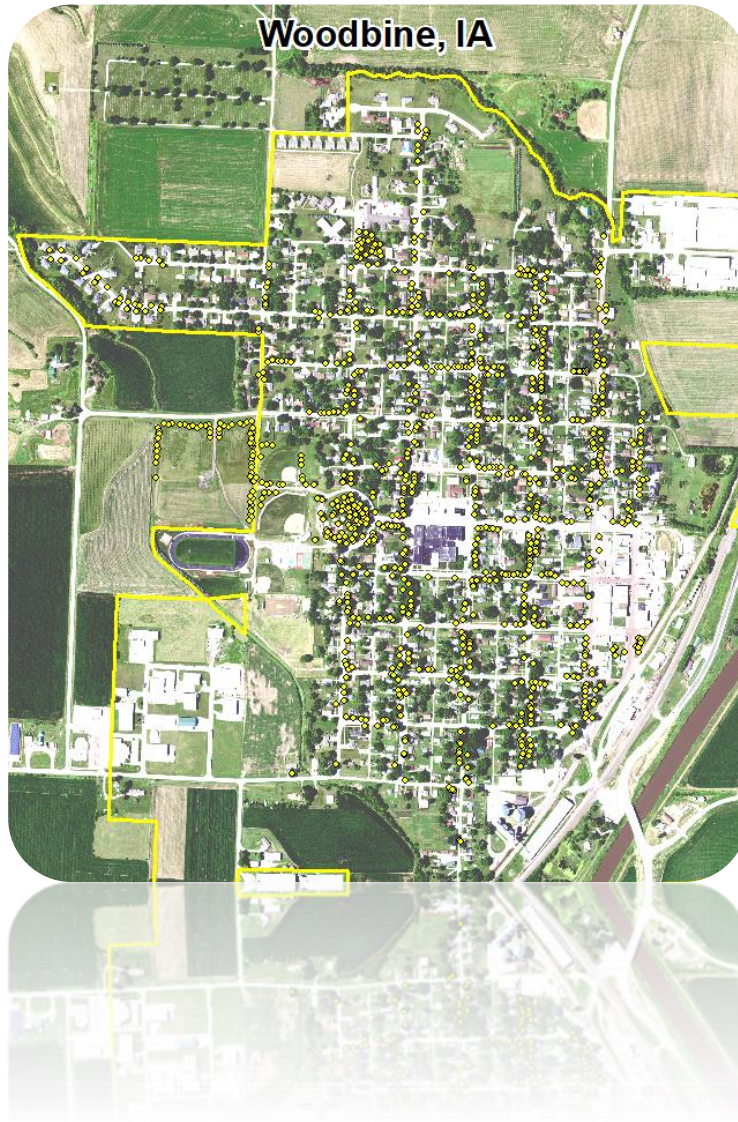# 2019 Woodbine Community Tree Inventory & Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Woodbine with managing its community 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). Woodbine's community forest trees were inventoried in 2012, and Ash was 18% of the total tree population at that time. The 2019 inventory showed that ash has dropped to 15.7% of the community tree population. EAB was confirmed in Missouri Valley in 2016, and was found in other areas of Harrison County soon after. The likelihood of ongoing ash decline and death in Woodbine and surrounding communities is high. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues. At the same time, replanting efforts can be planned for, so the impacts of community tree loss is hopefully more subtle.

Inventory and Results

In 2019, 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 **996** trees inventoried.

- Woodbine's trees provide **$197,671** of benefits annually, an average of **$198.46** a tree
- There are over **56** species of trees
- The top three genera are: **Maple 34%, Ash 16%, and Oak 14%**
- **22% of trees are in need of some type of management**
- **39** 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 **39** trees needing removal, **16** trees are over **24** inches in diameter at 4.5 ft and are identified as being of critical concern (recommended for immediate removal) *City ownership of the trees recommended for removal should be verified prior to any removal*
- **49 of the 156** ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- **176 trees were found to need pruning (cleaning)** - one third of these trees should be pruned/cleaned every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm/Siberian elm, evergreen, willow or black walnut. If non-native ornamental trees are used, the species should be researched to see if the tree species has invasive tendencies. Trees with invasive potential (Bradford Pear, Empress Tree, Norway Maple, Amur Maple) should not be used.
- Check ash trees with a visual survey yearly, and schedule the tree inventory to be updated in the 7th year.

- With the current tree removal budget (assuming 50/50 cost share with the landowner) it could take **16** years to remove just ash, and **18** years to remove all ash and other trees indicated in this inventory for removal assuming tree removals average $1000 per tree. The tree budget should be increased to $15,000 per year ($30,000 total with cost-share) to accomplish these removal needs in an expedited 6-year time frame.

Introduction

This plan was developed to assist Woodbine 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 2016 arrival of Emerald Ash Borer (EAB), an invasive pest that kills native ash trees, it is time to prepare for the ongoing costs of tree removal or treatment and replacement planting. With proper planning and management of the current canopy in Woodbine, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2019, 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 **996** 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. Woodbine's trees reduce energy related costs by approximately **$49,969** annually (Appendix A, Table 1). These savings are both in Electricity (**238.1 MWh)** and in Natural Gas **(32,548.2 Therms).**

Annual Stormwater Benefits
Woodbine's trees intercept about **2,780,938** gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides **$75,363** of benefits to the city.

Annual Air Quality Benefits
Air quality is a persistent public health issue in Iowa. The community 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 Woodbine, it is estimated that trees remove **3,092.2 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 **$8,692** (Appendix A, Table 3).

Annual Carbon Benefits
Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Woodbine, trees sequester about **647,473** lbs of carbon a year with an associated net value of **$7,431** (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. Woodbine receives **$56,215** 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, Woodbine's trees provide **$197,671** of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on

average each of the **996** trees in Woodbine provide approximately **$198.46** annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Woodbine has over **56** different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Woodbine Iowa Percentage by Genus		
Maple	343	34.4%
Ash	156	15.7%
Oak	135	13.6%
Hackberry	89	8.9%
Basswood/Linden	41	4.1%
Apple	38	3.8%
Spruce	26	2.6%
Pine	22	2.2%
Honey Locust	21	2.1%
Pear	20	2.0%
Kentucky Coffee Tree	16	1.6%
Sycamore	11	1.1%
Broadleaf Deciduous Other	10	1.0%
Juniper (Red Cedar)	10	1.0%
Conifer Species	9	0.9%
Hickory	5	0.5%
White cedar	5	0.5%
Elm	5	0.5%
Japanese Tree Lilac	4	0.4%
Birch	3	0.3%
E. Redbud	3	0.3%
Ginkgo	3	0.3%
Tulip Tree	3	0.3%
Aspen	3	0.3%
Prunus (Cherry/Plum)	3	0.3%
Willow	3	0.3%
Catalpa	2	0.2%
Magnolia	2	0.2%
Mulberry	2	0.2%
Yellowwood	1	0.1%
Flowering Dogwood	1	0.1%
Black Locust	1	0.1%
	996	100.0%

Age Class

Woodbine's community managed trees are pretty evenly distributed amongst all size classes. While large, mature trees do provide more benefits, they also take a long time to replace once they are severely damaged, or decline and die from natural or unnatural causes. Many sickly trees were removed after the 2012 inventory, any many more are recommended for removal from the 2019 inventory. For this reason, even more emphasis should be placed on increasing tree numbers in the youngest categories, to replace the oldest trees and any ash future removals.

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 Woodbine indicate that **97%** of the trees are in good or fair health, with only **3%** of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, **86%** of Woodbine's trees are in good or fair 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.

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	**176**	**18%**
Tree Removal	**39**	**4%**
Crown Raising	**2**	**<1%**
Crown Reduction	**2**	**<1%**

Canopy Cover

The total canopy with both private and public trees is **15%, or 127.71 acres**. The canopy cover included in the Woodbine inventory includes approximately **28.74** acres (Appendix A, Figure 4). A reasonable Canopy goal is to increase canopy to **20% (increase by 5%)**, in 30 years. To achieve this goal it is estimated that 21 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Woodbine'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.

<u>Land Use</u>

Single family residential	**77.7%**
Park/vacant/other	**21.8%**
Industrial/Large commercial	**<1%**
Multifamily residential	**<1%**

<u>Location</u>

Planting strip	**60%**
Front Yard	**39.9**

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

Woodbine has **19** 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). It is recommended to start with the large diameter critical concern trees first. There are **16** trees over **24** inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the remaining trees recommended for removal in the next 5 years. There are a total of **20** trees recommended for mature tree immediate removal.

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 **39 total** removals, **16** are ash trees. There are a total of **156** ash trees, and **49** of those have signs and symptoms that have been associated with EAB. **Of the 156 ash trees, 32 are considered to be in poor or dead/dying 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 6 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 Woodbine.

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 **(34.4%)** (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.

Six Year Maintenance Plan (additional funding will be necessary)
Year 1
    Removal: 19 critical concern trees
    Planting and Replacement: Apply for REC or tree planting programs to fill available planting spaces with suitable native trees (see attached Western Iowa Tree Species List). To replace the critical concern trees, 23 trees will be needed
    Visual Survey for signs and symptoms of EAB

Year 2
    Removal: Remove remaining 20 tree slated for mature tree immediate removal
    Crown Reduction/Raising: Complete 4 crown modifications as feasible
    Planting and Replacement: Continue replanting efforts, 24 trees will be needed to replace the 20 mature tree immediate removals
    Routine trimming: Contract to trim 1/3 of the 176 trees indicated for cleaning (if feasible)
    Visual Survey for signs and symptoms of EAB

Year 3
    Removal: 156 ash trees – 16 already removed = 140 remaining ash trees: Prioritize approximately 35 (or ¼ of 140) of the remaining ash in poor condition for removal
    Planting and Replacement: Replant in areas where removals have occurred – 1.2 x the number of ash removed = number of replacement trees
    Young Tree Pruning & Maintenance:
    Visual Survey for signs and symptoms of EAB

Year 4
    Removal: Prioritize another approximately 35 of the remaining ash in poor condition for removal
    Planting and Replacement: Replant in areas where removals have occurred – 1.2 x the number of ash removed = number of replacement trees
    Routine trimming: Contract to trim 1/3 of the trees indicated for cleaning
    Visual Survey for signs and symptoms of EAB

Year 5
    Removal: Prioritize another approximately 35 (1/4) of the remaining ash in poor condition for removal
    Planting and Replacement: Replant in areas where removals have occurred – 1.2 x the number of ash removed = number of replacement trees
    Visual Survey for signs and symptoms of EAB

Year 6
    Removal: Prioritize the remaining ash in poor condition for removal
    Planting and Replacement: Replant in areas where removals have occurred – 1.2 x the number of ash removed = number of replacement trees
    Routine trimming: Contract to trim the final 1/3 of the trees indicated for cleaning
    Visual Survey for signs and symptoms of EAB

    Contact DNR District Forester in Year 6 to have inventory done again for year 7
    ***An annual tree budget increase to $15,000 per year ($30,000 total) does not include tree cleaning or planting expenses. ***

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 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/Siberian 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, and if trees are starting to show early symptoms of EAB infestation. City Code **151.06 states "If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the 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 fourteen (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."**

Budget

Purposed Budget Increase

EAB will continue to kill ash trees in Woodbine for years to come. There are 156 total ash trees and 23 other tree critical concern and immediate mature tree removals (16 of the 156 ash are also slated for immediate removal). There are 179 trees that are slated for immediate removal or are likely to need removal in the next 6 years. With the 50/50 cost-share and current tree budget, it would take nearly 18 years to pay for all of these removals. In order to expedite the process into a 6-year budgeting timeframe, the city budget would need to be increased at least $10,000 beyond what it already is (each year), in order to pay for all the 179 potential removals. Additionally, it is recommended that Woodbine 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 **33 ash trees could be treated** (every other year treatment, and factoring in Woodbine's 50/50 cost-share policy and holding the current funding rate). This would be **33** ash trees in excellent health selected for treatment, and Woodbine would still need to find **additional funding for 39 removals (16 of which are ash).** These scenarios are options for moving forward, but either way it is suggested to increase the tree removal budget to account for inevitable surges of needed tree removals.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Woodbine

2/6/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	53.0	4,020	6,969.8	6,830	10,851	(N/A)	14.7	21.7	74.32
Green ash	43.9	3,335	6,058.6	5,937	9,273	(N/A)	14.1	18.6	66.23
Sugar maple	19.6	1,484	2,622.1	2,570	4,054	(N/A)	9.0	8.1	45.04
Northern hackberry	31.7	2,407	4,514.2	4,424	6,831	(N/A)	8.9	13.7	76.75
Maple	8.7	662	1,146.3	1,123	1,785	(N/A)	5.9	3.6	30.26
Northern red oak	8.9	675	1,211.2	1,187	1,862	(N/A)	5.5	3.7	33.85
Pin oak	15.7	1,190	2,090.0	2,048	3,238	(N/A)	4.4	6.5	73.59
Apple	3.5	268	542.7	532	800	(N/A)	3.8	1.6	21.05
American basswood	7.3	556	1,051.9	1,031	1,587	(N/A)	3.2	3.2	49.60
Norway maple	6.9	524	992.1	972	1,497	(N/A)	2.7	3.0	55.43
Blue spruce	0.8	58	116.6	114	172	(N/A)	2.1	0.3	8.21
Honeylocust	3.7	284	498.1	488	772	(N/A)	2.1	1.5	36.75
Eastern white pine	1.6	121	212.7	208	330	(N/A)	1.9	0.7	17.36
Red maple	2.8	216	367.4	360	576	(N/A)	1.8	1.2	32.01
Swamp white oak	0.6	46	99.3	97	144	(N/A)	1.7	0.3	8.46
Kentucky coffeetree	2.7	202	371.0	364	565	(N/A)	1.6	1.1	35.32
White ash	3.5	268	417.5	409	677	(N/A)	1.5	1.4	45.13
Callery pear	1.5	115	231.0	226	341	(N/A)	1.4	0.7	24.37
American sycamore	3.6	271	476.8	467	738	(N/A)	1.1	1.5	67.08
Black walnut	2.8	215	398.1	390	605	(N/A)	1.0	1.2	60.50
Littleleaf linden	1.4	104	189.3	186	290	(N/A)	0.9	0.6	32.20
Bur oak	1.3	96	174.4	171	267	(N/A)	0.9	0.5	29.63
White oak	0.1	10	16.6	16	26	(N/A)	0.8	0.1	3.24
Pear	0.4	28	64.8	63	92	(N/A)	0.6	0.2	15.31
Spruce	0.0	1	3.3	3	5	(N/A)	0.5	0.0	0.93
Conifer Evergreen Small	0.0	1	3.3	3	5	(N/A)	0.5	0.0	0.93
Hickory	1.4	106	185.8	182	288	(N/A)	0.5	0.6	57.52
Northern white cedar	0.1	9	21.0	21	30	(N/A)	0.5	0.1	5.99
Broadleaf Deciduous Large	1.7	125	225.3	221	346	(N/A)	0.4	0.7	86.52
Japanese tree lilac	0.7	50	100.7	99	149	(N/A)	0.4	0.3	37.15
Quaking aspen	0.3	22	41.2	40	62	(N/A)	0.3	0.1	20.64
Birch	0.4	33	65.1	64	96	(N/A)	0.3	0.2	32.14
Willow	0.9	67	124.3	122	188	(N/A)	0.3	0.4	62.82
Broadleaf Deciduous Medium	0.8	64	126.5	124	188	(N/A)	0.3	0.4	62.74
Amur maple	0.3	26	57.3	56	83	(N/A)	0.3	0.2	27.51
Ginkgo	0.3	20	31.8	31	51	(N/A)	0.3	0.1	16.89
Tulip tree	0.1	8	14.7	14	22	(N/A)	0.3	0.0	7.32
Eastern redbud	0.3	21	41.3	40	62	(N/A)	0.3	0.1	20.58
Broadleaf Deciduous Small	0.0	2	5.0	5	7	(N/A)	0.3	0.0	2.38
Austrian pine	0.2	14	25.4	25	39	(N/A)	0.2	0.1	19.66
Cherry plum	0.1	11	25.7	25	36	(N/A)	0.2	0.1	18.19
Oak	0.3	22	41.8	41	63	(N/A)	0.2	0.1	31.57
Siberian elm	0.7	51	93.1	91	142	(N/A)	0.2	0.3	71.03
Conifer Evergreen Medium	0.2	14	25.4	25	39	(N/A)	0.2	0.1	19.66
Mulberry	0.1	6	13.5	13	19	(N/A)	0.2	0.0	9.53
Elm	0.7	54	100.5	99	153	(N/A)	0.2	0.3	76.46
Conifer Evergreen Large	0.3	25	44.3	43	69	(N/A)	0.2	0.1	34.32
Northern catalpa	0.4	30	54.1	53	83	(N/A)	0.2	0.2	41.34
Southern magnolia	0.5	34	59.6	58	93	(N/A)	0.2	0.2	46.36
Black cherry	0.1	6	12.8	13	18	(N/A)	0.1	0.0	18.19
Flowering dogwood	0.0	0	0.6	1	1	(N/A)	0.1	0.0	0.87
Yellowwood	0.0	0	0.8	1	1	(N/A)	0.1	0.0	1.10
Ash	0.3	24	47.4	46	71	(N/A)	0.1	0.1	70.84
Black locust	0.3	24	47.4	46	71	(N/A)	0.1	0.1	70.84
Scotch pine	0.1	4	9.5	9	14	(N/A)	0.1	0.0	13.58
American elm	0.5	40	67.0	66	106	(N/A)	0.1	0.2	105.59
Total	238.1	18,071	32,548.2	31,897	49,969	(N/A)	100.0	100.0	50.17

Table 2: Annual Stormwater Benefits

Woodbine

Annual Stormwater Benefits of Public Trees

2/6/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	835,834	22,651	(N/A)	14.7	30.1	155.14
Green ash	531,551	14,405	(N/A)	14.1	19.1	102.89
Sugar maple	182,427	4,944	(N/A)	9.0	6.6	54.93
Northern hackberry	331,676	8,988	(N/A)	8.9	11.9	100.99
Maple	59,016	1,599	(N/A)	5.9	2.1	27.11
Northern red oak	79,725	2,161	(N/A)	5.5	2.9	39.28
Pin oak	200,196	5,425	(N/A)	4.4	7.2	123.30
Apple	14,433	391	(N/A)	3.8	0.5	10.29
American basswood	72,657	1,969	(N/A)	3.2	2.6	61.53
Norway maple	66,046	1,790	(N/A)	2.7	2.4	66.29
Blue spruce	10,937	296	(N/A)	2.1	0.4	14.11
Honeylocust	39,920	1,082	(N/A)	2.1	1.4	51.52
Eastern white pine	18,313	496	(N/A)	1.9	0.7	26.12
Red maple	20,547	557	(N/A)	1.8	0.7	30.93
Swamp white oak	3,104	84	(N/A)	1.7	0.1	4.95
Kentucky coffeetree	35,293	956	(N/A)	1.6	1.3	59.78
White ash	32,647	885	(N/A)	1.5	1.2	58.98
Callery pear	10,484	284	(N/A)	1.4	0.4	20.29
American sycamore	52,158	1,413	(N/A)	1.1	1.9	128.50
Black walnut	30,912	838	(N/A)	1.0	1.1	83.77
Littleleaf linden	10,354	281	(N/A)	0.9	0.4	31.18
Bur oak	12,622	342	(N/A)	0.9	0.5	38.00
White oak	758	21	(N/A)	0.8	0.0	2.57
Pear	1,330	36	(N/A)	0.6	0.0	6.01
Spruce	244	7	(N/A)	0.5	0.0	1.32
Conifer Evergreen Small	122	3	(N/A)	0.5	0.0	0.66
Hickory	13,408	363	(N/A)	0.5	0.5	72.67
Northern white cedar	1,337	36	(N/A)	0.5	0.0	7.25
Broadleaf Deciduous Large	25,459	690	(N/A)	0.4	0.9	172.48
Japanese tree lilac	3,279	89	(N/A)	0.4	0.1	22.22
Quaking aspen	1,824	49	(N/A)	0.3	0.1	16.47
Birch	4,363	118	(N/A)	0.3	0.2	39.41
Willow	8,938	242	(N/A)	0.3	0.3	80.74
Broadleaf Deciduous Medium	8,723	236	(N/A)	0.3	0.3	78.80
Amur maple	1,703	46	(N/A)	0.3	0.1	15.38
Ginkgo	1,101	30	(N/A)	0.3	0.0	9.94
Tulip tree	644	17	(N/A)	0.3	0.0	5.81
Eastern redbud	1,000	27	(N/A)	0.3	0.0	9.03
Broadleaf Deciduous Small	84	2	(N/A)	0.3	0.0	0.75
Austrian pine	2,300	62	(N/A)	0.2	0.1	31.16
Cherry plum	529	14	(N/A)	0.2	0.0	7.17
Oak	2,762	75	(N/A)	0.2	0.1	37.43
Siberian elm	6,718	182	(N/A)	0.2	0.2	91.03
Conifer Evergreen Medium	2,300	62	(N/A)	0.2	0.1	31.16
Mulberry	272	7	(N/A)	0.2	0.0	3.68
Elm	9,433	256	(N/A)	0.2	0.3	127.82
Conifer Evergreen Large	7,574	205	(N/A)	0.2	0.3	102.63
Northern catalpa	5,508	149	(N/A)	0.2	0.2	74.64
Southern magnolia	5,417	147	(N/A)	0.2	0.2	73.40
Black cherry	264	7	(N/A)	0.1	0.0	7.17
Flowering dogwood	7	0	(N/A)	0.1	0.0	0.20
Yellowwood	12	0	(N/A)	0.1	0.0	0.33
Ash	3,764	102	(N/A)	0.1	0.1	102.01
Black locust	3,764	102	(N/A)	0.1	0.1	102.01
Scotch pine	596	16	(N/A)	0.1	0.0	16.14
American elm	4,551	123	(N/A)	0.1	0.2	123.33
Citywide total	2,780,938	75,363	(N/A)	100.0	100.0	75.67

Table 3: Annual Air Quality Benefits

Woodbine

Annual Air Quality Benefits of Public Trees

2/6/2020

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($) Standard Error	% of Total Trees	Avg. $/tree
	O₃	NO₂	PM₁₀	SO₂		NO₂	PM₁₀	VOC	SO₂							
Silver maple	155.9	26.4	75.3	6.9	837	249.7	36.5	34.9	239.6	1,562	-80.3	-301	744.8	2,098 (N/A)	14.7	14.37
Green ash	70.9	11.3	33.1	3.2	375	210.2	30.6	29.1	199.1	1,308	0.0	0	587.6	1,684 (N/A)	14.1	12.03
Sugar maple	22.3	3.8	11.7	1.0	122	92.8	13.5	12.9	88.6	579	-18.0	-68	228.6	634 (N/A)	9.0	7.05
Northern hackberry	56.0	9.7	27.9	2.5	304	153.2	22.2	21.1	143.8	950	0.0	0	436.4	1,254 (N/A)	8.9	14.09
Maple	11.7	2.0	5.8	0.5	63	41.2	6.0	5.8	39.5	258	-4.3	-16	108.2	305 (N/A)	5.9	5.17
Northern red oak	16.2	2.8	8.0	0.7	88	42.3	6.2	5.9	40.3	264	-23.0	-86	99.3	265 (N/A)	5.5	4.82
Pin oak	38.1	6.7	19.1	1.7	207	74.3	10.8	10.4	71.0	464	-69.6	-261	162.4	410 (N/A)	4.4	9.32
Apple	4.1	0.7	2.0	0.2	22	17.4	2.5	2.4	16.0	107	0.0	0	45.1	129 (N/A)	3.8	3.39
American basswood	9.2	1.6	4.6	0.4	50	35.5	5.1	4.9	33.3	220	-8.0	-30	86.5	240 (N/A)	3.2	7.49
Norway maple	13.7	2.4	6.7	0.6	74	33.5	4.8	4.6	31.3	207	-3.2	-12	94.5	269 (N/A)	2.7	9.98
Blue spruce	1.6	0.3	1.4	0.2	11	3.8	0.5	0.5	3.5	23	-3.9	-15	7.8	19 (N/A)	2.1	0.91
Honeylocust	7.7	1.3	3.5	0.3	40	17.7	2.6	2.5	16.9	110	-6.0	-23	46.4	128 (N/A)	2.1	6.12
Eastern white pine	1.9	0.4	1.7	0.2	13	7.6	1.1	1.1	7.2	47	-6.0	-23	15.1	37 (N/A)	1.9	1.97
Red maple	4.4	0.8	2.1	0.2	24	13.4	2.0	1.9	12.9	84	-1.6	-6	36.1	102 (N/A)	1.8	5.66
Swamp white oak	0.3	0.0	0.2	0.0	2	3.1	0.4	0.4	2.8	19	-0.1	0	7.1	20 (N/A)	1.7	1.17
Kentucky coffeetree	4.9	0.8	2.2	0.2	26	12.7	1.9	1.8	12.0	79	0.0	0	36.5	105 (N/A)	1.6	6.56
White ash	5.0	0.8	2.4	0.2	27	16.2	2.4	2.3	16.0	103	0.0	0	45.4	129 (N/A)	1.5	8.62
Callery pear	1.6	0.3	0.9	0.1	9	7.5	1.1	1.0	6.9	46	-0.4	-2	18.8	53 (N/A)	1.4	3.79
American sycamore	9.7	1.6	4.3	0.4	51	16.9	2.5	2.4	16.2	106	0.0	0	53.9	156 (N/A)	1.1	14.23
Black walnut	3.6	0.6	1.8	0.2	19	13.6	2.0	1.9	12.8	85	0.0	0	36.4	104 (N/A)	1.0	10.39
Littleleaf linden	1.4	0.2	0.7	0.1	8	6.6	1.0	0.9	6.2	41	-0.7	-3	16.4	46 (N/A)	0.9	5.10
Bur oak	1.4	0.2	0.7	0.1	7	6.0	0.9	0.8	5.7	38	0.0	0	15.8	45 (N/A)	0.9	5.00
White oak	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.4	4 (N/A)	0.8	0.48
Pear	0.2	0.0	0.1	0.0	1	1.9	0.3	0.3	1.7	12	0.0	0	4.5	13 (N/A)	0.6	2.14
Spruce	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	-0.1	0	0.1	0 (N/A)	0.5	0.05
Conifer Evergreen Small	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.2	0 (N/A)	0.5	0.09
Hickory	1.5	0.2	0.7	0.1	8	6.6	1.0	0.9	6.3	41	0.0	0	17.3	49 (N/A)	0.5	9.83
Northern white cedar	0.1	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.4	-1	1.2	3 (N/A)	0.5	0.62
Broadleaf Deciduous Large	3.9	0.6	1.7	0.2	20	7.9	1.1	1.1	7.5	49	0.0	0	24.0	69 (N/A)	0.4	17.37
Japanese tree lilac	1.1	0.2	0.5	0.1	6	3.2	0.5	0.4	3.0	20	0.0	0	9.0	26 (N/A)	0.4	6.45
Quaking aspen	0.1	0.0	0.1	0.0	0	1.4	0.2	0.2	1.3	9	0.0	0	3.2	9 (N/A)	0.3	2.99
Birch	0.9	0.2	0.5	0.0	5	2.1	0.3	0.3	2.0	13	-0.2	-1	6.0	17 (N/A)	0.3	5.73
Willow	1.9	0.3	0.9	0.1	10	4.2	0.6	0.6	4.0	26	-0.4	-2	12.3	35 (N/A)	0.3	11.69
Broadleaf Deciduous Medium	1.8	0.3	0.9	0.1	10	4.1	0.6	0.6	3.8	26	-0.4	-2	11.9	34 (N/A)	0.3	11.30
Amur maple	0.5	0.1	0.2	0.0	3	1.7	0.2	0.2	1.6	11	0.0	0	4.7	13 (N/A)	0.3	4.48

Table 4: Annual Carbon Stored

Woodbine

Stored CO2 Benefits of Public Trees

2/6/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	3,689,351	27,670	(N/A)	14.7	33.2	189.52
Green ash	2,324,208	17,432	(N/A)	14.1	20.9	124.51
Sugar maple	644,624	4,835	(N/A)	9.0	5.8	53.72
Northern hackberry	863,220	6,474	(N/A)	8.9	7.8	72.74
Maple	134,741	1,011	(N/A)	5.9	1.2	17.13
Northern red oak	336,196	2,521	(N/A)	5.5	3.0	45.84
Pin oak	1,032,029	7,740	(N/A)	4.4	9.3	175.91
Apple	65,784	493	(N/A)	3.8	0.6	12.98
American basswood	334,348	2,508	(N/A)	3.2	3.0	78.36
Norway maple	226,006	1,695	(N/A)	2.7	2.0	62.78
Blue spruce	13,174	99	(N/A)	2.1	0.1	4.71
Honeylocust	99,236	744	(N/A)	2.1	0.9	35.44
Eastern white pine	11,931	89	(N/A)	1.9	0.1	4.71
Red maple	49,589	372	(N/A)	1.8	0.4	20.66
Swamp white oak	5,428	41	(N/A)	1.7	0.0	2.39
Kentucky coffeetree	161,541	1,212	(N/A)	1.6	1.5	75.72
White ash	88,582	664	(N/A)	1.5	0.8	44.29
Callery pear	27,861	209	(N/A)	1.4	0.3	14.93
American sycamore	337,905	2,534	(N/A)	1.1	3.0	230.39
Black walnut	116,258	872	(N/A)	1.0	1.0	87.19
Littleleaf linden	31,320	235	(N/A)	0.9	0.3	26.10
Bur oak	44,758	336	(N/A)	0.9	0.4	37.30
White oak	790	6	(N/A)	0.8	0.0	0.74
Pear	4,553	34	(N/A)	0.6	0.0	5.69
Spruce	12	0	(N/A)	0.5	0.0	0.02
Conifer Evergreen Sm	13	0	(N/A)	0.5	0.0	0.02
Hickory	47,347	355	(N/A)	0.5	0.4	71.02
Northern white cedar	521	4	(N/A)	0.5	0.0	0.78
Broadleaf Deciduous	130,403	978	(N/A)	0.4	1.2	244.51
Japanese tree lilac	17,430	131	(N/A)	0.4	0.2	32.68
Quaking aspen	3,104	23	(N/A)	0.3	0.0	7.76
Birch	15,398	115	(N/A)	0.3	0.1	38.49
Willow	32,184	241	(N/A)	0.3	0.3	80.46
Broadleaf Deciduous	30,171	226	(N/A)	0.3	0.3	75.43
Amur maple	8,559	64	(N/A)	0.3	0.1	21.40
Ginkgo	2,338	18	(N/A)	0.3	0.0	5.85
Tulip tree	1,059	8	(N/A)	0.3	0.0	2.65
Eastern redbud	4,123	31	(N/A)	0.3	0.0	10.31
Broadleaf Deciduous	205	2	(N/A)	0.3	0.0	0.51
Austrian pine	1,402	11	(N/A)	0.2	0.0	5.26
Cherry plum	1,816	14	(N/A)	0.2	0.0	6.81
Oak	8,643	65	(N/A)	0.2	0.1	32.41
Siberian elm	24,490	184	(N/A)	0.2	0.2	91.84
Conifer Evergreen Me	1,402	11	(N/A)	0.2	0.0	5.26
Mulberry	922	7	(N/A)	0.2	0.0	3.46
Elm	41,716	313	(N/A)	0.2	0.4	156.43
Conifer Evergreen La	10,833	81	(N/A)	0.2	0.1	40.62
Northern catalpa	25,955	195	(N/A)	0.2	0.2	97.33
Southern magnolia	8,808	66	(N/A)	0.2	0.1	33.03
Black cherry	908	7	(N/A)	0.1	0.0	6.81
Flowering dogwood	14	0	(N/A)	0.1	0.0	0.10
Yellowwood	17	0	(N/A)	0.1	0.0	0.13
Ash	14,280	107	(N/A)	0.1	0.1	107.10
Black locust	14,280	107	(N/A)	0.1	0.1	107.10
Scotch pine	257	2	(N/A)	0.1	0.0	1.93
American elm	29,353	220	(N/A)	0.1	0.3	220.15
Citywide total	11,121,398	83,410	(N/A)	100.0	100.0	83.75

Table 5: Annual Carbon Sequestered

Woodbine

Annual CO₂ Benefits of Public Trees

2/6/2020

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	248,924	1,867	-17,709	-617	-137	88,851	666	319,449	2,396 (N/A)	14.7	32.2	16.41
Green ash	104,386	783	-11,156	-468	-87	73,709	553	166,471	1,249 (N/A)	14.1	16.8	8.92
Sugar maple	38,809	291	-3,094	-205	-25	32,802	246	68,313	512 (N/A)	9.0	6.9	5.69
Northern hackberry	42,750	321	-4,144	-309	-33	53,189	399	91,486	686 (N/A)	8.9	9.2	7.71
Maple	14,839	111	-647	-80	-5	14,632	110	28,744	216 (N/A)	5.9	2.9	3.65
Northern red oak	9,715	73	-1,614	-110	-13	14,907	112	22,898	172 (N/A)	5.5	2.3	3.12
Pin oak	82,350	618	-4,954	-174	-38	26,293	197	103,515	776 (N/A)	4.4	10.4	17.64
Apple	5,567	42	-316	-50	-3	5,928	44	11,130	83 (N/A)	3.8	1.1	2.20
American basswood	20,765	156	-1,605	-84	-13	12,291	92	31,368	235 (N/A)	3.2	3.2	7.35
Norway maple	9,035	68	-1,085	-73	-9	11,590	87	19,467	146 (N/A)	2.7	2.0	5.41
Blue spruce	660	5	-63	-16	-1	1,285	10	1,865	14 (N/A)	2.1	0.2	0.67
Honeylocust	8,245	62	-477	-30	-4	6,265	47	14,003	105 (N/A)	2.1	1.4	5.00
Eastern white pine	1,454	11	-57	-27	-1	2,682	20	4,052	30 (N/A)	1.9	0.4	1.60
Red maple	4,443	33	-238	-26	-2	4,774	36	8,953	67 (N/A)	1.8	0.9	3.73
Swamp white oak	1,327	10	-29	-9	0	1,026	8	2,315	17 (N/A)	1.7	0.2	1.02
Kentucky coffeetree	6,315	47	-776	-31	-6	4,455	33	9,964	75 (N/A)	1.6	1.0	4.67
White ash	4,899	37	-425	-32	-3	5,916	44	10,359	78 (N/A)	1.5	1.0	5.18
Callery pear	2,788	21	-134	-17	-1	2,538	19	5,175	39 (N/A)	1.4	0.5	2.77
American sycamore	5,573	42	-1,622	-42	-12	5,979	45	9,888	74 (N/A)	1.1	1.0	6.74
Black walnut	7,115	53	-558	-30	-4	4,748	36	11,275	85 (N/A)	1.0	1.1	8.46
Littleleaf linden	4,014	30	-150	-16	-1	2,305	17	6,153	46 (N/A)	0.9	0.6	5.13
Bur oak	3,038	23	-215	-14	-2	2,115	16	4,924	37 (N/A)	0.9	0.5	4.10
White oak	307	2	-4	-3	0	212	2	512	4 (N/A)	0.8	0.1	0.48
Pear	578	4	-22	-6	0	626	5	1,176	9 (N/A)	0.6	0.1	1.47
Spruce	18	0	0	-1	0	30	0	47	0 (N/A)	0.5	0.0	0.07
Conifer Evergreen Small	3	0	0	-1	0	31	0	32	0 (N/A)	0.5	0.0	0.05
Hickory	3,264	24	-227	-14	-2	2,332	17	5,355	40 (N/A)	0.5	0.5	8.03
Northern white cedar	116	1	-3	-3	0	207	2	317	2 (N/A)	0.5	0.0	0.48
Broadleaf Deciduous Large	3,743	28	-626	-19	-5	2,769	21	5,867	44 (N/A)	0.4	0.6	11.00
Japanese tree lilac	382	3	-84	-10	-1	1,102	8	1,390	10 (N/A)	0.4	0.1	2.61
Quaking aspen	626	5	-15	-4	0	476	4	1,084	8 (N/A)	0.3	0.1	2.71
Birch	599	4	-74	-5	-1	722	5	1,242	9 (N/A)	0.3	0.1	3.11
Willow	756	6	-154	-10	-1	1,472	11	2,064	15 (N/A)	0.3	0.2	5.16
Broadleaf Deciduous Medi	1,310	10	-145	-9	-1	1,419	11	2,575	19 (N/A)	0.3	0.3	6.44
Amur maple	706	5	-41	-5	0	583	4	1,243	9 (N/A)	0.3	0.1	3.11
Ginkgo	208	2	-11	-4	0	432	3	625	5 (N/A)	0.3	0.1	1.56
Tulip tree	214	2	-5	-2	0	168	1	375	3 (N/A)	0.3	0.0	0.94
Eastern redbud	419	3	-20	-4	0	470	4	866	6 (N/A)	0.3	0.1	2.16
Broadleaf Deciduous Smal	55	0	-1	-1	0	48	0	102	1 (N/A)	0.3	0.0	0.25
Austrian pine	129	1	-7	-3	0	319	2	439	3 (N/A)	0.2	0.0	1.64
Cherry plum	228	2	-9	-2	0	248	2	465	3 (N/A)	0.2	0.0	1.74
Oak	734	6	-41	-3	0	490	4	1,179	9 (N/A)	0.2	0.1	4.42
Siberian elm	1,279	10	-118	-7	-1	1,122	8	2,277	17 (N/A)	0.2	0.2	8.54
Conifer Evergreen Medium	129	1	-7	-3	0	319	2	439	3 (N/A)	0.2	0.0	1.64
Mulberry	123	1	-4	-1	0	130	1	246	2 (N/A)	0.2	0.0	0.92
Elm	1,816	14	-200	-8	-2	1,202	9	2,811	21 (N/A)	0.2	0.3	10.54
Conifer Evergreen Large	443	3	-52	-6	0	557	4	943	7 (N/A)	0.2	0.1	3.53
Northern catalpa	962	7	-125	-4	-1	654	5	1,487	11 (N/A)	0.2	0.2	5.58
Southern magnolia	476	4	-42	-5	0	758	6	1,187	9 (N/A)	0.2	0.1	4.45
Black cherry	114	1	-4	-1	0	124	1	232	2 (N/A)	0.1	0.0	1.74
Flowering dogwood	9	0	0	0	0	6	0	14	0 (N/A)	0.1	0.0	0.10
Yellowwood	5	0	0	0	0	7	0	12	0 (N/A)	0.1	0.0	0.09
Ash	0	0	-69	-4	-1	539	4	466	3 (N/A)	0.1	0.0	3.49
Black locust	0	0	-69	-4	-1	539	4	466	3 (N/A)	0.1	0.0	3.49
Scotch pine	53	0	-1	-1	0	94	1	145	1 (N/A)	0.1	0.0	1.08
American elm	655	5	-141	-5	-1	883	7	1,392	10 (N/A)	0.1	0.1	10.44
Citywide total	647,473	4,856	-53,390	-2,617	-420	399,373	2,995	990,839	7,431 (N/A)	100.0	100.0	7.46

Table 6: Annual Social and Aesthetic Benefits

Woodbine

Annual Aesthetic/Other Benefits of Public Trees

2/6/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	18,160	(N/A)	14.7	32.3	124.38
Green ash	8,153	(N/A)	14.1	14.5	58.23
Sugar maple	4,286	(N/A)	9.0	7.6	47.62
Northern hackberry	5,353	(N/A)	8.9	9.5	60.15
Maple	2,140	(N/A)	5.9	3.8	36.28
Northern red oak	806	(N/A)	5.5	1.4	14.65
Pin oak	6,011	(N/A)	4.4	10.7	136.61
Apple	321	(N/A)	3.8	0.6	8.44
American basswood	1,569	(N/A)	3.2	2.8	49.03
Norway maple	851	(N/A)	2.7	1.5	31.51
Blue spruce	190	(N/A)	2.1	0.3	9.05
Honeylocust	1,982	(N/A)	2.1	3.5	94.38
Eastern white pine	419	(N/A)	1.9	0.7	22.03
Red maple	616	(N/A)	1.8	1.1	34.22
Swamp white oak	181	(N/A)	1.7	0.3	10.65
Kentucky coffeetree	518	(N/A)	1.6	0.9	32.37
White ash	684	(N/A)	1.5	1.2	45.62
Callery pear	315	(N/A)	1.4	0.6	22.49
American sycamore	394	(N/A)	1.1	0.7	35.85
Black walnut	583	(N/A)	1.0	1.0	58.33
Littleleaf linden	453	(N/A)	0.9	0.8	50.34
Bur oak	284	(N/A)	0.9	0.5	31.59
White oak	80	(N/A)	0.8	0.1	10.00
Pear	32	(N/A)	0.6	0.1	5.34
Spruce	29	(N/A)	0.5	0.1	5.76
Conifer Evergreen Small	21	(N/A)	0.5	0.0	4.27
Hickory	281	(N/A)	0.5	0.5	56.12
Northern white cedar	48	(N/A)	0.5	0.1	9.62
Broadleaf Deciduous Large	250	(N/A)	0.4	0.4	62.47
Japanese tree lilac	22	(N/A)	0.4	0.0	5.47
Quaking aspen	86	(N/A)	0.3	0.2	28.56
Birch	60	(N/A)	0.3	0.1	20.14
Willow	71	(N/A)	0.3	0.1	23.54
Broadleaf Deciduous Medium	118	(N/A)	0.3	0.2	39.19
Amur maple	42	(N/A)	0.3	0.1	13.87
Ginkgo	22	(N/A)	0.3	0.0	7.20
Tulip tree	39	(N/A)	0.3	0.1	13.03
Eastern redbud	24	(N/A)	0.3	0.0	7.98
Broadleaf Deciduous Small	2	(N/A)	0.3	0.0	0.71
Austrian pine	46	(N/A)	0.2	0.1	23.16
Cherry plum	13	(N/A)	0.2	0.0	6.40
Oak	72	(N/A)	0.2	0.1	36.21
Siberian elm	92	(N/A)	0.2	0.2	46.00
Conifer Evergreen Medium	46	(N/A)	0.2	0.1	23.16
Mulberry	6	(N/A)	0.2	0.0	3.22
Elm	132	(N/A)	0.2	0.2	66.10
Conifer Evergreen Large	73	(N/A)	0.2	0.1	36.67
Northern catalpa	72	(N/A)	0.2	0.1	35.93

Southern magnolia	60	(N/A)	0.2	0.1	30.20
Black cherry	6	(N/A)	0.1	0.0	6.40
Flowering dogwood	0	(N/A)	0.1	0.0	0.03
Yellowwood	3	(N/A)	0.1	0.0	2.74
Ash	0	(N/A)	0.1	0.0	0.00
Black locust	0	(N/A)	0.1	0.0	0.00
Scotch pine	15	(N/A)	0.1	0.0	15.42
American elm	82	(N/A)	0.1	0.1	82.32
Citywide total	56,215	(N/A)	100.0	100.0	56.44

Table 7: Summary of Benefits in Dollars

Woodbine

Total Annual Benefits of Public Trees by Species ($)

2/6/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	10,851	2,396	2,098	22,651	18,160	56,156	(N/A)	28.4
Green ash	9,273	1,249	1,684	14,405	8,153	34,763	(N/A)	17.6
Sugar maple	4,054	512	634	4,944	4,286	14,430	(N/A)	7.3
Northern hackberry	6,831	686	1,254	8,988	5,353	23,112	(N/A)	11.7
Maple	1,785	216	305	1,599	2,140	6,046	(N/A)	3.1
Northern red oak	1,862	172	265	2,161	806	5,265	(N/A)	2.7
Pin oak	3,238	776	410	5,425	6,011	15,861	(N/A)	8.0
Apple	800	83	129	391	321	1,724	(N/A)	0.9
American basswood	1,587	235	240	1,969	1,569	5,600	(N/A)	2.8
Norway maple	1,497	146	269	1,790	851	4,553	(N/A)	2.3
Blue spruce	172	14	19	296	190	692	(N/A)	0.4
Honeylocust	772	105	128	1,082	1,982	4,069	(N/A)	2.1
Eastern white pine	330	30	37	496	419	1,312	(N/A)	0.7
Red maple	576	67	102	557	616	1,918	(N/A)	1.0
Swamp white oak	144	17	20	84	181	446	(N/A)	0.2
Kentucky coffeetree	565	75	105	956	518	2,219	(N/A)	1.1
White ash	677	78	129	885	684	2,453	(N/A)	1.2
Callery pear	341	39	53	284	315	1,032	(N/A)	0.5
American sycamore	738	74	156	1,413	394	2,776	(N/A)	1.4
Black walnut	605	85	104	838	583	2,215	(N/A)	1.1
Littleleaf linden	290	46	46	281	453	1,115	(N/A)	0.6
Bur oak	267	37	45	342	284	975	(N/A)	0.5
White oak	26	4	4	21	80	134	(N/A)	0.1
Pear	92	9	13	36	32	182	(N/A)	0.1
Spruce	5	0	0	7	29	41	(N/A)	0.0
Conifer Evergreen Smal	5	0	0	3	21	30	(N/A)	0.0
Hickory	288	40	49	363	281	1,021	(N/A)	0.5
Northern white cedar	30	2	3	36	48	120	(N/A)	0.1
Broadleaf Deciduous La	346	44	69	690	250	1,399	(N/A)	0.7
Japanese tree lilac	149	10	26	89	22	296	(N/A)	0.1
Quaking aspen	62	8	9	49	86	214	(N/A)	0.1
Birch	96	9	17	118	60	302	(N/A)	0.2
Willow	188	15	35	242	71	552	(N/A)	0.3
Broadleaf Deciduous M	188	19	34	236	118	595	(N/A)	0.3
Amur maple	83	9	13	46	42	193	(N/A)	0.1
Ginkgo	51	5	8	30	22	115	(N/A)	0.1
Tulip tree	22	3	3	17	39	84	(N/A)	0.0
Eastern redbud	62	6	10	27	24	129	(N/A)	0.1
Broadleaf Deciduous Sn	7	1	1	2	2	13	(N/A)	0.0
Austrian pine	39	3	4	62	46	156	(N/A)	0.1
Cherry plum	36	3	5	14	13	72	(N/A)	0.0
Oak	63	9	10	75	72	229	(N/A)	0.1
Siberian elm	142	17	25	182	92	459	(N/A)	0.2
Conifer Evergreen Medi	39	3	4	62	46	156	(N/A)	0.1
Mulberry	19	2	3	7	6	37	(N/A)	0.0
Elm	153	21	28	256	132	590	(N/A)	0.3
Conifer Evergreen Large	69	7	0	205	73	354	(N/A)	0.2
Northern catalpa	83	11	16	149	72	331	(N/A)	0.2

Southern magnolia	93	9	13	147	60	322 (N/A)	0.2
Black cherry	18	2	3	7	6	36 (N/A)	0.0
Flowering dogwood	1	0	0	0	0	1 (N/A)	0.0
Yellowwood	1	0	0	0	3	4 (N/A)	0.0
Ash	71	3	14	102	0	190 (N/A)	0.1
Black locust	71	3	14	102	0	190 (N/A)	0.1
Scotch pine	14	1	1	16	15	48 (N/A)	0.0
American elm	106	10	23	123	82	345 (N/A)	0.2
Citywide Total	49,969	7,431	8,692	75,363	56,215	197,671 (N/A)	100.0
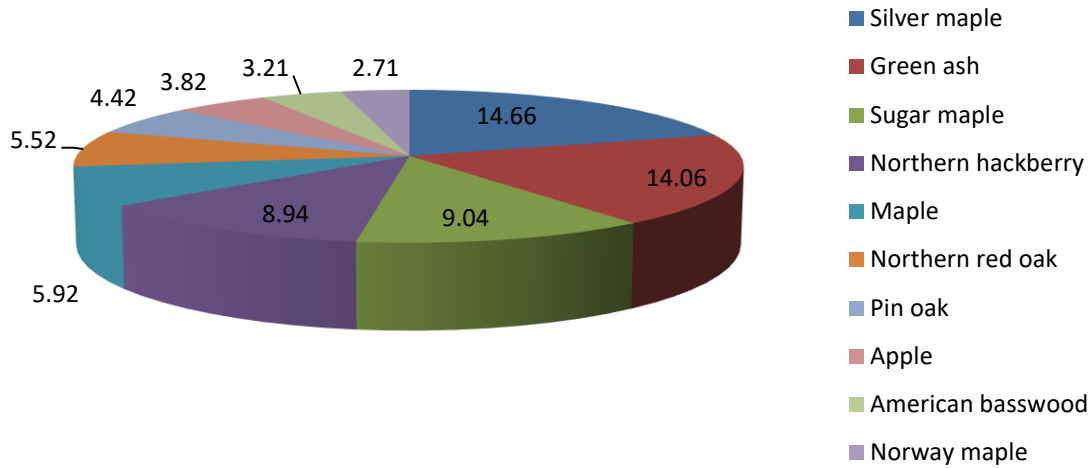
Figure 1: Species Distribution

Relative Age Distribution of Top 10 Public Tree Species (%)
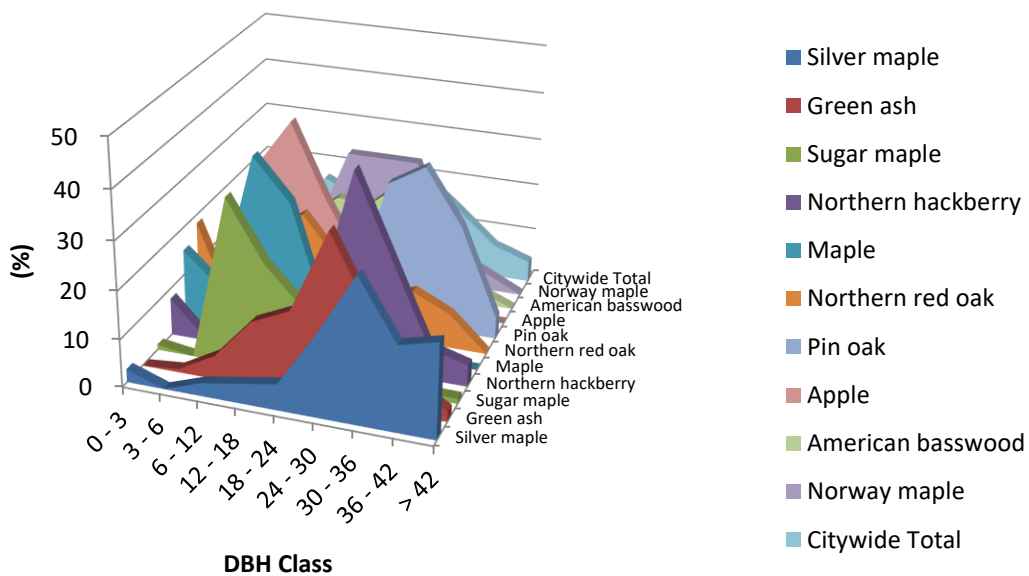
Figure 2: Relative Age Class
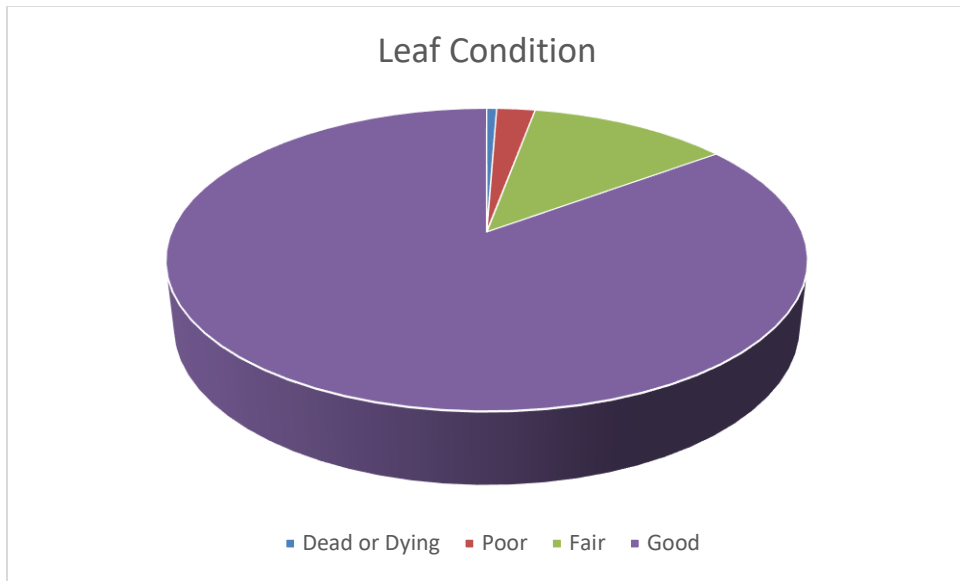
Figure 3: Foliage Condition
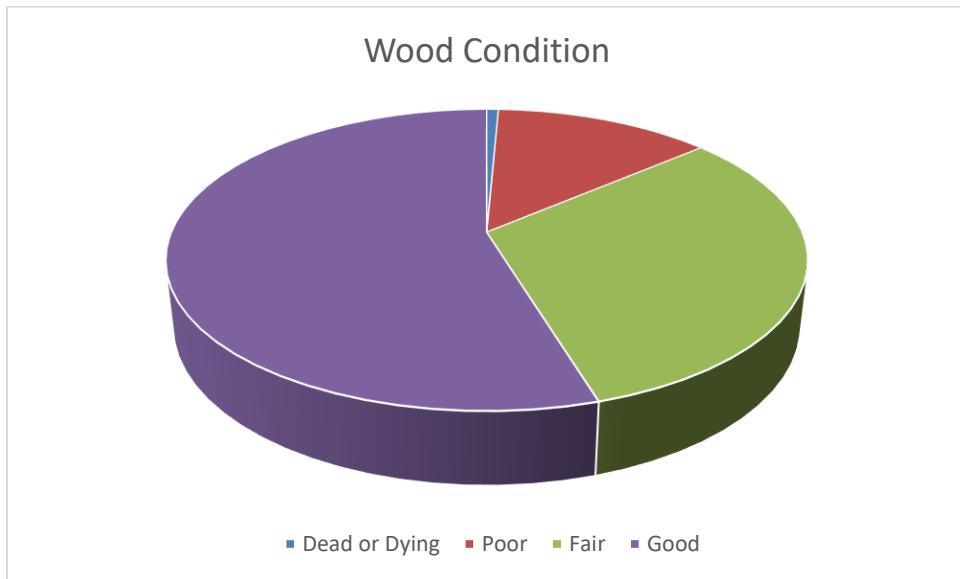
Figure 4: Wood Condition

Canopy Cover
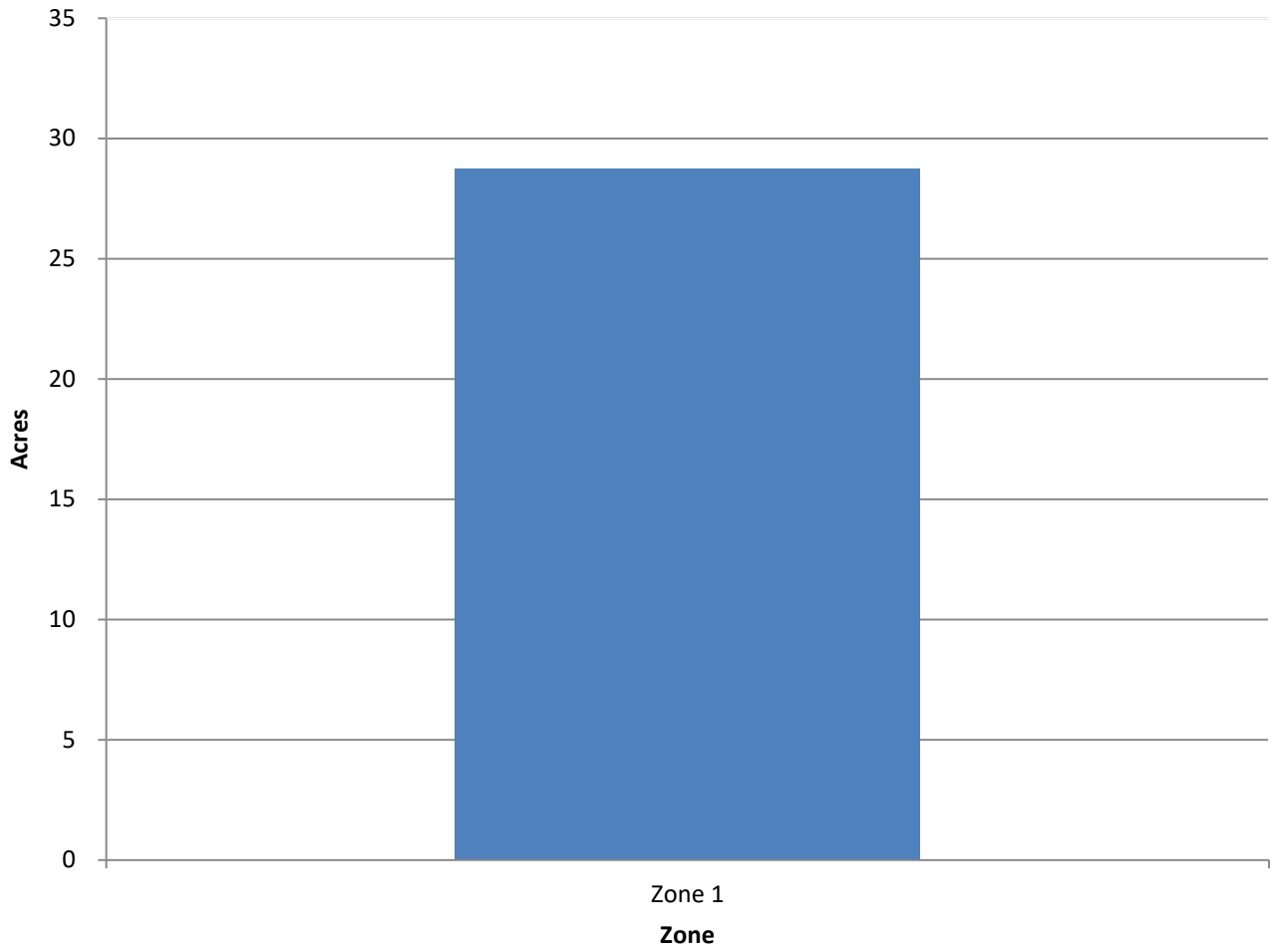
Figure 5: Canopy Cover in Acres
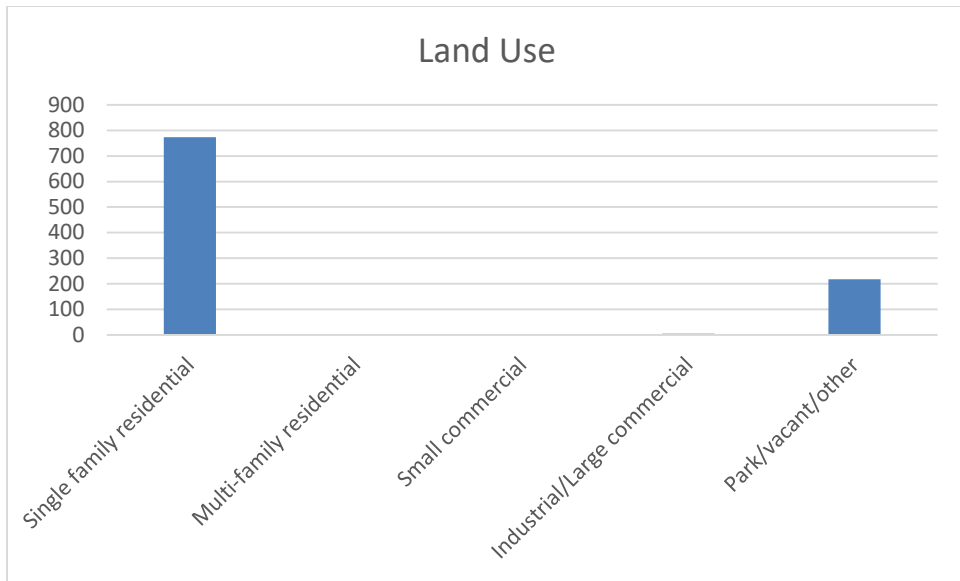
Figure 6: Land Use of city/park trees
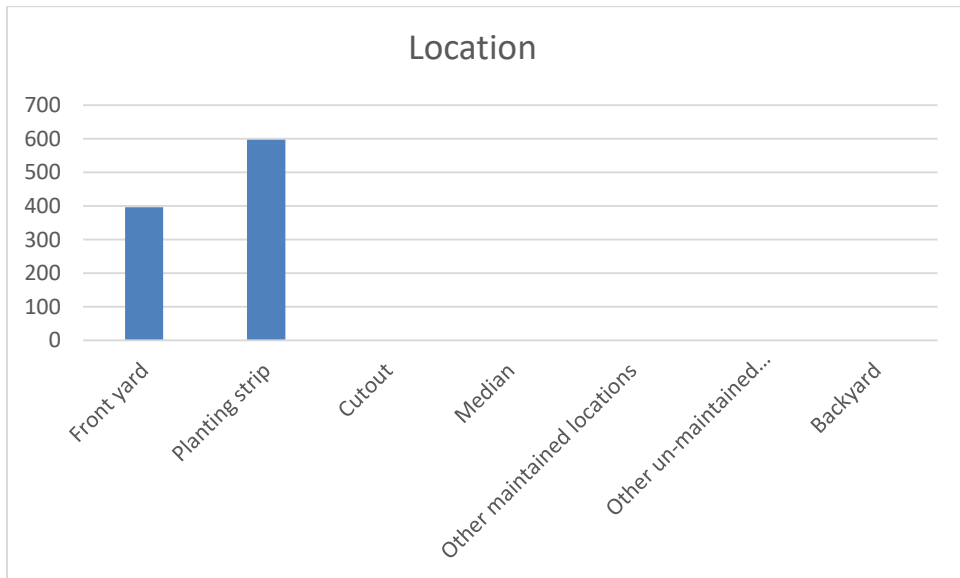
Figure 7: Location of city/park trees
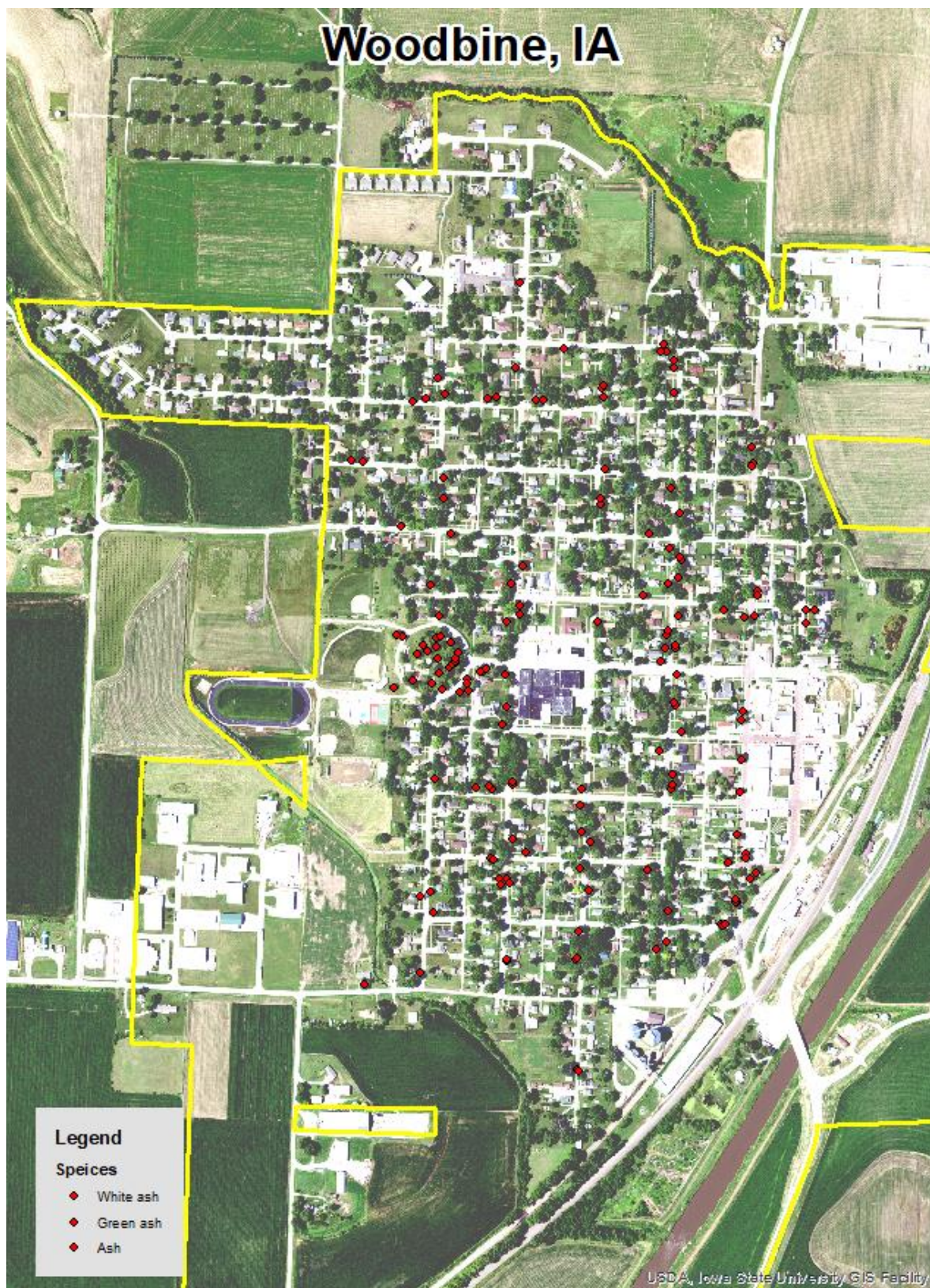
Figure 1: Location of Ash Trees
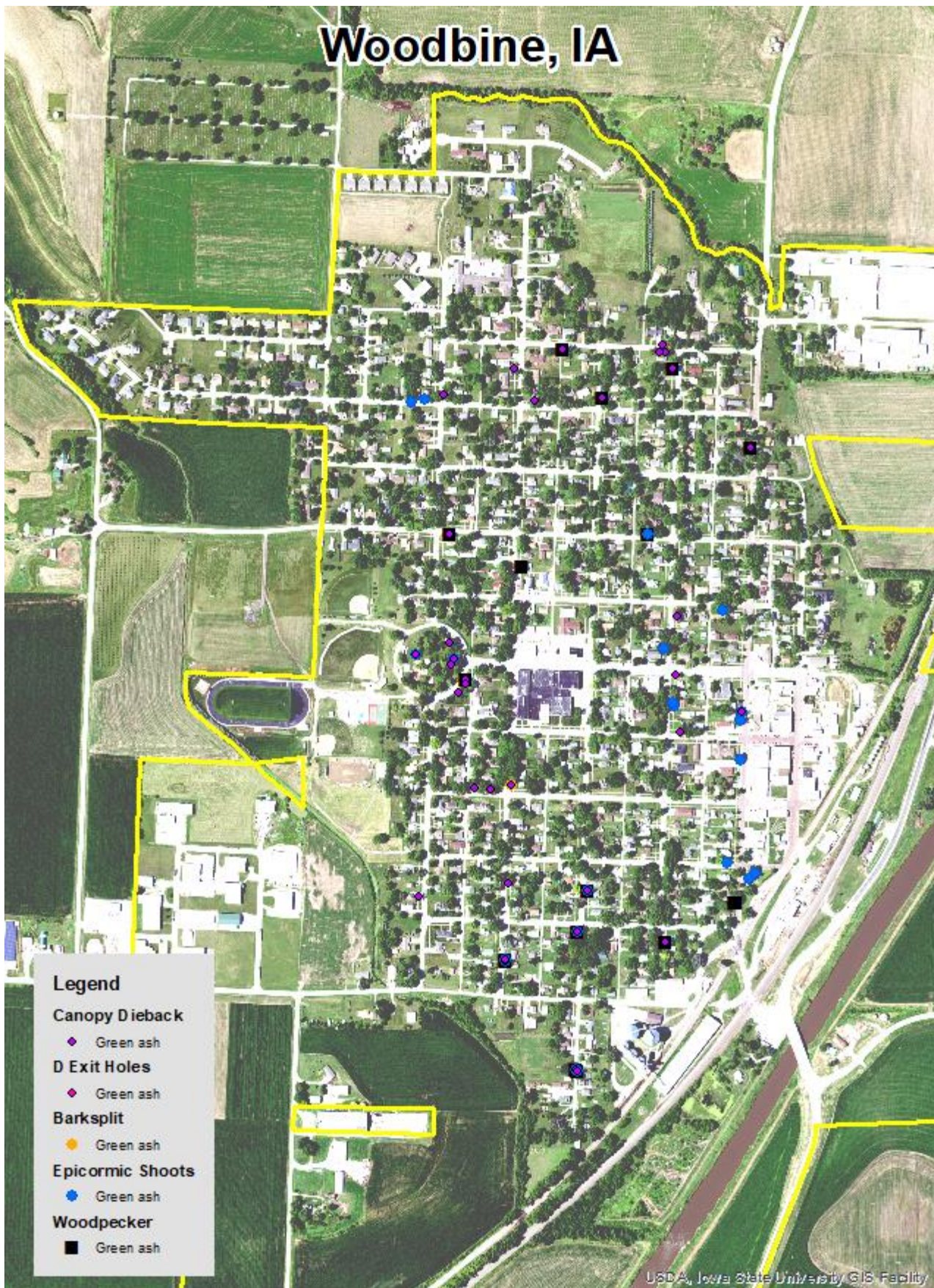
Figure 2: Location of EAB symptoms
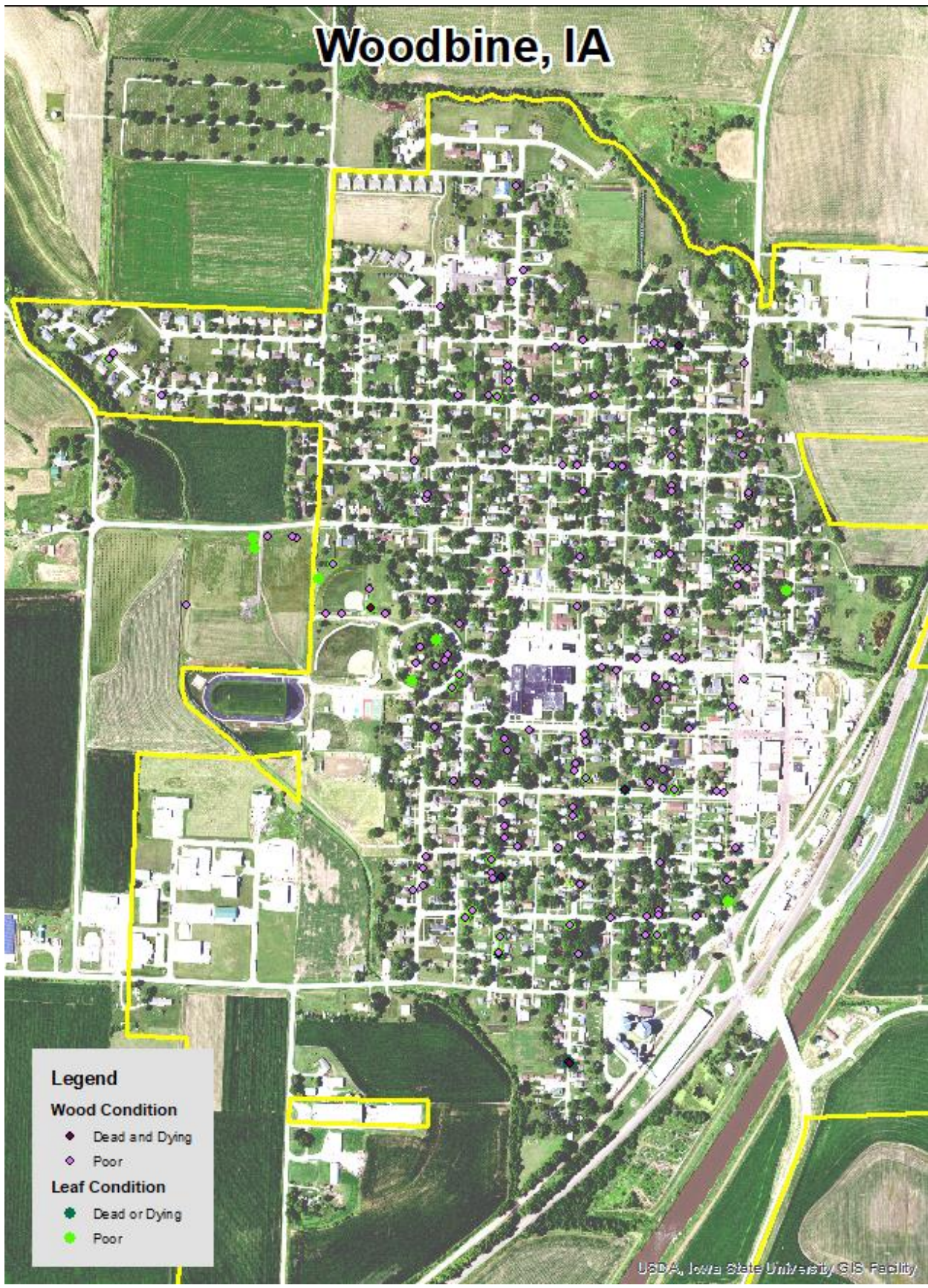
Figure 3: Location of Poor Condition Trees
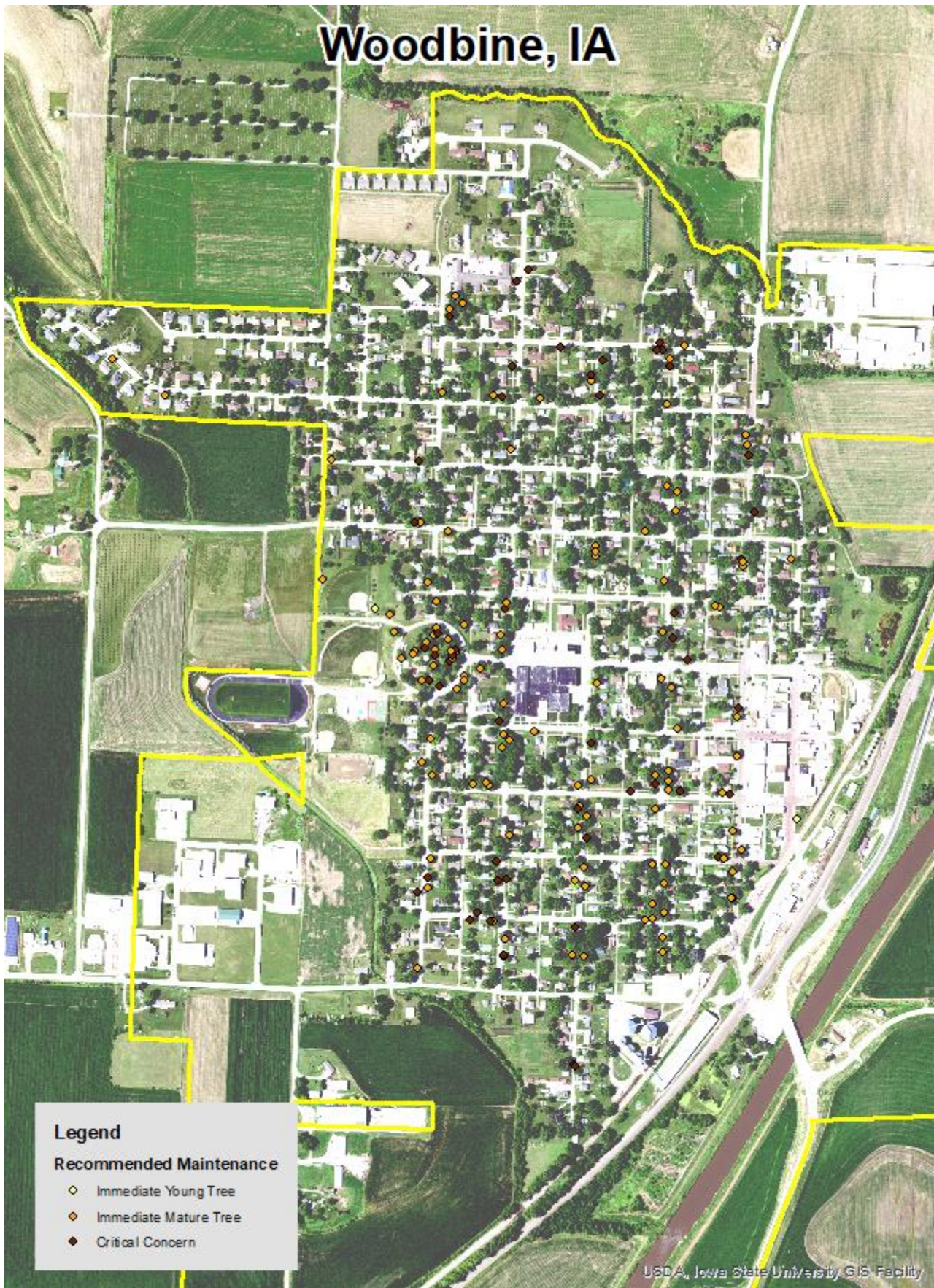
Figure 4: Location of Trees with Recommended Maintenance
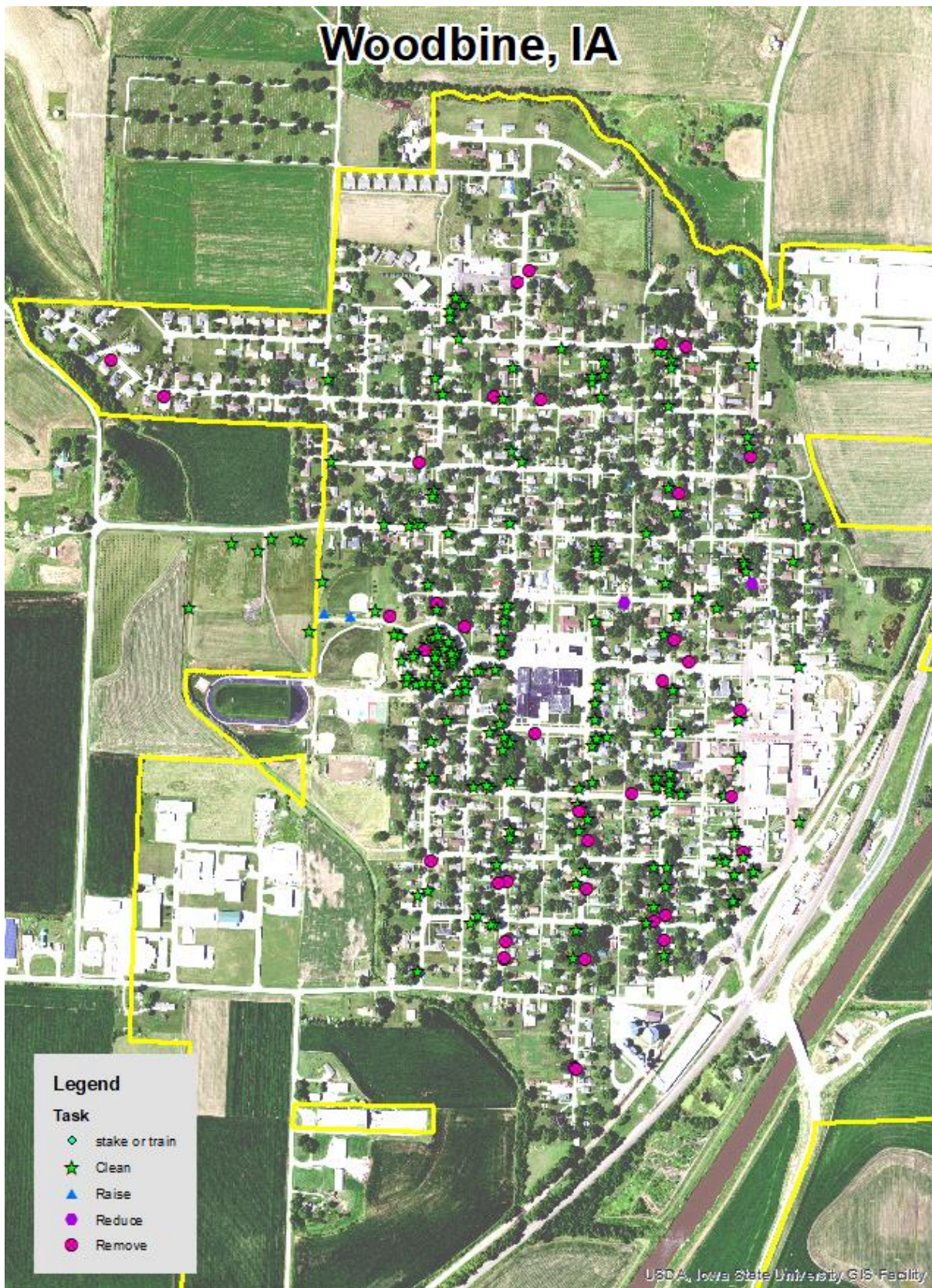
Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Woodbine Tree Ordinances

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