caterpillar Spray	SC SC	1/2 tsp. 2 Tbsp. 2 Tbsp.	Early Stage Biorational*	C H H
Tebufenozide (Confirm)	25% EC	1/4 - 1/2 Tsp.	Early Stage Biorational*	C

**Biorational pesticides are derived from natural sources and have little or no adverse effect on beneficial organisms.*

READ AND FOLLOW ALL LABEL INSTRUCTIONS. THIS INCLUDES DIRECTIONS FOR USE, PRECAUTIONARY STATEMENTS (HAZARDS TO HUMANS, DOMESTIC ANIMALS, AND ENDANGERED SPECIES), ENVIRONMENTAL HAZARDS, RATES OF APPLICATION, NUMBER OF APPLICATIONS, REENTRY INTERVALS, HARVEST RESTRICTIONS, STORAGE AND DISPOSAL, AND ANY SPECIFIC WARNINGS AND/OR PRECAUTIONS FOR SAFE HANDLING OF THE PESTICIDE.