Tree Management Plan

Village of Antioch, Illinois

September 2013

Prepared for:
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Mission Statement

To enhance and preserve the quality of life by providing fiscally sound and responsive services, programs, and facilities with the highest degree of professionalism, integrity, and efficiency so that Antioch continues to be a great place to live and work.

Acknowledgments

Antioch's vision to promote and preserve the urban forest and improve the management of public trees was a fundamental inspiration for this project. This vision will ensure canopy continuity, which will reduce stormwater runoff and improve air quality, public health, and aesthetic values.

This inventory and management plan was partially funded by Illinois Department of Natural Resources in cooperation with the U.S. Forest Service in part by the Urban and Community Forestry Assistance Grant

The Village also recognizes the support of its Mayor and Village Council:

Mayor Lawrence M. Hanson

Trustees Dennis B. Crosby, Mary C. Dominiak, Jerry T. Johnson, Scott A. Pierce, Ted P. Poulos, and George C. Sakas

Executive Summary

This management plan was developed for the Village of Antioch by Davey Resource Group with a focus on addressing short- and long-term maintenance needs for inventoried public trees. Davey Resource Group completed a tree inventory to gain an understanding of the needs of the existing urban forest and to project a recommended maintenance schedule for tree care. Analysis of inventory data and a vision for the urban forest was utilized to develop this plan.

State of the Existing Urban Forest

The September 2013 inventory included trees, stumps, and planting sites along public street rights-of-way (ROW). The Village selected areas for the inventory which included every village neighborhood except for the Clublands of Antioch. A total of 5,011 sites were recorded during the inventory: 4,341 individual trees, 31 stumps, and 639 planting sites. Analysis of the tree inventory data found:

- The overall condition of the inventoried tree population is rated Fair.
- Two genera, *Acer* (maple) and *Fraxinus* (ash), make up large percentages of the street ROW trees (32% and 25%, respectively) and threatens biodiversity.
- One species, *Fraxinus pennsylvanica* (green ash), was above the 10% recommended threshold for a single species at 16%.
- The abundance of ash creates a concern for the streetscape due to the presence of emerald ash borer (*Agrilus planipennis*) (EAB) and the threat to wipe out all ash in the community in about six years if left untreated.
- Overall, the diameter size class distribution of the inventoried tree population trended towards the ideal with a greater number of young trees than established, maturing, or mature trees.

Tree Maintenance and Planting Needs

Trees provide many environmental and economic benefits that justify spending the time and money for planting and maintenance. Maintenance needs recommended during the inventory include tree and stump removal (4%), pruning (83%), and planting (13%). Reducing tree-related risk should be prioritized so that those with the highest risk are addressed first. The inventory noted several High Risk trees (2% of trees assessed); these trees should be removed or pruned immediately to promote public safety. Moderate and Low Risk trees should be addressed after all elevated risk tree maintenance has been completed. Trees should be planted to mitigate removals and create canopy.

Tree Removal	• High Priority= 27 trees • Low Priority= 117 trees • Ash = 595 trees
Pruning	• High Priority = 28 trees
RP Cycle	• Number of trees in 5-year cycle = approximately 271 each year
YTT Cycle	• Number of trees in 3-year cycle = approximately 349 each year
EAB Management Stratagey	• Ash tree treatment in 2-year cycle = 253 trees each year • Inspection and pruning for safety of treated ash trees = 253 trees each year
Tree Planting	• Number of trees = at least 200 each year

Antioch's urban forest will benefit greatly from a three-year young tree training cycle and a five-year routine pruning cycle. Proactive pruning cycles improve the overall health of the tree population and may eventually reduce program costs. In most cases, pruning cycles will correct defects in trees before they worsen, which will avoid costly problems. Based on inventory data, at least 349 young trees should be structurally pruned each year during the young tree training cycle and approximately 271 trees should be cleaned during the routine pruning cycle each year. This excludes ash trees. Management costs for ash trees are summarized with the EAB management strategy.

EAB is an exotic, invasive pest affecting ash trees. All ash trees in a community typically die within six years of EAB infestation. Antioch's trees show signs of EAB infestation and it is estimated that the pest has been present for 7–8 years. We recommend the Village use a combination of treatment and removal of its ash tree population in order to reduce the impacts from canopy loss. We recommend treating ash trees in Good or Fair condition that are greater than six inches diameter at breast height (DBH). Treatment should occur in a two-year cycle for approximately 250 trees each year. Treated ash will need to be regularly inspected and pruned should the trees' health worsen.

Planting trees is necessary to maintain canopy cover and to replace trees that have been removed or lost to natural mortality (expected to be 1–3% per year) or other threats (for example, construction, invasive pests, or impacts from weather events such as storms, wind, ice, snow, flooding, and drought). We recommend planting at least 200 trees of a variety of species each year to offset these losses and maintain canopy and maximum benefits. Planting this number of trees would allow Antioch to replace all ash removed in five years, replace trees removed due to 1% mortality, and fill 5% (32 sites) of vacant sites found during the inventory each year.

Photograph 1. The Village of. Antioch recognizes that its urban forest is critical to ecosystem health and economic growth. Planning and action is required to promote and sustain a healthy urban forest.

Village-wide tree planting should focus on creating canopy in areas that promote economic growth (such as business districts), in parking lots and near buildings with insufficient shade, and where there are gaps in the existing canopy. Trees of varied species should be planted; however, the planting of maple and littleleaf linden should be limited until the species distribution normalizes. All ash should be removed temporarily from planting lists. We provide a planting list that offers smart choices for species selection and diversity to build a resilient urban forest that will not be greatly affected by any single invasive pest or disease.

Urban Forest Program Needs

Adequate funding will be needed for the Village to implement an effective management program that will provide short- and long-term public benefit, to ensure that priority maintenance is performed expediently, and to establish proactive maintenance cycles. The estimated total cost for the first year of this five-year program is $161,000; this total will decrease to approximately $113,000 per year by Year 4 of the program. High-priority removal and pruning and EAB management is costly; most of this work is scheduled during the first three years of the program, which is why the budget is higher for those years. After this priority work has been completed, the urban forestry program will mostly involve proactive work, which is generally less costly so budgets for later years are projected to be lower.

Supporting proactive management of trees through funding will, over the long term, reduce municipal tree care management costs and possibly the costs to build, manage, and support some village infrastructure.

Antioch has many opportunities to improve its urban forest. Planned tree planting and a systematic approach to tree maintenance will transform an on-demand, priority-based operation into a cost-effective, proactive program. Investing in this tree management program will promote public safety, improve tree care efficiency, and increase the economic, environmental, and social benefits the community receives from its trees.

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Introduction

The Village of Antioch is home to more than 14,400 full-time residents who enjoy the beauty and benefits of their urban forest. The Village manages trees on public property—along the street ROW and in public spaces.

Antioch conducted an inventory of public trees in 2013. The Village celebrates Arbor Day and was a Tree City USA for 17 years.

Approach to Tree Management

The best approach to managing an urban forest is to develop an organized, proactive program using tools (such as a tree inventory and a tree management plan) to set goals and measure progress. These tools can be utilized to establish tree care priorities, generate strategic planting plans, draft cost-effective budgets based on projected needs, and ultimately minimize the need for costly, reactive solutions to crises or urgent hazards.

In September 2013, Antioch worked with Davey Resource Group to inventory trees and to develop a management plan. This plan considers the general condition, diversity, and distribution of the inventoried trees and provides a prioritized system for managing street ROW trees. The following tasks were completed:

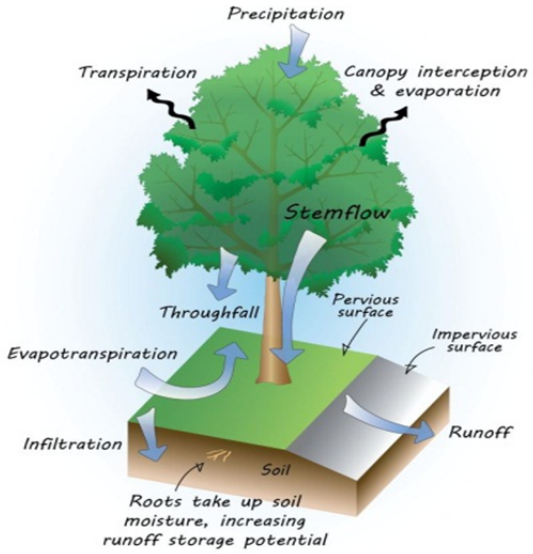
- inventory of trees, stumps, and planting sites within the street ROW
- analysis of tree inventory data
- development of a plan that prioritizes the recommended tree maintenance
- development of an EAB management strategy

This plan is divided into four sections:

- Section 1 (*Benefits of the Urban Forest*) presents information about the economic, environmental, and social benefits that trees provide to the community.
- Section 2 (*Tree Inventory Analysis*) summarizes the tree inventory data and presents trends, results, and observations.
- Section 3 (*Tree Management Program*) utilizes the inventory data to develop a prioritized maintenance schedule and projected budget for the implementation of the recommended tree maintenance over a five-year period.
- Section 4 *(Emerald Ash Borer Response Planning and Management Strategy)* describes the destructive nature of this invasive pest, ways to mitigate its effects, and suggests an approach to managing the village's ash tree population.

Section 1: Benefits of the Urban Forest

The urban forest plays an important role in supporting and improving the quality of life in urban areas. A tree's shade and beauty softens the often-hard appearance of urban landscapes and streetscapes. When properly maintained, trees provide abundant environmental, economic, and social benefits to a community far in excess of the time and money invested in their planting, pruning, protection, and removal.

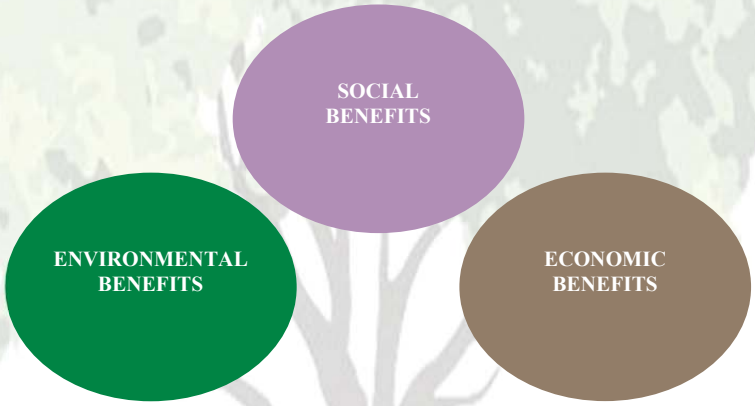


- Trees reduce stormwater runoff by capturing and storing rainfall in their canopy and releasing water into the atmosphere.
- Tree roots and leaf litter create soil conditions that promote the infiltration of rainwater into the soil.
- Trees help slow down and temporarily store runoff and reduce pollutants by taking up nutrients and other pollutants from soils and water through their roots.
- Trees transform pollutants into less harmful substances.

Photograph 2. Trees provide economic, environmental, and social benefits, including temperature moderation, reduction of air pollutants and stormwater management costs, energy conservation, and increased property values.

- Tree-lined streets are safer; traffic speeds and the amount of stress drivers feel are reduced, which likely reduces road rage/aggressive driving (Wolf, 1998(b); Kuo and Sullivan, 2001(b)).
- Chicago apartment buildings with medium amounts of greenery had 42% fewer crimes than those without any trees (Kuo and Sullivan 2001(a)).
- Chicago apartment buildings with high levels of greenery had 52% fewer crimes than those without any trees (Kuo and Sullivan 2001(a)).
- Hospital patients recovering from surgery who had a view of a grove of trees through their windows required fewer pain relievers, experienced fewer complications, and left the hospital sooner than similar patients who had a view of a brick wall (Ulrich 1984, 1986).

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



- Trees increase residential property values 3–7% when present in the yard and 9% when adjacent as street trees. Commercial property rental rates were 7% higher when trees were on the property (Wolf 2009).
- On average, consumers will pay about 11% more for goods in landscaped areas, with this figure being as high as 50% for convenience goods (Wolf 1998(a); Wolf 1999; and Wolf 2003).
- Consumers also feel that the quality of the products is better in business districts having trees than those considered barren (Wolf 1998(a))
- The quality of landscaping along the routes leading to the business district had a positive influence on consumers' perceptions of the area (Wolf 2000).

Section 2: Tree Inventory Analysis

In September 2013, Davey Resource Group International Society of Arboriculture (ISA) Certified Arborists assessed and inventoried trees, stumps, and planting sites along the street ROW. A total of 5,011 sites were collected during the inventory: 4,341 trees, 31 stumps, and 639 vacant planting sites. Figure 1 provides a detailed breakdown of the number and type of sites inventoried.

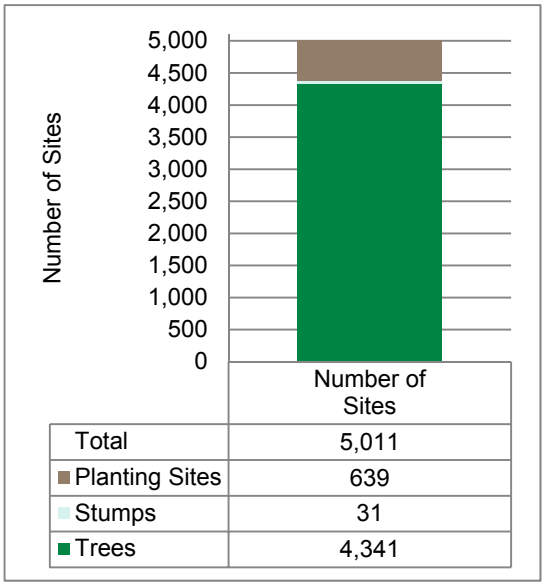


Figure 1. Sites inventoried during the 2013 inventory.

Data Collection Methods

Tree inventory data were collected using a system developed by Davey Resource Group that utilizes a customized ArcPad® program loaded onto pen-based field computers equipped with geographic information system (GIS) and global positioning system (GPS) receivers. The knowledge and professional judgment of Davey Resource Group's arborists ensure the high quality of inventory data.

Data fields are defined in the glossary and the site location method is provided in Appendix A. At each site, the following data fields were collected:

- condition
- mapping coordinate
- notes
- primary maintenance needs
- risk assessment
- risk rating[1]
- site location[2]
- species
- stems
- tree size[3]

[1]includes probability of failure, size of defect, target impact, and other hazards
[2] includes address, assigned, street, on street, side, and site values
[3]measured in inches in diameter at 4.5 feet above ground (or DBH)

Primary maintenance recommendations are based on American National Standards Institute (ANSI) A300 Standards (2008). Risk assessment and risk ratings are based on the *Urban Tree Risk Management* (Pokorny et al. 2003).

Photograph 3. One Davey Resource Group inventory arborist measures tree diameter at DBH while another records tree attributes on a pen tablet.

Project Area

All village neighborhoods except for the Clublands of Antioch were inventoried.

Assessment of Tree Inventory Data

Data analysis and professional judgment are used to make generalizations about the state of the inventoried tree population. Recognizing trends in the data can help guide short- and long-term management planning. In this plan, the following criteria and indicators of the inventoried tree population were assessed:

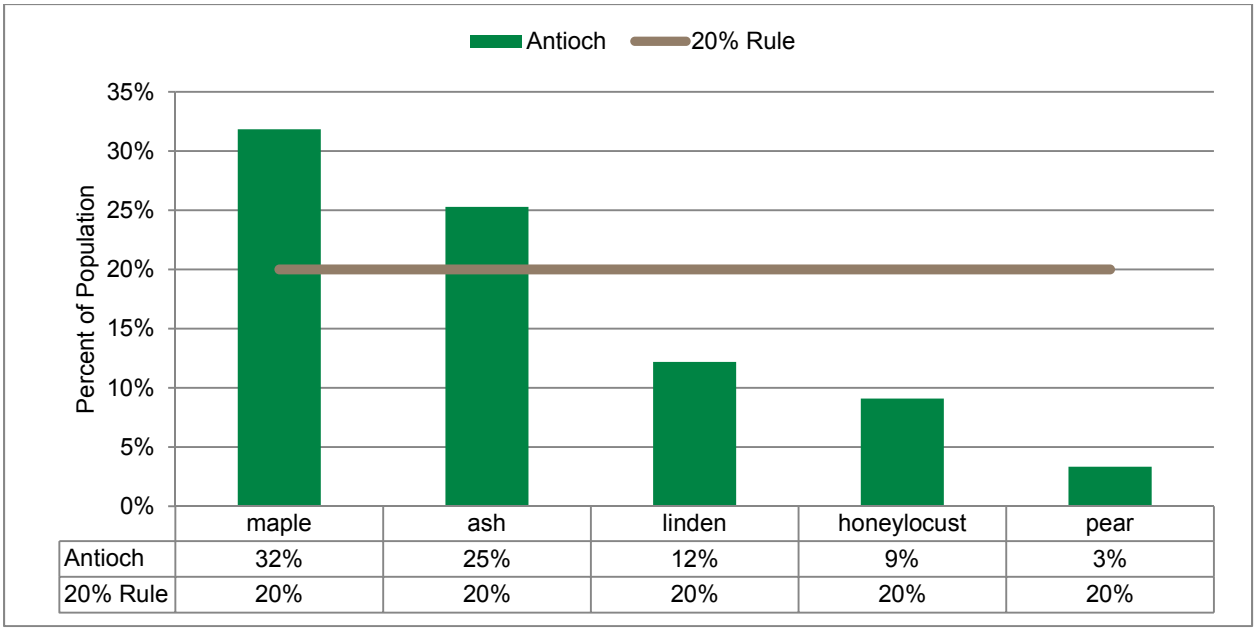
- Species diversity, the variety of species in a specific population, affects the population's ability to sustain threats from invasive pests, diseases, and extreme weather. It also impacts tree maintenance needs and costs, tree planting goals, and canopy continuity.
- The diameter size class distribution can be used to indicate the relative age of a tree population. Distribution data affects the valuation of tree-related benefits as well as the estimation of maintenance needs and costs, planting goals, and canopy continuity.
- The general health of a tree population indicates how well trees are performing given their site-specific conditions. General health affects both short- and long-term maintenance needs and costs as well as canopy continuity.
- Street ROW stocking level is the portion of existing street ROW trees compared to the total number of potential street ROW trees (number of inventoried trees plus the number of potential planting spaces). The stocking level can help determine tree planting needs and budgets.

Analysis of inventory data provides insight into past maintenance practices and growing conditions that may affect future management decisions; other findings are presented for these purposes.

Species Diversity

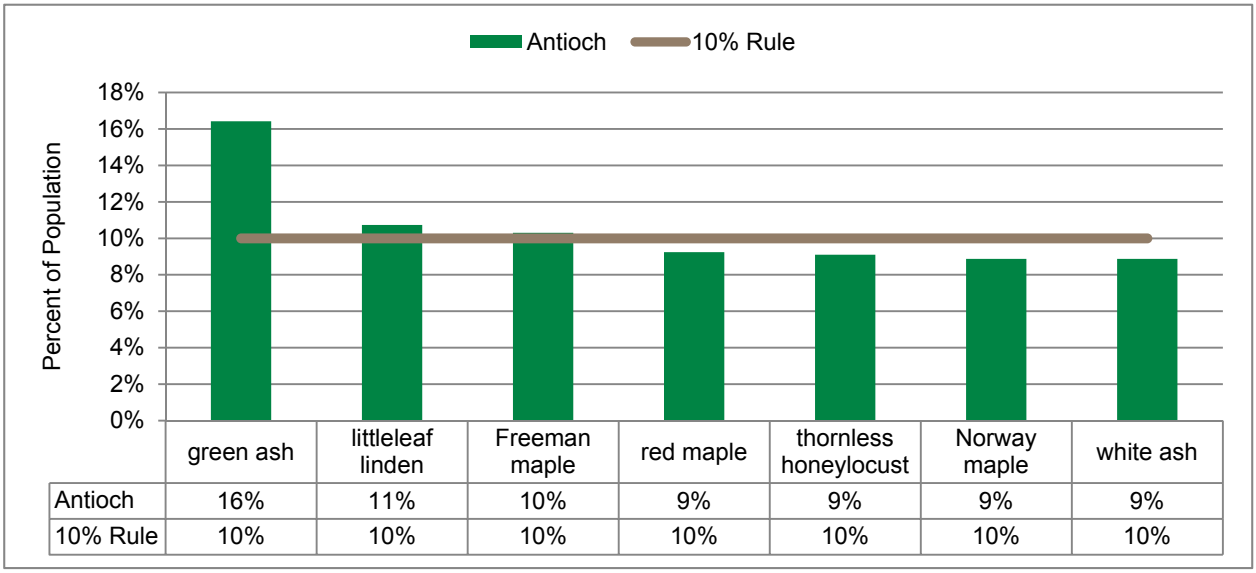
Species diversity affects maintenance costs, planting goals, canopy continuity, and the forestry program's ability to respond to threats from invasive pests or diseases. Low species diversity (large number of trees of the same species) can lead to severe losses in the event of species-specific epidemics such as the devastating results of Dutch elm disease (*Ophiostoma novo-ulmi*) (DED) throughout New England and the Midwest. Because of the introduction and spread of DED in the 1930s and its presence today, massive numbers of *Ulmus americana* (American elm), a popular street tree in Midwestern cities and towns, have perished (Karnosky 1979). Many Midwestern communities were stripped of most of their mature shade trees, creating a drastic void in canopy cover. Many communities replanted to replace the lost elm trees. Ash and maple trees were popular replacements for American elm in the wake of Dutch elm disease. Unfortunately, some of the replacement species for American elm trees are now overabundant and are a concern for biodiversity. EAB and Asian longhorned beetle (*Anoplophora glabripennis*) (ALB) are exotic insect pests that attack some of the most prevalent urban shade trees and some agricultural trees throughout the country.

The composition of a tree population should follow the 10-20-30 Rule for species diversity: a single species should represent no more than 10% of the urban forest, a single genera no more than 20%, and a single family no more than 30%.



	maple	ash	linden	honeylocust	pear
Antioch	32%	25%	12%	9%	3%
20% Rule	20%	20%	20%	20%	20%

Figure 2. Five most abundant genera in the 2013 inventory.



	green ash	littleleaf linden	Freeman maple	red maple	thornless honeylocust	Norway maple	white ash
Antioch	16%	11%	10%	9%	9%	9%	9%
10% Rule	10%	10%	10%	10%	10%	10%	10%

Figure 3. All species representing more than 5% of inventoried trees in the 2013 inventory.

Findings

Analysis of Antioch's tree inventory data indicated that the population's diversity does not meet the 10-20-30 Rule. There are 43 genera and 79 species represented in the 2013 inventory.

Figure 2 compares the percentages of the top five genera identified during the inventory to the 20% Rule. Maple and ash both exceed the recommended 20% maximum for a genera in a population comprising 32% and 25% of the inventoried tree population, respectively.

Figure 3 compares the percentages of the most common species on the street ROW to the 10% Rule. Green ash far exceeds the recommended 10% maximum for a single species in a population comprising 16% of the inventoried tree population. *Tilia cordata* (Littleleaf linden) and *Acer* × *freemanii* (Freeman maple) are just above or are at the recommended 10%, with four additional species approaching the 10% threshold as well.

Discussion/Recommendations

Maple, ash, and littleleaf linden dominate the streets. Their abundance in the landscape makes it a concern and limit biodiversity. Ash is a target of the EAB and EAB is present in Antioch's urban forest. The planting of ash should be stopped completely until the urban forest industry promotes the planting of ash again. Like varieties of elm resistant to Dutch elm disease, the industry is working on EAB resistant varieties of ash. Considering the large quantity of Freeman maple, red maple, *Acer platanoides (*Norway maple), and littleaf linden, the planting of these species should be limited to maximize Antioch's urban tree population diversity.

Having a diverse population of trees will ensure that Antioch's urban forest is sustainable at the street and neighborhood levels, as well as village-wide. See Appendix B for Davey Resource Group's recommended tree species list for planting.

Diameter Size Class Distribution

Analyzing the diameter size class distribution provides an estimate of the relative age of a tree population and insight into maintenance practices and needs.

The inventoried trees were categorized into the following diameter size classes: young (0–8 inches DBH), established (9–17 inches DBH), maturing (18–24 inches DBH), and mature trees (>24 inches DBH). These categories were chosen so that the population could be analyzed following Richards' ideal distribution (1983). Richards proposed an ideal diameter size class distribution for street trees based on observations of well-adapted trees in Syracuse, New York. Richards' ideal distribution suggests that the largest fraction of trees (approximately 40% of the population) should be young with a smaller fraction (approximately 10%) in the large-diameter size class. A tree population with the ideal distribution would have an abundance of newly planted and young trees, with established, maturing, and mature trees present in lower numbers.

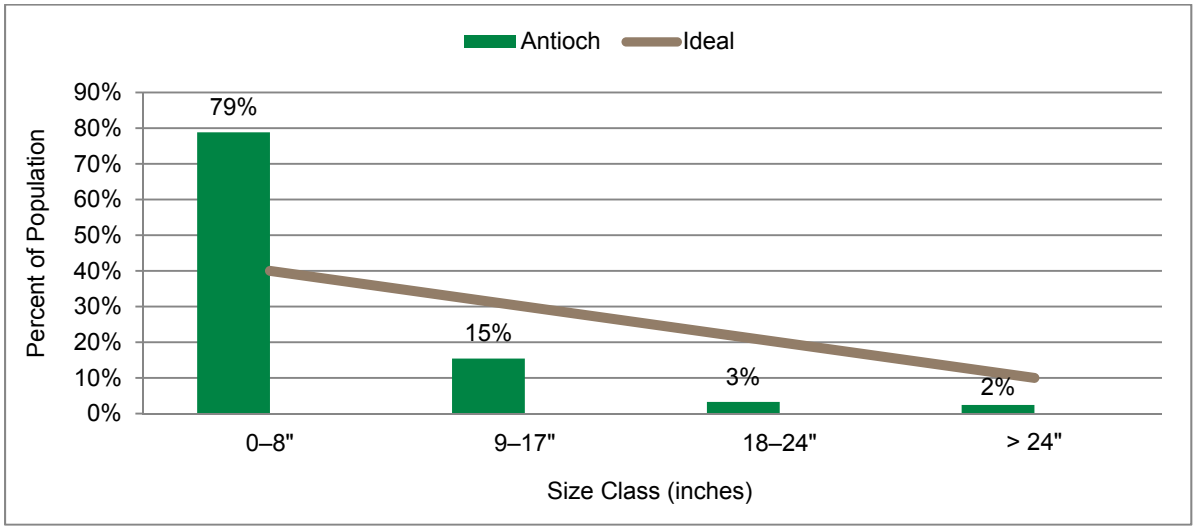


Figure 4. Comparison of diameter size class distribution for ROW trees to the ideal distribution.

Findings

Figure 4 compares Antioch's diameter size class distribution of the inventoried tree population to the ideal proposed by Richards (1983). Antioch's distribution trends toward the ideal; however, young trees nearly double the ideal while larger diameter size classes fall short of the ideal.

Discussion/Recommendations

Newly planted trees dominate Antioch's population. Even though it may appear that Antioch has too many young trees, this is not the case. Actually, Antioch has too few established, maturing, and mature trees and, thus, the distribution is skewed. The majority of older trees are in the Old Town section of the village with the surrounding neighborhoods consisting almost entirely of newly planted young trees. One of Antioch's objectives is to have an uneven-aged distribution of trees at the street and neighborhood level, as well as village-wide. Davey Resource Group recommends that Antioch continue to support a strong planting and maintenance program to ensure that young, healthy trees are in place to fill in gaps in tree canopy and provide for gradual succession of older trees. The Village must promote tree preservation and proactive tree care to ensure younger trees age with well-distributed branch structure and older trees survive as long as possible. Tree planting and proper tree care will allow the distribution to normalize over time.

Planting trees is necessary to increase canopy cover and to replace trees lost to natural mortality (expected to be 1–3% per year) and other threats (for example, invasive pests or impacts from weather events such as storms, wind, ice, snow, flooding, and drought). Planning for the replacement of existing trees and finding the best places to create new canopy is critical.

General Health

Davey Resource Group assessed the condition of individual trees based on methods defined by the ISA. Several factors were considered for each tree, including: root characteristics; branch structure; trunk, canopy, and foliage condition; and the presence of pests. The condition of each inventoried tree was rated Excellent, Very Good, Good, Fair, Poor, Critical, or Dead.

In this plan, the general health of the inventoried tree population was characterized by the most prevalent condition assigned during the inventory.

Comparing the condition of the inventoried tree population with relative tree age can provide some insight into the stability of the population. In this plan, relative age was based on DBH. Since tree species have different lifespans and mature at different diameters, heights, and crown spreads, actual tree age cannot be determined from diameter size class alone. However, general classifications of size can be extrapolated into relative age classes. The following categories are used to describe relative age: young (0–8 inches DBH), established (9–17 inches DBH), maturing (18–24 inches DBH), and mature (>24 inches DBH).

Figures 5 and 6 illustrate the general health and percent of young, established, mature, and maturing trees to their condition.

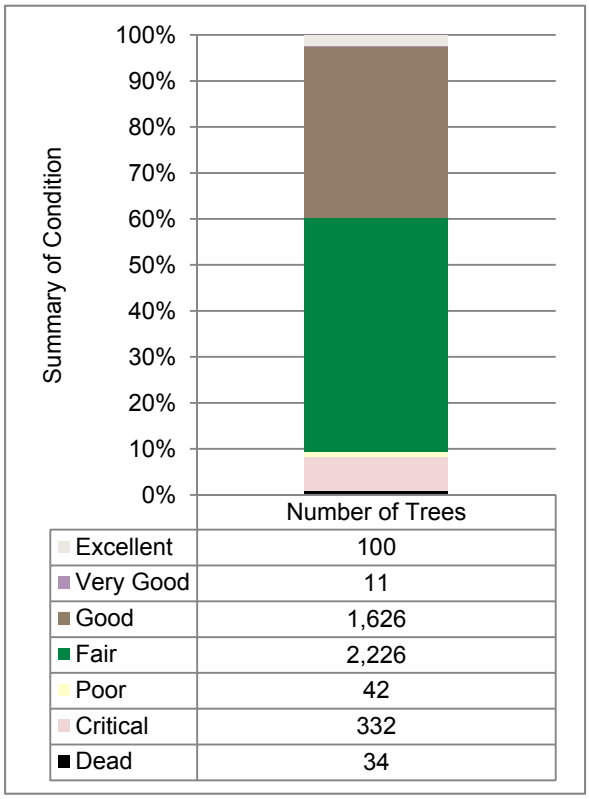


Figure 5. Condition of street ROW trees during the 2013 inventory.

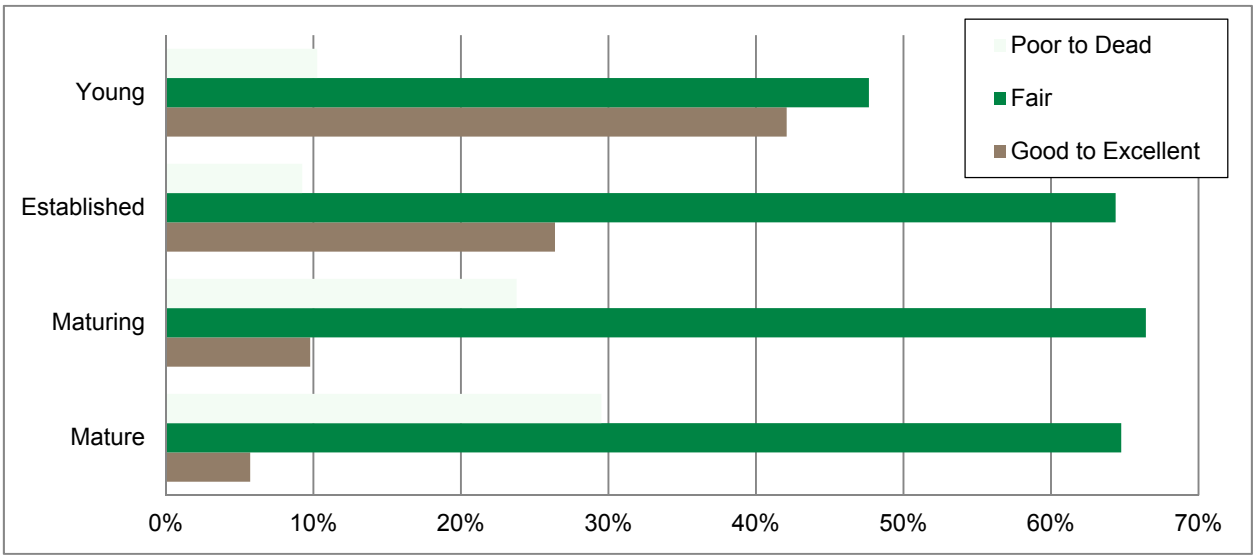


Figure 6. Tree condition by relative age during the 2013 inventory.

Findings

Most of the inventoried trees were recorded to be in Fair or Good condition, 51% and 37%, respectively (Figure 5). Based on these data, the general health of the overall inventoried tree population is rated Fair. Figure 6 illustrates that most of the young, established, maturing, and mature trees were rated to be in Fair condition.

Photograph 4. These trees in Good condition enhance the business district.

Discussion/Recommendations

Even though the condition of Antioch's inventoried tree population is typical, data analysis lent the following insight into historical maintenance practices and future maintenance needs:

- Remove Dead trees and trees in Critical condition. Because of their failed health, these trees most likely will not recover even if care is increased.
- Poor condition ratings were generally due to visible signs or symptoms of decline and environmental stress, decay, dead limbs, or poor structure. These trees may require removal or corrective pruning, regular inspections and possible intensive plant health care to improve their vigor.
- Young and established trees rated in Fair condition can benefit from improvements in structure that in time may improve their health. Pruning should follow *ANSI A300 (Part 1)*.
- Proper tree care practices are needed for the long-term general health of the urban forest. A few of the newly planted trees were improperly mulched. Follow guidelines developed by the ISA and those recommended by *ANSI A300 (Part 1)* to ensure that tree maintenance practices improve the general health of the urban forest.

Street ROW Stocking Level

Stocking is a traditional forestry term used to measure the density and distribution of trees. For an urban forest such as Antioch's, stocking level is used to estimate the total number of sites along the street ROW that could have trees.

Stocking level is the ratio of street ROW spaces that are occupied by trees to total street ROW spaces that are suitable for trees. For example, a street ROW tree inventory of 1,000 total sites with 750 existing trees and 250 vacant planting sites would have a stocking level of 75%.

For an urban area, Davey Resource Group recommends that the street ROW stocking level be at least 90% so that no more than 10% of the potential planting sites along the street ROW are vacant.

Antioch's inventory data set included vacant planting sites. Because the data included vacant planting sites, the stocking level can be projected more accurately compared to an estimated stocking level.

Findings

The inventory found 639 vacant planting sites. Of the inventoried sites, 457 were potential planting sites for large-sized trees (8-foot-wide and greater growing space size); 67 for medium-sized trees (6- to 7-foot-wide growing space sizes); and 115 for small-sized trees (4- to 5-foot-wide growing space sizes). These are potential sites due to the manner of inventory work. The placement of underground utility lines was not taken into consideration during observation of site restrictions. Based on the data gathered during this inventory, Antioch's current street ROW tree stocking level is 87%. The addition of 138 new trees and replacement of 31 stumps will bring Antioch to the recommended 90% stocking level.

Discussion/Recommendation

Fully stocking the street ROW with trees is a worthy goal. Inadequate tree planting and maintenance budgets and tree mortality will result in lowered stocking levels. Nevertheless, working to attain a fully stocked street ROW is worthwhile because it will promote canopy continuity and environmental sustainability. The Village should continue the effort to grow its street ROW population from its current stocking level of 87% towards the ideal of 90% or better. Generally, this entails a planned program of planting, care, and maintenance for the village's street ROW trees.

Emerald ash borer is present in the village's ash trees. There are 1,098 ash trees in the population. Without treatment, the number of ash needing removal due to EAB could reduce the stocking level to 65%. If budgets allow and follow-up maintenance is feasible, Davey Resource Group recommends that the Village increase the number of trees to be planted to equal 200 trees per year. This will cover the replacement of ash trees in five years, 1% of trees lost to mortality, and fill 5% of vacant sites located during the inventory each year. If possible, exceed this recommendation to increase the urban forest's canopy cover and benefits.

Calculations of trees per capita are important in determining how well forested a city is for its residents. The more residents and the greater the housing density a city possesses, the greater the need for trees to provide benefits.

Antioch's ratio of street trees per capita is 0.30, slightly below the mean ratio of 0.37 reported for 22 US cities (McPherson and Rowntree 1989). There is 1 tree for every 3.3 residents and Antioch's potential is 1 tree for every 2.9 residents.

Potential Threats from Pests

Insects and diseases pose serious threats to tree health. Awareness and early diagnosis are crucial to ensuring the health and continuity of the street trees. Appendix C provides information about some of the current potential threats to Antioch's trees and includes websites where more detailed information can be found.

Many pests target a single species or an entire genus. The inventory data were analyzed to provide a general estimate of the percentage of trees susceptible to some of the known pests in Illinois. It is important to note that the figure presents data for exotic pests and many of these pests were not seen among Antioch's street ROW trees during the inventory.

Findings

Hesperophanes campestris (Chinese longhorned beetle) and ALB are a known threat to a large percentage of the inventoried street trees (64% and 50%, respectively). These pests were not detected in Antioch but if they were, the Village could see severe losses in its tree population.

EAB is present in Antioch; Davey Resource Group staff found infested ash during the 2013 inventory. There were 1,098 ash trees inventoried within the street ROW and 60 were confirmed to have EAB with an additional 111 showing potential symptoms. Private trees were not part of this inventory, but also showed signs and symptoms of infestation.

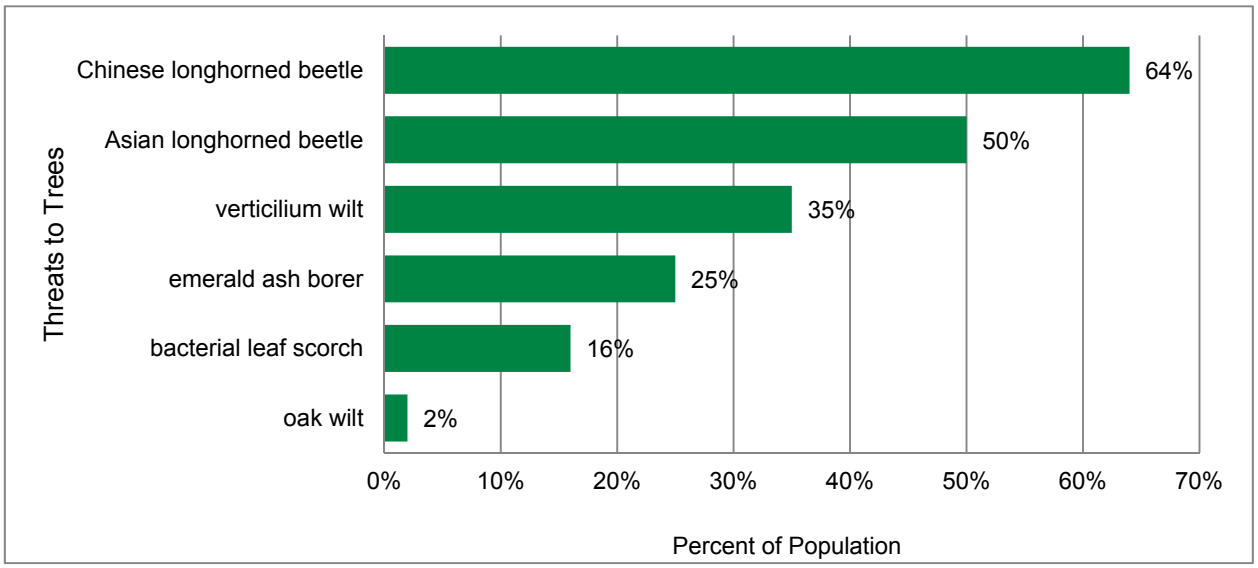


Figure 7. Potential impact of exotic pests based on tree species identified during 2013 inventory.

Discussion/Recommendations

Antioch should be aware of the signs and symptoms of infestations and should be prepared to act if a significant threat is observed in their tree population or in a community nearby. An integrated pest management plan should be established and include identifying and monitoring threats, understanding the economic threshold, selecting the correct treatment, properly timing management strategies, recordkeeping, and evaluating results. An extended look at Davey Resource Group's recommended planning and management of EAB is provided in Section 4.

Section 3: Tree Management Program

This tree management program was developed to uphold Antioch's comprehensive vision for preserving its urban forest. This five-year program is based on the tree inventory data and was designed to reduce risk through prioritized tree removal and pruning and to improve tree health and structure through pruning cycles. Tree planting to mitigate removals and increase canopy cover and public outreach are important parts of the program as well. The planning and management of the ash tree population in relation to EAB is not part of this section. Look to Section 4 for recommended planning and management of EAB.

Implementing a tree care program is an ongoing process; however, tree work must always be prioritized to reduce public safety risks. Davey Resource Group recommends completing the work recommended during the inventory based on the risk rating assigned; however, it is also essential to routinely monitor the tree population to identify other Severe or High Risk trees so that they may be systematically alleviated. Pruning cycles and tree planting should be completed regularly; however, priority work (especially for trees rated as Severe or High Risk) must at times take precedence to ensure that risk is managed expediently.

How Risk Was Assessed During the Inventory

Every tree has an inherent risk of tree failure or defective tree part failure. During the inventory, Davey Resource Group performed a risk assessment for each tree and assigned a risk rating following protocol based on the *Urban Tree Risk Management* (Pokorny et al. 2003). The probability of failure, size of defective part, probability of target impact, and other risk factors were evaluated for each tree inventoried. Independent point values were assigned and summed to generate the risk rating.

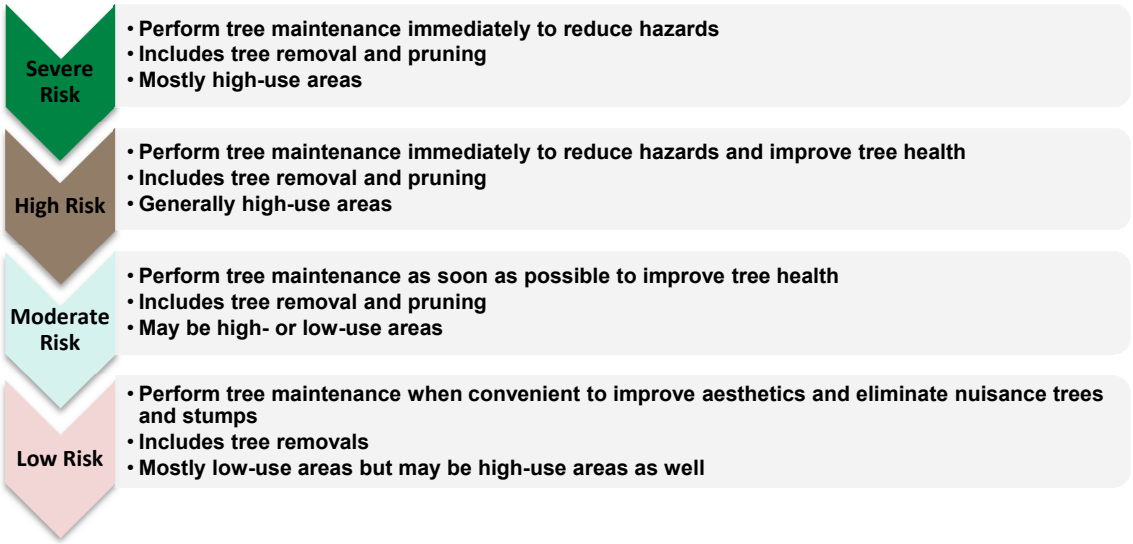
- Probability of Failure (1–4 points). Identifies the most likely failure and rates the likelihood that the structural defect(s) will result in failure based on observed, current conditions.
- Size of Defective Part (1–3 points). Rates the size of the part most likely to fail.
- Probability of Target Impact (1–3 points). Rates the use and occupancy of the area that would be struck by the defective part.
- Other Risk Factors (0–2 points). This category is used if professional judgment suggests the need to increase the risk rating. It is especially helpful when growth characteristics become a factor in risk rating. For example, some tree species have growth patterns that make them more vulnerable to certain defects such as weak branch unions and branching shedding.

Once the risk rating is calculated, a level of risk is assigned to each tree based on its risk rating. The assigned risk rating allows for effective prioritization of tree maintenance work.

- Severe Risk (rating of 9 or 10): Trees described as Severe Risk have defects that cannot be cost-effectively or practically treated. Most of the trees in this category have multiple or significant defects in the trunk, crown, or critical root zone. Defective trees and/or tree parts are generally larger than 20 inches in diameter and are found in areas of frequent occupation, such as a main thoroughfare, a congested street, and/or near a school.

- High Risk (rating of 7 or 8): Trees designated as High Risk have defects that may or may not be cost-effectively or practically treated. Most of the trees in this category have multiple or significant defects affecting more than 40% of the trunk, crown, or critical root zone. Defective trees and/or tree parts are generally 4–20 inches in diameter and are found in areas of frequent occupation, such as a main thoroughfare, a congested street, and/or near a school.
- Moderate Risk (rating of 5 or 6): Trees described as Moderate Risk have defects that may be cost-effectively or practically treated. Most of the trees in this category exhibit several moderate defects affecting less than 40% of a tree's trunk, crown, or critical root zone. These trees may be in high-, moderate-, or low-use areas.
- Low Risk (rating of 3 or 4): Trees designated as Low Risk have minor visible structural defects or wounds and are typically found in areas with moderate- to low-use areas.
- None (rating of 0): Used for planting sites and stumps.

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



Priority and Proactive Maintenance

For many communities, a proactive tree management program is considered to be unfeasible, and an on-demand response to urgent situations is the norm. Research has shown that a proactive program that includes a routine pruning cycle will improve the overall health of a tree population (Miller and Sylvester 1981). Proactive tree maintenance has many advantages over priority maintenance: the most significant advantage is reduced risk. When trees are assessed and pruned regularly in a proactive program, most defects will be found and eliminated before they escalate to a hazardous situation with an unacceptable level of risk. Other advantages of a proactive program are more predictable budgets and projectable workloads, reduced long-term tree maintenance costs, and increased environmental and economic benefits from trees.

In this plan, the recommended tree maintenance work was divided into either priority or proactive maintenance. Priority maintenance includes tree removals and pruning of trees with an assessed risk rating of seven or greater (High and Severe Risk). Proactive tree maintenance includes pruning of trees with an assessed risk of six or less (Moderate or Low Risk) and trees that are young. Tree planting, inspections, and community outreach are also considered proactive maintenance.

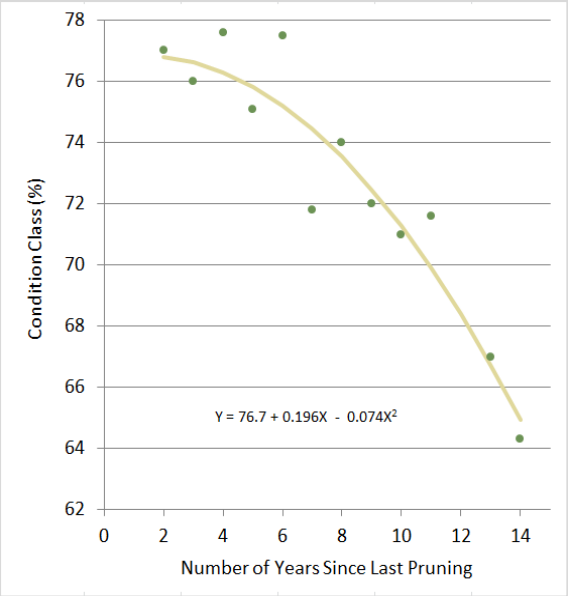


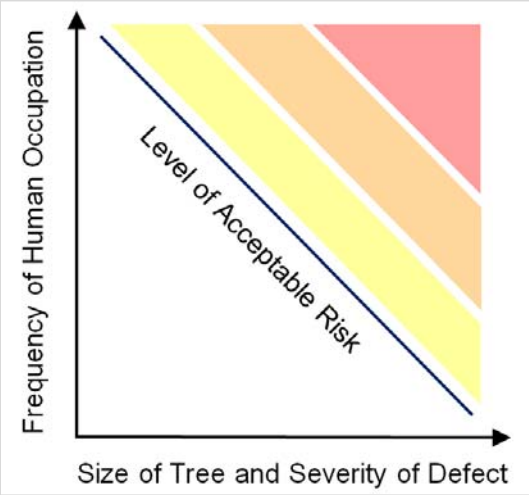
Figure 8. Relationship between average tree condition class and number of years since last pruning (adapted from Miller and Sylvester 1981).

Determination of acceptable risk ultimately lies with the Village of Antioch managers. Trees often have associated risks; the location of a tree is an important factor in the determination and the acceptability of risk for any given tree. The level of risk associated with a tree increases as the frequency of human occupation increases in the vicinity of the tree. For example, a tree located next to a heavily traveled street will have a higher level of risk than a similar tree in an open field.

Why Prune Trees on a Cycle?
Miller and Sylvester (1981) examined the frequency of pruning for 40,000 street and boulevard trees in Milwaukee, Wisconsin. They documented a decline in tree health as the length of the pruning cycle increased. When pruning was not completed for more than 10 years, average tree condition was rated 10% lower than when trees had been pruned within the last several years. Miller and Sylvester suggested that a pruning cycle of five years is optimal for urban trees.

Priority Maintenance

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



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

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

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

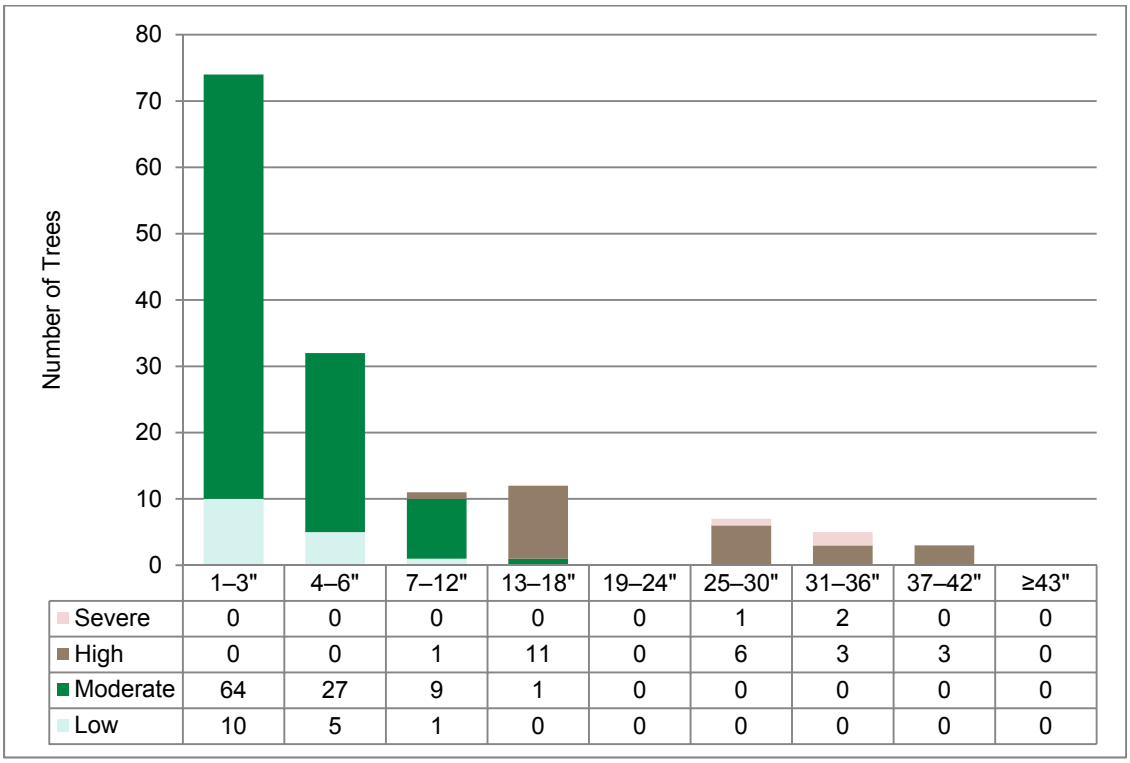
In this plan, all tree removals and Severe and High Risk pruning are included in the priority maintenance program.

Priority Tree Removal

Although tree removal is usually considered a last resort and may sometimes create a reaction from the community, there are circumstances when it is necessary. Trees fail from natural causes, such as diseases, insects, and weather conditions, and from physical injury due to vehicles, vandalism, and root disturbances. Davey Resource Group recommends that trees be removed when corrective pruning will not adequately eliminate the hazard or when it is cost-prohibitive to correct problems. Trees causing obstructions or interfering with power lines or other infrastructure should be removed when their defects cannot be corrected through pruning or other maintenance practices. Nuisance trees and diseased trees also merit removal.

Even though large, short-term expenditures may be required, funding and expediently completing priority tree removals is important to reduce risk and to promote public safety.

Figure 9 presents tree removals identified during the inventory by risk rating and diameter size class. The following sections briefly summarize the recommended removals, but excludes all ash trees as they will be discussed in Section 4.



	1–3"	4–6"	7–12"	13–18"	19–24"	25–30"	31–36"	37–42"	≥43"
Severe	0	0	0	0	0	1	2	0	0
High	0	0	1	11	0	6	3	3	0
Moderate	64	27	9	1	0	0	0	0	0
Low	10	5	1	0	0	0	0	0	0

Figure 9. Tree removals by risk rating and diameter size class.

Severe Risk

The inventory identified three Severe Risk trees that were recommended for removal. The size of the defect, the probability of failure, or the location of the trees in relation to their surroundings were reasons for Severe Risk ratings. These trees are large in size (25–36 inches DBH) and should be removed immediately to promote public safety.

High Risk

High Risk removals have observable and sizeable defects with elevated probabilities of failure. The location of these trees in relation to their surroundings also increases their risk. The inventory identified 24 High Risk trees recommended for removal. The diameter size classes for these trees ranged between 7–12 inches DBH and 37–42 inches DBH. These trees should be removed immediately because of their assigned risk. Severe and High Risk removals can be performed concurrently.

Moderate Risk

Tree removals in this category still pose some risk, but have a smaller size of defect and/or less potential for target impact. The inventory identified 101 Moderate Risk trees recommended for removal. All Moderate Risk trees were smaller than 18 inches DBH. These trees should be removed as soon as possible after all Severe and High Risk removals have been completed.

Low Risk

Low Risk removals pose little threat; these trees are generally small, dead, invasive, or poorly formed trees that need to be removed. Eliminating these trees will reduce breeding site locations for insects and diseases and will increase the aesthetic value of the area. Healthy trees growing in poor locations or undesirable species are also included in this category.

The inventory identified 16 Low Risk trees recommended for removal. All of these trees were smaller than 12 inches DBH. All Low Risk trees should be removed when convenient and after all Severe, High, and Moderate Risk removals have been completed.

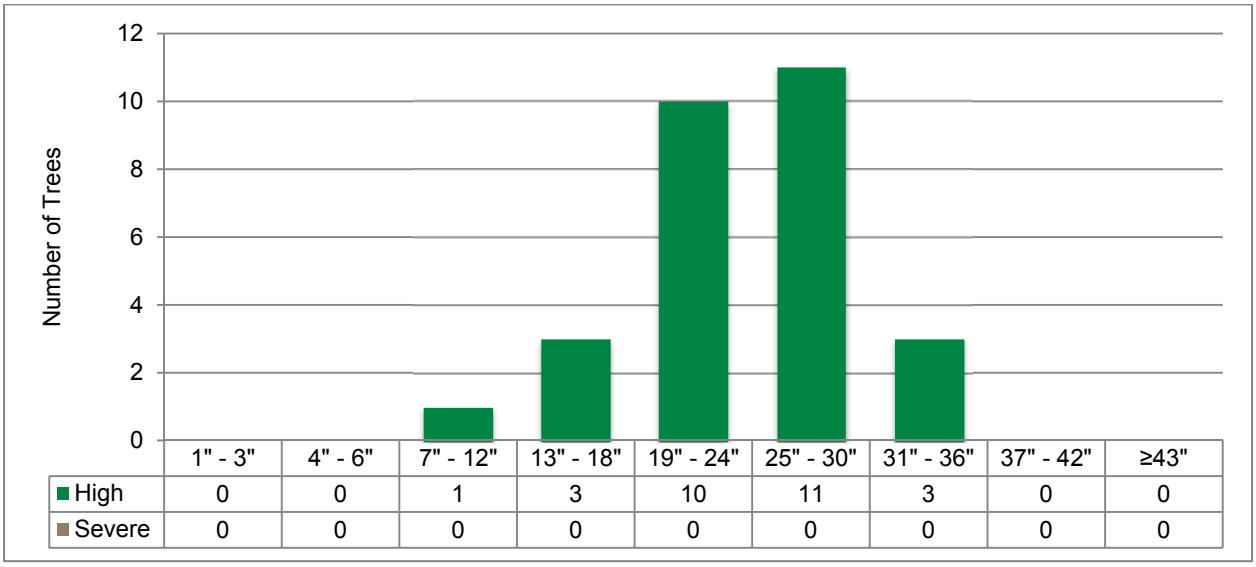
Stump Removal

The inventory identified 31 stumps recommended for removal. These stumps ranged in size from 6 to 52 inches in diameter.

Priority Pruning

Priority pruning generally requires cleaning the canopy of both small and large trees to remove hazardous defects such as dead and/or broken branches that may be present even when the rest of the tree is sound. In these cases, pruning the branch or branches can correct the problem and alleviate risk associated with the tree. Priority pruning includes trees with Severe and High Risk.

Figure 10 presents the number of trees recommended for pruning by size class and the sections that follow briefly summarize the recommendation, but exclude all ash trees as they will be discussed in Section 4.



	1" - 3"	4" - 6"	7" - 12"	13" - 18"	19" - 24"	25" - 30"	31" - 36"	37" - 42"	≥43"
High	0	0	1	3	10	11	3	0	0
Severe	0	0	0	0	0	0	0	0	0

Figure 10. Tree pruning by risk rating and diameter size class.

Severe Risk

The inventory did not identify any Severe Risk trees recommended for pruning.

High Risk

High Risk trees recommended for pruning have observable and sizeable defects with elevated probabilities of failure. The location of these trees in relation to their surroundings also increases their risk. The inventory identified 28 High Risk trees recommended for pruning. The diameter size classes for these trees ranged between 7–12 inches DBH and 31–36 inches DBH. This pruning should be performed immediately because of assigned risk.

Proactive Maintenance

Proactive tree maintenance requires that trees are managed and maintained under the responsibility of an individual, department, or agency. Typically, tree work is performed during a cycle. Individual tree health and form are routinely addressed during the cycle. When trees are planted, they are planted selectively and with purpose. Ultimately, proactive tree maintenance should reduce crisis situations in the urban forest as every tree in the managed population is visited, assessed, and maintained regularly. Davey Resource Group recommends proactive tree maintenance that includes pruning cycles, inspections, and planned tree planting.

Pruning Cycles

The goals of pruning cycles are to visit, assess, and prune trees on a regular schedule to improve health and reduce risk. Typically, Davey Resource Group recommends that pruning cycles begin after all Severe and High Risk trees are corrected through priority removal or pruning. However, because of the long-term benefit that will come from implementing pruning cycles, Davey Resource Group may recommend it be implemented sooner. To ensure all trees receive the type of pruning they need to mature with better structure and fewer hazards, two pruning cycles are recommended: the young tree training cycle (YTT Cycle) and the routine pruning cycle (RP Cycle). The cycles differ in the type of pruning, the general age of the target tree, and the cycle length.

YTT Cycle

Trees included in the YTT Cycle are less than twelve inches DBH. These younger trees sometimes have branch structures that can lead to potential problems as the tree ages. Potential structural problems include codominant leaders, multiple limbs attaching at the same point on the trunk, or crossing/interfering limbs. If these problems are not corrected, they may worsen as the tree grows, increasing risk and creating potential liability.

YTT pruning is performed to improve tree form or structure; the recommended length of a YTT Cycle is three years because young trees tend to grow at faster rates (on average) than more mature trees.

The YTT Cycle differs from the RP Cycle in that these trees generally can be pruned from the ground with a pole pruner or pruning shear The objective is to increase structural integrity by pruning for one dominant leader. Of course, this is species-specific since many trees such as *Betula nigra* (river birch) may naturally have more than one leader. For these trees, YTT pruning is used to develop a strong structural architecture of branches so that future growth will lead to a healthy, structurally sound tree.

Discussion/Recommendations

Davey Resource Group recommends that Antioch implement a three-year YTT Cycle (excluding ash). During the inventory, 1,745 trees smaller than 12 inches DBH were inventoried and were recommended for training. Since the number trees is so large (51%) and the benefit of beginning the YTT Cycle is great, Davey Resource Group recommends that the YTT cycle begin as soon as possible.

In future years, the number of trees in the YTT Cycle will be based on tree planting efforts and growth rates of young trees. As trees are planted, they will need to enter the YTT Cycle after establishment, typically 2-3 years after planting. The Village should strive to prune approximately one-third of its young trees each year.

RP Cycle

The RP Cycle includes established, maturing, and mature trees (most >12 inches DBH) that need cleaning and crown raising and reducing to remove deadwood and to improve structure. Over time, routine pruning generally improves health and reduces risk, as most problems can be corrected before they escalate into more costly priority tree work. Included in this cycle are Moderate and Low Risk trees that require pruning and that pose some risk but have a smaller size of defect and/or less potential for target impact. The hazards found within these trees can usually be remediated during the RP Cycle.

The length of the RP Cycle is based on the size of the tree population and what was assumed to be a reasonable number of trees for a program to prune per year. Generally, the RP Cycle recommended for a tree population is five years but may extend to seven years if the population is large.

Discussion/Recommendations

Davey Resource Group recommends that the Village establish a five-year RP Cycle where approximately one-fifth of the tree population (excluding ash) is to be pruned each year. The 2013 tree inventory identified approximately 271 trees that should be pruned each year. Davey Resource Group recommends that the RP Cycle begin in Year 1 of this five-year plan and that it commence after all High Risk trees are removed or pruned.

The inventory found a large number of trees (45%) on the street ROW needed routine pruning. Figure 11 shows that a variety of tree sizes will require pruning; however, most of the trees that require routine pruning were smaller than 24 inches DBH.

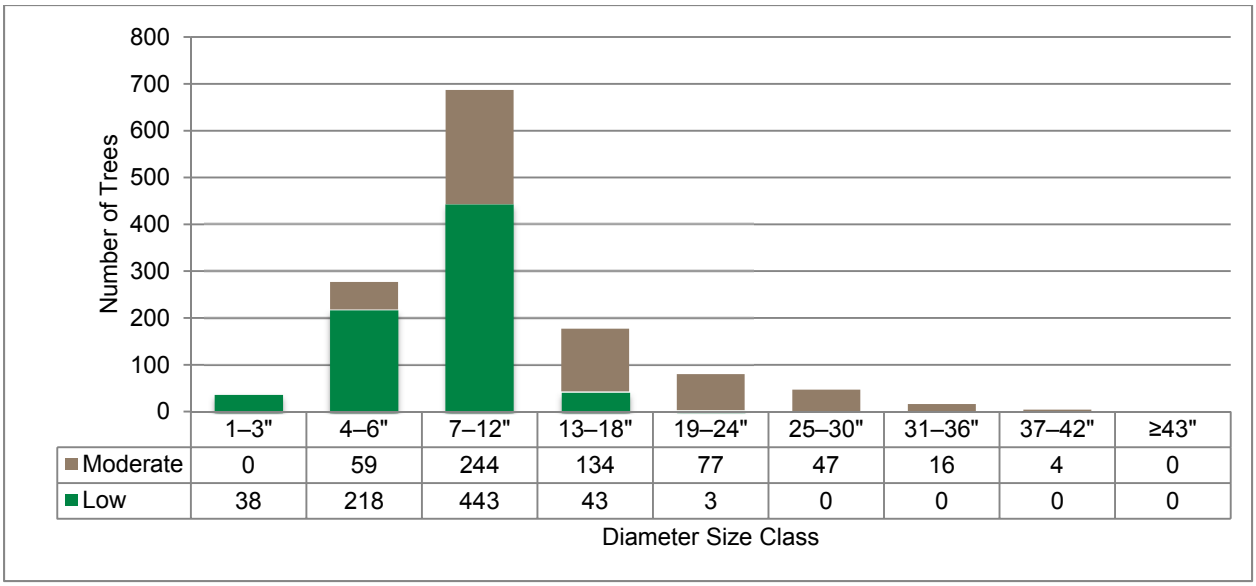


Figure 11. Trees recommended for the RP Cycle by diameter size class.

Pruning Cycle Progression

The recommended number of trees in the pruning cycles will need to be modified to reflect changes in the tree population as trees are planted, age, and die. Newly planted trees will enter the YTT Cycle once they become established. As young trees reach maturity, they will be shifted from the YTT Cycle into the RP Cycle. When a tree reaches the end of its useful life, it should be removed and, thus, eliminated from the RP Cycle.

Inspections

Inspections are essential to unveiling potential problems with trees. They should be performed by a qualified arborist who is trained in the art and science of planting, caring for, and maintaining individual trees. Arborists are knowledgeable about the needs of trees and are trained and equipped to provide proper care.

Trees along the street ROW should be inspected regularly and attended to as needed based on the inspection findings. When trees need additional or new work, they should be added to the maintenance schedule and budgeted for as appropriate. In addition to locating new hazards, inspections are an opportunity to look for signs and symptoms of pests and diseases. Antioch has a large population of trees susceptible to pests and diseases. The EAB management strategy is located in Section 4 and a brief discussion of key pests is found in Appendix C.

Tree Planting

Planting trees is a worthwhile goal as long as trees species are carefully selected and correctly planted. Without upfront planning and follow-up tree care, a newly planted tree may become a future problem instead of a benefit to the community.

When planting trees:

- Consider the specific purpose of the tree planting.
- Assess the site and know its limitations, for example, overhead wires, confined spaces, and/or soil type.
- Select the species or cultivar that best matches site conditions.
- Examine trees before buying them and buy for quality.

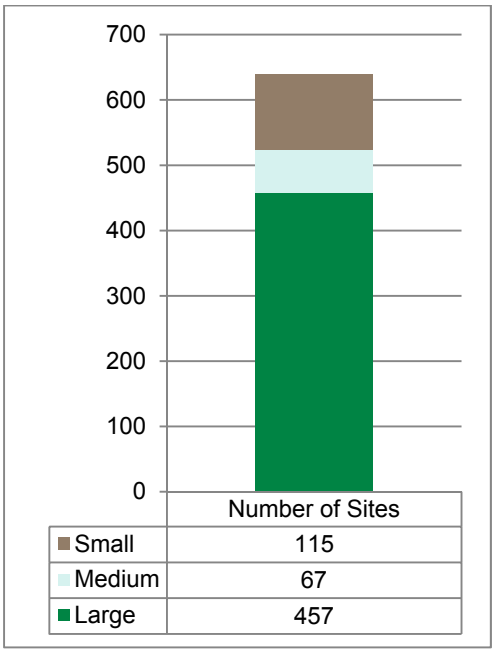
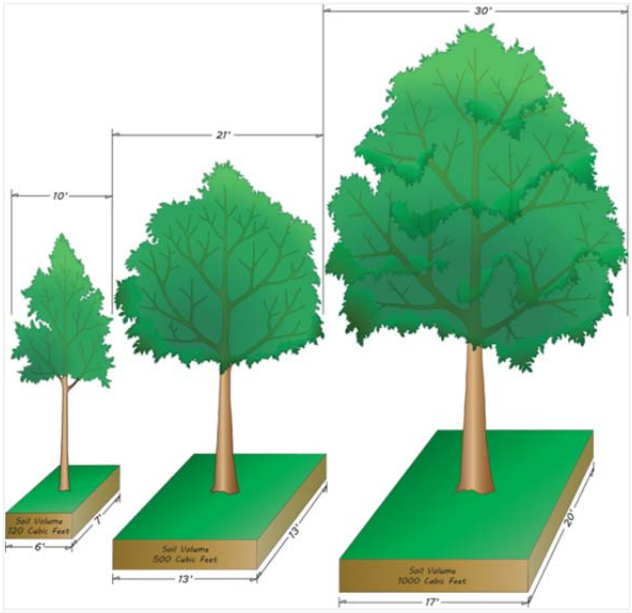


Figure 12. Vacant planting sites identified by mature tree size.

Inventoried Street ROW Planting Space

The goal of tree planting is to have a vigorous, healthy tree that lives to the limits of its natural longevity. That can be difficult to achieve in an urban growing environment because the soils can typically be of poor quality and irrigation is limited. However, proper planning, species selection, tree planting techniques, and follow-up tree maintenance will improve the chance of tree planting success.



Minimum recommended requirements for tree sites based on tree size/dimensions. Illustration based on the work of Casey Trees, 2008.

Findings

The inventory found 639 planting spaces with 72% of those sites being for large-sized trees, 10% for medium-sized trees, and 18% for small-sized trees (Figure 12). The planting of small-sized trees is good for where the growing space is either too small for a medium- or large-sized species or where overhead utilities are present.

Tree Species Selection

Selecting a limited number of species could simplify decision-making processes; however, careful deliberation and selection of a wide variety of species will be more beneficial and can save money. Planting a variety of species can decrease the impact of species-specific pests and diseases by limiting the number of susceptible trees in a population, which will reduce the time and money spent to mitigate a problem if such an event were to occur. A wide variety of tree species may help to limit the impacts from physical events such as strong storms, wind, ice, flooding, and drought, as different tree species react differently to stress.

Antioch is located in USDA Hardiness Zone 5b, which identifies a climatic region where the average annual minimum temperature is between -15 to -10 degrees (°F). Tree species selected for planting in Antioch should be appropriate for this zone.

Tree species should be selected for their durability and low-maintenance characteristics. These attributes are highly dependent on site characteristics below ground (soil texture, soil structure, drainage, soil pH, nutrients, road salt, and root spacing). Matching a species to its favored soil conditions is the most important task when planning for a low-maintenance landscape. Plants that are well-matched to their environmental site conditions are much more likely to resist pathogens and insect pests and will, therefore, require less maintenance overall.

The Right Tree in the Right Place is a mantra for tree planting used by the Arbor Day Foundation (http://www.arborday.org/trees/rightTreeAndPlace/) and many utility companies nationwide.

Trees come in many different shapes and sizes, and often change dramatically over their lifetimes. Some grow tall, some grow wide, and some have extensive root systems. Before selecting a tree for planting, make sure it is the right tree—know how tall, wide, and deep it will be at maturity. Equally important to selecting the right tree is choosing the right spot to plant it. Blocking an unsightly view or creating some shade may be a priority, but it is important to consider how a tree may impact existing utility lines as it grows taller, wider, and deeper. If at maturity the tree's canopy will reach overhead lines, it is best to choose another tree or a different location. Taking the time to consider location before planting can prevent power disturbances and improper utility pruning practices.

A major consideration for street trees is the amount of litter dropped by mature trees. Trees such as *Pyrus calleryana* (Callery pear) have weak wood and typically drop many small branches during a growing season. Others, such as *Malus* spp. (crabapple), drop high volumes of fruit. In certain species, such as *Ginko biloba* (ginko), female trees produce offensive smelling/large fruit; male trees, however, produce no fruit. Furthermore, a few species of trees, including *Crataegus* spp. (hawthorn), may have substantial thorns. These species should be avoided in high-traffic areas.

Seasonal color should also be considered when planning tree plantings. Flowering varieties are particularly welcome in the spring and deciduous trees that display bright colors in autumn can add a great deal of interest to surrounding landscapes.

Appendix B lists tree species recommended for planting based on inventory findings; this list provides expected height at maturity for each species and is designed to promote species diversity.

Davey Resource Group recommends halting the planting of ash and limiting the planting of maples and littleleaf linden until the species distribution normalizes. Maples already occupy 32% of the street ROW, which is well in excess of the recommended maximum for a genus (20% of the population) with green ash and littleleaf linden above the recommended maximum for a species (16% and 11% of the population, respectively).

Photograph 5. Mulch piled too deep and touching the trunk of the tree will harm and may kill the tree. Davey Resource Group suggests that any mulch piled up around a tree trunk be spread out into a thin 1-2 inch layer over the ground and not touch the trunk.

Tips for Planting Trees

To ensure a successful tree planting effort:

- Handle trees with care. Trees are living organisms and are perishable. Protect trees from damage during transport and when loading and unloading. Use care not to break branches, and do not lift it by the trunk.
- If trees are stored prior to planting, keep the roots moist.

- Dig the planting hole according to the climate. Generally, the planting hole is two to three times wider and not quite as deep as the root ball. The root flair is at or just above ground level.
- Fill the hole with native soil unless it is undesirable, in which case add soil amendments as appropriate for local conditions. Gently tamp and add water during filling to reduce large air pockets to ensure a consistent medium of soil, oxygen, and water.
- Stake the tree as necessary to prevent it from shifting too much in the wind.
- Add a thin layer (1–2 inches) of mulch to help prevent weeds and keep the soil around the tree moist. Do not allow mulch to touch the trunk.

Newly Planted and Young Tree Maintenance

Equal in importance to planting trees is caring for them after they are planted. After planting a tree, it must receive maintenance for several years.

Watering

Initially, watering is the key to survival; new trees typically require at least 60 days of watering to establish. Determine how often to irrigate trees based on time of planting, drought status, species selection, and site condition.

Mulching

Mulch can be applied to the growspace around a newly planted tree (or even a more mature tree) to ensure that no weeds grow, the tree is protected from mechanical damage, and the growspace is moist. Mulch should be applied in a thin layer, generally one to two inches, and the growing area covered. Mulch should not touch the tree trunk or be piled up around the tree.

Life-Long Tree Care

After the tree is established, it will require routine tree care, which includes inspections, routine pruning, watering, plant health care, and integrated pest management as needed.

The Village should employ qualified arborists to provide most of the routine tree care. An arborist can determine the type of pruning necessary to maintain or improve the health, appearance, and safety of trees. These techniques may include eliminating branches that rub each other; removing limbs that interfere with wires and buildings or that obstruct streets, sidewalks or signage; removing dead, damaged, or weak limbs that pose a hazard or may lead to decay; removing diseased or insect-infested limbs; creating better structure to lessen wind resistance and reduce the potential for storm damage; and removing branches, or thinning, to increase light penetration.

An arborist can help decide whether a tree should be removed and if so, how urgent the removal is. Additionally, an arborist can provide advice about and perform tree maintenance when disasters such as storms or droughts occur. Storm-damaged trees can often be dangerous to remove or trim. An arborist can assist in advising or performing the job in a safe manner, while reducing further risk of damage to property.

Plant Health Care, a concept of preventive maintenance to keep trees in good health, will help a tree better defend itself against insects, disease, and site problems. Arborists can help determine proper plant health so the village's tree population will remain healthy, providing benefits to the community for as long as possible.

Integrated Pest Management is a process involving common sense and sound solutions for treating and controlling pests. These solutions incorporate basic steps: identifying the problem, understanding pest biology, monitoring trees, and determining action thresholds. The practice of Integrated Pest Management can differ dramatically site by site, individual tree by individual tree; a qualified arborist will be able to make sure that the village's trees are properly diagnosed and that a beneficial and realistic action plan is developed.

The arborist can also help with cabling or bracing for added support to branches with weak attachment, aeration to improve root growth, and installation of lightning protection systems.

Educating the community in basic tree care is a good way to promote the Village's urban forestry program and encourage tree planting on private property. The Village should encourage citizens to water trees on the ROW adjacent to their homes and to reach out to the Village if they notice any changes in the trees such as: signs or symptoms of pests, early fall foliage, or new mechanical or vehicle damage.

Community Outreach

The data that have been collected and analyzed to develop this plan contribute significant information about the tree population and can be utilized to guide the proactive management of that resource. These data can also be utilized to promote the value of the urban forest and the tree management program in that:

- Tree inventory data can be utilized to justify needed priority and proactive tree maintenance activities as well as tree planting and preservation initiatives.
- Species data can be utilized to guide the development of tree species selection for planting projects with the objective of improving species diversity and limiting the introduction of invasive species.
- Information in this plan can be utilized to advise citizens about the presence of threats, such as EAB, to urban trees.

Various avenues for outreach exist. Maps can be created and posted on websites, in parks, or in business areas. Public service announcements can be developed. Articles can be written and programs developed about trees and the benefits they provide. Arbor Day or Earth Day celebrations can be magnified and signs can be hung from trees to show the contributions trees make to the community. Even contests can be created to make people aware that trees are important. Trees provide oxygen we need to breathe, shade to cool our neighborhoods, and canopies to stand under to get out of the rain.

Antioch has the data to provide solid, meaningful outreach about the urban forest.

Inventory and Plan Updates

Davey Resource Group recommends that the inventory and management plan be updated so the Village can sustain its program and accurately project future program and budget needs:

- Conduct inspections of trees after all severe weather events. Record changes in tree condition, maintenance needs, and risk/risk rating in the inventory database. Update the tree maintenance schedule and acquire the funds needed to promote public safety. Schedule work based on risk.
- Perform routine inspections of public trees as needed. Windshield surveys (inspections performed from a vehicle) in line with an ANSI Level I risk assessment (ANSI 2011) will help Village staff stay current regarding changing conditions. Update the tree maintenance schedule and the budget as needed so that identified tree work may be performed efficiently. Schedule work based on risk.
- If the recommended work cannot be completed as suggested in this plan, modify maintenance schedules and budgets accordingly.
- Update the inventory database as work is performed. Add new tree work to the schedule when work is identified through inspections or a citizen call process.
- Re-inventory the street ROW in five to seven years, updating all data fields.
- Revise the Tree Management Plan after five or seven years when the re-inventory has been completed.

Maintenance Schedule

Utilizing data from the 2013 Village of Antioch tree inventory, an annual maintenance schedule was developed detailing the number and type of tasks recommended for completion each year. Budget projections were made by Davey Resource Group utilizing industry knowledge and public bid tabulations; actual costs were not specified by the Village of Antioch. A summary of the maintenance schedule is presented here and the complete table of estimated costs for Antioch's five-year tree management program is presented in Appendix D.

The schedule provides a framework for completing the inventory maintenance recommendations over the next five years. Following this schedule can shift tree care activities from an on-demand system to a more proactive tree care program.

To implement the maintenance schedule, the Village's tree maintenance budget should be no less than $161,000 for the first year of implementation, dropping to approximately $113,000 by years four and five. Annual budget funds are needed to ensure that hazard trees are remediated and that critical YTT and RP Cycles can commence. With proper professional tree care, the safety, health, and beauty of the urban forest will improve.

If routing efficiencies and/or contract specifications allow for the accomplishment of more tree work, or if the schedule requires modification to meet budgetary or other needs, then it should be modified accordingly. Unforeseen situations, such as severe weather events, may arise and change the maintenance needs of trees. Should conditions or maintenance needs change, budgets and equipment will need to be adjusted to meet the new demands.

FY 2014

$160,716

- 27 Priority Removals
- 28 Priority Pruning
- YTT Cycle 1/3 of Young Trees Structurally Pruned; 349 Trees
- RP Cycle 1/5 of Public Trees Cleaned; 271 Trees
- 200 Trees Recommended for Planting and Follow-Up Care
- Ash tree managment; 92 Removals and 253 Trees Pruned andTreated
- Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined

FY 2015

$156,690

- 117 Low Priority Removals
- 31 Stump Removals
- YTT Cycle 1/3 of Young Trees Structurally Pruned; 349 Trees
- RP Cycle 1/5 of Public Trees Cleaned; 271 Trees
- 200 Trees Recommended for Planting and Follow-Up Care
- Ash Tree Managment; 344 Removals and 250 Trees Pruned and Treated
- Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined

FY 2016

$129,571

- YTT Cycle 1/3 of Young Trees Structurally Pruned; 349 Trees
- RP Cycle 1/5 of Public Trees Cleaned; 271 Trees
- 200 Trees Recommended for Planting and Follow-Up Care
- Ash Tree Managment; 159 Removals and 251 Trees Pruned and Treated
- Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined

FY 2017

$112,770

- YTT Cycle 1/3 of Young Trees Structurally Pruned; 349 Trees
- RP Cycle 1/5 of Public Trees Cleaned; 271 Trees
- 200 Trees Recommended for Planting and Follow-Up Care
- Ash Tree Managment; 250 Trees Pruned and Treated
- Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined

FY2018

$113,276

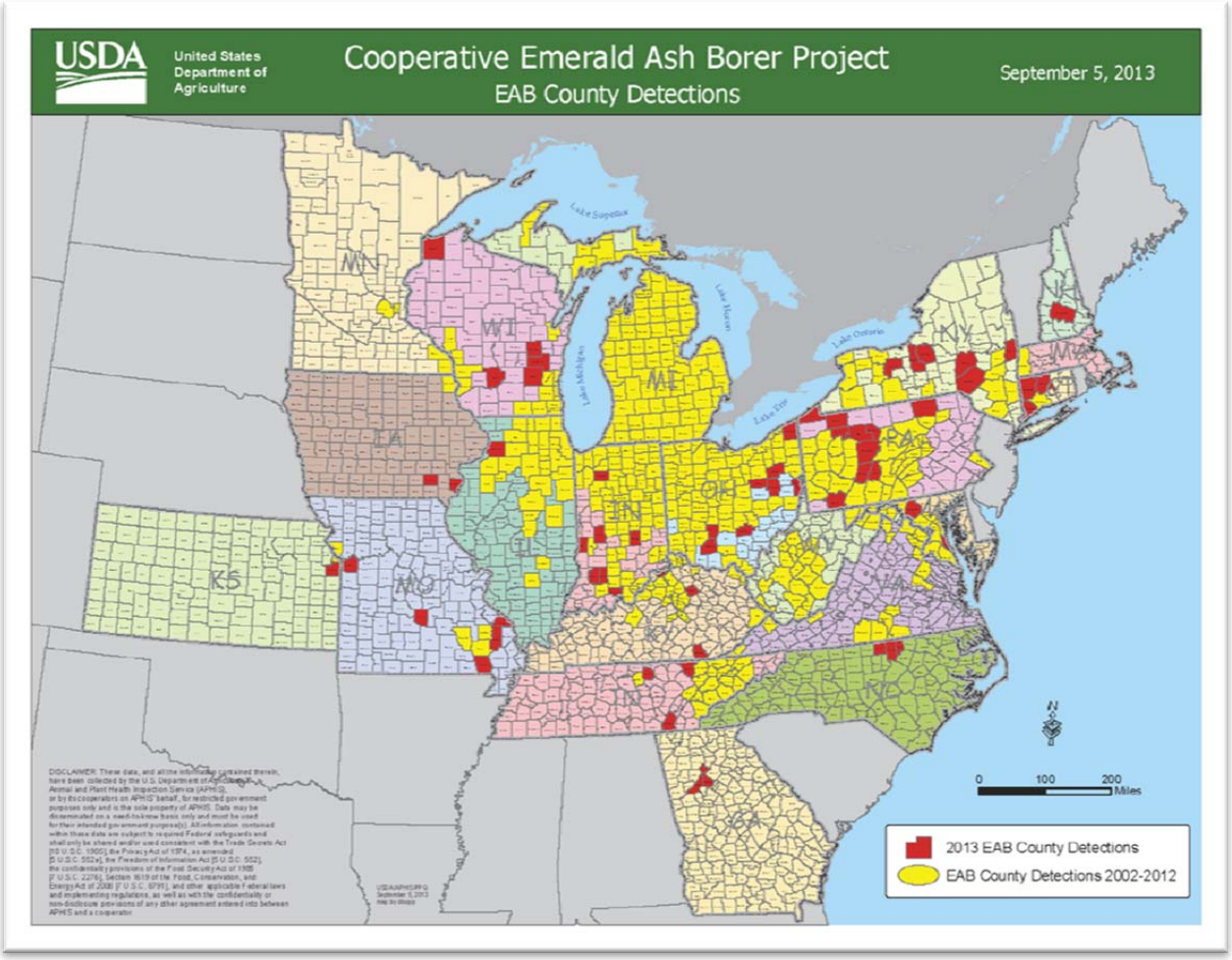
- YTT Cycle 1/3 of Young Trees Structurally Pruned; 349 Trees
- RP Cycle 1/5 of Public Trees Cleaned; 271 Trees
- 200 Trees Recommended for Planting and Follow-Up Care
- Ash Tree Managment; 251 Trees Pruned and Treated
- Inclusion of Newly Found Priority Tree Work (Removal or Pruning): Costs To Be Determined

Section 4. Emerald Ash Borer Response Planning and Management Strategy

Throughout the United States, urban and community forests are under increased pressure from exotic and invasive insects and diseases. Exotic pests that arrive from overseas typically have no natural predators and become invasive when our native trees and shrubs do not have appropriate defense mechanisms to fight them off. Individual tree mortality from these pests can range from two weeks with oak wilt (*Ceratocystis fagacearum*) (OW) to six years or more with EAB (Knight, Brown, and Long 2013).

An integral part of tree management is being aware of invasive insects and diseases in the area and how to best manage them. Depending on the tree diversity within Antioch's urban forest, an invasive insect or disease has the potential to negatively impact the tree population.

This section provides the different management strategies for dealing with EAB. Included is information on how to effectively monitor EAB, increase public education, handle ash debris, reforest, work with stakeholders, and utilize ash wood.



Map 1. EAB Detections throughout North America as of September 2013. Map courtesy of USDA.

Emerald Ash Borer

Emerald ash borer is a small insect native to Asia. In North America, the borer is an invasive species that is highly destructive to ash trees in its introduced range. The potential damage of EAB rivals that of chestnut blight and Dutch elm disease. Chestnut blight is a fungus that was introduced in North America around 1900 and by 1940 it wiped out most of the mature American chestnut population. Dutch elm disease is a fungus spread by the elm bark beetle. Since its discovery in the United States in 1928, it has killed millions of elm trees. EAB is thought to have been introduced into the United States and Canada in the 1990s but was not positively identified in North America until 2002 in Canton, Michigan. It has now been confirmed in 14 states and has killed at least 50–100 million ash trees so far and threatens another 7.5 billion ash trees throughout North America. The EAB is a serious pest and is known to attack all native ash trees, including white, green, blue, and black ash. The state is committed to early detection and thoughtful management of this pest.

EAB has been identified in the Village of Antioch and poses a serious threat to the health and condition of Antioch's ash tree population.

Photograph 6. EAB adults grow to 5/8 inch in length. Photo courtesy of Wisconsin's Emerald Ash Borer Information

Photograph 7. EAB larvae. Photo courtesy of www.emeraldashborer.info

Photograph 8. An adult EAB emerged from this D-shaped exit hole Photo courtesy of Wisconsin's Emerald Ash Borer Information Source.

Identification

The adult beetle is elongate, metallic green, and 3⁄8- to 5⁄8-inch long. The adult beetle emerges from late May until early August, feeding on a small amount of foliage. The adult females then lay eggs on the trunk and branches of ash trees and, in about a week, the eggs hatch into larvae, which then bore into the tree. Larvae are creamy white in color, can grow up to an inch long, and are found underneath the bark of the trees. The larvae tunnel and feed on the inner bark and phloem, creating winding galleries as they feed. This cuts off the flow of the water and nutrients to the tree, causing dieback and death.

Photograph 9. Larvae consume the cambium and phloem, effectively girdling the tree and eventually causing death within a few years.

Photograph 10. This ash tree is declining from EAB infestation. The loss of water and nutrients from the intense larvae tunneling can cause the trees to lose between 30% and 50% of their canopy during the first year of infestation. Photo courtesy of The University of Wisconsin, Madison).

EAB can be very difficult to detect. Initial symptoms include yellowing and/or thinning of the foliage and longitudinal bark splitting. The entire canopy may die back, or symptoms may be restricted to certain branches. Declining trees may sprout epicormic shoots at the tree base or on branches. Woodpecker injury is often apparent on branches of infested trees, especially in late winter. Removal of bark reveals tissue callusing and frass-filled serpentine tunneling. The S-shaped larval feeding tunnels are about 1⁄4 inch in diameter. Tunneling may occur from the upper branches to the trunk and root flare. Adults emerge from the trunk and branches in a characteristic D-shaped exit hole that is about 1/8 inch in diameter. The loss of water and nutrients from the intense larvae tunneling can cause trees to lose between 30% and 50% of their canopy during the first year of infestation. Trees often die within two six following infestation (Knight, Brown, and Long 2013).

Ash Population

With the threat of EAB already in Antioch, it is crucial that the Village have an action plan. Some of the most important questions to answer will be, "How many ash trees do we have, where are they located, and what actions should we take?" In order to answer these questions, Antioch needs to maintain an up-to-date inventory, know what resources are available, and understand the Village's priorities.

Based on the current public tree inventory, there are 1,098 ash trees distributed throughout the Village. Most of the ash trees were rated in Fair condition. Table 1 shows the diameter class of each ash tree by its condition class. Of the 1,098 ash trees inventoried, 171 currently show possible signs or symptoms of EAB.

Table 1. Ash Tree Condition Versus Diameter Class Matrix

		Diameter Class (inches)									
		1–3	4–6	7–12	13–18	19–24	25–30	31–36	37–42	43+	Total
Condition Class	Excellent	0	0	0	0	0	0	0	0	0	0
	Very Good	0	0	0	0	0	0	0	0	0	0
	Good	5	154	67	4	0	0	0	0	0	230
	Fair	20	324	392	25	10	4	1	0	0	776
	Poor	7	38	18	10	8	2	2	0	0	85
	Critical	0	3	0	2	1	0	0	0	0	6
	Dead	1	0	0	0	0	0	0	0	0	1
	Total	33	519	477	41	19	6	3	0	0	1,098

Ash Tree Risk Reduction Pruning and Removals

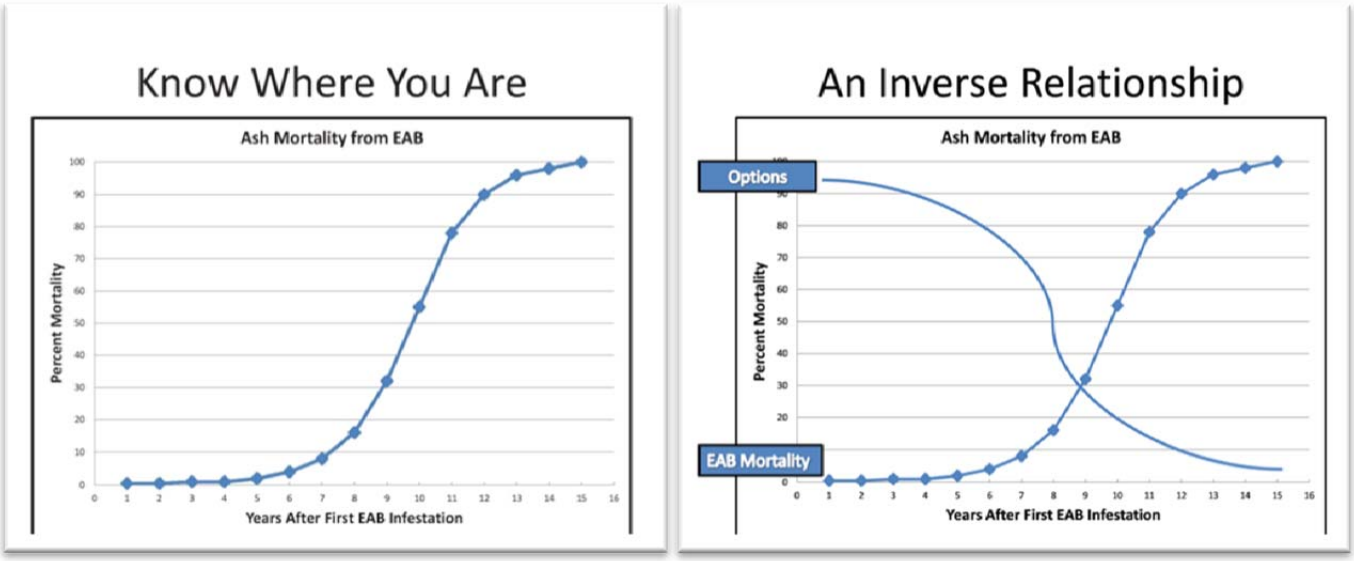
As EAB infestation spreads within Antioch, preparation for this threat becomes one of the Village's highest priorities. Budgeted funds and personnel should be refocused to concentrate on the ash tree population. Davey Resource Group recommends the Village perform both treatment and safety related activities on ash trees. These activities will end up saving the Village money and increasing productivity. However, it is only recommended due to EAB and the eventual removal of infested ash trees.

Davey Resource Group also recommends that Antioch proactively remove ash trees during road reconstruction projects and other public works activities. By proactively removing ash trees during construction, the cost and impacts will be lower.

In the event that Antioch decides to proactively remove ash trees, Davey Resource Group recommends that the Village remove all ash trees less than seven inches and trees that are rated as Dead, Critical, or Poor condition first. These trees are providing little benefit to the community and the cost for removals should be less significant.

EAB Management

The graphs below demonstrate how management options decrease with prolonged infestation. Antioch is currently placed between Years 7 and 8 on both graphs and has an advantage in that there is still a little time to prepare and select a management option.



Source: Emerald Ash Borer University 2012

EAB Management Options

With no specific strategy or budget in place for the impending infestation of EAB, Antioch should explore strategies for managing EAB that provide the most economic benefit and increase public safety. These EAB management strategies include do nothing, remove and replace all ash, treat all ash, or a combination of the strategies. These strategies and their associated costs are described below.

EAB Strategy 1: Do Nothing

This means letting EAB run its course and having no plan for dealing with EAB. This strategy includes not removing and not treating any ash trees. This strategy is economical in the beginning of an infestation because it costs the Village no money, but it would become a severe public safety issue within a few years. Davey Resource Group does not recommend this management strategy.

Photograph 11. This is an example of a do nothing strategy. These ash trees became infested with EAB and eventually died. They have now become a public safety issue.

EAB Strategy 2: Remove and Replace all Ash

Remove and replace all 1,098 ash trees by 2017. This strategy would benefit public safety from the EAB infestation but would have an impact on the Village's budget. In order to achieve this strategy and remove all of the ash trees by 2017, the Village would most likely have to contract work out. Removing mature ash trees that are in Good and Fair condition would take away all of the valuable benefits that these trees provide to the Village. Removal and replacement ultimately benefits the Village by increasing public safety but will require a lot of upfront cost. It will be very important to replace all of these ash trees once they have been removed.

The total approximate cost for this strategy would be $469,435; $198,530 would be the approximate cost to remove all ash trees, $29,345 would be the approximate cost to remove all stumps, and $241,560 would be the approximate cost to replace all ash trees as shown in Table 6.

Table 2. Cost to Remove and Replace all Ash

Management Strategy	Management Action	# of Trees	Cost
Remove and Replace All Ash Trees	Removal All	1,098	$198,530
	Replace All	1,098	$241,560
	Stump Removal	1,098	$29,345
	Total		$469,435

EAB Strategy 3: Treat all Ash

Treating all ash trees in Antioch could reduce the annual mortality rate, stabilize removals, and would be less expensive than removing and replacing all ash trees. Treating all ash would enable these trees to keep providing the village with the monetary benefits that they provide. On the other hand, treating all ash trees is not an ideal practice because some of these ash trees will eventually become infested with EAB and some of these ash trees are less desirable to retain.

Injection treatment loses its effectiveness against EAB after two years. It is recommended that no ash tree go without treatment after two years of initial application. If Antioch wanted to biennially treat all of its 1,073 ash trees that are not recommended for removal, it would cost approximately $49,524 every two years. This means that it would cost the Village approximately $24,762 annually to treat all of Antioch's 1,073 ash trees for the remainder of their lives while EAB is present. The cost to remove the 25 ash trees recommended for removal is approximately $5,845 and approximately $850 to remove all stumps. A two-year treatment period and removal of the recommended 25 trees would cost the Village an estimated $56,219 as shown in Table 7.

Table 3. Cost to Treat All Ash

Management Strategy	Management Action	# of Trees	Cost
Treat All Ash Trees	Treat all Ash Trees for Two Years	1,073	49,524$
	Ash Trees Recommended for removal	25	5,845$
	Stump Removal	25	850$
	Total	1,098	56,219$

EAB Strategy 4: Combination of Removals and Treatment

This strategy is intended to give the Village options for a combination of removing and treating ash trees to stabilize annual removals, annual budgets, and prolong the life of ash trees that are in Good and Fair condition. Table 8 is an EAB matrix table that is intended to organize trees that should be considered for removal and trees that should be considered for treatment. The description of this EAB matrix table goes into detail about why certain ash trees should be considered for removal or treatment.

Table 4. EAB Matrix Table

	Diameter size class (inches)							
Condition Class		1–3	4–6	7–12	13–18	19–24	25–30	≥31	Total
	Good	5	154	67	4	0	0	0	230
	Fair	20	324	392	25	10	4	1	776
	Poor	7	38	18	10	8	2	2	85
	Critical	0	3	0	2	1	0	0	6
	Dead	1	0	0	0	0	0	0	1
	Total	33	519	477	41	19	6	3	1,098

Based on these numbers, Davey Resource Group makes the following recommendations:

Remove 595 Trees

- Trees in the "Poor," "Critical," and "Dead" condition class are recommended for removal. These trees are recommended for removal because they are more susceptible to EAB infestation and if not removed could pose a public safety issue in the future. A total of 92 trees are recommended for removal and replacement.
- The remaining 503 trees are <7 inches DBH and are recommended for removal and replacement. These trees don't provide as many benefits to the community compared to mature ash trees. It would be in the best interest of the Village to remove these trees and replace them with a more diversified mix of trees.

Chemically Treat 432 Trees (Low–Moderate Priority for Treatment)

- The intent here is to defer removal of a large block of trees within the matrix of "Fair" condition class between 7 inches and 36 inches DBH. These 432 trees are considered to be "low–moderate priority" for chemical treatment. Without treatment, many of these trees will become infested with EAB and, therefore, have to be removed in a timely manner. However, treating these trees can stabilize annual budgets and removals each year. Treating these trees could be economically beneficial and reduce the chance for a public safety issue in the near future.

Chemically Treat 71 Trees (High Priority for Treatment)

- Candidates for chemical treatment shall exhibit "Good" condition or better, have no more than 30% dieback, and be located in an appropriate site (i.e., not under overhead utilities). Treating these 71 ash trees will help keep these trees around for a long time and the village will profit from the monetary benefits these ash trees provide.

Private Trees

In addition to ash trees located on public property, EAB will impact trees located on private property. The number of private ash trees is unknown but it could be equal or more than the ash trees located on public property. During the inventory, it was evident to the inventory arborists that there is an abundance of ash trees located on private properties. The cost to remove ash trees will be higher on private property because of the greater inaccessibility to these areas. It is crucial that the Village promote public education about EAB so that it can reduce the potential of Village involvement with regulating tree removals on private properties. The public education section will explain more on how to minimize anxiety from private homeowners and give examples on how to go about informing the public about managing their ash trees.

Dying and infested ash trees on private property will pose a threat to human and public safety. In the event that Village officials have to get involved with private property owners about a potential infested ash tree, Antioch should consider utilizing the Village's tree ordinance.

Public Education

It is crucial for Antioch property owners to be well informed about EAB. Their assistance and cooperation will be vital in helping to detect heavily infested trees, managing ash trees on private property, and the reforestation process that will come from the removal of ash trees. Antioch should inform the public that EAB has been discovered in the Village. A well-informed public is more likely to accept what is happening without panicking and cooperate with the Village's requests. The following are examples of how Antioch should go about informing the public:

Photograph 13. Posting information about EAB on ash trees around the City could promote private homeowners to become more proactive in managing their ash trees.

- News releases
- Village newsletter articles
- Post information about EAB on the Village's website
- Display information packets at public buildings
- Postcard mailings to ash tree owners
- Door hangers explaining maintenance options
- Presentations to community groups
- Tie ribbons around ash trees and place tags on the trees with information about EAB

Reforestation

As the ash tree population is being reduced in Antioch, the Village will need to develop a plan to replant where ash trees have been removed. The Village could lose 25% of its tree population due to EAB. It will be vital to promptly reforest Antioch because of the numerous benefits that ash trees provide the community. Some of the benefits that these ash trees provide the Village include, but are not limited to, removing pollutants from the air, helping improve summer temperatures, reducing stormwater runoff and energy consumption, and providing social and psychological benefits.

If Antioch is to replace all the ash trees, it will cost approximately $469,435. This would be a huge financial burden on the Village, but replacement is important and has long-term benefits. The cost of replanting ash trees could be spread out over multiple years by establishing a goal for planting a certain amount of trees each year. Reduce costs by working with private property owners and volunteers. This could include giving private property owners the option of paying for trees adjacent to their property and getting to pick the tree they want from a list of approved species. Antioch should also explore grants for reforestation. Organizing volunteer groups to participate in planting trees can help decrease planting costs.

It is important to consider diversification when replacing ash trees. Without diversification, a community is much more vulnerable to catastrophic losses that impact budgets and community appearance. Davey Resource Group recommends that no one species represent more than 10% and that no one genus comprises more than 20% of the total public tree population. Since EAB has been found in the local community, there might be a possibility that local nurseries have a shortage of trees. Antioch might want to consider nurseries in other regions for trees or developing a relationship with local nurseries and encouraging price breaks for property owners who are replacing ash trees with approved species.

Conclusions

Managing trees in urban areas is often complicated. Dealing with the recommendations of experts, needs of residents, pressures of local economics and politics, concerns for public safety and liability issues, physical aspects of trees, forces of nature and severe weather events, and expectation for all of these issues to be resolved at the same time is a considerable challenge. The Village must carefully consider each specific issue and balance these pressures with a knowledgeable understanding of trees and their needs. If balance is achieved, Antioch's beauty will flourish and the health and safety of its trees and citizens will be maintained.

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Glossary

address number (data field): The address number was recorded based on the visual observation by the Davey Resource Group arborist at the time of the inventory of the actual address number posted on a building at the inventoried site. In instances where there was no posted address number on a building or sites were located by vacant lots with no GIS parcel addressing data available, the address number assigned was matched as closely as possible to opposite or adjacent addresses by the arborist(s) and an "X" was added to the number in the database to indicate that the address number was assigned.

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

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

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

assigned: Address information denoting that the actual address was not visible ad thusly assigned a number by field staff

block side (data field): Address information for a site that includes the *on street*. The *on street* is the street that the site is actually located on.

botanical name (data field): The species is noted in its scientific name

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

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

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

community forest: see **urban forest**.

common name (data field): The species is noted in its common name

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

cycle: Planned length of time between vegetation maintenance activities.

date (data field):

diameter (data field):: See **tree size**.

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

epicormic shoots: a shoot that grows from a bud under the bark. Growth is stimulated when damage occurs higher up on the plant.

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

frass: the refuse left behind by boring insects. It is a finely masticated, indigestible material created as a byproduct of feeding often found inside or below the tunnels of invasive pests.

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

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

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

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

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

inventory: See **tree inventory**.

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

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

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

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

none (risk rating): Equal to zero. It is used only for planting sites and stumps.

notes (data field): Describes additional pertinent information.

on street: See **block side.**

ordinance: See **tree ordinance**.

plant tree (primary maintenance): If collected during an inventory, this data field identifies vacant planting sites as small, medium, or large (indicating the ultimate size that the tree will attain), depending on the growspace available and the presence of overhead wires.

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

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

Staff (data field): The arborist that collected the information will be noted

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

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

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

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

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

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

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

side (data field): Each site is assigned a side value to aid in locating the site. Side values include: *front*, *side to*, *side away*, *median* (includes islands), and *rear* based on the site's location in relation the lot's street frontage. The *front* side is the side that faces the address street. *Side to* is the name of the street the arborist is walking towards as data are being collected. The *side from* is the name of the street the arborist is walking away from while collecting data. *Median* indicates a median or island. The *rear* is the side of the lot opposite the front.

site (data field): All sites at an address are assigned a *site number*. Sites numbers are not unique; they are sequential to the side of the address only (the only unique number is the tree identification number assigned to each site). Site numbers are collected in the direction of vehicular traffic flow. The only exception is a one-way street. Site numbers along a one-way street are collected as if the street were actually a two-way street, so some site numbers will oppose traffic.

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

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

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

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

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

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

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

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

time (data field): The time of collection is noted

topping: Topping, reducing tree size using internodal cuts without regard to tree health or structural integrity, is not an acceptable pruning practice.

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

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

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

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

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

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

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

Appendix A. Site Location Methods

Equipment and Base Maps

Inventory arborists use CF-19 Panasonic Toughbook® unit(s) and Trimble® GPS Pathfinder® ProXH™ receiver(s).

Base map layers were loaded onto these unit(s) to help locate sites during the inventory. The table below lists the base map layers utilized along with source and format information for each layer.

Table 1. Base Map Layers Utilized for Inventory

Imagery/Data Source	Date	Projection
6 in Aerials from the City of Antioch	2012	NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Basemap layers from the City of Antioch	2012	NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet

Appendix B. Recommended Species for Future Planting

Proper landscaping and tree planting are critical components of the atmosphere, livability, and ecological quality of a community's urban forest. The tree species listed below have been evaluated for factors such as size, disease and pest resistance, seed or fruit set, and availability. The following list is offered to assist all relevant city personnel in selecting appropriate tree species. These trees have been selected because of their aesthetic and functional characteristics and their ability to thrive in the majority of soil and climate conditions (USDA Hardiness Zone 5b) found in Antioch, Illinois.

Deciduous Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer nigrum	black maple	
Acer saccharum	sugar maple	'Legacy'
*Aesculus flava**	yellow buckeye	
Aesculus hippocastanum	Horse chestnut	
Betula nigra	river birch	Heritage®
Carpinus betulus	European hornbeam	'Franz Fontaine'
Carya illinoinensis	Pecan	
*Castanea mollissima**	Chinese chestnut	
Celtis occidentalis	common hackberry	'Prairie Pride'
Cercidiphyllum japonicum	katsuratree	'Aureum'
Corylus colurna	Turkish filbert	
*Diospyros virginiana**	common persimmon	
*Fagus grandifolia**	American beech	
*Fagus sylvatica**	European beech	(numerous exist)
Ginkgo biloba	ginkgo	(male trees only)
Gymnocladus dioica	Kentucky coffeetree	Prairie Titan®
*Juglans regia**	English walnut	'Hansen'
*Larix decidua**	European larch	
Liquidambar styraciflua	American sweetgum	Cherokee™
Liriodendron tulipifera	tuliptree	'Fastigiatum'
Maclura pomifera	osage-orange	'White Shield','Witchita'
*Magnolia acuminata**	cucumbertree magnolia	(numerous exist)
*Magnolia macrophylla**	bigleaf magnolia	
Metasequoia glyptostroboides	dawn redwood	'Emerald Feathers'
Nyssa sylvatica	black tupelo	
Pinus flexilis	Limber pine	
Platanus x *acerifolia*	London planetree	'Yarwood'
*Platanus occidentalis**	American sycamore	
Quercus alba	white oak	
Quercus bicolor	swamp white oak	

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

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

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Aesculus x *carnea*	red horsechestnut	
*Alnus glutinosa**	common alder	'Pyramidalis'
Asimina triloba	paw paw	
Cladrastis kentukea	American yellowwood	'Rosea'
Eucommia ulmoides	hardy rubbertree	
Koelreuteria paniculata	goldenraintree	
Ostrya virginiana	eastern hophornbeam	
Parrotia persica	Persian parrotia	'Vanessa'
Phellodendron amurense	amur corktree	'Macho'
Prunus maackii	amur chokecherry	'Amber Beauty'
Prunus sargentii	Sargent cherry	
Pyrus calleryana	callery pear	'Earlyred'
Quercus acutissima	sawtooth oak	
Quercus cerris	European turkey oak	
Sorbus alnifolia	Korean mountainash	'Redbird'

Small Trees: 15 to 30 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Acer buergerianum	trident maple	Streetwise®
Acer campestre	hedge maple	Queen Elizabeth™
Acer cappadocicum	coliseum maple	'Aureum'
Acer ginnala	amur maple	Red Rhapsody™
Acer griseum	paperbark maple	
Acer miyabei	Miyabe maple	
Acer palmatum	Japanese maple	
*Acer pensylvanicum**	striped maple	
Acer truncatum	Shantung maple	
*Aesculus pavia**	red buckeye	
Amelanchier arborea	downy serviceberry	(numerous exist)
Amelanchier laevis	Allegheny serviceberry	
Carpinus caroliniana	American hornbeam	
Cercis canadensis	eastern redbud	'Forest Pansy'
Chionanthus virginicus	white fringetree	
Cornus alterniflolia	Pagoda dogwood	
Cornus kousa	Kousa dogwood	(numerous exist)
*Cornus mas**	corneliancherry dogwood	'Spring Sun'
Corylus avellana	European filbert	'Contorta'
*Cotinus coggygria**	common smoketree	'Flame'
*Cotinus obovata**	American smoketree	
Crataegus phaenopyrum	Washington hawthorn	Princeton Sentry™
Crataegus viridis	green hawthorn	'Winter King'
*Franklinia alatamaha**	Franklinia	
Halesia tetraptera	Carolina silverbell	'Arnold Pink'
Magnolia x *soulangiana**	saucer magnolia	'Alexandrina'
*Magnolia stellata**	star magnolia	'Centennial'
*Magnolia tripetala**	umbrella magnolia	
*Magnolia virginiana**	sweetbay magnolia	Moonglow®
Malus spp.	flowering crabapple	(disease resistant only)
Oxydendrum arboreum	sourwood	'Mt. Charm'
Prunus subhirtella	Higan cherry	pendula
Prunus virginiana	common chokecherry	'Schubert'
Styrax japonicus	Japanese snowbell	'Emerald Pagoda'
Syringa reticulata	Japanese tree lilac	'Ivory Silk'

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

Coniferous and Evergreen Trees

Large Trees: Greater than 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Abies balsamea	balsam fir	
Abies concolor	white fir	'Violacea'
Chamaecyparis nootkatensis	Nootka falsecypress	'Pendula'
Cryptomeria japonica	Japanese cryptomeria	'Sekkan-sugi'
*Ilex opaca**	American holly	
Picea omorika	Serbian spruce	
Picea orientalis	Oriental spruce	
Pinus densiflora	Japanese red pine	
Pinus strobus	eastern white pine	
Pinus sylvestris	Scotch pine	
Psedotsuga menziesii	Douglasfir	
Thuja plicata	western arborvitae	(numerous exist)
Tsuga canadensis	eastern hemlock	

Medium Trees: 31 to 45 Feet in Height at Maturity

Scientific Name	Common Name	Cultivar
Chamaecyparis thyoides	Atlantic whitecedar	(numerous exist)
Juniperus virginiana	eastern redcedar	
Pinus bungeana	lacebark pine	
Pinus flexilis	limber pine	
Thuja occidentalis	eastern arborvitae	(numerous exist)

Small Trees: 15 to 30 Feet in Height at Maturity

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

Note: * denotes species recommended for use as street trees.

This suggested species list was compiled using the excellent references *Dirr's Hardy Trees and Shrubs* (Dirr 2003) and *Manual of Woody Landscape Plants (5th Edition)* (Dirr 1998). Cultivar selections are only recommendations and are based on Davey Resource Group's experience and tree availability in the nursery trade.

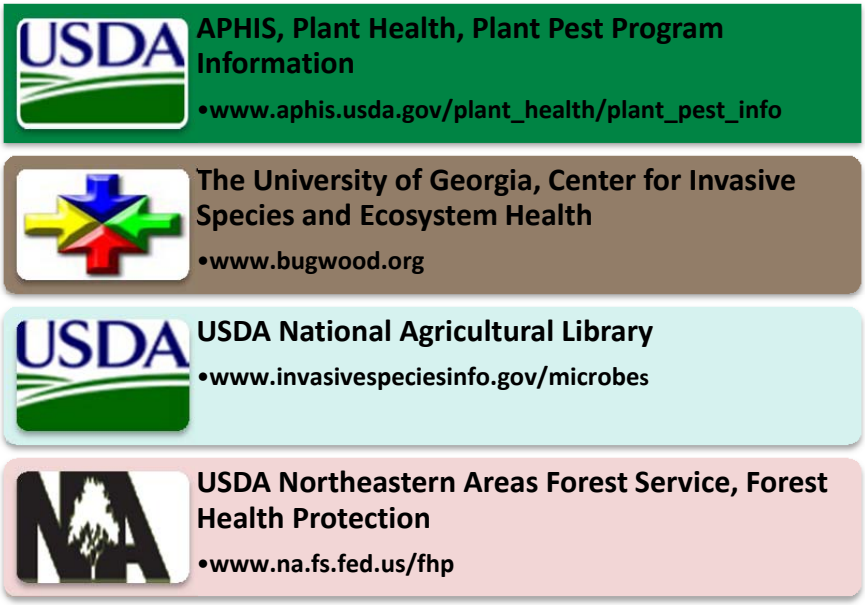
Appendix C. Invasive Pests and Diseases That Affect Trees

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

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

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

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



Asian Longhorned Beetle

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

Adult Asian longhorned beetle.
Photograph courtesy New Bedford Guide, 2011.

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

Bacterial Leaf Scorch

Bacterial leaf scorch (BLS) is an infectious chronic disease caused by the fastidious, gram-negative, xylem-limited bacterium *Xylella fastidiosa*. This bacterium, which is transmitted by xylem-feeding insects, colonizes and physically "clogs" the tree's water conducting tissues or xylem. Water transport becomes disrupted in roots, branches, and leaves due to large amounts of multiplying bacteria and their by-products. The presence of the bacteria also triggers a reaction in the tree that plugs the xylem, further impeding water transport and eventually killing the tree.

Photograph 2. "Leaf scorching" symptom

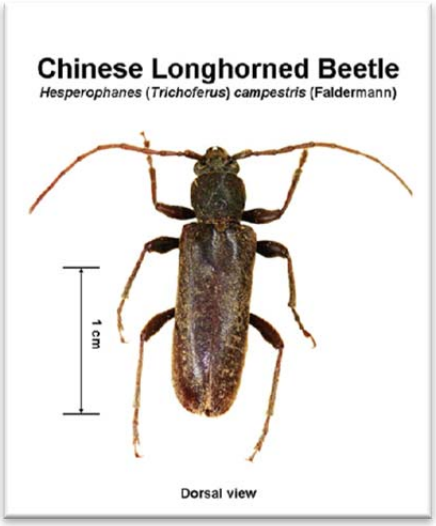
Bacterial leaf spreads systemically and causes slow decline and death of a tree. BLS is not new but is appearing more frequently in landscape trees in various parts of the country. It has been found in coastal U.S. states from New York to Texas, in Washington, DC, as well as in California, Indiana, Kentucky, Nebraska, and Ohio. This may simply be because more people recognize the symptoms.

Chinese Long-horned Beetle

Hesperophanes campestris; synonym *Trichoferus campestris* is similar to ALB and appeared for the first time in 2009 near O'Hare airport and in Crawford county in east central Illinois. It has also been found near Minneapolis, Minnesota and in Quebec, Canada.

The insect is originally from Asia and parts of Eastern Europe and spreads through movement of infested wood and by flying. It has a similar life cycle as the Asian long-horned beetle (ALB) and causes similar damage to trees.

Adults are elongate, 11 to 20 mm body with long antennae and parallel sided elytra (hardened wing covers). Dark brown to brownish-orange in color with legs and antennae often being lighter in color than rest of body. Elytra covered with short hairs.

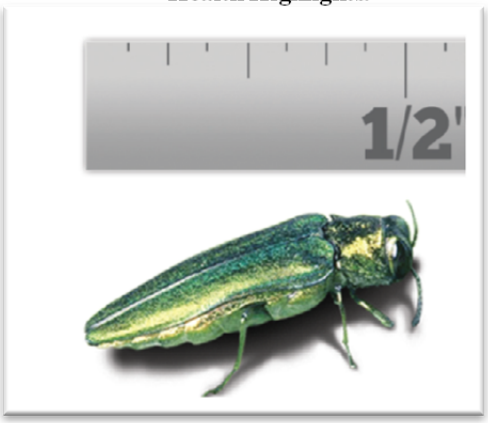


Photograph 3. Close-up of the adult Chineses long-horned beetle. Photograph from IL DNR Forest Health Highlights.

Emerald Ash Borer

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

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



Close-up of the emerald ash borer. Photograph from APHIS (a), 2011

The tree species preferred as hosts by the EAB are in the genus Fraxinus (ash).

Oak Wilt

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

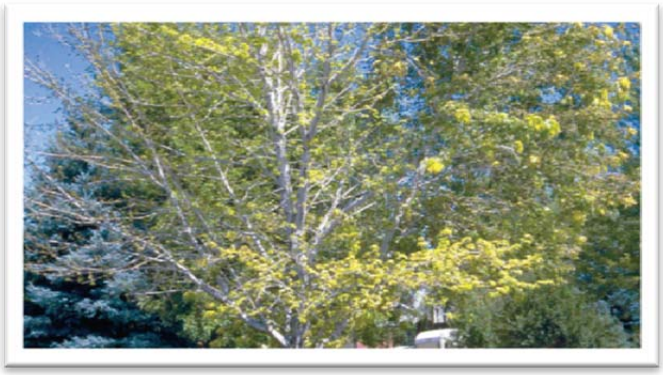
Oak wilt symptoms on red and white oak leaves. Photograph courtesy Rexrode and Brown (1983).

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

Verticillium Wilt

Verticillium wilt is a vascular wilt of hardwoods and is caused by two closely related species of fungi, *Verticillium albo-atrum* and *V. dahliae*. Typical symptoms include chlorosis, wilting, marginal and interveinal necrosis of the foliage, branch dieback, and mortality (Photograph 7). Symptoms often progress from the lower canopy upward.

Over 300 plant species are affected by Verticillium wilt and is particularly destructive to trees in landscaped plantings with ash, catalpa, elm, maple, and sumac being the most common hosts.



Photograph 8. Verticillium wilt on silver maple. Photograph from USDA Forest Service(c), 2013

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Appendix D. Estimated Costs for the Village of Antioch's Five-Year Tree Management Program

Estimated Costs for Each Activity			2014		2015		2016		2017		2018		Five-Year
Activity	Diameter	Cost/Tree	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	Cost
High Priority Removal	1-3"	$25	0	$0	0	$0	0	$0	0	$0	0	$0	$0
(excluding ash trees)	4-6"	$105	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$220	1	$220	0	$0	0	$0	0	$0	0	$0	$220
	13-18"	$355	11	$3,905	0	$0	0	$0	0	$0	0	$0	$3,905
	19-24"	$525	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	25-30"	$845	7	$5,915	0	$0	0	$0	0	$0	0	$0	$5,915
	31-36"	$1,140	5	$5,700	0	$0	0	$0	0	$0	0	$0	$5,700
	37-42"	$1,470	3	$4,410	0	$0	0	$0	0	$0	0	$0	$4,410
	43"+	$1,850	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			**27**	**$20,150**	0	$0	0	$0	0	$0	0	$0	**$20,150**
Low Priority Removal	1-3"	$25	0	$0	74	$1,850	0	$0	0	$0	0	$0	$1,850
(excluding ash trees)	4-6"	$105	0	$0	32	$3,360	0	$0	0	$0	0	$0	$3,360
	7-12"	$220	0	$0	10	$2,200	0	$0	0	$0	0	$0	$2,200
	13-18"	$355	0	$0	1	$355	0	$0	0	$0	0	$0	$355
	19-24"	$525	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	25-30"	$845	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	31-36"	$1,140	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	37-42"	$1,470	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	43"+	$1,850	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			0	$0	**117**	**$7,765**	0	$0	0	$0	0	$0	**$7,765**
Stump Removal	1-3"	$25	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4-6"	$25	0	$0	6	$150	0	$0	0	$0	0	$0	$150
	7-12"	$25	0	$0	7	$175	0	$0	0	$0	0	$0	$175
	13-18"	$40	0	$0	6	$240	0	$0	0	$0	0	$0	$240
	19-24"	$60	0	$0	4	$240	0	$0	0	$0	0	$0	$240
	25-30"	$85	0	$0	4	$340	0	$0	0	$0	0	$0	$340
	31-36"	$110	0	$0	3	$330	0	$0	0	$0	0	$0	$330
	37-42"	$130	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	43"+	$160	0	$0	1	$160	0	$0	0	$0	0	$0	$160
Activity Total(s)			0	$0	**31**	**$1,635**	0	$0	0	$0	0	$0	**$1,635**
Ash Removal	1-3"	$25	8	$200	20	$500	5	$125	0	$0	0	$0	$825
	4-6"	$105	41	$4,305	324	$34,020	154	$16,170	0	$0	0	$0	$54,495
	7-12"	$220	18	$3,960	0	$0	0	$0	0	$0	0	$0	$3,960
	13-18"	$355	12	$4,260	0	$0	0	$0	0	$0	0	$0	$4,260
	19-24"	$525	9	$4,725	0	$0	0	$0	0	$0	0	$0	$4,725
	25-30"	$845	2	$1,690	0	$0	0	$0	0	$0	0	$0	$1,690
	31-36"	$1,140	2	$2,280	0	$0	0	$0	0	$0	0	$0	$2,280
	37-42"	$1,470	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	43"+	$1,850	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			**92**	**$21,420**	**344**	**$34,520**	**159**	**$16,295**	0	$0	0	$0	**$72,235**
High Priority Prune	1-3"	$20	0	$0	0	$0	0	$0	0	$0	0	$0	$0
(excluding ash trees)	4-6"	$30	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$75	1	$75	0	$0	0	$0	0	$0	0	$0	$75
	13-18"	$120	3	$360	0	$0	0	$0	0	$0	0	$0	$360
	19-24"	$170	10	$1,700	0	$0	0	$0	0	$0	0	$0	$1,700
	25-30"	$225	11	$2,475	0	$0	0	$0	0	$0	0	$0	$2,475
	31-36"	$305	3	$915	0	$0	0	$0	0	$0	0	$0	$915
	37-42"	$380	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	43"+	$590	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			**28**	**$5,525**	0	$0	0	$0	0	$0	0	$0	**$5,525**
Routine Pruning	1-3"	$20	8	$160	8	$160	8	$160	8	$160	8	$160	$800
(excluding ash trees)	4-6"	$30	55	$1,650	55	$1,650	55	$1,650	55	$1,650	55	$1,650	$8,250
	7-12"	$75	137	$10,275	137	$10,275	137	$10,275	137	$10,275	137	$10,275	$51,375
	13-18"	$120	36	$4,320	36	$4,320	36	$4,320	36	$4,320	36	$4,320	$21,600
	19-24"	$170	18	$3,060	18	$3,060	18	$3,060	18	$3,060	18	$3,060	$15,300
	25-30"	$225	12	$2,700	12	$2,700	12	$2,700	12	$2,700	12	$2,700	$13,500
	31-36"	$305	4	$1,220	4	$1,220	4	$1,220	4	$1,220	4	$1,220	$6,100
	37-42"	$380	1	$380	1	$380	1	$380	1	$380	1	$380	$1,900
	43"+	$590	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			**271**	**$23,765**	**271**	**$23,765**	**271**	**$23,765**	**271**	**$23,765**	**271**	**$23,765**	**$118,825**
Ash Treatment*	1-3"	$12	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4-6"	$30	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$57	230	$13,110	229	$13,053	229	$13,053	229	$13,053	229	$13,053	$65,322
	13-18"	$93	15	$1,395	14	$1,302	14	$1,302	14	$1,302	14	$1,302	$6,603
	19-24"	$129	5	$645	5	$645	5	$645	5	$645	5	$645	$3,225
	25-30"	$165	2	$330	2	$330	2	$330	2	$330	2	$330	$1,650
	31-36"	$201	1	$201	0	$0	1	$201	0	$0	1	$201	$603
	37-42"	$237	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	43"+	$258	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			**253**	**$15,681**	**250**	**$15,330**	**251**	**$15,531**	**250**	**$15,330**	**251**	**$15,531**	**$77,403**
Treated Ash Routine Prune	1-3"	$20	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	4-6"	$30	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	7-12"	$75	230	$17,250	229	$17,175	229	$17,175	229	$17,175	229	$17,175	$85,950
	13-18"	$120	15	$1,800	14	$1,680	14	$1,680	14	$1,680	14	$1,680	$8,520
	19-24"	$170	5	$850	5	$850	5	$850	5	$850	5	$850	$4,250
	25-30"	$225	2	$450	2	$450	2	$450	2	$450	2	$450	$2,250
	31-36"	$305	1	$305	0	$0	1	$305	0	$0	1	$305	$915
	37-42"	$380	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	43"+	$590	0	$0	0	$0	0	$0	0	$0	0	$0	$0
Activity Total(s)			**253**	**$20,655**	**250**	**$20,155**	**251**	**$20,460**	**250**	**$20,155**	**251**	**$20,460**	**$101,885**
Young Tree Training Pruning	1-3"	$20	113	$2,260	113	$2,260	113	$2,260	113	$2,260	113	$2,260	$11,300
(excluding ash trees)	4-6"	$30	232	$6,960	232	$6,960	232	$6,960	232	$6,960	232	$6,960	$34,800
	7-12"	$75	4	$300	4	$300	4	$300	4	$300	4	$300	$1,500
Activity Total(s)			**349**	**$9,520**	**349**	**$9,520**	**349**	**$9,520**	**349**	**$9,520**	**349**	**$9,520**	**$47,600**
Tree Planting	Purchasing	$110	200	$22,000	200	$22,000	200	$22,000	200	$22,000	200	$22,000	$110,000
	Planting	$110	200	$22,000	200	$22,000	200	$22,000	200	$22,000	200	$22,000	$110,000
Activity Total(s)			**400**	**$44,000**	**400**	**$44,000**	**400**	**$44,000**	**400**	**$44,000**	**400**	**$44,000**	**$220,000**
Young Tree Maintenance	Mulching	TBD	0		0		0		0		0		$0
	Watering	TBD	0		0		0		0		0		$0
Activity Total(s)			0		0		0		0		0		$0
Activity Grand Total			**1673**		**2012**		**1681**		**1520**		**1522**		**$8,408**
Cost Grand Total				**$160,716**		**$156,690**		**$129,571**		**$112,770**		**$113,276**	**$673,023**

*Treatment cost assumes a cost of $6 per inch. Except for the 43"+ class, the cost per tree equation is dollars per inch x mean DBH of diameter class. The 43"+ class used 43".