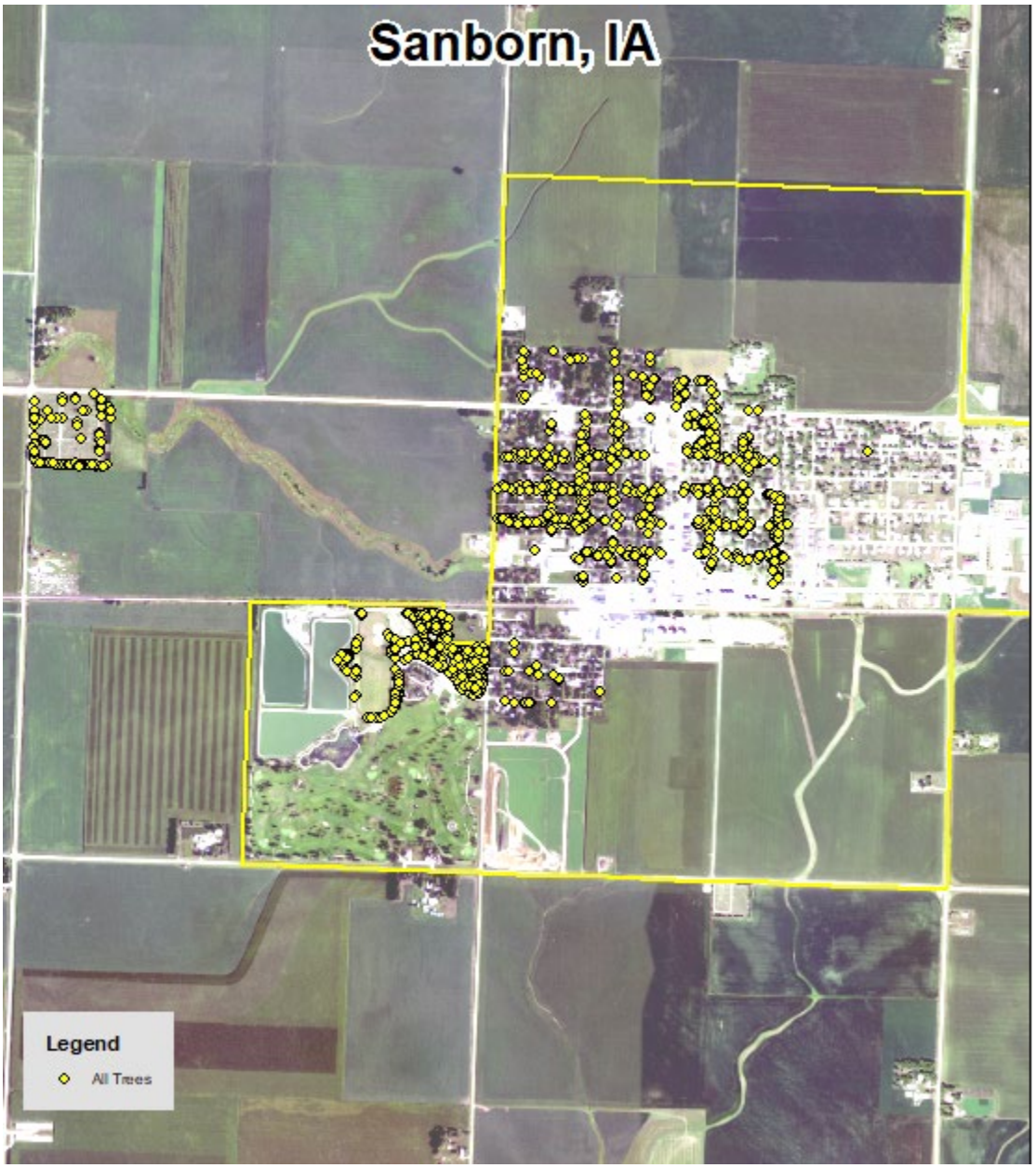
# Sanborn, IA




2023 Urban Forest Management Plan

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# Executive Summary

## Overview

This plan was developed to assist the City of Sanborn 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 33% of Sanborn'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 2022, a tree inventory was conducted 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 1,091 trees inventoried.

- Sanborn's trees provide $216,197 of benefits annually, an average of $198 a tree
- There are over 45 species of trees
- The top three genera are: Maple 38%, Ash 33%, and Spruce 9%
- 4% of trees are in need of some type of management
- 33 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 33 trees needing removal, 6 trees are critical concerns must be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- 109 of the 360 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
- With the current budget it could take 54 years to remove ash – Suggestion: request a budget increase and apply for grants to plant replacement trees

# Introduction

This plan was developed to assist Sanborn 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 recovery from Emerald Ash Borer (EAB), an invasive pest that kills native ash trees, it is time to prepare for the increased costs of tree removal or treatment and replacement planting. With proper planning and management of the current canopy in Sanborn, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Sanborn'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 Sanborn 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 Sanborn's urban forestry goals.

# Inventory

In 2022, a tree inventory was conducted 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 1,091 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as 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. Sanborn's trees reduce energy related costs by approximately $52,480 annually (Appendix A, Table 1). These savings are both in Electricity (253.6 MWh) and in Natural Gas (33,910.0Therms).

### Annual Stormwater Benefits

Sanborn's trees intercept about 3,087,825 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $83,680 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 Sanborn, it is estimated that trees remove 3,237.6 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 $9,053 (Appendix A, Table 3).

### Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Sanborn, trees sequester about 1,082,311 lbs of carbon a year with an associated value of $8,117 (Appendix A, Table 5). In addition, the trees store 11,191,106 lbs of carbon, with a yearly benefit of $83,933 (Appendix A, Table 4).

### 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. Sanborn receives $62,867 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, Sanborn's trees provide $216,197 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 1,091 trees in Sanborn provide approximately $198 annually (Appendix A, Table 7).

# Forest Structure

### Species Distribution

Sanborn has over 45 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genera is as follows:

| | | |
|---|---|---|
| Maple | 412 | 38% |
| Ash | 360 | 33% |

| | | |
|---|---|---|
| Spruce | 99 | 9% |
| Linden Basswood | 40 | 4% |
| Oak | 32 | 3% |
| Apple (crabapple) | 25 | 2% |
| Pine | 25 | 2% |
| Honey Locust | 24 | 2% |
| Walnut | 14 | 1% |
| other | 10 | 1% |
| Ginkgo | 10 | 1% |
| Hackberry | 6 | 1% |
| Elm | 6 | 1% |
| Cottonwood/Poplar | 5 | <1% |
| Willow | 5 | <1% |
| Buckeye | 4 | <1% |
| Cedar | 4 | <1% |
| Mulberry | 2 | <1% |
| Cork tree | 2 | <1% |
| Sumac | 2 | <1% |
| Birch | 1 | <1% |
| Kentucky Coffeetree | 1 | <1% |
| Plum | 1 | <1% |
| Pear | 1 | <1% |

### Age Class

Most of Sanborn's trees (43%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Sanborn's size curve is on the smaller side, indicating a younger stand.

### 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 Sanborn indicate that 92% 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). 32% of Sanborn'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 10% of the population. This 10% 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 | 10 | 1% |
| Tree Removal | 33 | 3% |
| Possible Treatment | 143 | 13% |

### Canopy Cover

The total canopy with both private and public trees is 6%, 72 acres. The canopy cover on city own properties included in the Sanborn inventory includes approximately 30 acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 3%, in 30 years on all lands. To achieve this goal, it is estimated that 89 trees need to be planted annually on public and/or private lands.

### Land Use and Location

The majority of Sanborn's city and park trees are in planting strips 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 | 49% |
| Park/vacant/other | 48% |
| Industrial/Large commercial | 1% |
| Small commercial | 1% |
| Multifamily residential | <1% |

| Location | |
|---|---|
| Front yard | 56% |
| Planting strip | 40% |
| Median | 4% |
| Cutout (surrounded by pavement) | <1% |

# 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

Sanborn has 6 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). There are 5 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately (within one year). Please refer to the six year maintenance plan at the end of this section. After all of the critical concern and immediate trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 32 trees with these needs.

Poor tree species

After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 33 removals, 12 are ash trees. There are a total of 360 ash trees, and 109 of those have signs and symptoms that have been associated with EAB. In

addition, there are 4 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 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 number of trees helps ensure continuation of the benefits of the existing forest in Sanborn.

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 20% of the urban forest and a single species (i.e. silver maple, sugar maple, white oak, bur oak) not make up more than 10% of the total urban forest. Presently, the forest is heavily planted with maple (38%) (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, as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

**Continual Monitoring**

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.

# Budget and Emerald Ash Borer Plan

**Six Year Maintenance Plan with <u>Needs Additional Funding</u> for EAB**

**Current Budget** $7,000/year, Total $42,000 over 6 years

**FY 2023**

Removal: 6 critical concern trees and 2 immediate $5,600

Planting and Replacement: 9 trees to be planted in open locations, $900

Young Tree Pruning & Maintenance: $500
Potential EAB Treatment– **see cost assessment small amount $1,200 – all treatable ash $21,450**

**FY 2024**

Removal: 6 trees
*Or saving for ash tree treatment and/or future ash removal, $4,200
Planting and Replacement: 6 trees in open locations from year one removals, $600
Young Tree Pruning & Maintenance: $500
Routine trimming: Contract to trim 1/3 of the city trees, $1,700
Potential EAB Treatment

**FY 2025**

Removal: 8 trees
Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals, $900
Young Tree Pruning & Maintenance: $500
Potential EAB Treatment – see cost assessment

**FY 2026**

Removal: 6 trees
Planting and Replacement: 7 trees in open locations from previous removals, $600
Routine trimming: Contract to trim 1/3 of the city trees, $1,700
Young Tree Pruning & Maintenance: $500
Potential EAB Treatment– see cost assessment

**FY 2027**

Removal: 5 trees and 3 removals of any new critical concern trees and ash in poor health
Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals, $900
Young Tree Pruning & Maintenance: $500
Potential EAB Treatment– see cost assessment

**FY 2028**

Removal: 6 trees - removal of any new critical concern trees and ash in poor health
Planting and Replacement: 7 trees in open locations from previous removals, $600
Routine trimming: Contract to trim 1/3 of the city trees, $1,700
Young Tree Pruning & Maintenance: $500
Potential EAB Treatment– see cost assessment

*Reduction of ash over 6 years: Approximately 21 ash trees removed (approximately 6% of ash). It will take approximately 54 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 to 15 years of its arrival.
**To remove all ash trees within 6 years, the budget would need to be increased to $52,000 a year.

## 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 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 for your county.

## 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? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

## Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance 151.02 (Appendix C). 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 if preventative treatments are not being used. City Code 151.06 states "If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within 14 days of said notification. If such owner, occupant, or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property."

Proposed Budget Increase
EAB could potentially kill all ash trees in Sanborn within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $52,000 a year. It is recommended that Sanborn 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 instance, in this treatment scenario, the average ash diameter is 20 inches and at $15 per inch, about 4 trees could be treated per year (every other year treatment) would be $1,200. This would be 8 trees selected for treatment, and Sanborn would still need to find $281,600 for removal. Alternatively, if there are 143 treatable trees, it would cost approximately $21,450 a year for treatment and leave $173,600 (total ash- 8 *removal cost) for removal. 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 Sanborn. 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**

**Sanborn**

**Annual Energy Benefits of Public Trees**

2/4/2023

| Species | Total Electricity (MWh) | Electricity ($) | Total Natural Gas (Therms) | Natural Gas ($) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|
| Green ash | 77.2 | 5,860 | 10,389.2 | 10,181 | 16,042 | (N/A) | 32.5 | 30.6 | 45.19 |
| Silver maple | 94.4 | 7,166 | 12,337.1 | 12,090 | 19,256 | (N/A) | 26.3 | 36.7 | 67.09 |
| Norway maple | 18.3 | 1,390 | 2,594.4 | 2,543 | 3,932 | (N/A) | 7.0 | 7.5 | 51.74 |
| Spruce | 6.2 | 474 | 803.1 | 787 | 1,261 | (N/A) | 4.1 | 2.4 | 28.02 |
| Blue spruce | 5.2 | 393 | 688.0 | 674 | 1,067 | (N/A) | 3.9 | 2.0 | 24.81 |
| Sugar maple | 6.9 | 521 | 920.2 | 902 | 1,423 | (N/A) | 2.5 | 2.7 | 52.70 |
| Apple | 2.0 | 155 | 315.6 | 309 | 464 | (N/A) | 2.3 | 0.9 | 18.56 |
| Honeylocust | 6.0 | 452 | 755.3 | 740 | 1,192 | (N/A) | 2.2 | 2.3 | 49.66 |
| American basswood | 6.6 | 499 | 928.6 | 910 | 1,409 | (N/A) | 2.0 | 2.7 | 64.03 |
| Austrian pine | 2.2 | 167 | 291.1 | 285 | 453 | (N/A) | 1.8 | 0.9 | 22.63 |
| Littleleaf linden | 3.0 | 226 | 380.0 | 372 | 598 | (N/A) | 1.6 | 1.1 | 33.22 |
| Black walnut | 4.1 | 311 | 555.1 | 544 | 855 | (N/A) | 1.3 | 1.6 | 61.11 |
| Red maple | 1.3 | 97 | 180.2 | 177 | 274 | (N/A) | 1.0 | 0.5 | 24.89 |
| Norway spruce | 1.4 | 104 | 170.2 | 167 | 271 | (N/A) | 1.0 | 0.5 | 24.62 |
| Ginkgo | 0.6 | 46 | 89.3 | 88 | 133 | (N/A) | 0.9 | 0.3 | 13.31 |
| Bur oak | 0.8 | 62 | 117.2 | 115 | 177 | (N/A) | 0.9 | 0.3 | 17.67 |
| Swamp white oak | 1.0 | 78 | 146.4 | 143 | 222 | (N/A) | 0.8 | 0.4 | 24.63 |
| Northern red oak | 1.2 | 94 | 171.3 | 168 | 261 | (N/A) | 0.8 | 0.5 | 29.05 |
| Maple | 0.5 | 37 | 69.8 | 68 | 105 | (N/A) | 0.7 | 0.2 | 13.14 |
| Conifer Evergreen Large | 1.1 | 80 | 137.1 | 134 | 215 | (N/A) | 0.6 | 0.4 | 30.65 |
| Northern hackberry | 1.5 | 115 | 215.3 | 211 | 326 | (N/A) | 0.5 | 0.6 | 54.32 |
| American elm | 2.4 | 183 | 314.8 | 308 | 491 | (N/A) | 0.5 | 0.9 | 98.29 |
| White ash | 1.1 | 80 | 139.9 | 137 | 217 | (N/A) | 0.5 | 0.4 | 43.48 |
| Willow | 1.5 | 115 | 219.2 | 215 | 330 | (N/A) | 0.5 | 0.6 | 66.03 |
| Eastern red cedar | 0.3 | 24 | 48.7 | 48 | 72 | (N/A) | 0.4 | 0.1 | 18.02 |
| Scotch pine | 0.3 | 26 | 42.7 | 42 | 67 | (N/A) | 0.4 | 0.1 | 16.86 |
| Ohio buckeye | 0.9 | 68 | 123.3 | 121 | 189 | (N/A) | 0.4 | 0.4 | 47.22 |
| Pin oak | 0.7 | 52 | 90.2 | 88 | 141 | (N/A) | 0.3 | 0.3 | 46.86 |
| Black poplar | 1.0 | 75 | 140.6 | 138 | 213 | (N/A) | 0.3 | 0.4 | 70.91 |
| Amur corktree | 0.5 | 36 | 59.0 | 58 | 94 | (N/A) | 0.2 | 0.2 | 46.78 |
| Sumac | 0.4 | 28 | 49.3 | 48 | 76 | (N/A) | 0.2 | 0.1 | 38.13 |
| Boxelder | 0.4 | 27 | 51.2 | 50 | 78 | (N/A) | 0.2 | 0.1 | 38.79 |
| Broadleaf Deciduous Small | 0.0 | 2 | 4.4 | 4 | 6 | (N/A) | 0.2 | 0.0 | 3.13 |
| Mulberry | 0.2 | 17 | 35.4 | 35 | 52 | (N/A) | 0.2 | 0.1 | 25.77 |
| Paper birch | 0.2 | 18 | 27.0 | 26 | 44 | (N/A) | 0.1 | 0.1 | 44.23 |
| Broadleaf Evergreen Mediu | 0.2 | 18 | 24.2 | 24 | 41 | (N/A) | 0.1 | 0.1 | 41.29 |
| White oak | 0.1 | 7 | 13.7 | 13 | 21 | (N/A) | 0.1 | 0.0 | 20.64 |
| Red pine | 0.1 | 4 | 9.5 | 9 | 14 | (N/A) | 0.1 | 0.0 | 13.58 |
| Kentucky coffeetree | 0.3 | 25 | 46.9 | 46 | 71 | (N/A) | 0.1 | 0.1 | 70.91 |
| Chinese elm | 0.4 | 33 | 59.0 | 58 | 91 | (N/A) | 0.1 | 0.2 | 91.02 |
| Cherry plum | 0.2 | 15 | 31.6 | 31 | 46 | (N/A) | 0.1 | 0.1 | 46.14 |
| Eastern cottonwood | 0.4 | 33 | 59.0 | 58 | 91 | (N/A) | 0.1 | 0.2 | 91.02 |
| Amur maple | 0.0 | 0 | 0.6 | 1 | 1 | (N/A) | 0.1 | 0.0 | 0.87 |
| Callery pear | 0.0 | 3 | 6.2 | 6 | 9 | (N/A) | 0.1 | 0.0 | 8.99 |
| Cottonwood | 0.4 | 33 | 59.0 | 58 | 91 | (N/A) | 0.1 | 0.2 | 91.02 |
| Total | 253.6 | 19,248 | 33,910.0 | 33,232 | 52,480 | (N/A) | 100.0 | 100.0 | 48.10 |

## Table 2: Annual Stormwater Benefits

**Sanborn**

**Annual Stormwater Benefits of Public Trees**

2/4/2023

| Species | Total rainfall interception (Gal) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|
| Green ash | 799,592 | 21,669 | (N/A) | 32.5 | 25.9 | 61.04 |
| Silver maple | 1,419,251 | 38,462 | (N/A) | 26.3 | 46.0 | 134.01 |
| Norway maple | 172,507 | 4,675 | (N/A) | 7.0 | 5.6 | 61.51 |
| Spruce | 116,108 | 3,147 | (N/A) | 4.1 | 3.8 | 69.92 |
| Blue spruce | 73,275 | 1,986 | (N/A) | 3.9 | 2.4 | 46.18 |
| Sugar maple | 70,601 | 1,913 | (N/A) | 2.5 | 2.3 | 70.86 |
| Apple | 8,611 | 233 | (N/A) | 2.3 | 0.3 | 9.33 |
| Honeylocust | 40,293 | 1,092 | (N/A) | 2.2 | 1.3 | 45.50 |
| American basswood | 72,105 | 1,954 | (N/A) | 2.0 | 2.3 | 88.82 |
| Austrian pine | 29,225 | 792 | (N/A) | 1.8 | 0.9 | 39.60 |
| Littleleaf linden | 20,363 | 552 | (N/A) | 1.6 | 0.7 | 30.66 |
| Black walnut | 45,247 | 1,226 | (N/A) | 1.3 | 1.5 | 87.59 |
| Red maple | 8,509 | 231 | (N/A) | 1.0 | 0.3 | 20.96 |
| Norway spruce | 22,218 | 602 | (N/A) | 1.0 | 0.7 | 54.74 |
| Ginkgo | 2,720 | 74 | (N/A) | 0.9 | 0.1 | 7.37 |
| Bur oak | 5,206 | 141 | (N/A) | 0.9 | 0.2 | 14.11 |
| Swamp white oak | 6,697 | 181 | (N/A) | 0.8 | 0.2 | 20.17 |
| Northern red oak | 10,853 | 294 | (N/A) | 0.8 | 0.4 | 32.68 |
| Maple | 3,814 | 103 | (N/A) | 0.7 | 0.1 | 12.92 |
| Conifer Evergreen Large | 22,091 | 599 | (N/A) | 0.6 | 0.7 | 85.53 |
| Northern hackberry | 13,581 | 368 | (N/A) | 0.5 | 0.4 | 61.34 |
| American elm | 22,756 | 617 | (N/A) | 0.5 | 0.7 | 123.33 |
| White ash | 11,990 | 325 | (N/A) | 0.5 | 0.4 | 64.98 |
| Willow | 16,466 | 446 | (N/A) | 0.5 | 0.5 | 89.25 |
| Eastern red cedar | 4,588 | 124 | (N/A) | 0.4 | 0.1 | 31.08 |
| Scotch pine | 3,886 | 105 | (N/A) | 0.4 | 0.1 | 26.32 |
| Ohio buckeye | 7,168 | 194 | (N/A) | 0.4 | 0.2 | 48.57 |
| Pin oak | 5,548 | 150 | (N/A) | 0.3 | 0.2 | 50.11 |
| Black poplar | 11,829 | 321 | (N/A) | 0.3 | 0.4 | 106.85 |
| Amur corktree | 2,818 | 76 | (N/A) | 0.2 | 0.1 | 38.19 |
| Sumac | 1,333 | 36 | (N/A) | 0.2 | 0.0 | 18.06 |
| Boxelder | 3,809 | 103 | (N/A) | 0.2 | 0.1 | 51.62 |
| Broadleaf Deciduous Small | 76 | 2 | (N/A) | 0.2 | 0.0 | 1.03 |
| Mulberry | 1,243 | 34 | (N/A) | 0.2 | 0.0 | 16.84 |
| Paper birch | 1,466 | 40 | (N/A) | 0.1 | 0.0 | 39.72 |
| Broadleaf Evergreen Medium | 1,775 | 48 | (N/A) | 0.1 | 0.1 | 48.11 |
| White oak | 608 | 16 | (N/A) | 0.1 | 0.0 | 16.47 |
| Red pine | 596 | 16 | (N/A) | 0.1 | 0.0 | 16.14 |
| Kentucky coffeetree | 3,943 | 107 | (N/A) | 0.1 | 0.1 | 106.85 |
| Chinese elm | 7,239 | 196 | (N/A) | 0.1 | 0.2 | 196.17 |
| Cherry plum | 1,174 | 32 | (N/A) | 0.1 | 0.0 | 31.82 |
| Eastern cottonwood | 7,239 | 196 | (N/A) | 0.1 | 0.2 | 196.17 |
| Amur maple | 7 | 0 | (N/A) | 0.1 | 0.0 | 0.20 |
| Callery pear | 163 | 4 | (N/A) | 0.1 | 0.0 | 4.41 |
| Cottonwood | 7,239 | 196 | (N/A) | 0.1 | 0.2 | 196.17 |
| Citywide total | 3,087,825 | 83,680 | (N/A) | 100.0 | 100.0 | 76.70 |

## Table 3: Annual Air Quality Benefits

**Sanborn**

**Annual Air Quality Benefits of Public Trees**

2/4/2023

| 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 | $SO_2$ | | | | | | | |
| Green ash | 95.3 | 15.2 | 46.4 | 4.3 | 510 | 367.0 | 53.6 | 51.1 | 349.9 | 2,290 | 0.0 | 0 | 982.7 | 2,800 (N/A) | 32.5 | 7.89 |
| Silver maple | 248.8 | 42.2 | 121.4 | 11.0 | 1,339 | 444.1 | 65.1 | 62.1 | 427.0 | 2,781 | -125.9 | -472 | 1,295.8 | 3,648 (N/A) | 26.3 | 12.71 |
| Norway maple | 35.9 | 6.2 | 17.6 | 1.6 | 194 | 88.4 | 12.8 | 12.2 | 83.1 | 548 | -8.4 | -31 | 249.3 | 711 (N/A) | 7.0 | 9.35 |
| Spruce | 13.6 | 2.7 | 11.1 | 1.7 | 90 | 29.3 | 4.3 | 4.1 | 28.3 | 184 | -59.2 | -222 | 35.8 | 51 (N/A) | 4.1 | 1.13 |
| Blue spruce | 10.3 | 2.0 | 8.5 | 1.3 | 68 | 24.4 | 3.6 | 3.4 | 23.4 | 153 | -27.0 | -101 | 49.9 | 119 (N/A) | 3.9 | 2.78 |
| Sugar maple | 9.0 | 1.5 | 4.6 | 0.4 | 49 | 32.6 | 4.8 | 4.5 | 31.1 | 203 | -7.1 | -27 | 81.3 | 225 (N/A) | 2.5 | 8.35 |
| Apple | 2.5 | 0.4 | 1.2 | 0.1 | 13 | 10.1 | 1.4 | 1.4 | 9.2 | 62 | 0.0 | 0 | 26.3 | 75 (N/A) | 2.3 | 3.00 |
| Honeylocust | 6.9 | 1.1 | 3.3 | 0.3 | 37 | 27.9 | 4.1 | 3.9 | 27.0 | 175 | -4.6 | -17 | 69.9 | 195 (N/A) | 2.2 | 8.11 |
| American basswood | 9.8 | 1.7 | 4.8 | 0.4 | 53 | 31.7 | 4.6 | 4.4 | 29.8 | 197 | -8.4 | -31 | 78.8 | 218 (N/A) | 2.0 | 9.92 |
| Austrian pine | 3.7 | 0.7 | 3.2 | 0.5 | 25 | 10.4 | 1.5 | 1.5 | 10.0 | 65 | -10.5 | -39 | 20.9 | 50 (N/A) | 1.8 | 2.52 |
| Littleleaf linden | 2.7 | 0.5 | 1.5 | 0.1 | 15 | 14.0 | 2.1 | 2.0 | 13.5 | 88 | -1.4 | -5 | 34.8 | 97 (N/A) | 1.6 | 5.40 |
| Black walnut | 5.6 | 0.9 | 2.7 | 0.3 | 30 | 19.5 | 2.8 | 2.7 | 18.6 | 122 | 0.0 | 0 | 53.1 | 152 (N/A) | 1.3 | 10.82 |
| Red maple | 1.6 | 0.3 | 0.8 | 0.1 | 8 | 6.1 | 0.9 | 0.9 | 5.8 | 38 | -0.6 | -2 | 15.8 | 45 (N/A) | 1.0 | 4.05 |
| Norway spruce | 2.6 | 0.5 | 2.1 | 0.3 | 17 | 6.4 | 0.9 | 0.9 | 6.2 | 40 | -10.6 | -40 | 9.3 | 17 (N/A) | 1.0 | 1.57 |
| Ginkgo | 0.3 | 0.0 | 0.2 | 0.0 | 2 | 2.9 | 0.4 | 0.4 | 2.7 | 18 | -0.1 | 0 | 6.8 | 19 (N/A) | 0.9 | 1.92 |
| Bur oak | 0.2 | 0.0 | 0.2 | 0.0 | 1 | 3.9 | 0.6 | 0.5 | 3.7 | 24 | 0.0 | 0 | 9.2 | 26 (N/A) | 0.9 | 2.57 |
| Swamp white oak | 1.0 | 0.2 | 0.6 | 0.0 | 6 | 5.0 | 0.7 | 0.7 | 4.7 | 31 | -0.3 | -1 | 12.6 | 36 (N/A) | 0.8 | 3.95 |
| Northern red oak | 2.1 | 0.4 | 1.1 | 0.1 | 12 | 5.9 | 0.9 | 0.8 | 5.6 | 37 | -3.1 | -11 | 13.8 | 37 (N/A) | 0.8 | 4.09 |
| Maple | 0.8 | 0.1 | 0.4 | 0.0 | 5 | 2.3 | 0.3 | 0.3 | 2.2 | 14 | -0.3 | -1 | 6.3 | 18 (N/A) | 0.7 | 2.24 |
| Conifer Evergreen Large | 2.7 | 0.5 | 2.1 | 0.3 | 17 | 5.0 | 0.7 | 0.7 | 4.8 | 31 | -12.7 | -48 | 4.1 | 1 (N/A) | 0.6 | 0.12 |
| Northern hackberry | 2.0 | 0.4 | 1.1 | 0.1 | 11 | 7.3 | 1.1 | 1.0 | 6.9 | 45 | 0.0 | 0 | 19.8 | 56 (N/A) | 0.5 | 9.42 |
| American elm | 6.0 | 1.0 | 2.8 | 0.3 | 32 | 11.4 | 1.7 | 1.6 | 10.9 | 71 | 0.0 | 0 | 35.6 | 103 (N/A) | 0.5 | 20.61 |
| White ash | 1.9 | 0.3 | 0.9 | 0.1 | 10 | 5.0 | 0.7 | 0.7 | 4.8 | 31 | 0.0 | 0 | 14.4 | 41 (N/A) | 0.5 | 8.24 |
| Willow | 3.7 | 0.6 | 1.8 | 0.2 | 20 | 7.4 | 1.1 | 1.0 | 6.9 | 46 | -0.8 | -3 | 21.7 | 62 (N/A) | 0.5 | 12.45 |
| Eastern red cedar | 0.8 | 0.2 | 0.7 | 0.1 | 5 | 1.6 | 0.2 | 0.2 | 1.5 | 10 | -2.5 | -9 | 2.7 | 6 (N/A) | 0.4 | 1.40 |
| Scotch pine | 0.4 | 0.1 | 0.4 | 0.0 | 3 | 1.6 | 0.2 | 0.2 | 1.5 | 10 | -1.3 | -5 | 3.1 | 8 (N/A) | 0.4 | 1.92 |
| Ohio buckeye | 1.4 | 0.2 | 0.7 | 0.1 | 7 | 4.3 | 0.6 | 0.6 | 4.1 | 27 | -0.3 | -1 | 11.6 | 33 (N/A) | 0.4 | 8.22 |
| Pin oak | 0.8 | 0.1 | 0.4 | 0.0 | 4 | 3.2 | 0.5 | 0.5 | 3.1 | 20 | -1.6 | -6 | 7.1 | 19 (N/A) | 0.3 | 6.28 |
| Black poplar | 1.5 | 0.2 | 0.7 | 0.1 | 8 | 4.8 | 0.7 | 0.7 | 4.5 | 30 | 0.0 | 0 | 13.1 | 37 (N/A) | 0.3 | 12.48 |
| Amur corktree | 0.4 | 0.1 | 0.2 | 0.0 | 2 | 2.2 | 0.3 | 0.3 | 2.1 | 14 | -0.1 | 0 | 5.6 | 16 (N/A) | 0.2 | 7.92 |
| Sumac | 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) | 0.2 | 6.56 |
| Boxelder | 0.5 | 0.1 | 0.2 | 0.0 | 3 | 1.7 | 0.3 | 0.2 | 1.6 | 11 | -0.2 | -1 | 4.5 | 13 (N/A) | 0.2 | 6.29 |
| Broadleaf Deciduous Small | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.1 | 0.0 | 0.0 | 0.1 | 1 | 0.0 | 0 | 0.3 | 1 (N/A) | 0.2 | 0.41 |
| Mulberry | 0.4 | 0.1 | 0.2 | 0.0 | 2 | 1.1 | 0.2 | 0.1 | 1.0 | 7 | 0.0 | 0 | 3.1 | 9 (N/A) | 0.2 | 4.53 |
| Paper birch | 0.1 | 0.0 | 0.1 | 0.0 | 1 | 1.1 | 0.2 | 0.2 | 1.1 | 7 | 0.0 | 0 | 2.6 | 7 (N/A) | 0.1 | 7.42 |
| Broadleaf Evergreen Medium | 0.1 | 0.0 | 0.1 | 0.0 | 1 | 1.0 | 0.2 | 0.1 | 1.0 | 7 | -0.5 | -2 | 2.1 | 5 (N/A) | 0.1 | 5.49 |
| White oak | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.5 | 0.1 | 0.1 | 0.4 | 3 | 0.0 | 0 | 1.1 | 3 (N/A) | 0.1 | 2.99 |
| Red 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) | 0.1 | 1.48 |
| Kentucky coffeetree | 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) | 0.1 | 12.48 |
| Chinese elm | 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) | 0.1 | 19.04 |
| Cherry plum | 0.4 | 0.1 | 0.2 | 0.0 | 2 | 1.0 | 0.1 | 0.1 | 0.9 | 6 | 0.0 | 0 | 2.9 | 8 (N/A) | 0.1 | 8.35 |
| 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) | 0.1 | 19.04 |
| Amur maple | 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) | 0.1 | 0.11 |
| Callery pear | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.2 | 0.0 | 0.0 | 0.2 | 1 | 0.0 | 0 | 0.4 | 1 (N/A) | 0.1 | 1.21 |
| 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) | 0.1 | 19.04 |
| Citywide total | 480.1 | 81.4 | 246.1 | 24.0 | 2,624 | 1,202.1 | 175.6 | 167.5 | 1,148.5 | 7,508 | -287.8 | -1,079 | 3,237.6 | 9,053 (N/A) | 100.0 | 8.30 |

**Table 4: Annual Carbon Stored**

Sanborn

## Stored CO2 Benefits of Public Trees

2/4/2023

| Species | Total Stored CO2 (lbs) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|
| Green ash | 3,159,715 | 23,698 | (N/A) | 32.5 | 28.2 | 66.75 |
| Silver maple | 5,525,477 | 41,441 | (N/A) | 26.3 | 49.4 | 144.39 |
| Norway maple | 593,709 | 4,453 | (N/A) | 7.0 | 5.3 | 58.59 |
| Spruce | 146,918 | 1,102 | (N/A) | 4.1 | 1.3 | 24.49 |
| Blue spruce | 72,652 | 545 | (N/A) | 3.9 | 0.6 | 12.67 |
| Sugar maple | 254,512 | 1,909 | (N/A) | 2.5 | 2.3 | 70.70 |
| Apple | 40,196 | 301 | (N/A) | 2.3 | 0.4 | 12.06 |
| Honeylocust | 85,213 | 639 | (N/A) | 2.2 | 0.8 | 26.63 |
| American basswood | 361,897 | 2,714 | (N/A) | 2.0 | 3.2 | 123.37 |
| Austrian pine | 23,532 | 176 | (N/A) | 1.8 | 0.2 | 8.82 |
| Littleleaf linden | 60,932 | 457 | (N/A) | 1.6 | 0.5 | 25.39 |
| Black walnut | 180,873 | 1,357 | (N/A) | 1.3 | 1.6 | 96.90 |
| Red maple | 18,627 | 140 | (N/A) | 1.0 | 0.2 | 12.70 |
| Norway spruce | 25,640 | 192 | (N/A) | 1.0 | 0.2 | 17.48 |
| Ginkgo | 4,272 | 32 | (N/A) | 0.9 | 0.0 | 3.20 |
| Bur oak | 8,647 | 65 | (N/A) | 0.9 | 0.1 | 6.49 |
| Swamp white oak | 17,387 | 130 | (N/A) | 0.8 | 0.2 | 14.49 |
| Northern red oak | 44,900 | 337 | (N/A) | 0.8 | 0.4 | 37.42 |
| Maple | 9,550 | 72 | (N/A) | 0.7 | 0.1 | 8.95 |
| Conifer Evergreen La | 32,558 | 244 | (N/A) | 0.6 | 0.3 | 34.88 |
| Northern hackberry | 30,971 | 232 | (N/A) | 0.5 | 0.3 | 38.71 |
| American elm | 120,032 | 900 | (N/A) | 0.5 | 1.1 | 180.05 |
| White ash | 33,800 | 254 | (N/A) | 0.5 | 0.3 | 50.70 |
| Willow | 60,745 | 456 | (N/A) | 0.5 | 0.5 | 91.12 |
| Eastern red cedar | 2,758 | 21 | (N/A) | 0.4 | 0.0 | 5.17 |
| Scotch pine | 2,635 | 20 | (N/A) | 0.4 | 0.0 | 4.94 |
| Ohio buckeye | 22,629 | 170 | (N/A) | 0.4 | 0.2 | 42.43 |
| Pin oak | 19,859 | 149 | (N/A) | 0.3 | 0.2 | 49.65 |
| Black poplar | 47,318 | 355 | (N/A) | 0.3 | 0.4 | 118.30 |
| Amur corktree | 7,248 | 54 | (N/A) | 0.2 | 0.1 | 27.18 |
| Sumac | 6,074 | 46 | (N/A) | 0.2 | 0.1 | 22.78 |
| Boxelder | 15,381 | 115 | (N/A) | 0.2 | 0.1 | 57.68 |
| Broadleaf Deciduous | 192 | 1 | (N/A) | 0.2 | 0.0 | 0.72 |
| Mulberry | 6,921 | 52 | (N/A) | 0.2 | 0.1 | 25.95 |
| Paper birch | 3,672 | 28 | (N/A) | 0.1 | 0.0 | 27.54 |
| Broadleaf Evergreen l | 1,851 | 14 | (N/A) | 0.1 | 0.0 | 13.88 |
| White oak | 1,035 | 8 | (N/A) | 0.1 | 0.0 | 7.76 |
| Red pine | 257 | 2 | (N/A) | 0.1 | 0.0 | 1.93 |
| Kentucky coffeetree | 15,773 | 118 | (N/A) | 0.1 | 0.1 | 118.30 |
| Chinese elm | 39,259 | 294 | (N/A) | 0.1 | 0.4 | 294.44 |
| Cherry plum | 6,743 | 51 | (N/A) | 0.1 | 0.1 | 50.57 |
| Eastern cottonwood | 39,259 | 294 | (N/A) | 0.1 | 0.4 | 294.44 |
| Amur maple | 14 | 0 | (N/A) | 0.1 | 0.0 | 0.10 |
| Callery pear | 218 | 2 | (N/A) | 0.1 | 0.0 | 1.64 |
| Cottonwood | 39,259 | 294 | (N/A) | 0.1 | 0.4 | 294.44 |
| Citywide total | 11,191,106 | 83,933 | (N/A) | 100.0 | 100.0 | 76.93 |

## Table 5: Annual Carbon Sequestered

**Sanborn**

**Annual CO Benefits of Public Trees**

2/4/2023

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Green ash | 174,799 | 1,311 | -15,167 | -814 | -120 | 129,511 | 971 | 288,329 | 2,162 (N/A) | 32.5 | 26.6 | 6.09 |
| Silver maple | 402,988 | 3,022 | -26,525 | -1,058 | -207 | 158,362 | 1,188 | 533,768 | 4,003 (N/A) | 26.3 | 49.3 | 13.95 |
| Norway maple | 21,459 | 161 | -2,852 | -195 | -23 | 30,710 | 230 | 49,122 | 368 (N/A) | 7.0 | 4.5 | 4.85 |
| Spruce | 6,018 | 45 | -705 | -115 | -6 | 10,472 | 79 | 15,670 | 118 (N/A) | 4.1 | 1.4 | 2.61 |
| Blue spruce | 4,443 | 33 | -349 | -92 | -3 | 8,678 | 65 | 12,680 | 95 (N/A) | 3.9 | 1.2 | 2.21 |
| Sugar maple | 14,465 | 108 | -1,222 | -72 | -10 | 11,515 | 86 | 24,685 | 185 (N/A) | 2.5 | 2.3 | 6.86 |
| Apple | 3,154 | 24 | -193 | -30 | -2 | 3,422 | 26 | 6,353 | 48 (N/A) | 2.3 | 0.6 | 1.91 |
| Honeylocust | 11,050 | 83 | -410 | -45 | -3 | 9,983 | 75 | 20,578 | 154 (N/A) | 2.2 | 1.9 | 6.43 |
| American basswood | 20,979 | 157 | -1,737 | -75 | -14 | 11,018 | 83 | 30,185 | 226 (N/A) | 2.0 | 2.8 | 10.29 |
| Austrian pine | 1,727 | 13 | -113 | -37 | -1 | 3,696 | 28 | 5,272 | 40 (N/A) | 1.8 | 0.5 | 1.98 |
| Littleleaf linden | 6,996 | 52 | -292 | -33 | -2 | 4,985 | 37 | 11,656 | 87 (N/A) | 1.6 | 1.1 | 4.86 |
| Black walnut | 9,813 | 74 | -868 | -42 | -7 | 6,883 | 52 | 15,786 | 118 (N/A) | 1.3 | 1.5 | 8.46 |
| Red maple | 2,478 | 19 | -89 | -13 | -1 | 2,149 | 16 | 4,525 | 34 (N/A) | 1.0 | 0.4 | 3.08 |
| Norway spruce | 1,463 | 11 | -123 | -23 | -1 | 2,299 | 17 | 3,617 | 27 (N/A) | 1.0 | 0.3 | 2.47 |
| Ginkgo | 520 | 4 | -21 | -11 | 0 | 1,006 | 8 | 1,495 | 11 (N/A) | 0.9 | 0.1 | 1.12 |
| Bur oak | 1,819 | 14 | -42 | -11 | 0 | 1,367 | 10 | 3,134 | 24 (N/A) | 0.9 | 0.3 | 2.35 |
| Swamp white oak | 1,944 | 15 | -87 | -11 | -1 | 1,728 | 13 | 3,575 | 27 (N/A) | 0.8 | 0.3 | 2.98 |
| Northern red oak | 1,493 | 11 | -216 | -16 | -2 | 2,067 | 16 | 3,329 | 25 (N/A) | 0.8 | 0.3 | 2.77 |
| Maple | 1,177 | 9 | -46 | -6 | 0 | 810 | 6 | 1,936 | 15 (N/A) | 0.7 | 0.2 | 1.81 |
| Conifer Evergreen Large | 1,308 | 10 | -156 | -19 | -1 | 1,771 | 13 | 2,904 | 22 (N/A) | 0.6 | 0.3 | 3.11 |
| Northern hackberry | 1,721 | 13 | -149 | -14 | -1 | 2,541 | 19 | 4,099 | 31 (N/A) | 0.5 | 0.4 | 5.12 |
| American elm | 2,985 | 22 | -576 | -23 | -4 | 4,044 | 30 | 6,430 | 48 (N/A) | 0.5 | 0.6 | 9.64 |
| White ash | 3,060 | 23 | -163 | -10 | -1 | 1,775 | 13 | 4,662 | 35 (N/A) | 0.5 | 0.4 | 6.99 |
| Willow | 1,866 | 14 | -292 | -16 | -2 | 2,549 | 19 | 4,108 | 31 (N/A) | 0.5 | 0.4 | 6.16 |
| Eastern red cedar | 165 | 1 | -13 | -6 | 0 | 538 | 4 | 684 | 5 (N/A) | 0.4 | 0.1 | 1.28 |
| Scotch pine | 302 | 2 | -13 | -6 | 0 | 565 | 4 | 849 | 6 (N/A) | 0.4 | 0.1 | 1.59 |
| Ohio buckeye | 996 | 7 | -109 | -9 | -1 | 1,504 | 11 | 2,382 | 18 (N/A) | 0.4 | 0.2 | 4.47 |
| Pin oak | 2,128 | 16 | -95 | -7 | -1 | 1,153 | 9 | 3,179 | 24 (N/A) | 0.3 | 0.3 | 7.95 |
| Black poplar | 2,571 | 19 | -227 | -11 | -2 | 1,657 | 12 | 3,990 | 30 (N/A) | 0.3 | 0.4 | 9.97 |
| Amur corktree | 772 | 6 | -35 | -4 | 0 | 790 | 6 | 1,523 | 11 (N/A) | 0.2 | 0.1 | 5.71 |
| Sumac | 535 | 4 | -29 | -4 | 0 | 617 | 5 | 1,119 | 8 (N/A) | 0.2 | 0.1 | 4.20 |
| Boxelder | 1,219 | 9 | -74 | -5 | -1 | 606 | 5 | 1,746 | 13 (N/A) | 0.2 | 0.2 | 6.55 |
| Broadleaf Deciduous Smal | 47 | 0 | -1 | -1 | 0 | 43 | 0 | 88 | 1 (N/A) | 0.2 | 0.0 | 0.33 |
| Mulberry | 38 | 0 | -33 | -4 | 0 | 372 | 3 | 373 | 3 (N/A) | 0.2 | 0.0 | 1.40 |
| Paper birch | 445 | 3 | -18 | -2 | 0 | 393 | 3 | 819 | 6 (N/A) | 0.1 | 0.1 | 6.14 |
| Broadleaf Evergreen Medi | 143 | 1 | -9 | -2 | 0 | 388 | 3 | 520 | 4 (N/A) | 0.1 | 0.0 | 3.90 |
| White oak | 209 | 2 | -5 | -1 | 0 | 159 | 1 | 361 | 3 (N/A) | 0.1 | 0.0 | 2.71 |
| Red pine | 53 | 0 | -1 | -1 | 0 | 94 | 1 | 145 | 1 (N/A) | 0.1 | 0.0 | 1.08 |
| Kentucky coffeetree | 857 | 6 | -76 | -4 | -1 | 552 | 4 | 1,330 | 10 (N/A) | 0.1 | 0.1 | 9.97 |
| Chinese elm | 912 | 7 | -188 | -5 | -1 | 734 | 6 | 1,453 | 11 (N/A) | 0.1 | 0.1 | 10.90 |
| Cherry plum | 478 | 4 | -32 | -3 | 0 | 335 | 3 | 778 | 6 (N/A) | 0.1 | 0.1 | 5.84 |
| Eastern cottonwood | 912 | 7 | -188 | -5 | -1 | 734 | 6 | 1,453 | 11 (N/A) | 0.1 | 0.1 | 10.90 |
| Amur maple | 9 | 0 | 0 | 0 | 0 | 6 | 0 | 14 | 0 (N/A) | 0.1 | 0.0 | 0.10 |
| Callery pear | 96 | 1 | -2 | -1 | 0 | 65 | 0 | 158 | 1 (N/A) | 0.1 | 0.0 | 1.18 |
| Cottonwood | 912 | 7 | -188 | -5 | -1 | 734 | 6 | 1,453 | 11 (N/A) | 0.1 | 0.1 | 10.90 |
| Citywide total | 713,523 | 5,351 | -53,729 | -2,864 | -424 | 425,381 | 3,190 | 1,082,311 | 8,117 (N/A) | 100.0 | 100.0 | 7.44 |

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

Sanborn

## Annual Aesthetic/Other Benefits of Public Trees

2/4/2023

| Species | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|
| Green ash | 15,772 | (N/A) | 32.5 | 25.1 | 44.43 |
| Silver maple | 31,018 | (N/A) | 26.3 | 49.3 | 108.08 |
| Norway maple | 2,072 | (N/A) | 7.0 | 3.3 | 27.26 |
| Spruce | 1,311 | (N/A) | 4.1 | 2.1 | 29.14 |
| Blue spruce | 940 | (N/A) | 3.9 | 1.5 | 21.86 |
| Sugar maple | 1,542 | (N/A) | 2.5 | 2.5 | 57.10 |
| Apple | 181 | (N/A) | 2.3 | 0.3 | 7.24 |
| Honeylocust | 2,381 | (N/A) | 2.2 | 3.8 | 99.21 |
| American basswood | 1,518 | (N/A) | 2.0 | 2.4 | 68.99 |
| Austrian pine | 459 | (N/A) | 1.8 | 0.7 | 22.93 |
| Littleleaf linden | 793 | (N/A) | 1.6 | 1.3 | 44.07 |
| Black walnut | 797 | (N/A) | 1.3 | 1.3 | 56.96 |
| Red maple | 369 | (N/A) | 1.0 | 0.6 | 33.51 |
| Norway spruce | 316 | (N/A) | 1.0 | 0.5 | 28.70 |
| Ginkgo | 61 | (N/A) | 0.9 | 0.1 | 6.13 |
| Bur oak | 258 | (N/A) | 0.9 | 0.4 | 25.79 |
| Swamp white oak | 212 | (N/A) | 0.8 | 0.3 | 23.56 |
| Northern red oak | 130 | (N/A) | 0.8 | 0.2 | 14.39 |
| Maple | 154 | (N/A) | 0.7 | 0.2 | 19.20 |
| Conifer Evergreen Large | 185 | (N/A) | 0.6 | 0.3 | 26.44 |
| Northern hackberry | 258 | (N/A) | 0.5 | 0.4 | 42.95 |
| American elm | 386 | (N/A) | 0.5 | 0.6 | 77.16 |
| White ash | 332 | (N/A) | 0.5 | 0.5 | 66.46 |
| Willow | 165 | (N/A) | 0.5 | 0.3 | 33.00 |
| Eastern red cedar | 70 | (N/A) | 0.4 | 0.1 | 17.51 |
| Scotch pine | 87 | (N/A) | 0.4 | 0.1 | 21.72 |
| Ohio buckeye | 105 | (N/A) | 0.4 | 0.2 | 26.14 |
| Pin oak | 187 | (N/A) | 0.3 | 0.3 | 62.36 |
| Black poplar | 197 | (N/A) | 0.3 | 0.3 | 65.59 |
| Amur corktree | 78 | (N/A) | 0.2 | 0.1 | 39.16 |
| Sumac | 31 | (N/A) | 0.2 | 0.0 | 15.48 |
| Boxelder | 93 | (N/A) | 0.2 | 0.1 | 46.27 |
| Broadleaf Deciduous Small | 2 | (N/A) | 0.2 | 0.0 | 1.05 |
| Mulberry | 2 | (N/A) | 0.2 | 0.0 | 1.03 |
| Paper birch | 46 | (N/A) | 0.1 | 0.1 | 45.86 |
| Broadleaf Evergreen Medium | 35 | (N/A) | 0.1 | 0.1 | 34.98 |
| White oak | 29 | (N/A) | 0.1 | 0.0 | 28.56 |
| Red pine | 15 | (N/A) | 0.1 | 0.0 | 15.42 |
| Kentucky coffeetree | 66 | (N/A) | 0.1 | 0.1 | 65.59 |
| Chinese elm | 58 | (N/A) | 0.1 | 0.1 | 58.34 |
| Cherry plum | 29 | (N/A) | 0.1 | 0.0 | 28.80 |
| Eastern cottonwood | 58 | (N/A) | 0.1 | 0.1 | 58.34 |
| Amur maple | 0 | (N/A) | 0.1 | 0.0 | 0.03 |
| Callery pear | 13 | (N/A) | 0.1 | 0.0 | 12.89 |
| Cottonwood | 58 | (N/A) | 0.1 | 0.1 | 58.34 |
| Citywide total | 62,867 | (N/A) | 100.0 | 100.0 | 57.62 |

## Table 7: Summary of Benefits in Dollars

**Sanborn**

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

2/4/2023

| Species | Energy | $CO_2$ | Air Quality | Stormwater | Aesthetic/Other | Total ($) | Standard Error | % of Total $ |
|---|---|---|---|---|---|---|---|---|
| Green ash | 16,042 | 2,162 | 2,800 | 21,669 | 15,772 | 58,445 | (N/A) | 27.0 |
| Silver maple | 19,256 | 4,003 | 3,648 | 38,462 | 31,018 | 96,387 | (N/A) | 44.6 |
| Norway maple | 3,932 | 368 | 711 | 4,675 | 2,072 | 11,758 | (N/A) | 5.4 |
| Spruce | 1,261 | 118 | 51 | 3,147 | 1,311 | 5,887 | (N/A) | 2.7 |
| Blue spruce | 1,067 | 95 | 119 | 1,986 | 940 | 4,207 | (N/A) | 1.9 |
| Sugar maple | 1,423 | 185 | 225 | 1,913 | 1,542 | 5,288 | (N/A) | 2.4 |
| Apple | 464 | 48 | 75 | 233 | 181 | 1,001 | (N/A) | 0.5 |
| Honeylocust | 1,192 | 154 | 195 | 1,092 | 2,381 | 5,014 | (N/A) | 2.3 |
| American basswood | 1,409 | 226 | 218 | 1,954 | 1,518 | 5,325 | (N/A) | 2.5 |
| Austrian pine | 453 | 40 | 50 | 792 | 459 | 1,793 | (N/A) | 0.8 |
| Littleleaf linden | 598 | 87 | 97 | 552 | 793 | 2,128 | (N/A) | 1.0 |
| Black walnut | 855 | 118 | 152 | 1,226 | 797 | 3,149 | (N/A) | 1.5 |
| Red maple | 274 | 34 | 45 | 231 | 369 | 951 | (N/A) | 0.4 |
| Norway spruce | 271 | 27 | 17 | 602 | 316 | 1,233 | (N/A) | 0.6 |
| Ginkgo | 133 | 11 | 19 | 74 | 61 | 298 | (N/A) | 0.1 |
| Bur oak | 177 | 24 | 26 | 141 | 258 | 625 | (N/A) | 0.3 |
| Swamp white oak | 222 | 27 | 36 | 181 | 212 | 677 | (N/A) | 0.3 |
| Northern red oak | 261 | 25 | 37 | 294 | 130 | 747 | (N/A) | 0.3 |
| Maple | 105 | 15 | 18 | 103 | 154 | 395 | (N/A) | 0.2 |
| Conifer Evergreen Large | 215 | 22 | 1 | 599 | 185 | 1,021 | (N/A) | 0.5 |
| Northern hackberry | 326 | 31 | 56 | 368 | 258 | 1,039 | (N/A) | 0.5 |
| American elm | 491 | 48 | 103 | 617 | 386 | 1,645 | (N/A) | 0.8 |
| White ash | 217 | 35 | 41 | 325 | 332 | 951 | (N/A) | 0.4 |
| Willow | 330 | 31 | 62 | 446 | 165 | 1,034 | (N/A) | 0.5 |
| Eastern red cedar | 72 | 5 | 6 | 124 | 70 | 277 | (N/A) | 0.1 |
| Scotch pine | 67 | 6 | 8 | 105 | 87 | 274 | (N/A) | 0.1 |
| Ohio buckeye | 189 | 18 | 33 | 194 | 105 | 538 | (N/A) | 0.2 |
| Pin oak | 141 | 24 | 19 | 150 | 187 | 521 | (N/A) | 0.2 |
| Black poplar | 213 | 30 | 37 | 321 | 197 | 797 | (N/A) | 0.4 |
| Amur corktree | 94 | 11 | 16 | 76 | 78 | 276 | (N/A) | 0.1 |
| Sumac | 76 | 8 | 13 | 36 | 31 | 165 | (N/A) | 0.1 |
| Boxelder | 78 | 13 | 13 | 103 | 93 | 299 | (N/A) | 0.1 |
| Broadleaf Deciduous Sm | 6 | 1 | 1 | 2 | 2 | 12 | (N/A) | 0.0 |
| Mulberry | 52 | 3 | 9 | 34 | 2 | 99 | (N/A) | 0.0 |
| Paper birch | 44 | 6 | 7 | 40 | 46 | 143 | (N/A) | 0.1 |
| Broadleaf Evergreen Me | 41 | 4 | 5 | 48 | 35 | 134 | (N/A) | 0.1 |
| White oak | 21 | 3 | 3 | 16 | 29 | 71 | (N/A) | 0.0 |
| Red pine | 14 | 1 | 1 | 16 | 15 | 48 | (N/A) | 0.0 |
| Kentucky coffeetree | 71 | 10 | 12 | 107 | 66 | 266 | (N/A) | 0.1 |
| Chinese elm | 91 | 11 | 19 | 196 | 58 | 375 | (N/A) | 0.2 |
| Cherry plum | 46 | 6 | 8 | 32 | 29 | 121 | (N/A) | 0.1 |
| Eastern cottonwood | 91 | 11 | 19 | 196 | 58 | 375 | (N/A) | 0.2 |
| Amur maple | 1 | 0 | 0 | 0 | 0 | 1 | (N/A) | 0.0 |
| Callery pear | 9 | 1 | 1 | 4 | 13 | 29 | (N/A) | 0.0 |
| Cottonwood | 91 | 11 | 19 | 196 | 58 | 375 | (N/A) | 0.2 |
| Citywide Total | 52,480 | 8,117 | 9,053 | 83,680 | 62,867 | 216,197 | (N/A) | 100.0 |

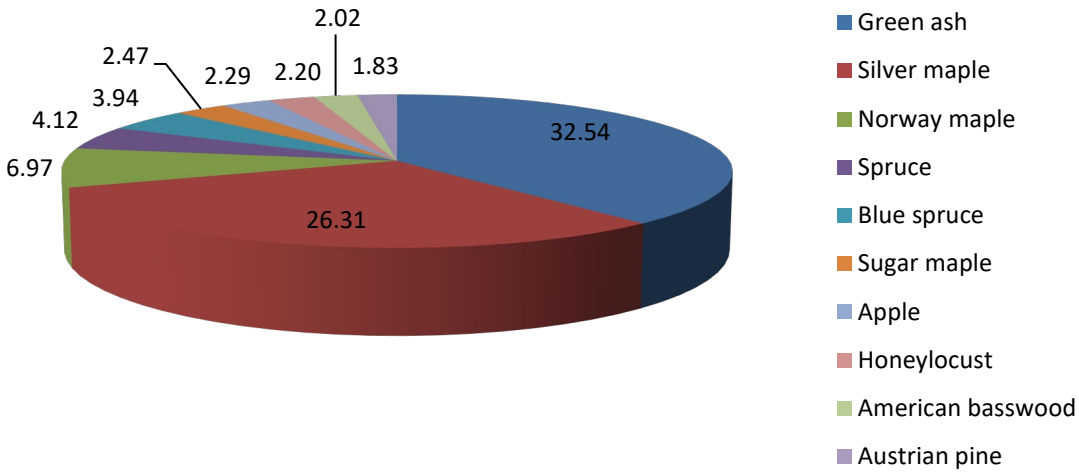


**Figure 1: Species Distribution**

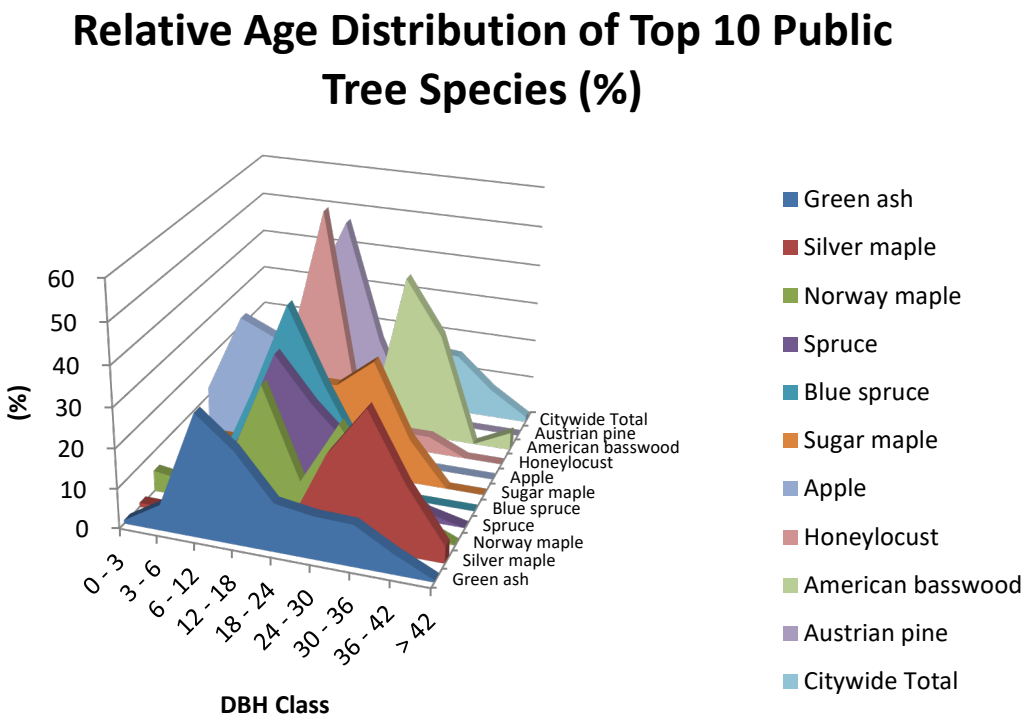


**Figure 2: Relative Age Class**

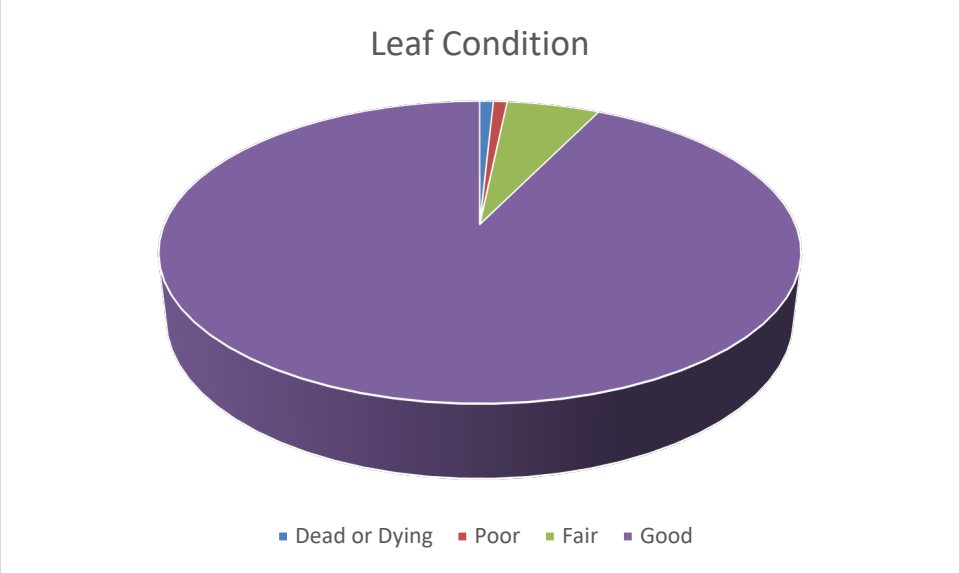


**Figure 3: Foliage Condition**

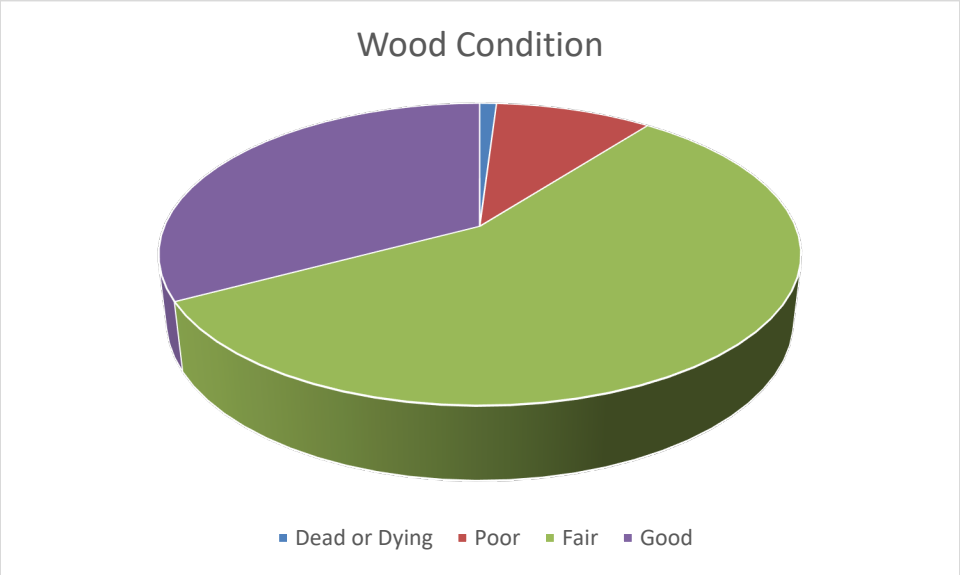


**Figure 4: Wood Condition**

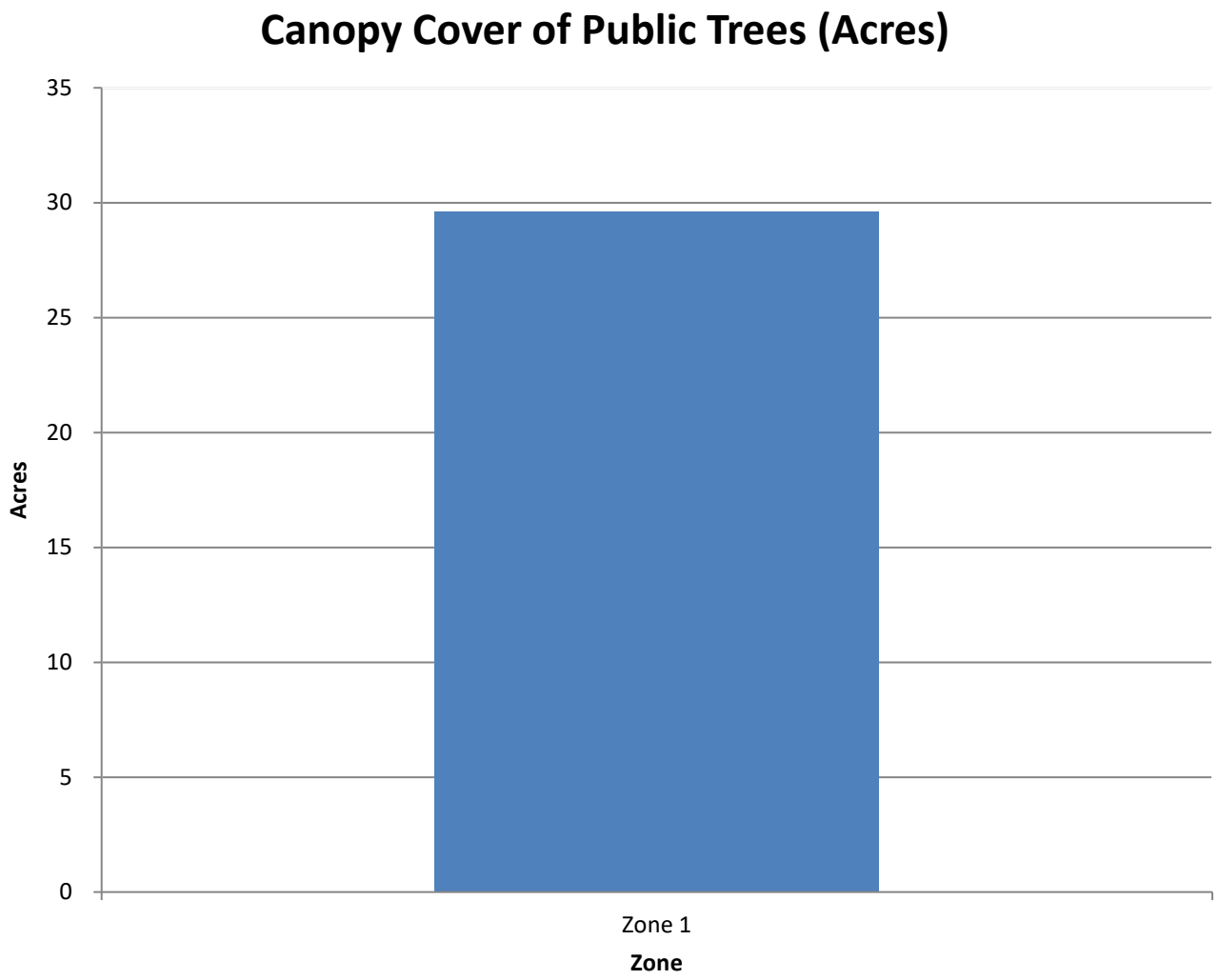


**Figure 5: Canopy Cover in Acres**

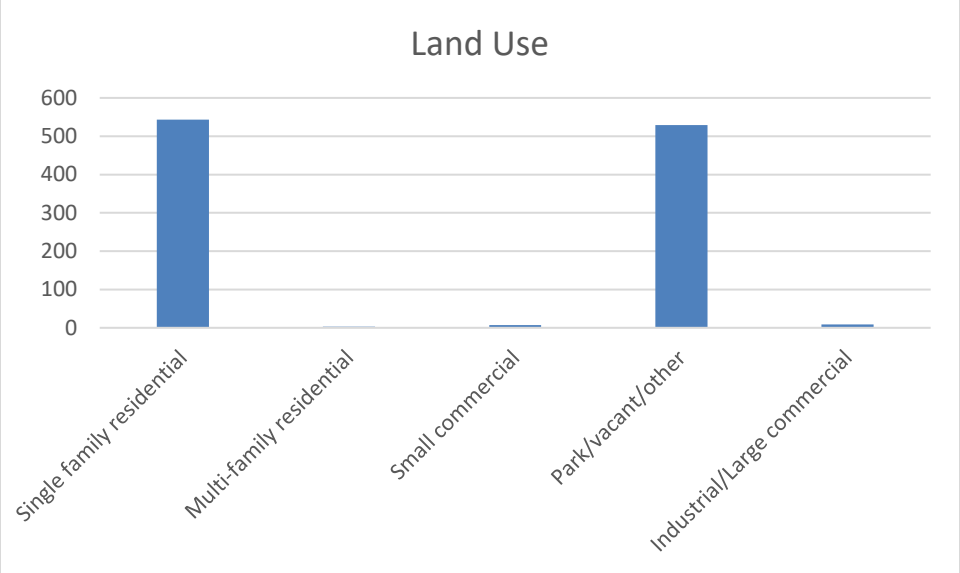


**Figure 6: Land Use of city/park trees**

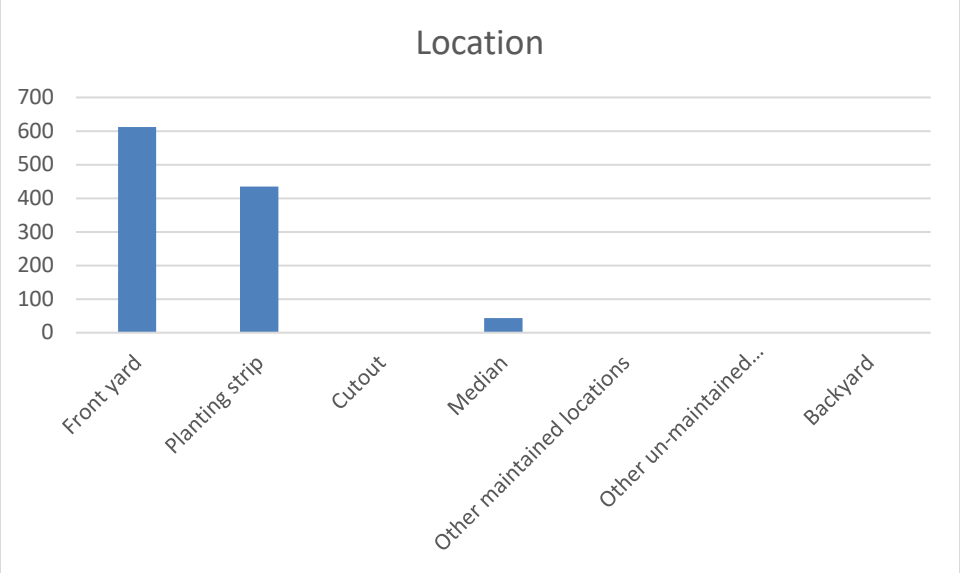


**Figure 7: Location of city/park trees**

# Appendix B: ArcGIS Mapping

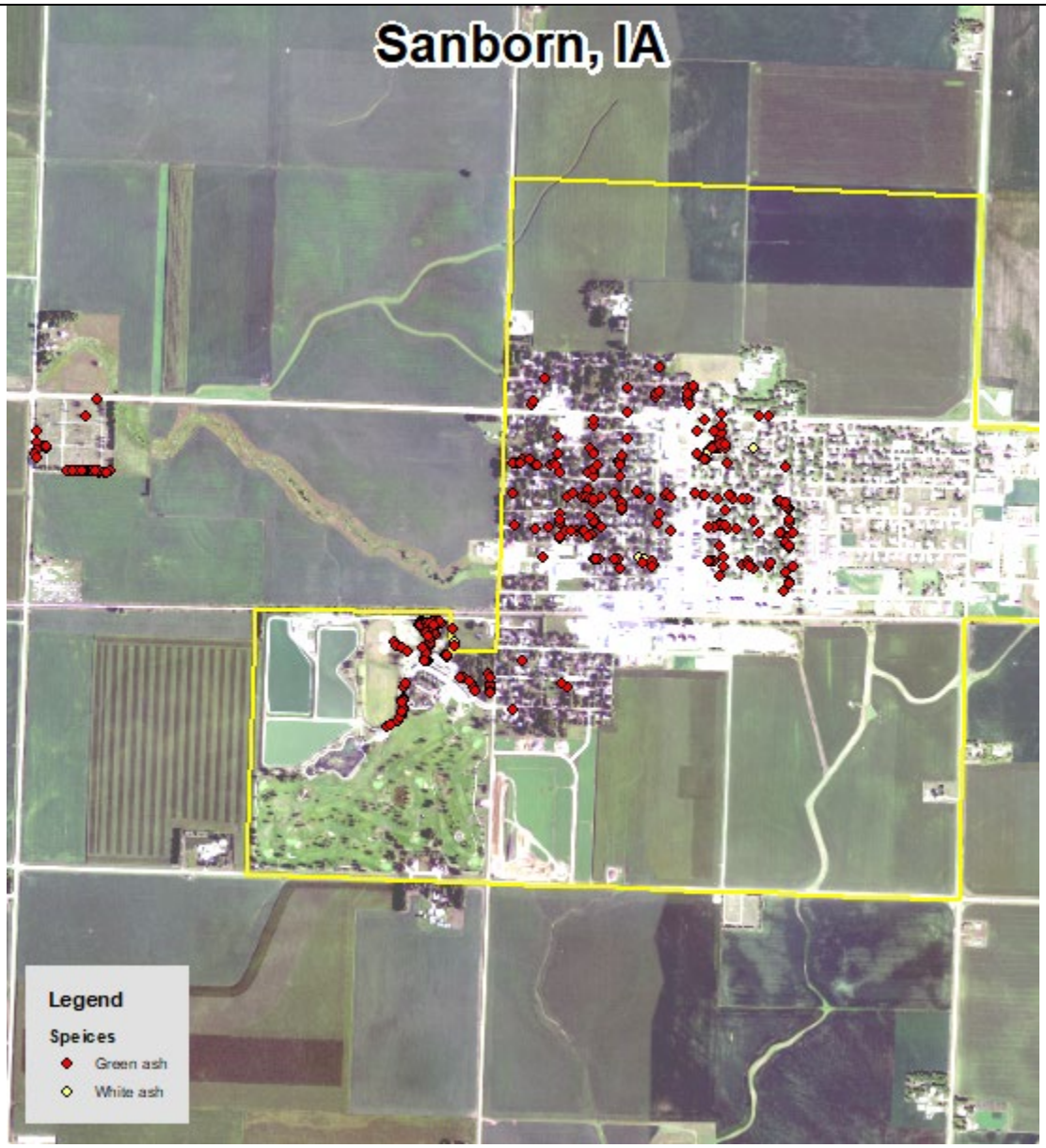

**Figure 1: Location of Ash Trees**

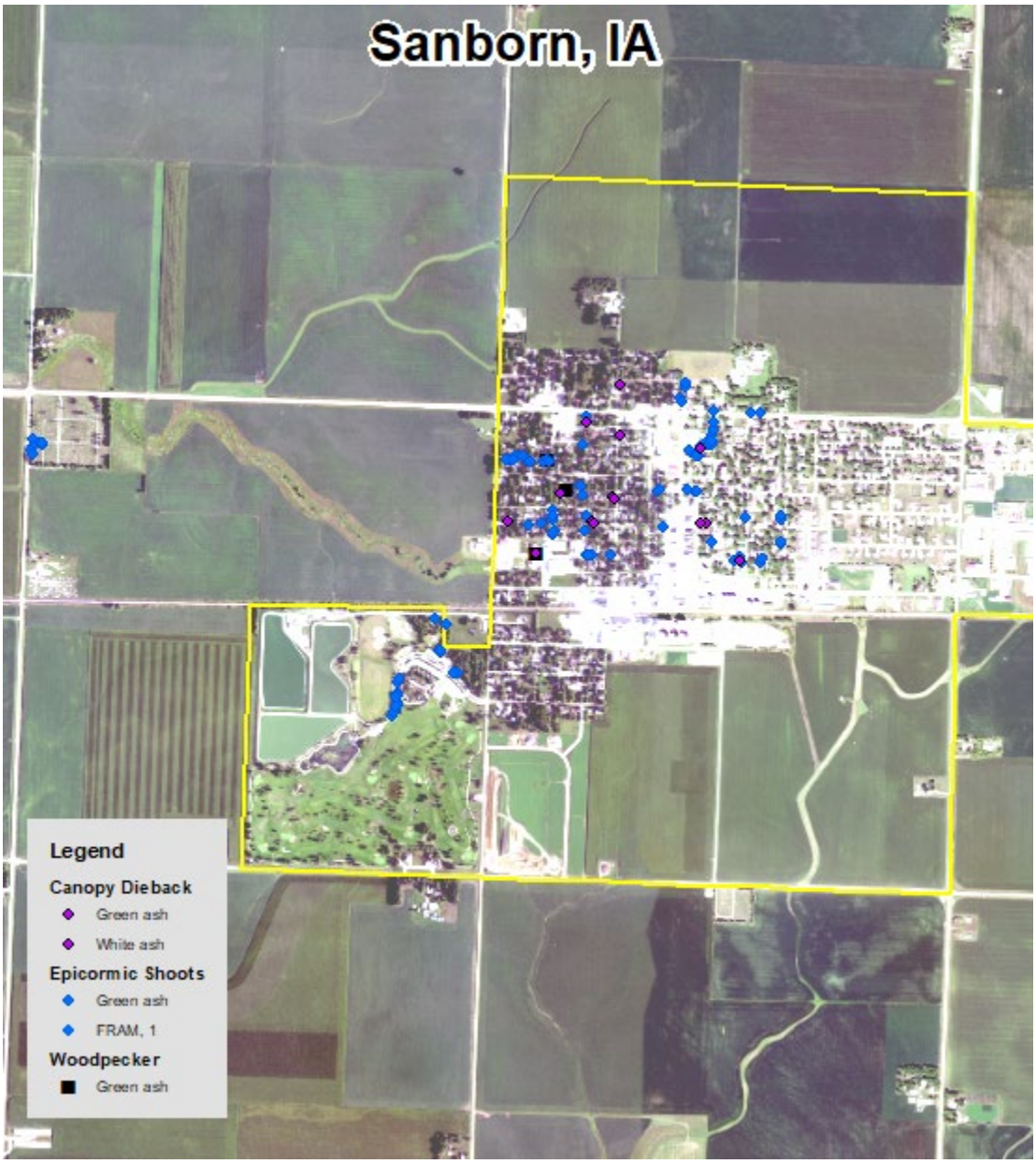


**Figure 2: Location of EAB symptoms**

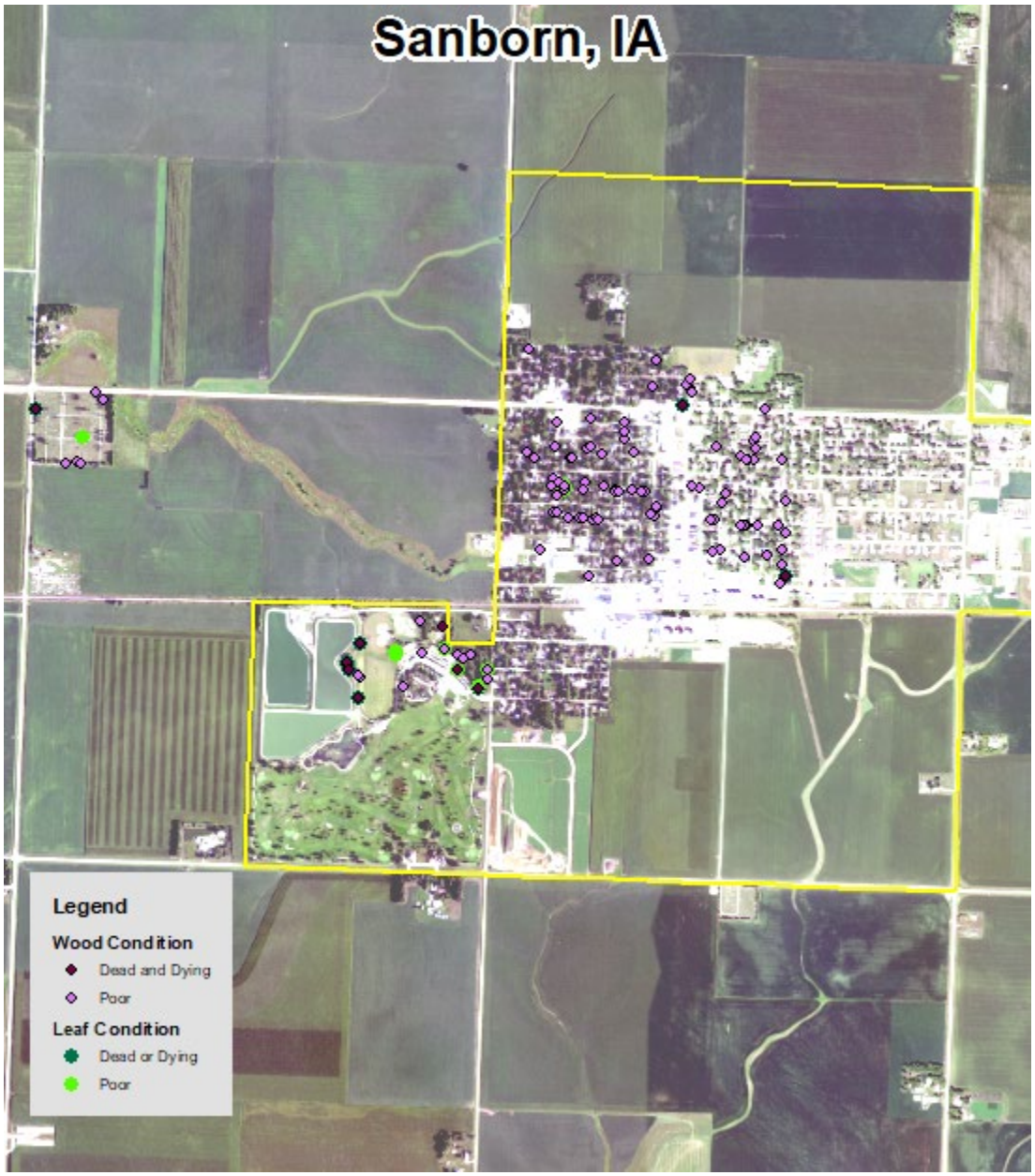


**Figure 3: Location of Poor Condition Trees**

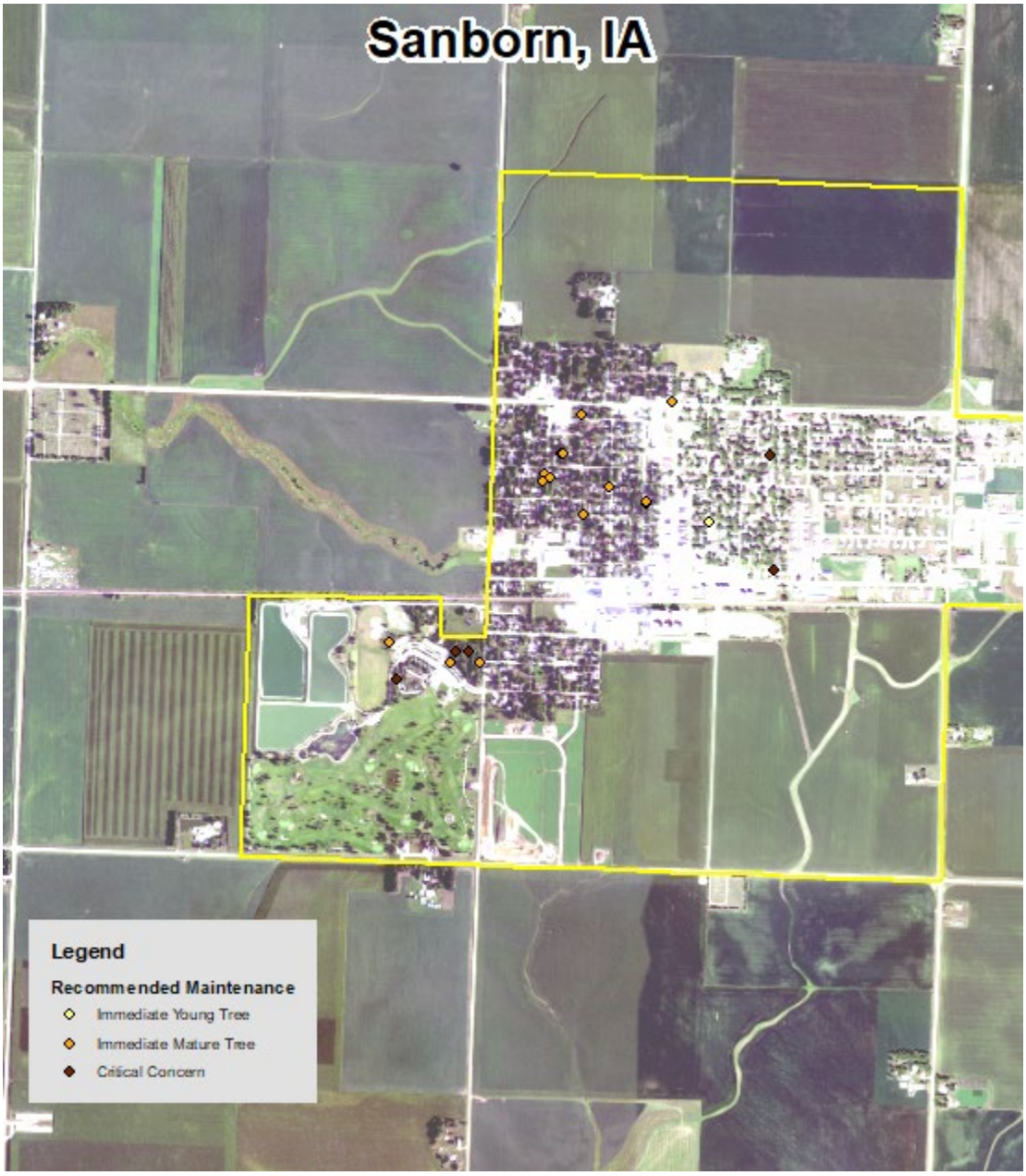


**Figure 4: Location of Trees with Recommended Maintenance**

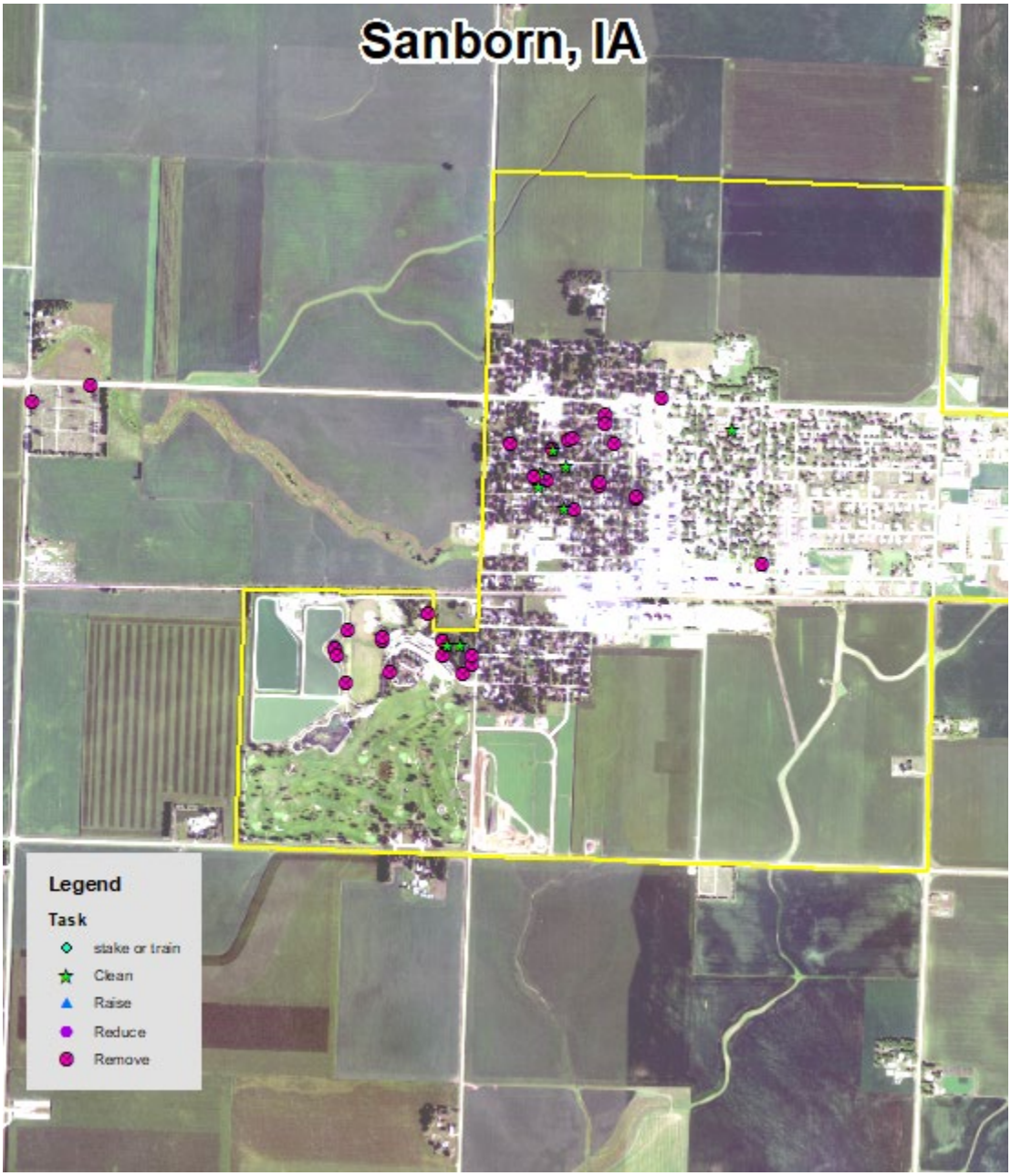


**Figure 5: Maintenance Tasks** ***City ownership of the trees recommended for removal should be verified prior to any removal***

# Appendix C: Sanborn Tree Ordinances

## CHAPTER 151

## TREES



### 151.01 DEFINITION.

For use in this chapter, "parking" means that part of the street, avenue, or highway in the City not covered by sidewalk and lying between the lot line and the curb line or, on unpaved streets, that part of the street, avenue, or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

### 151.02 PLANTING RESTRICTIONS.

No tree shall be planted in any parking or street except in accordance with the following:

1. Alignment. All trees planted in any street shall be planted in the parking midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line 10 feet from the property line.

2. Spacing. Trees shall not be planted on any parking that is less than nine feet in width, or contains less than 81 square feet of exposed soil surface per tree. Trees shall not be planted closer than 20 feet from street intersections (property lines extended) and 10 feet from driveways. If it is at all possible, trees should be planted inside the property lines and not between the sidewalk and the curb.

3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow, or black walnut.

### 151.03 DUTY TO TRIM TREES.

The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least 15 feet above the surface of the street and eight feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

*(Code of Iowa, Sec. 364.12[2c and e])*

### 151.04 TRIMMING TREES TO BE SUPERVISED.

Except as allowed in Section 151.03, it is unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

### 151.05 DISEASE CONTROL.

Any dead, diseased, or damaged tree or shrub that may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance.

### 151.06 INSPECTION AND REMOVAL.

The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased or damaged, and such trees and shrubs shall be subject to the following:

1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.

2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within 14 days of said notification. If such owner, occupant, or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.

*(Code of Iowa, Sec. 364.12[3b and h])*

The State of Iowa is an Equal Opportunity Employer and provider of ADA services.

Federal law prohibits employment discrimination on the basis of race, color, age, religion, national origin, sex or disability. State law prohibits employment discrimination on the basis of race, color, creed, age, sex, sexual orientation, gender identity, national origin, religion, pregnancy, or disability. State law also prohibits public accommodation (such as access to services or physical facilities) discrimination on the basis of race, color, creed, religion, sex, sexual orientation, gender identity, religion, national origin, or disability. If you believe you have been discriminated against in any program, activity or facility as described above, or if you desire further information, please contact the Iowa Civil Rights Commission, 1-800-457-4416, or write to the Iowa Department of Natural Resources, Wallace State Office Bldg., 502 E 9th St, Des Moines IA 50319.

If you need accommodations because of disability to access the services of this Agency, please contact the Director at 515-725-8200.