# Birmingham, IA


2016 Urban Forest Management Plan
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# Executive Summary

## Overview

This plan was developed to assist the City of Birmingham with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 8% of Birmingham's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

## Inventory and Results

In 2015, a tree inventory was conducted by Matt Brewer, Iowa DNR, using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 132 trees inventoried.

- Birmingham's trees provide $25,402 of benefits annually, an average of $192 a tree
- There are over 30 species of trees
- The top three genera are: Maple 45%, Ash 8%, and Oak 8%
- 19% of trees are in need of some type of management
- 9 trees are recommended for removal

## Recommendations

The core recommendations are detailed in the Recommendations Section. The Emerald Ash Borer Plan includes management recommendations as well. Below are some key recommendations.

- Of the 9 trees needing removal, 5 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- 4 of the 11 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- Budget impacts from ash removal – Suggestion: request a budget increase to at least $800-$1,650 a year and apply for grants to plant replacement trees

# Introduction

This plan was developed to assist Birmingham with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with more and more of that money spent on tree removal. With the arrival of Emerald Ash Borer (EAB), an invasive pest that kills native ash trees, it is time to prepare for the increased costs of tree removal and replacement planting. With proper planning and management of the current canopy in Birmingham, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Birmingham's infrastructure and one of the greatest assets to the community. The benefits of trees are immense. Trees provide the community with improved air quality, stormwater runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and create a desirable place to live, to name just a few benefits. It is essential that these benefits be maintained for the people of Birmingham and future generations through good urban forestry management.

Good urban forestry management involves setting goals and developing management strategies to achieve these goals. An essential part of developing management strategies is a comprehensive public tree inventory. The inventory supplies information that will be used for maintenance, removal schedules, tree planting and budgeting. Basing actions on this information will help meet Birmingham's urban forestry goals.

# Inventory

In 2015, a tree inventory was conducted by Matt Brewer, Iowa DNR, that included 100% of the city owned trees on both streets and parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms associated with EAB were noted for all ash trees. The signs and symptoms noted

were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

# Inventory Results

The data collected for the 132 city trees was entered into the USDA Forest Service program i-Tree Streets, part of the i-Tree suite. The following are results from the i-Tree Streets analysis.

## *Annual Benefits*

### Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Birmingham's trees reduce energy related costs by approximately $6,262 annually (Appendix A, Table 1). These savings are both in Electricity (30.1 MWh) and in Natural Gas (4,062.5 Therms).

### Annual Stormwater Benefits

Birmingham's trees intercept about 345,015 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $9,350 of benefits to the city.

### Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and emitting volatile organic matter (ozone). In Birmingham, it is estimated that trees remove 386.9 lbs of air pollution (ozone ($O_3$), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide ($NO_2$), and sulfur dioxide ($SO_2$)) per year with a net value of $1,087 (Appendix A, Table 3).

### Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Birmingham, trees sequester about 89,594 lbs of carbon a year with an associated value of $672 (Appendix A, Table 4). In addition, the trees store 1,239,212 lbs of carbon, with a yearly benefit of $9,294 (Appendix A, Table 5).

### Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Birmingham receives $7,699 in annual social benefits from trees (Appendix A, Table 6).

### Financial Summary of all Benefits

According to the USDA Forest Service i-Tree Streets analysis, Birmingham's trees provide $25,402 of benefits annually. Benefits of individual trees vary based on size, species, health and

location, but on average each of the 132 trees in Birmingham provides approximately $192 annually (Appendix A, Table 7).

## ***Forest Structure***

### Species Distribution

Birmingham has over 30 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genera is as follows:

| | | |
|---|---|---|
| Maple | 60 | 45% |
| Ash | 11 | 8% |
| Oak | 11 | 8% |
| Eastern Redbud | 8 | 6% |
| Spruce | 7 | 5% |
| Mulberry | 6 | 5% |
| Elm | 5 | 4% |
| Catalpa | 3 | 2% |
| Black Walnut | 3 | 2% |
| Pine | 3 | 2% |
| Hackberry | 2 | 2% |
| Honeylocust | 2 | 2% |
| Apple/Crabapple | 2 | 2% |
| Eastern Red Cedar | 1 | 1% |
| Aspen/Cottonwood | 1 | 1% |
| Pear | 1 | 1% |
| | | |
| Other Small Deciduous | 4 | 3% |
| Other Large Deciduous | 1 | 1% |
| Other Large Evergreen | 1 | 1% |

### Age Class

Almost half of Birmingham's trees (45%) are between 18 and 36 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that a large number of trees are in the smallest size categories (a downward slope) to prepare for natural mortality and to maintain canopy cover. Birmingham will have an aging tree population as this 45% matures, and should consider new plantings (currently only 7% are under 6 inches in diameter) to develop the next generation of trees.

### Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Birmingham indicate that 62% of the trees are in good health, with only 2% of the foliage in poor health, dead or dying (Appendix A, Figure 3 &

Appendix B, Figure 3). Additionally, 56% of Birmingham's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 14% of the population. This 14% is an estimate of trees that need management follow up.

### Management Needs

The following outlines the specific management needs of the street and park trees by number of trees and percent of canopy (Appendix B, Figure 3).

| | | |
|---|---|---|
| Crown Cleaning | 16 | 12% |
| Tree Removal | 9 | 7% |

### Canopy Cover

The total canopy with both private and public trees is 10% (66 acres). The canopy cover included in the Birmingham inventory includes approximately 4 acres (Appendix A, Figure 4).

### Land Use and Location

The majority of Birmingham's city and park trees are in yard settings in single family residential neighborhoods (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

| Land Use | |
|---|---|
| Single family residential | 52% |
| Park/vacant/other | 47% |
| Small commercial | 2% |

| Location | |
|---|---|
| Front yard | 71% |
| Planting strip | 29% |

## Recommendations

### Risk Management

Hazardous trees can be a significant threat to both people and property. Trees that are dead or dying, or that have large issues such as trunk cracks longer than 18 inches should be removed. Broken branches and branches that interfere with motorist's vision of pedestrians, vehicles, traffic signs and signals, etc. should be removed.

Hazardous trees

Birmingham has 1 critical concern tree which needs immediate removal. This tree can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). Please

refer to the six year maintenance plan at the end of this section. After the critical concern tree is addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 25 trees with these needs.

Poor tree species

After the removal of the critical concern tree, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 9 removals, 0 are ash trees. There are a total of 11 ash trees, and 4 of those have signs and symptoms that have been associated with EAB. In addition, there are 0 ash trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

## Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

## Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant at least 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same or greater number of trees helps ensure continuation of the benefits of the existing forest in Birmingham.

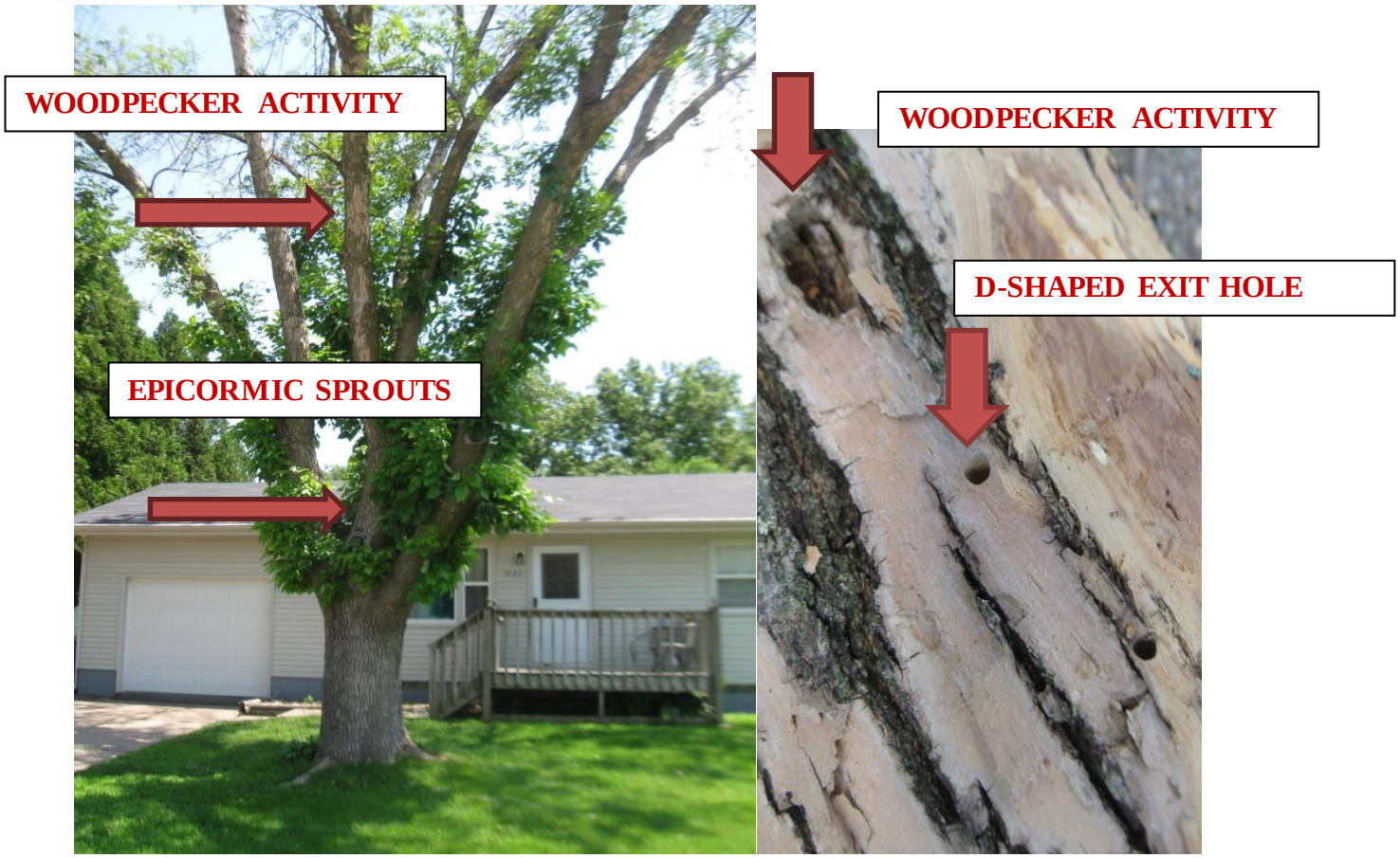
It is important to plant a diverse mix of species in the urban forest to maintain canopy health, since most insects and diseases target a genus (ash) or species (green ash) of trees. Current diversity recommendations advise that a genus (i.e. maple, oak) not make up more than 10% of the urban forest and a single species (i.e. silver maple, sugar maple, white oak, bur oak) not make up more than 5-10% of the total urban forest. Presently, the forest is heavily planted with maple (45%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

## Continual Monitoring For EAB

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended that ash trees be checked with a visual survey every year for tree decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped

borer exit holes, and wood pecker damage (See examples below). Once EAB arrives in Birmingham, it could potentially kill all ash within 4 to 10 years of its arrival.


**EAB infested tree in Muscatine with top thinning and many new green epicormic sprouts**




**EAB infested tree in Muscatine with sprouting, wood pecker activity, and D-shaped exit holes**

# Emerald Ash Borer Plan

## Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). *City ownership of the tree recommended for removal should be verified prior to any removal*

## Treatment of Ash Trees

Chemical treatment can be an effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit http://extension.entm.purdue.edu/treecomputer/

## EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:

- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

In addition, any other article, product or means of conveyance not listed above may be designated as a regulated article if a USDA inspector determines that it presents a risk of spreading EAB once a quarantine is in effect.

## Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? The entire state of Iowa is under quarantine, so regulated articles may not be moved into non-quarantined states. For more information, please visit http://www.emeraldashborer.info/.

### Canopy Replacement

As budget permits, all removed trees will be replaced. The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

### Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genera other than ash will be prioritized by hazardous or emergency situations only.

### Monitoring

It is recommended that ash trees be checked with a visual survey every year for tree death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

### Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB.

## Six Year Maintenance Plan and Cost Estimates

**Year 1 (FY 2016)**

| | |
|---|---|
| Remove 1 critical concern tree that needs immediate attention | $900 |
| Remove 4 trees (marked for removal) | $3,600 |
| Plant and Maintain 10 trees in open locations (pursue grants) | $1,000 |
| Ash tree treatment (if elected), 8 trees in good condition, average 12–18" | avg. $225/tree |
| -$15 per inch, treated every two years, see note | |
| *Or saving for future ash removal | |
| Visual Survey for signs and symptoms of EAB | |

**Year 2 (FY 2017)**

| | |
|---|---|
| Remove 4 trees (marked for removal) | $3,600 |
| Plant and Maintain 10 trees in open locations (pursue grants) | $1,000 |
| Ash tree treatment (if elected) or saving for future ash removal | |
| Routine trimming: Contract to trim 1/3 of the city trees (~$300 per tree) | |
| Visual Survey for signs and symptoms of EAB | |

**Year 3 (FY 2018)**

| | |
|---|---|
| Remove any new critical concern trees and ash in poor health | $900/tree |
| Plant and Maintain 20 trees in open locations (pursue grants) | $2,000 |
| Ash tree treatment (if elected) or saving for future ash removal | |
| Visual Survey for signs and symptoms of EAB | |

**Year 4 (FY 2019)**

| | |
|---|---|
| Remove any new critical concern trees and ash in poor health | $900/tree |
| Plant and Maintain 20 trees in open locations (pursue grants) | $2,000 |
| Ash tree treatment (if elected) or saving for future ash removal | |
| Routine trimming: Contract to trim 1/3 of the city trees (~$300 per tree) | |
| Visual Survey for signs and symptoms of EAB | |

**Year 5 (FY 2020)**

| | |
|---|---|
| Remove any new critical concern trees and ash in poor health | $900/tree |
| Plant and Maintain 20 trees in open locations (pursue grants) | $2,000 |
| Ash tree treatment (if elected) or saving for future ash removal | |
| Visual Survey for signs and symptoms of EAB | |

**Year 6 (FY 2021)**

| | |
|---|---|
| Remove any new critical concern trees and ash in poor health | $900/tree |
| Plant and Maintain 20 trees in open locations (pursue grants) | $2,000 |
| Ash tree treatment (if elected) or saving for future ash removal | |
| Routine trimming: Contract to trim 1/3 of the city trees (~$300 per tree) | |
| Visual Survey for signs and symptoms of EAB | |

*****Reduction of ash in poor health will reduce exposure to Emerald Ash Borer over time. EAB could potentially kill all ash within 4-15 years of its arrival.
******Assuming a cost of $900 per tree for removal, the budget would need to be increased to $1,650 a year to remove all ash trees within 6 years.
*******Suggest a future (post ash removal and replacement) budget of at least $2 per capita (population 448). Currently, this amount would cover about 55% of what would be needed to remove EAB infested trees over a six year period. Suggest setting aside additional funds to prepare for the expected arrival of EAB. Planting would be at least partially dependent on receiving grant funds annually.

Proposed Budget Increase

EAB could potentially kill all ash trees in Birmingham within 4-15 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $1,650 a year. If the budget were increased to $800 a year all ash could be removed within 13 years. Additionally, it is recommended that Birmingham apply for grants to fund replacement trees. Utility Company grants are usually between $500 and $10,000 for community-based, tree-planting projects that include parks, gateways, cemeteries, nature trails, libraries, nursing homes, and schools.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For an example, if the average ash diameter is 20 inches and treatment costs $15 per inch, then treating 10 trees would cost about $3,000 (every other year treatment). This would be 10 trees selected for treatment, and Birmingham would still need to find $900 per tree for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $4,500 every two years for treatment and leave five less trees for removal (for at least two more years). These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Birmingham. It is suggested to consider increasing the budget to plan for this.

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# Appendix A: i-Tree Data

**Table 1: Annual Energy Benefits**

## Annual Energy Benefits of Public Trees

1/15/2016

| Species | Total Electricity (MWh) | Electricity ($) | Total Natural Gas (Therms) | Natural Gas ($) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|
| Silver maple | 14.1 | 1,067 | 1,832.3 | 1,796 | 2,862 | (N/A) | 31.8 | 45.7 | 68.15 |
| Green ash | 2.6 | 195 | 343.5 | 337 | 532 | (N/A) | 8.3 | 8.5 | 48.36 |
| Eastern redbud | 0.9 | 67 | 136.1 | 133 | 201 | (N/A) | 6.1 | 3.2 | 25.07 |
| Swamp white oak | 0.7 | 51 | 108.1 | 106 | 157 | (N/A) | 6.1 | 2.5 | 19.62 |
| Spruce | 0.5 | 41 | 76.7 | 75 | 116 | (N/A) | 5.3 | 1.9 | 16.60 |
| Mulberry | 0.8 | 60 | 119.5 | 117 | 177 | (N/A) | 4.5 | 2.8 | 29.50 |
| Sugar maple | 1.0 | 79 | 133.5 | 131 | 210 | (N/A) | 3.8 | 3.4 | 41.98 |
| Norway maple | 1.0 | 78 | 135.9 | 133 | 211 | (N/A) | 3.0 | 3.4 | 52.79 |
| Broadleaf Deciduous Small | 0.0 | 2 | 5.7 | 6 | 8 | (N/A) | 3.0 | 0.1 | 2.00 |
| Elm | 1.3 | 97 | 174.4 | 171 | 268 | (N/A) | 3.0 | 4.3 | 67.02 |
| Black walnut | 0.7 | 52 | 98.7 | 97 | 149 | (N/A) | 2.3 | 2.4 | 49.62 |
| Catalpa | 1.0 | 79 | 147.4 | 144 | 224 | (N/A) | 2.3 | 3.6 | 74.61 |
| Apple | 0.2 | 14 | 25.3 | 25 | 39 | (N/A) | 1.5 | 0.6 | 19.50 |
| Maple | 0.4 | 28 | 46.6 | 46 | 74 | (N/A) | 1.5 | 1.2 | 36.76 |
| Boxelder | 0.5 | 36 | 67.1 | 66 | 102 | (N/A) | 1.5 | 1.6 | 50.95 |
| Pin oak | 0.7 | 51 | 92.0 | 90 | 141 | (N/A) | 1.5 | 2.3 | 70.52 |
| Eastern white pine | 0.3 | 21 | 34.3 | 34 | 55 | (N/A) | 1.5 | 0.9 | 27.30 |
| Red maple | 0.4 | 30 | 56.4 | 55 | 85 | (N/A) | 1.5 | 1.4 | 42.63 |
| Honeylocust | 0.7 | 56 | 94.8 | 93 | 149 | (N/A) | 1.5 | 2.4 | 74.28 |
| Amur maple | 0.4 | 28 | 49.3 | 48 | 76 | (N/A) | 1.5 | 1.2 | 38.13 |
| Northern hackberry | 0.5 | 37 | 73.0 | 72 | 109 | (N/A) | 1.5 | 1.7 | 54.41 |
| Scotch pine | 0.1 | 4 | 9.5 | 9 | 14 | (N/A) | 0.8 | 0.2 | 13.58 |
| Eastern red cedar | 0.0 | 0 | 0.7 | 1 | 1 | (N/A) | 0.8 | 0.0 | 0.93 |
| Eastern cottonwood | 0.4 | 33 | 59.0 | 58 | 91 | (N/A) | 0.8 | 1.5 | 91.02 |
| Siberian elm | 0.3 | 25 | 46.6 | 46 | 71 | (N/A) | 0.8 | 1.1 | 71.03 |
| Japanese maple | 0.1 | 6 | 12.8 | 13 | 18 | (N/A) | 0.8 | 0.3 | 18.19 |
| Broadleaf Deciduous Large | 0.3 | 25 | 46.9 | 46 | 71 | (N/A) | 0.8 | 1.1 | 70.91 |
| Northern red oak | 0.1 | 7 | 14.2 | 14 | 21 | (N/A) | 0.8 | 0.3 | 21.11 |
| Conifer Evergreen Large | 0.1 | 4 | 9.5 | 9 | 14 | (N/A) | 0.8 | 0.2 | 13.58 |
| Pear | 0.1 | 6 | 12.8 | 13 | 18 | (N/A) | 0.8 | 0.3 | 18.19 |
| Total | 30.1 | 2,281 | 4,062.5 | 3,981 | 6,262 | (N/A) | 100.0 | 100.0 | 47.44 |

**Table 2: Annual Stormwater Benefits**

## Annual Stormwater Benefits of Public Trees

1/15/2016

| Species | Total rainfall interception (Gal) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|
| Silver maple | 197,839 | 5,361 | (N/A) | 31.8 | 57.3 | 127.65 |
| Green ash | 22,736 | 616 | (N/A) | 8.3 | 6.6 | 56.01 |
| Eastern redbud | 3,634 | 98 | (N/A) | 6.1 | 1.1 | 12.31 |
| Swamp white oak | 3,691 | 100 | (N/A) | 6.1 | 1.1 | 12.50 |
| Spruce | 6,055 | 164 | (N/A) | 5.3 | 1.8 | 23.44 |
| Mulberry | 3,301 | 89 | (N/A) | 4.5 | 1.0 | 14.91 |
| Sugar maple | 9,157 | 248 | (N/A) | 3.8 | 2.7 | 49.63 |
| Norway maple | 7,992 | 217 | (N/A) | 3.0 | 2.3 | 54.14 |
| Broadleaf Deciduous Small | 91 | 2 | (N/A) | 3.0 | 0.0 | 0.62 |
| Elm | 14,842 | 402 | (N/A) | 3.0 | 4.3 | 100.55 |
| Black walnut | 7,141 | 194 | (N/A) | 2.3 | 2.1 | 64.51 |
| Catalpa | 13,376 | 363 | (N/A) | 2.3 | 3.9 | 120.83 |
| Apple | 674 | 18 | (N/A) | 1.5 | 0.2 | 9.13 |
| Maple | 2,229 | 60 | (N/A) | 1.5 | 0.6 | 30.21 |
| Boxelder | 5,323 | 144 | (N/A) | 1.5 | 1.5 | 72.12 |
| Pin oak | 7,181 | 195 | (N/A) | 1.5 | 2.1 | 97.30 |
| Eastern white pine | 4,508 | 122 | (N/A) | 1.5 | 1.3 | 61.08 |
| Red maple | 3,492 | 95 | (N/A) | 1.5 | 1.0 | 47.32 |
| Honeylocust | 9,370 | 254 | (N/A) | 1.5 | 2.7 | 126.96 |
| Amur maple | 1,333 | 36 | (N/A) | 1.5 | 0.4 | 18.06 |
| Northern hackberry | 4,237 | 115 | (N/A) | 1.5 | 1.2 | 57.41 |
| Scotch pine | 596 | 16 | (N/A) | 0.8 | 0.2 | 16.14 |
| Eastern red cedar | 24 | 1 | (N/A) | 0.8 | 0.0 | 0.66 |
| Eastern cottonwood | 7,239 | 196 | (N/A) | 0.8 | 2.1 | 196.17 |
| Siberian elm | 3,359 | 91 | (N/A) | 0.8 | 1.0 | 91.03 |
| Japanese maple | 264 | 7 | (N/A) | 0.8 | 0.1 | 7.17 |
| Broadleaf Deciduous Large | 3,943 | 107 | (N/A) | 0.8 | 1.1 | 106.85 |
| Northern red oak | 529 | 14 | (N/A) | 0.8 | 0.2 | 14.33 |
| Conifer Evergreen Large | 596 | 16 | (N/A) | 0.8 | 0.2 | 16.14 |
| Pear | 264 | 7 | (N/A) | 0.8 | 0.1 | 7.17 |
| Citywide total | 345,015 | 9,350 | (N/A) | 100.0 | 100.0 | 70.83 |

**Table 3: Annual Air Quality Benefits**

## Annual Air Quality Benefits of Public Trees

1/15/2016

| Species | Deposition (lb) | | | | Total Depos. ($) | Avoided (lb) | | | | Total Avoided ($) | BVOC Emissions (lb) | BVOC Emissions ($) | Total (lb) | Total ($) Standard Error | % of Total Trees | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $O_3$ | $NO_2$ | $PM_{10}$ | $SO_2$ | | $NO_2$ | $PM_{10}$ | VOC | $SO_2$ | | | | | | | |
| Silver maple | 33.7 | 5.7 | 16.6 | 1.5 | 182 | 66.1 | 9.7 | 9.3 | 63.6 | 414 | -17.3 | -65 | 188.9 | 531 (N/A) | 31.8 | 12.65 |
| Green ash | 2.3 | 0.4 | 1.2 | 0.1 | 12 | 12.2 | 1.8 | 1.7 | 11.7 | 76 | 0.0 | 0 | 31.3 | 89 (N/A) | 8.3 | 8.06 |
| Eastern redbud | 1.0 | 0.2 | 0.5 | 0.0 | 6 | 4.4 | 0.6 | 0.6 | 4.0 | 27 | 0.0 | 0 | 11.3 | 32 (N/A) | 6.1 | 4.04 |
| Swamp white oak | 0.3 | 0.1 | 0.2 | 0.0 | 2 | 3.4 | 0.5 | 0.5 | 3.0 | 21 | -0.1 | 0 | 7.9 | 22 (N/A) | 6.1 | 2.77 |
| Spruce | 0.6 | 0.1 | 0.6 | 0.1 | 4 | 2.6 | 0.4 | 0.4 | 2.4 | 16 | -1.9 | -7 | 5.2 | 13 (N/A) | 5.3 | 1.86 |
| Mulberry | 1.0 | 0.2 | 0.5 | 0.0 | 5 | 3.9 | 0.6 | 0.5 | 3.6 | 24 | 0.0 | 0 | 10.2 | 29 (N/A) | 4.5 | 4.85 |
| Sugar maple | 1.1 | 0.2 | 0.6 | 0.0 | 6 | 4.9 | 0.7 | 0.7 | 4.7 | 31 | -0.9 | -3 | 12.0 | 33 (N/A) | 3.8 | 6.67 |
| Norway maple | 1.5 | 0.3 | 0.8 | 0.1 | 8 | 4.9 | 0.7 | 0.7 | 4.7 | 30 | -0.4 | -1 | 13.2 | 37 (N/A) | 3.0 | 9.33 |
| Broadleaf Deciduous Small | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.2 | 0.0 | 0.0 | 0.1 | 1 | 0.0 | 0 | 0.4 | 1 (N/A) | 3.0 | 0.26 |
| Elm | 1.9 | 0.3 | 0.9 | 0.1 | 10 | 6.1 | 0.9 | 0.8 | 5.8 | 38 | 0.0 | 0 | 16.8 | 48 (N/A) | 3.0 | 12.02 |
| Black walnut | 0.8 | 0.1 | 0.4 | 0.0 | 4 | 3.3 | 0.5 | 0.5 | 3.1 | 21 | 0.0 | 0 | 8.7 | 25 (N/A) | 2.3 | 8.27 |
| Catalpa | 1.8 | 0.3 | 0.8 | 0.1 | 9 | 5.0 | 0.7 | 0.7 | 4.7 | 31 | 0.0 | 0 | 14.2 | 41 (N/A) | 2.3 | 13.55 |
| Apple | 0.2 | 0.0 | 0.1 | 0.0 | 1 | 0.9 | 0.1 | 0.1 | 0.8 | 6 | 0.0 | 0 | 2.3 | 7 (N/A) | 1.5 | 3.33 |
| Maple | 0.4 | 0.1 | 0.2 | 0.0 | 2 | 1.7 | 0.3 | 0.2 | 1.7 | 11 | -0.2 | -1 | 4.4 | 12 (N/A) | 1.5 | 6.20 |
| Boxelder | 0.7 | 0.1 | 0.3 | 0.0 | 4 | 2.3 | 0.3 | 0.3 | 2.2 | 14 | -0.3 | -1 | 6.0 | 17 (N/A) | 1.5 | 8.42 |
| Pin oak | 1.2 | 0.2 | 0.6 | 0.1 | 7 | 3.2 | 0.5 | 0.4 | 3.0 | 20 | -2.3 | -8 | 7.0 | 18 (N/A) | 1.5 | 9.04 |
| Eastern white pine | 0.5 | 0.1 | 0.4 | 0.1 | 3 | 1.3 | 0.2 | 0.2 | 1.2 | 8 | -1.9 | -7 | 2.1 | 4 (N/A) | 1.5 | 2.13 |
| Red maple | 0.8 | 0.1 | 0.4 | 0.0 | 4 | 1.9 | 0.3 | 0.3 | 1.8 | 12 | -0.3 | -1 | 5.3 | 15 (N/A) | 1.5 | 7.59 |
| Honeylocust | 1.9 | 0.3 | 0.8 | 0.1 | 10 | 3.4 | 0.5 | 0.5 | 3.3 | 22 | -1.5 | -6 | 9.3 | 26 (N/A) | 1.5 | 12.87 |
| Amur maple | 0.4 | 0.1 | 0.2 | 0.0 | 2 | 1.7 | 0.3 | 0.2 | 1.7 | 11 | 0.0 | 0 | 4.6 | 13 (N/A) | 1.5 | 6.56 |
| Northern hackberry | 0.6 | 0.1 | 0.3 | 0.0 | 3 | 2.4 | 0.3 | 0.3 | 2.2 | 15 | 0.0 | 0 | 6.3 | 18 (N/A) | 1.5 | 9.03 |
| Scotch pine | 0.1 | 0.0 | 0.1 | 0.0 | 0 | 0.3 | 0.0 | 0.0 | 0.3 | 2 | -0.2 | -1 | 0.6 | 1 (N/A) | 0.8 | 1.48 |
| Eastern red cedar | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 (N/A) | 0.8 | 0.09 |
| Eastern cottonwood | 1.2 | 0.2 | 0.5 | 0.1 | 6 | 2.1 | 0.3 | 0.3 | 2.0 | 13 | 0.0 | 0 | 6.6 | 19 (N/A) | 0.8 | 19.04 |
| Siberian elm | 0.5 | 0.1 | 0.3 | 0.0 | 3 | 1.6 | 0.2 | 0.2 | 1.5 | 10 | 0.0 | 0 | 4.4 | 13 (N/A) | 0.8 | 12.72 |
| Japanese maple | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.4 | 0.1 | 0.1 | 0.3 | 2 | 0.0 | 0 | 0.9 | 3 (N/A) | 0.8 | 2.55 |
| Broadleaf Deciduous Large | 0.5 | 0.1 | 0.2 | 0.0 | 3 | 1.6 | 0.2 | 0.2 | 1.5 | 10 | 0.0 | 0 | 4.4 | 12 (N/A) | 0.8 | 12.48 |
| Northern red oak | 0.1 | 0.0 | 0.0 | 0.0 | 0 | 0.5 | 0.1 | 0.1 | 0.4 | 3 | -0.1 | 0 | 1.1 | 3 (N/A) | 0.8 | 2.89 |
| Conifer Evergreen Large | 0.1 | 0.0 | 0.1 | 0.0 | 0 | 0.3 | 0.0 | 0.0 | 0.3 | 2 | -0.2 | -1 | 0.6 | 1 (N/A) | 0.8 | 1.48 |
| Pear | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.4 | 0.1 | 0.1 | 0.3 | 2 | 0.0 | 0 | 0.9 | 3 (N/A) | 0.8 | 2.55 |
| Citywide total | 55.2 | 9.3 | 27.6 | 2.6 | 299 | 142.8 | 20.8 | 19.9 | 136.1 | 891 | -27.4 | -103 | 386.9 | 1,087 (N/A) | 100.0 | 8.24 |

**Table 4: Annual Carbon Stored**

## Stored CO2 Benefits of Public Trees

1/15/2016

| Species | Total Stored CO2 (lbs) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|
| Silver maple | 737,657 | 5,532 | (N/A) | 31.8 | 59.5 | 131.72 |
| Green ash | 73,675 | 553 | (N/A) | 8.3 | 5.9 | 50.23 |
| Eastern redbud | 16,626 | 125 | (N/A) | 6.1 | 1.3 | 15.59 |
| Swamp white oak | 6,839 | 51 | (N/A) | 6.1 | 0.6 | 6.41 |
| Spruce | 3,624 | 27 | (N/A) | 5.3 | 0.3 | 3.88 |
| Mulberry | 15,541 | 117 | (N/A) | 4.5 | 1.3 | 19.43 |
| Sugar maple | 32,255 | 242 | (N/A) | 3.8 | 2.6 | 48.38 |
| Norway maple | 25,153 | 189 | (N/A) | 3.0 | 2.0 | 47.16 |
| Broadleaf Deciduous | 219 | 2 | (N/A) | 3.0 | 0.0 | 0.41 |
| Elm | 61,161 | 459 | (N/A) | 3.0 | 4.9 | 114.68 |
| Black walnut | 25,265 | 189 | (N/A) | 2.3 | 2.0 | 63.16 |
| Catalpa | 57,489 | 431 | (N/A) | 2.3 | 4.6 | 143.72 |
| Apple | 3,051 | 23 | (N/A) | 1.5 | 0.2 | 11.44 |
| Maple | 4,725 | 35 | (N/A) | 1.5 | 0.4 | 17.72 |
| Boxelder | 22,225 | 167 | (N/A) | 1.5 | 1.8 | 83.35 |
| Pin oak | 30,478 | 229 | (N/A) | 1.5 | 2.5 | 114.29 |
| Eastern white pine | 4,513 | 34 | (N/A) | 1.5 | 0.4 | 16.92 |
| Red maple | 9,046 | 68 | (N/A) | 1.5 | 0.7 | 33.92 |
| Honeylocust | 24,490 | 184 | (N/A) | 1.5 | 2.0 | 91.84 |
| Amur maple | 6,074 | 46 | (N/A) | 1.5 | 0.5 | 22.78 |
| Northern hackberry | 8,473 | 64 | (N/A) | 1.5 | 0.7 | 31.77 |
| Scotch pine | 257 | 2 | (N/A) | 0.8 | 0.0 | 1.93 |
| Eastern red cedar | 3 | 0 | (N/A) | 0.8 | 0.0 | 0.02 |
| Eastern cottonwood | 39,259 | 294 | (N/A) | 0.8 | 3.2 | 294.44 |
| Siberian elm | 12,245 | 92 | (N/A) | 0.8 | 1.0 | 91.84 |
| Japanese maple | 908 | 7 | (N/A) | 0.8 | 0.1 | 6.81 |
| Broadleaf Deciduous | 15,773 | 118 | (N/A) | 0.8 | 1.3 | 118.30 |
| Northern red oak | 1,025 | 8 | (N/A) | 0.8 | 0.1 | 7.68 |
| Conifer Evergreen La | 257 | 2 | (N/A) | 0.8 | 0.0 | 1.93 |
| Pear | 908 | 7 | (N/A) | 0.8 | 0.1 | 6.81 |
| Citywide total | 1,239,212 | 9,294 | (N/A) | 100.0 | 100.0 | 70.41 |

**Table 5: Annual Carbon Sequestered**

**Annual $CO_2$ Benefits of Public Trees**

1/15/2016

| Species | Sequestered (lb) | Sequestered ($) | Decomposition Release (lb) | Maintenance Release (lb) | Total Released ($) | Avoided (lb) | Avoided ($) | Net Total (lb) | Total Standard ($) Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Silver maple | 56,743 | 426 | -3,541 | -152 | -28 | 23,573 | 177 | 76,623 | 575 (N/A) | 31.8 | 57.3 | 13.68 |
| Green ash | 5,892 | 44 | -354 | -25 | -3 | 4,318 | 32 | 9,830 | 74 (N/A) | 8.3 | 7.4 | 6.70 |
| Eastern redbud | 1,507 | 11 | -80 | -12 | -1 | 1,486 | 11 | 2,901 | 22 (N/A) | 6.1 | 2.2 | 2.72 |
| Swamp white oak | 1,445 | 11 | -34 | -8 | 0 | 1,127 | 8 | 2,530 | 19 (N/A) | 6.1 | 1.9 | 2.37 |
| Spruce | 494 | 4 | -17 | -10 | 0 | 905 | 7 | 1,372 | 10 (N/A) | 5.3 | 1.0 | 1.47 |
| Mulberry | 877 | 7 | -75 | -11 | -1 | 1,324 | 10 | 2,116 | 16 (N/A) | 4.5 | 1.6 | 2.64 |
| Sugar maple | 1,931 | 14 | -155 | -11 | -1 | 1,747 | 13 | 3,512 | 26 (N/A) | 3.8 | 2.6 | 5.27 |
| Norway maple | 1,528 | 11 | -121 | -9 | -1 | 1,724 | 13 | 3,121 | 23 (N/A) | 3.0 | 2.3 | 5.85 |
| Broadleaf Deciduous Smal | 64 | 0 | -1 | -1 | 0 | 54 | 0 | 116 | 1 (N/A) | 3.0 | 0.1 | 0.22 |
| Elm | 3,119 | 23 | -294 | -13 | -2 | 2,147 | 16 | 4,959 | 37 (N/A) | 3.0 | 3.7 | 9.30 |
| Black walnut | 1,725 | 13 | -121 | -7 | -1 | 1,152 | 9 | 2,749 | 21 (N/A) | 2.3 | 2.1 | 6.87 |
| Catalpa | 2,673 | 20 | -276 | -11 | -2 | 1,755 | 13 | 4,141 | 31 (N/A) | 2.3 | 3.1 | 10.35 |
| Apple | 276 | 2 | -15 | -2 | 0 | 314 | 2 | 574 | 4 (N/A) | 1.5 | 0.4 | 2.15 |
| Maple | 648 | 5 | -23 | -3 | 0 | 616 | 5 | 1,239 | 9 (N/A) | 1.5 | 0.9 | 4.65 |
| Boxelder | 1,733 | 13 | -107 | -6 | -1 | 799 | 6 | 2,419 | 18 (N/A) | 1.5 | 1.8 | 9.07 |
| Pin oak | 2,982 | 22 | -146 | -7 | -1 | 1,123 | 8 | 3,953 | 30 (N/A) | 1.5 | 3.0 | 14.82 |
| Eastern white pine | 303 | 2 | -22 | -5 | 0 | 463 | 3 | 739 | 6 (N/A) | 1.5 | 0.6 | 2.77 |
| Red maple | 165 | 1 | -43 | -4 | 0 | 663 | 5 | 780 | 6 (N/A) | 1.5 | 0.6 | 2.93 |
| Honeylocust | 1,486 | 11 | -118 | -5 | -1 | 1,230 | 9 | 2,592 | 19 (N/A) | 1.5 | 1.9 | 9.72 |
| Amur maple | 535 | 4 | -29 | -4 | 0 | 617 | 5 | 1,119 | 8 (N/A) | 1.5 | 0.8 | 4.20 |
| Northern hackberry | 578 | 4 | -41 | -5 | 0 | 823 | 6 | 1,356 | 10 (N/A) | 1.5 | 1.0 | 5.08 |
| Scotch pine | 53 | 0 | -1 | -1 | 0 | 94 | 1 | 145 | 1 (N/A) | 0.8 | 0.1 | 1.08 |
| Eastern red cedar | 1 | 0 | 0 | 0 | 0 | 6 | 0 | 6 | 0 (N/A) | 0.8 | 0.0 | 0.05 |
| Eastern cottonwood | 912 | 7 | -188 | -5 | -1 | 734 | 6 | 1,453 | 11 (N/A) | 0.8 | 1.1 | 10.90 |
| Siberian elm | 640 | 5 | -59 | -4 | 0 | 561 | 4 | 1,139 | 9 (N/A) | 0.8 | 0.9 | 8.54 |
| Japanese maple | 114 | 1 | -4 | -1 | 0 | 124 | 1 | 232 | 2 (N/A) | 0.8 | 0.2 | 1.74 |
| Broadleaf Deciduous Larg | 857 | 6 | -76 | -4 | -1 | 552 | 4 | 1,330 | 10 (N/A) | 0.8 | 1.0 | 9.97 |
| Northern red oak | 147 | 1 | -5 | -1 | 0 | 160 | 1 | 301 | 2 (N/A) | 0.8 | 0.2 | 2.26 |
| Conifer Evergreen Large | 53 | 0 | -1 | -1 | 0 | 94 | 1 | 145 | 1 (N/A) | 0.8 | 0.1 | 1.08 |
| Pear | 114 | 1 | -4 | -1 | 0 | 124 | 1 | 232 | 2 (N/A) | 0.8 | 0.2 | 1.74 |
| Citywide total | 89,594 | 672 | -5,949 | -330 | -47 | 50,410 | 378 | 133,725 | 1,003 (N/A) | 100.0 | 100.0 | 7.60 |

**Table 6: Annual Social and Aesthetic Benefits**

# Annual Aesthetic/Other Benefits of Public Trees

1/15/2016

| Species | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|
| Silver maple | 4,427 | (N/A) | 31.8 | 57.5 | 105.40 |
| Green ash | 545 | (N/A) | 8.3 | 7.1 | 49.53 |
| Eastern redbud | 87 | (N/A) | 6.1 | 1.1 | 10.93 |
| Swamp white oak | 173 | (N/A) | 6.1 | 2.2 | 21.62 |
| Spruce | 142 | (N/A) | 5.3 | 1.8 | 20.25 |
| Mulberry | 50 | (N/A) | 4.5 | 0.7 | 8.36 |
| Sugar maple | 219 | (N/A) | 3.8 | 2.8 | 43.75 |
| Norway maple | 149 | (N/A) | 3.0 | 1.9 | 37.23 |
| Broadleaf Deciduous Small | 2 | (N/A) | 3.0 | 0.0 | 0.54 |
| Elm | 244 | (N/A) | 3.0 | 3.2 | 60.91 |
| Black walnut | 152 | (N/A) | 2.3 | 2.0 | 50.61 |
| Catalpa | 198 | (N/A) | 2.3 | 2.6 | 65.93 |
| Apple | 16 | (N/A) | 1.5 | 0.2 | 7.76 |
| Maple | 96 | (N/A) | 1.5 | 1.2 | 47.86 |
| Boxelder | 117 | (N/A) | 1.5 | 1.5 | 58.53 |
| Pin oak | 233 | (N/A) | 1.5 | 3.0 | 116.38 |
| Eastern white pine | 79 | (N/A) | 1.5 | 1.0 | 39.70 |
| Red maple | 30 | (N/A) | 1.5 | 0.4 | 14.92 |
| Honeylocust | 389 | (N/A) | 1.5 | 5.1 | 194.45 |
| Amur maple | 31 | (N/A) | 1.5 | 0.4 | 15.48 |
| Northern hackberry | 88 | (N/A) | 1.5 | 1.1 | 43.91 |
| Scotch pine | 15 | (N/A) | 0.8 | 0.2 | 15.42 |
| Eastern red cedar | 4 | (N/A) | 0.8 | 0.1 | 4.27 |
| Eastern cottonwood | 58 | (N/A) | 0.8 | 0.8 | 58.34 |
| Siberian elm | 46 | (N/A) | 0.8 | 0.6 | 46.00 |
| Japanese maple | 6 | (N/A) | 0.8 | 0.1 | 6.40 |
| Broadleaf Deciduous Large | 66 | (N/A) | 0.8 | 0.9 | 65.59 |
| Northern red oak | 16 | (N/A) | 0.8 | 0.2 | 16.24 |
| Conifer Evergreen Large | 15 | (N/A) | 0.8 | 0.2 | 15.42 |
| Pear | 6 | (N/A) | 0.8 | 0.1 | 6.40 |
| Citywide total | 7,699 | (N/A) | 100.0 | 100.0 | 58.33 |

**Table 7: Summary of Benefits in Dollars**

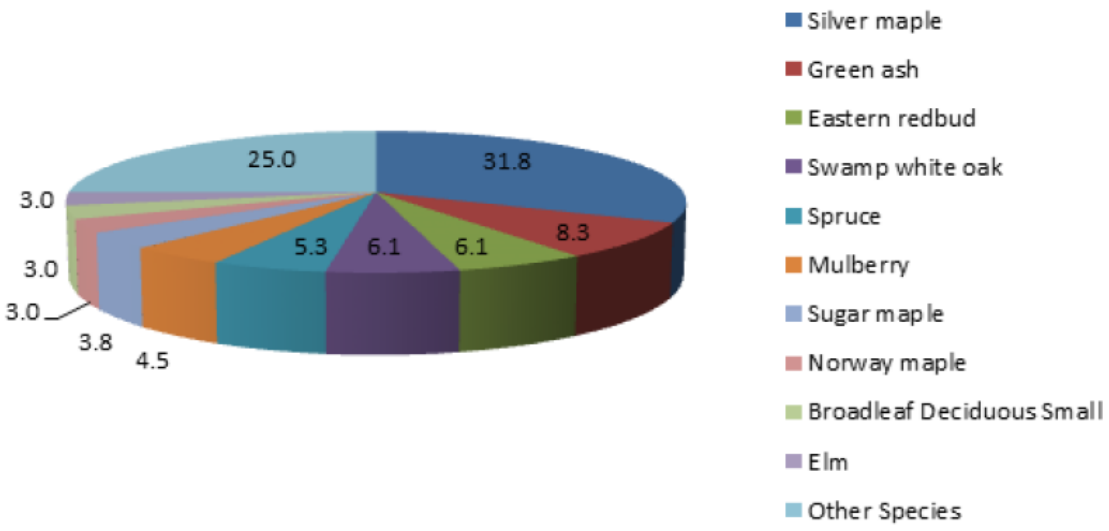
## Total Annual Benefits of Public Trees by Species ($)

1/15/2016

| Species | Energy | $CO_2$ | Air Quality | Stormwater | Aesthetic/Other | Total ($) | Standard Error | % of Total $ |
|---|---|---|---|---|---|---|---|---|
| Silver maple | 2,862 | 575 | 531 | 5,361 | 4,427 | 13,757 | (N/A) | 54.2 |
| Green ash | 532 | 74 | 89 | 616 | 545 | 1,855 | (N/A) | 7.3 |
| Eastern redbud | 201 | 22 | 32 | 98 | 87 | 441 | (N/A) | 1.7 |
| Swamp white oak | 157 | 19 | 22 | 100 | 173 | 471 | (N/A) | 1.9 |
| Spruce | 116 | 10 | 13 | 164 | 142 | 445 | (N/A) | 1.8 |
| Mulberry | 177 | 16 | 29 | 89 | 50 | 362 | (N/A) | 1.4 |
| Sugar maple | 210 | 26 | 33 | 248 | 219 | 736 | (N/A) | 2.9 |
| Norway maple | 211 | 23 | 37 | 217 | 149 | 637 | (N/A) | 2.5 |
| Broadleaf Deciduous Sn | 8 | 1 | 1 | 2 | 2 | 15 | (N/A) | 0.1 |
| Elm | 268 | 37 | 48 | 402 | 244 | 999 | (N/A) | 3.9 |
| Black walnut | 149 | 21 | 25 | 194 | 152 | 540 | (N/A) | 2.1 |
| Catalpa | 224 | 31 | 41 | 363 | 198 | 856 | (N/A) | 3.4 |
| Apple | 39 | 4 | 7 | 18 | 16 | 84 | (N/A) | 0.3 |
| Maple | 74 | 9 | 12 | 60 | 96 | 251 | (N/A) | 1.0 |
| Boxelder | 102 | 18 | 17 | 144 | 117 | 398 | (N/A) | 1.6 |
| Pin oak | 141 | 30 | 18 | 195 | 233 | 616 | (N/A) | 2.4 |
| Eastern white pine | 55 | 6 | 4 | 122 | 79 | 266 | (N/A) | 1.0 |
| Red maple | 85 | 6 | 15 | 95 | 30 | 231 | (N/A) | 0.9 |
| Honeylocust | 149 | 19 | 26 | 254 | 389 | 837 | (N/A) | 3.3 |
| Amur maple | 76 | 8 | 13 | 36 | 31 | 165 | (N/A) | 0.6 |
| Northern hackberry | 109 | 10 | 18 | 115 | 88 | 340 | (N/A) | 1.3 |
| Scotch pine | 14 | 1 | 1 | 16 | 15 | 48 | (N/A) | 0.2 |
| Eastern red cedar | 1 | 0 | 0 | 1 | 4 | 6 | (N/A) | 0.0 |
| Eastern cottonwood | 91 | 11 | 19 | 196 | 58 | 375 | (N/A) | 1.5 |
| Siberian elm | 71 | 9 | 13 | 91 | 46 | 229 | (N/A) | 0.9 |
| Japanese maple | 18 | 2 | 3 | 7 | 6 | 36 | (N/A) | 0.1 |
| Broadleaf Deciduous La | 71 | 10 | 12 | 107 | 66 | 266 | (N/A) | 1.0 |
| Northern red oak | 21 | 2 | 3 | 14 | 16 | 57 | (N/A) | 0.2 |
| Conifer Evergreen Large | 14 | 1 | 1 | 16 | 15 | 48 | (N/A) | 0.2 |
| Pear | 18 | 2 | 3 | 7 | 6 | 36 | (N/A) | 0.1 |
| Citywide Total | 6,262 | 1,003 | 1,087 | 9,350 | 7,699 | 25,402 | (N/A) | 100.0 |

## Species Distribution of Public Trees

1/15/2016

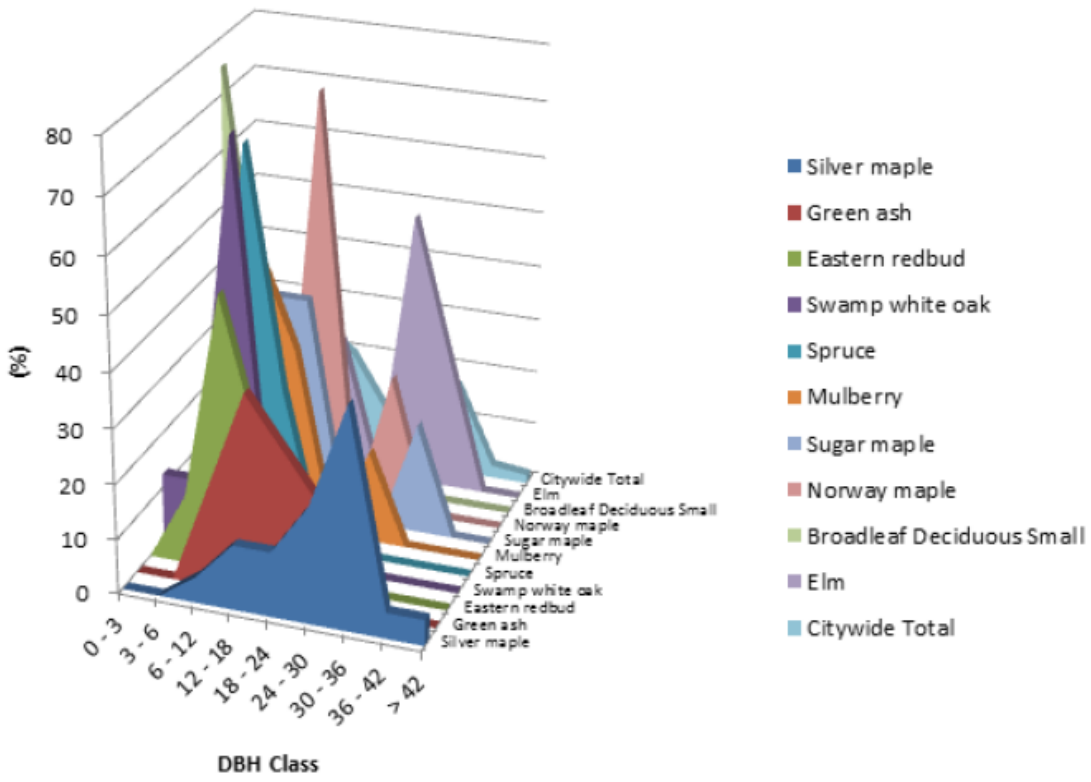



| Species | Percent |
|---|---|
| Silver maple | 31.8 |
| Green ash | 8.3 |
| Eastern redbud | 6.1 |
| Swamp white oak | 6.1 |
| Spruce | 5.3 |
| Mulberry | 4.5 |
| Sugar maple | 3.8 |
| Norway maple | 3.0 |
| Broadleaf Deciduous Small | 3.0 |
| Elm | 3.0 |
| Other Species | 25.0 |
| Total | 100.0 |

**Figure 1: Species Distribution**

## Relative Age Distribution of Top 10 Public Tree Species for All Zones (%)

1/15/2016




| | DBH class (in) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Species | 0-3 | 3-6 | 6-12 | 12-18 | 18-24 | 24-30 | 30-36 | 36-42 | > 42 |
| Silver maple | 0.00 | 0.00 | 4.76 | 11.90 | 11.90 | 21.43 | 40.48 | 4.76 | 4.76 |
| Green ash | 0.00 | 0.00 | 18.18 | 36.36 | 27.27 | 18.18 | 0.00 | 0.00 | 0.00 |
| Eastern redbud | 0.00 | 12.50 | 50.00 | 25.00 | 12.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| Swamp white oak | 12.50 | 12.50 | 75.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Spruce | 0.00 | 0.00 | 71.43 | 28.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mulberry | 0.00 | 0.00 | 50.00 | 33.33 | 0.00 | 16.67 | 0.00 | 0.00 | 0.00 |
| Sugar maple | 0.00 | 0.00 | 40.00 | 40.00 | 0.00 | 0.00 | 20.00 | 0.00 | 0.00 |
| Norway maple | 0.00 | 0.00 | 0.00 | 75.00 | 0.00 | 25.00 | 0.00 | 0.00 | 0.00 |
| Broadleaf Deciduous Sm | 75.00 | 25.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Elm | 0.00 | 0.00 | 0.00 | 25.00 | 0.00 | 50.00 | 25.00 | 0.00 | 0.00 |
| Citywide Total | 4.55 | 2.27 | 25.00 | 19.70 | 9.09 | 18.94 | 16.67 | 2.27 | 1.52 |

**Figure 2: Relative Age Class**

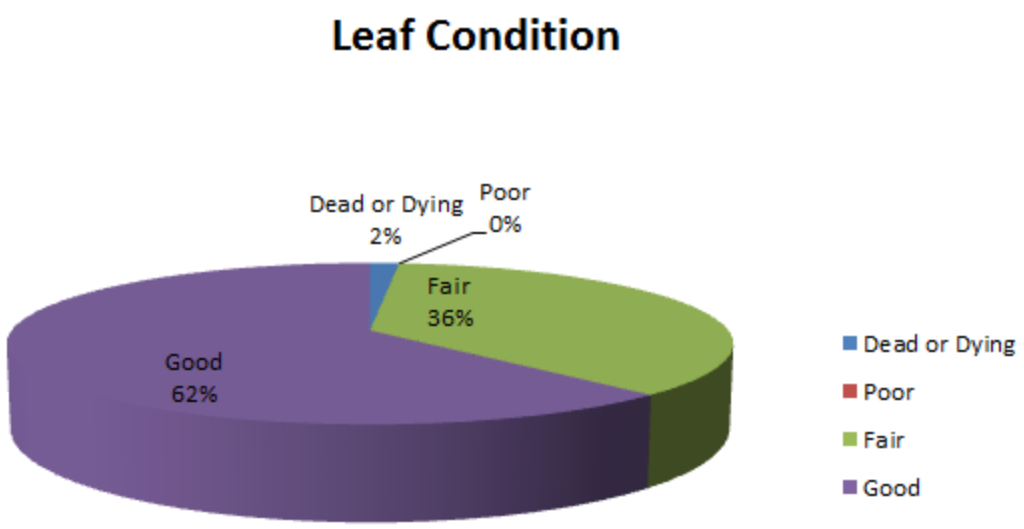



**Figure 3: Foliage Condition**

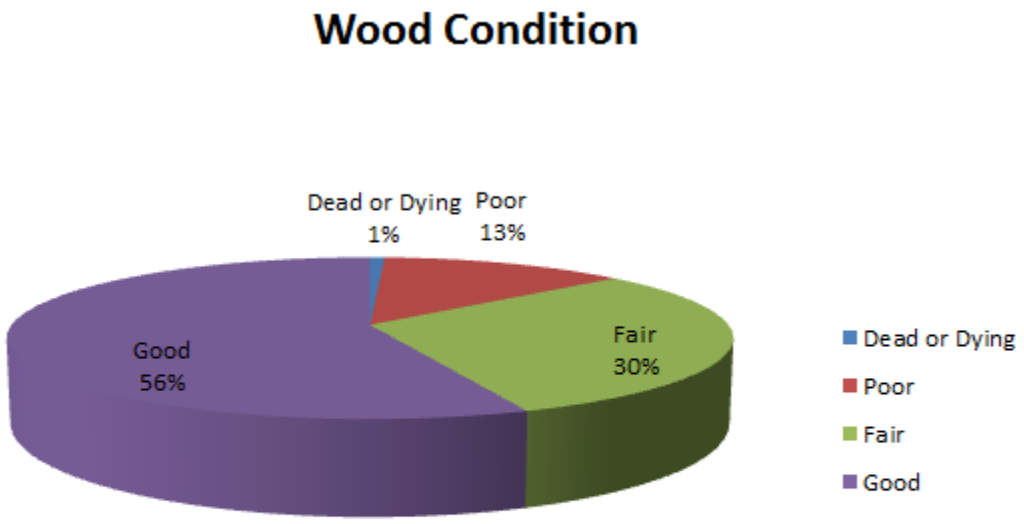
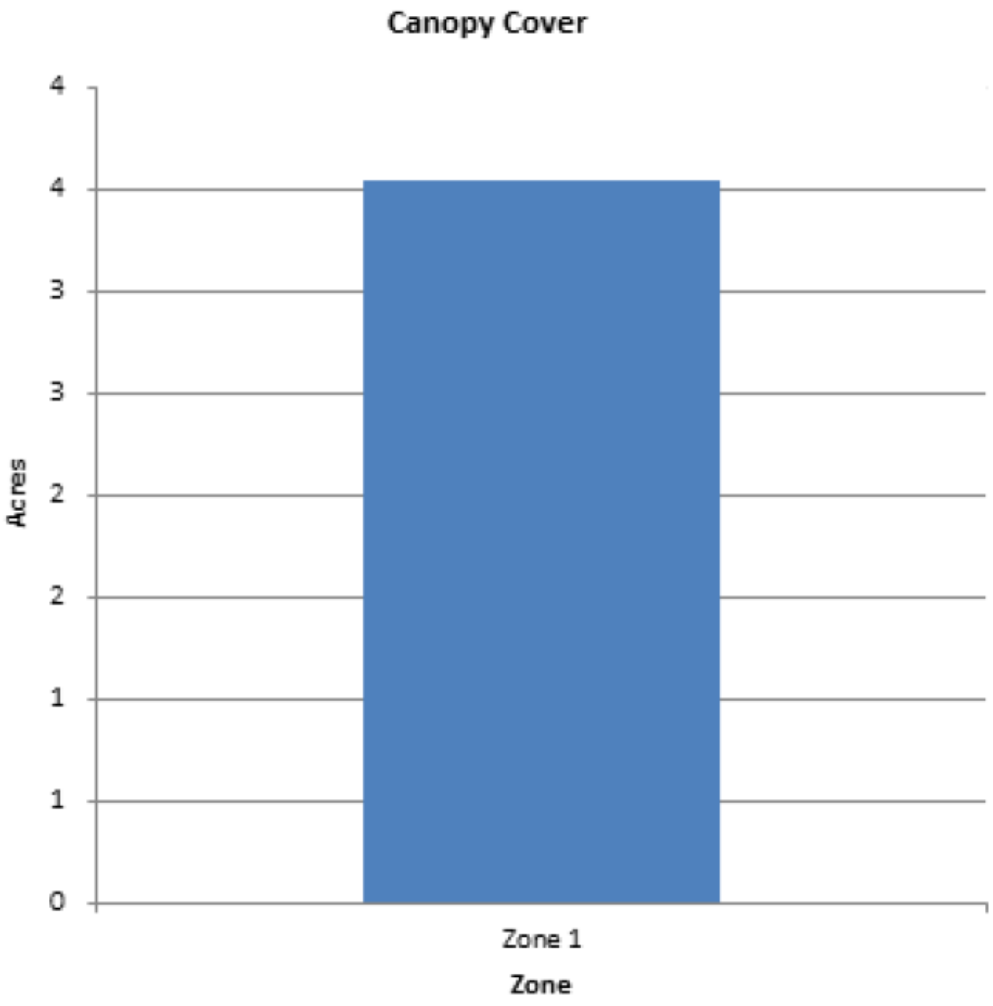



**Figure 4: Wood Condition**

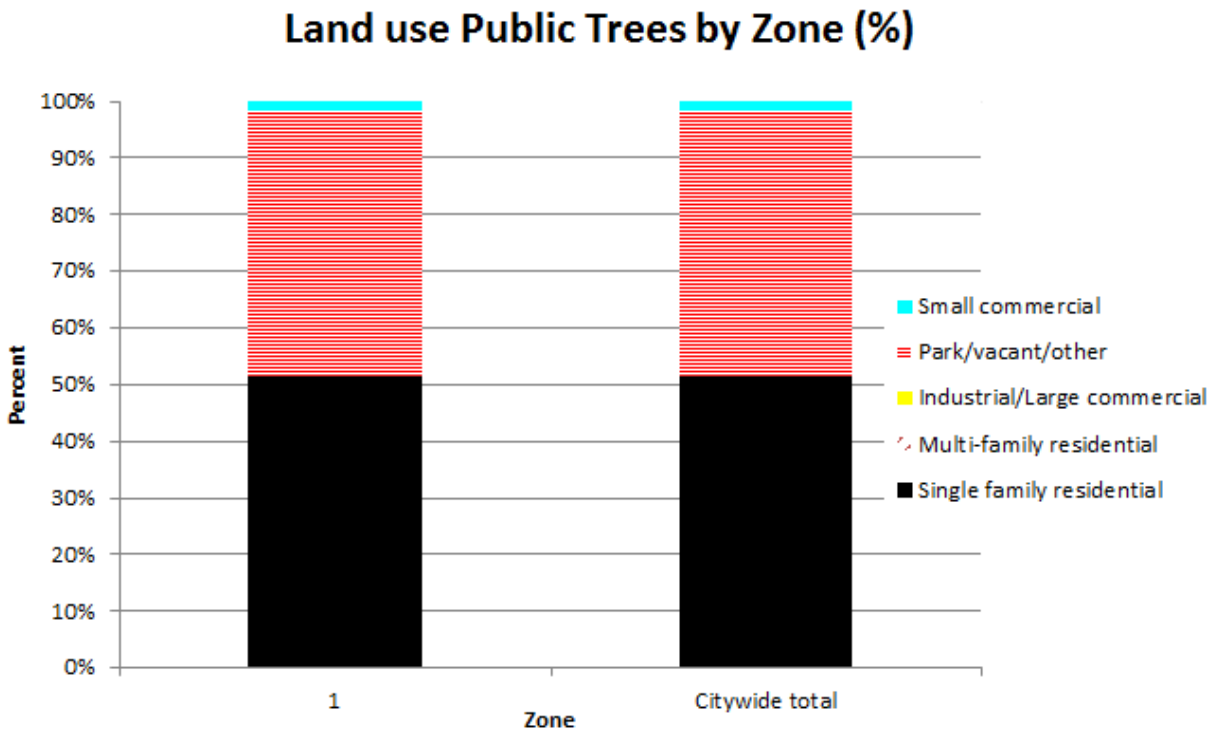
# Canopy Cover of Public Trees (Acres)

1/15/2016



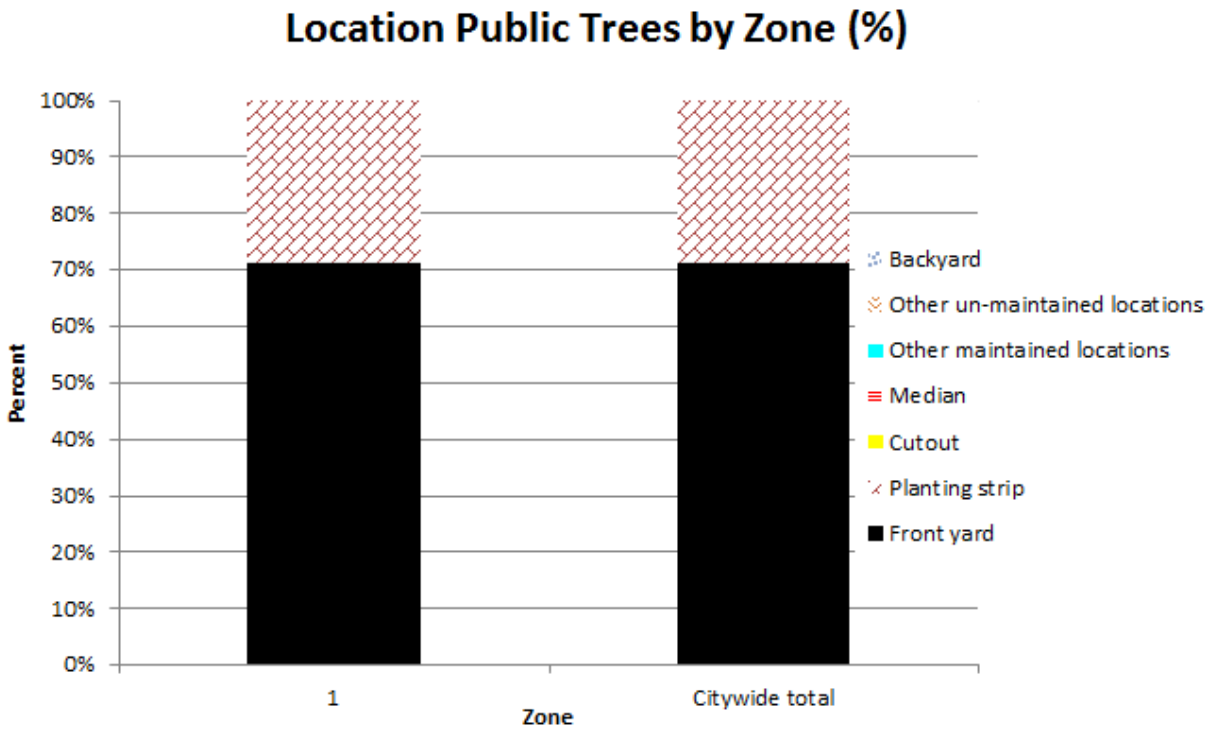

| Zone | Acres | % of Total Canopy Cover |
|---|---|---|
| Zone 1 | 4 | 100.0 |
| Citywide total | 4 | 100.0 |

**Figure 5: Canopy Cover in Acres**




| Zone | Single family residential | Multi-family residential | Industrial/Large commercial | Park/vacant /other | Small commercial |
|---|---|---|---|---|---|
| 1 | 51.52 | 0.00 | 0.00 | 46.97 | 1.52 |
| Citywide total | 51.52 | 0.00 | 0.00 | 46.97 | 1.52 |

**Figure 6: Land Use of city/park trees**




| Zone | Front yard | Planting strip | Cutout | Median | Other maintained locations | Other un-maintained locations | Backyard |
|---|---|---|---|---|---|---|---|
| 1 | 71.21 | 28.79 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Citywide total | 71.21 | 28.79 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Figure 7: Location of city/park trees**

# Appendix B: ArcGIS Mapping

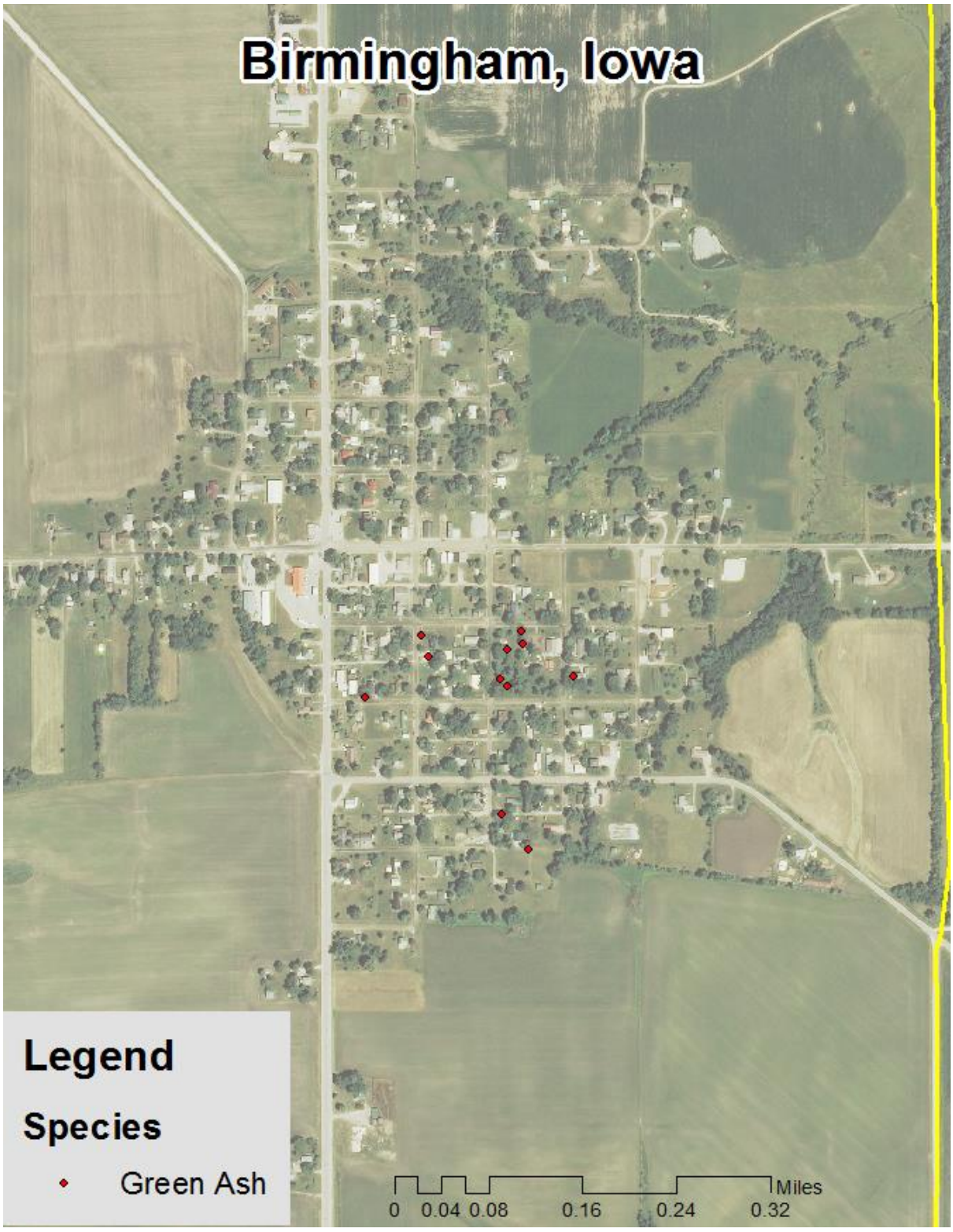



**Figure 1: Location of Ash Trees**


**Figure 2: Location of EAB symptoms**


**Figure 3: Location of Poor Condition Trees**


**Figure 4: Location of Trees with Recommended Maintenance**

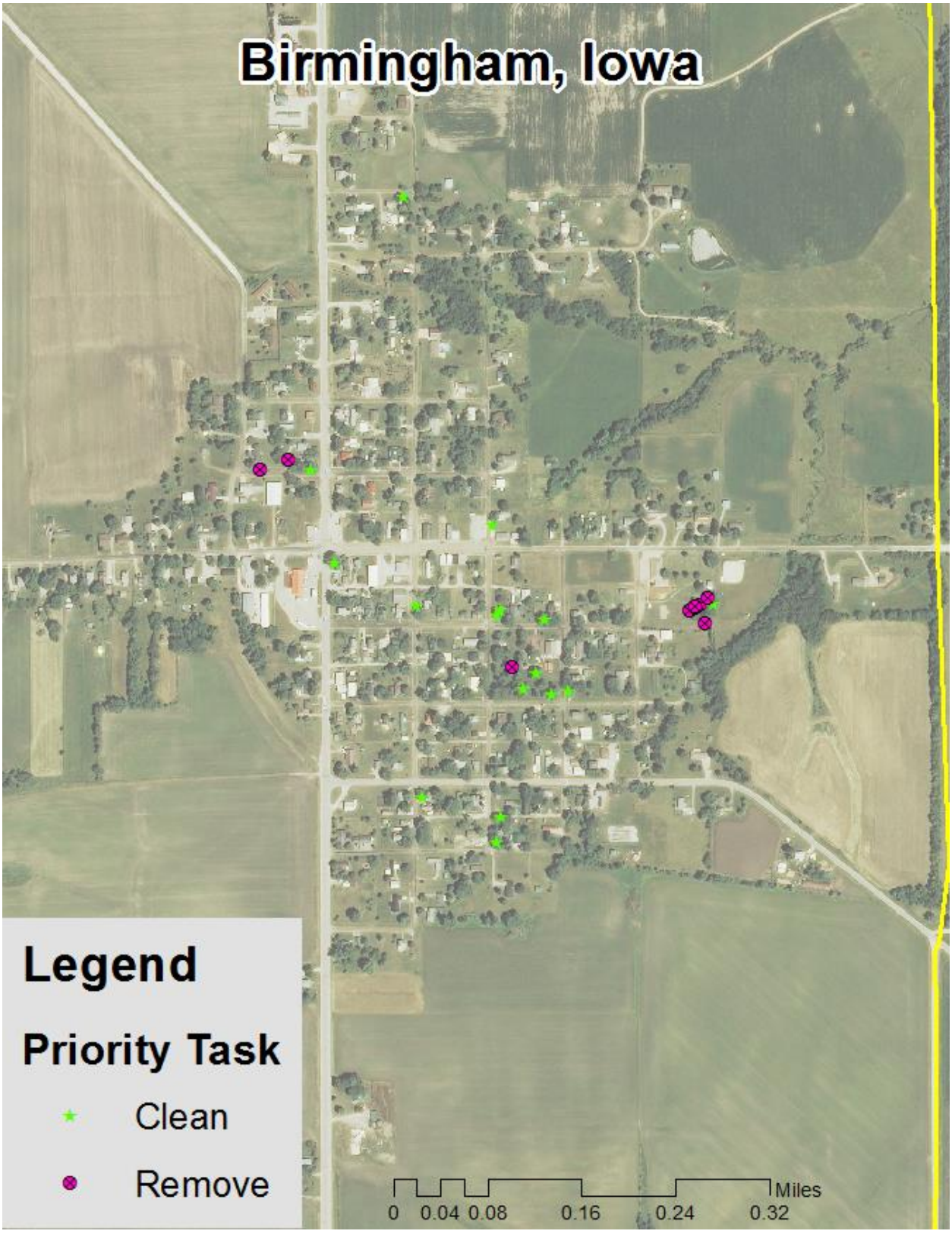



**Figure 5: Maintenance Tasks** ***City ownership of the trees recommended for removal should be verified prior to any removal***

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