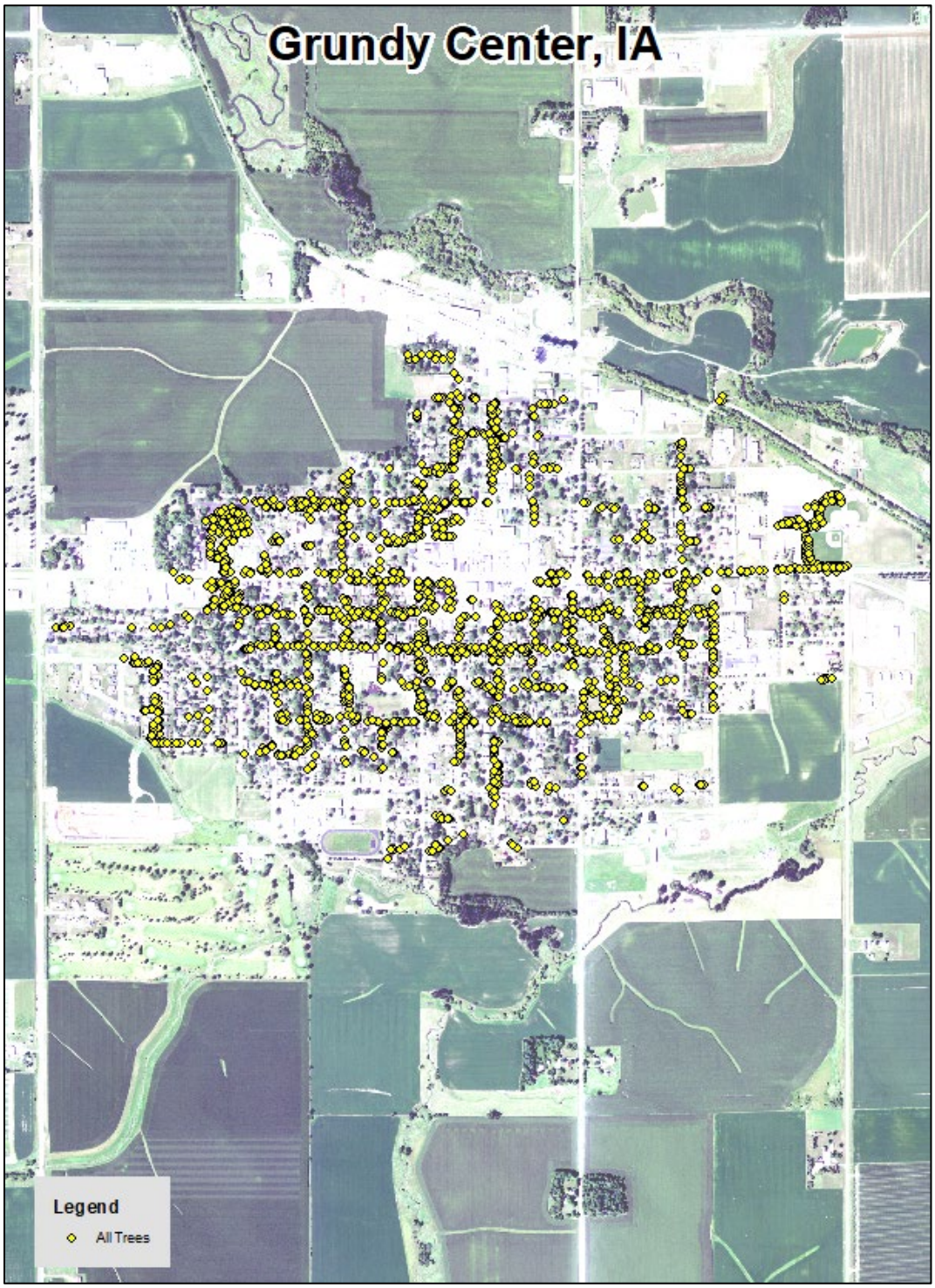
Grundy Center, IA



2022 Urban Forest Management Plan

Prepared by Mark J. Runkel
Iowa Department of Natural Resources

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Executive Summary

Overview

This plan was developed to assist the City of Grundy Center 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 16% of Grundy Center'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 2021, 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 2333 trees inventoried.

- Grundy Center's trees provide $349,675 of benefits annually, an average of $150 a tree
- There are over 26 species of trees
- The top three genera are: Maple 36%, Ash 16%, and Apple 11%
- 2% of trees are in need of some type of management
- 32 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 32 trees needing removal, 27 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- 139 of the 383 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

Introduction

This plan was developed to assist Grundy Center 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 Grundy Center, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Grundy Center'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 Grundy Center 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 Grundy Center'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 2333 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. Grundy Center's trees reduce energy related costs by approximately $98,036annually (Appendix A, Table 1). These savings are both in Electricity (471.9 MWh) and in Natural Gas (63,488.6 Therms).

Annual Stormwater Benefits

Grundy Center's trees intercept about 4,516,349 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $122,393 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 Grundy Center, it is estimated that trees remove 4,038 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 $16,314 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Grundy Center, trees sequester about 947,563 lbs of carbon a year with an associated value of 7,107 (Appendix A, Table 5). In addition, the trees store 16,050,985 lbs of carbon, with a yearly benefit of $120,382 (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. Grundy Center receives $100,504 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, Grundy Center's trees provide $349,675 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 2333 trees in Grundy Center provide approximately $150 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Grundy Center has over 26 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	862	36%
Ash	383	16%
Apple	265	11%
Oak	245	11%
Spruce	124	5%
Locust	115	5%
Linden/Basswood	70	3%
Hackberry	52	2%
Pine	48	2%
Lilac	35	2%
Walnut	20	1%
Birch/Aspen	18	1%
Elm	12	1%
Aspen	9	<1%
Birch	9	<1%
Cherry	9	<1%
Ginkgo	9	<1%
Sycamore	8	<1%
Pear	8	<1%
Hemlock	6	<1%
Hophornbeam	6	<1%
Ohio buckeye	4	<1%
Redbud	3	<1%
Eastern red cedar	3	<1%
Mulberry	3	<1%
Southern magnolia	1	<1%
Other Large Deciduous	21	1%
Other Large Evergreen	2	<1%

Age Class

Most of Grundy Center's trees (56%) 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. Grundy Center's size curve is on the smaller side, indicating a younger than average 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 Grundy Center indicate that 85% of the trees are in good health, with only 3% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 68% of Grundy Center'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 4% of the population. This 2% 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).

Tree Removal	32	1%
Crown Cleaning	17	<1%
Crown Raising	4	<1%
Tree Staking	3	<1%
Crown Reduction	2	<1%

Canopy Cover

The total canopy with both private and public trees is 160. The canopy cover on city own properties included in the Grundy Center inventory includes approximately 50 acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 1%, in 30 years on all lands. To achieve this goal it is estimated that 39 trees need to be planted annually on public and/or private lands.

Land Use and Location

The majority of Grundy Center'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	76%
Park/vacant/other	21%
Small commercial	2%
Industrial/Large commercial	<1%

Location	
Planting strip	63%
Front yard	36%
Median	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

Grundy Center has 1 critical concern tree that need immediate removal. This tree 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 27 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 trees marked as needing maintenance. There are a total of 2,190 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 32 removals, 12 are ash trees. There are a total of 383 ash trees, and 139 of those have signs and symptoms that have been associated with EAB. In addition, there are 17 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 Grundy Center.

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 (36%) (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. All trees planted must meet the restrictions in city ordinance 150 (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>No Additional Funding</u>

Current Budget $5,592/year, Total $33,552 over 6 years

FY 2022

Removal: 1 critical concern trees, 4 dead/dying ash trees ($4,000)
Planting and Replacement: 10 trees to be planted in open locations, $1000
Young Tree Pruning & Maintenance: $500
Visual Survey for signs and symptoms of EAB

FY 2023

Removal: 3 dead/dying ash trees ($2,400)
Planting and Replacement: 7 trees to be planted in open locations, $700
Young Tree Pruning & Maintenance: $500
Routine trimming: Contract to trim 1/3 of the city trees, $1,700
Visual Survey for signs and symptoms of EAB

FY 2024

Removal: 5 dead/dying ash trees ($4,000)
Planting and Replacement: 10 trees to be planted in open locations and locations from previous removals, $1000
Young Tree Pruning & Maintenance: $500
Visual Survey for signs and symptoms of EAB

FY 2025

Removal: 5 trees - removal of any new critical concern trees and ash in poor health ($4,000)
Planting and Replacement: 10 trees in open locations from previous removals, $1000
Young Tree Pruning & Maintenance: $500
Visual Survey for signs and symptoms of EAB

FY 2026

Removal: 5 trees - removal of any new critical concern trees and ash in poor health ($4,000)
Planting and Replacement: 10 trees in open locations from previous removals, $1000
Young Tree Pruning & Maintenance: $500
Visual Survey for signs and symptoms of EAB

FY 2027

Removal: 5 trees - removal of any new critical concern trees and ash in poor health ($4,000)
Planting and Replacement: 10 trees in open locations from previous removals ($1,000)
Young Tree Pruning & Maintenance: ($500)
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: Approximately 96 ash trees removed (approximately 25% of ash). It will take approximately 19 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 $51,067 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 150 (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 150.12 states “The City has the right to cause the removal of any dead or diseased trees on private property within the City when such trees constitute a hazard to life and property, or harbor insects or diseases which constitute a potential threat to other trees within the City. The Tree Board will notify in writing the owners of such trees. Removal shall be done by said owners at their own expense within sixty (60) days after the date of service of notice. In the event of failure of owners to comply with such provisions, the City shall have the authority to remove such trees and charge the cost of removal on the owner’s property tax notice.”

Proposed Budget Increase

EAB could potentially kill all ash trees in Grundy Center within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $66,400 per year. Additionally, it is recommended that Grundy Center 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 12 trees selected for treatment, and Grundy Center would still need to find $47,476 for removal. Alternatively, if there are 12 treatable trees, it would cost approximately $3,600 a year for treatment. 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 Grundy Center. It is suggested to consider increasing the budget to plan for this.

Works Cited

Census Bureau. 2010. http://censtats.census.gov/data/IA/1601964290.pdf (April, 2013)

USDA Forest Service, et al. 2006. i-Tree Software Suite v1.0 User's Manual. Pp. 27-40.

McPherson EG, Simpson JR, Peper PJ, Gardner SL, Vargas KE, Ho J, Maco S, Xiao Q. 2005b. City of Charleston, South Carolina, municipal forest resource analysis. Internal Tech Rep. Davis, CA: U.S. Department of Agriculture, Center for Urban Forest Research. p. 57

Nowak, DJ and JF Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

Peper, Paula J; McPherson, E Gregory; Simpson, James R; Vargas, Kelaine E; Xiao, Qingfu 2009. Lower Midwest community tree guide: benefits, costs, and strategic planting. Gen. Tech. Rep. PSW-GTR-219. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. p.115

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Grundy Center

Annual Energy Benefits of Public Trees

4/4/2022

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	80.6	6,115	11,379.0	11,151	17,266	(N/A)	14.6	17.6	50.78
Green ash	79.7	6,048	10,489.1	10,279	16,327	(N/A)	12.7	16.7	55.35
Apple	19.5	1,481	3,040.8	2,980	4,461	(N/A)	11.4	4.6	16.83
Sugar maple	45.3	3,435	5,880.7	5,763	9,198	(N/A)	7.5	9.4	52.56
Honeylocust	34.2	2,596	4,418.5	4,330	6,926	(N/A)	4.9	7.1	60.23
Northern red oak	17.0	1,290	2,231.4	2,187	3,477	(N/A)	4.3	3.5	34.77
Silver maple	31.8	2,410	4,167.5	4,084	6,494	(N/A)	4.0	6.6	69.09
Maple	15.4	1,168	1,977.9	1,938	3,106	(N/A)	4.0	3.2	33.40
White ash	21.0	1,595	2,433.4	2,385	3,980	(N/A)	3.7	4.1	46.28
Amur maple	8.7	659	1,306.8	1,281	1,940	(N/A)	3.0	2.0	27.71
Red maple	9.3	706	1,242.3	1,217	1,923	(N/A)	2.5	2.0	32.60
Spruce	6.5	490	805.5	789	1,279	(N/A)	2.3	1.3	24.14
Northern hackberry	10.1	766	1,417.9	1,390	2,155	(N/A)	2.2	2.2	41.45
Littleleaf linden	8.1	617	1,122.4	1,100	1,717	(N/A)	2.0	1.8	37.33
Bur oak	4.8	362	614.9	603	964	(N/A)	1.7	1.0	24.73
Pin oak	14.1	1,069	1,878.5	1,841	2,910	(N/A)	1.7	3.0	74.62
Japanese tree lilac	3.0	231	477.7	468	700	(N/A)	1.5	0.7	19.99
Austrian pine	3.1	236	416.3	408	644	(N/A)	1.4	0.7	19.51
Swamp white oak	4.2	319	590.6	579	898	(N/A)	1.3	0.9	29.94
Black maple	5.1	389	646.4	633	1,023	(N/A)	1.3	1.0	34.09
Norway spruce	4.6	347	584.4	573	919	(N/A)	1.2	0.9	32.84
Northern pin oak	8.5	645	1,256.7	1,232	1,876	(N/A)	1.2	1.9	69.49
Black spruce	1.7	130	264.9	260	389	(N/A)	1.1	0.4	15.58
American basswood	5.2	394	724.4	710	1,104	(N/A)	1.0	1.1	45.98
Black walnut	7.1	541	958.3	939	1,480	(N/A)	0.9	1.5	74.00
Blue spruce	1.6	123	226.5	222	345	(N/A)	0.8	0.4	19.18
Elm	1.2	93	154.5	151	244	(N/A)	0.5	0.2	20.36
Scotch pine	0.8	64	119.9	117	181	(N/A)	0.5	0.2	16.46
White oak	2.2	167	256.6	252	419	(N/A)	0.4	0.4	41.87
Ginkgo	0.7	56	95.3	93	149	(N/A)	0.4	0.2	16.58
Broadleaf Deciduous Large	3.1	234	414.5	406	640	(N/A)	0.4	0.7	71.14
American sycamore	3.3	248	443.3	434	683	(N/A)	0.3	0.7	85.34
Pear	0.9	65	126.0	123	188	(N/A)	0.3	0.2	23.50
Eastern hemlock	1.1	84	147.6	145	229	(N/A)	0.3	0.2	38.17
Quaking aspen	0.6	43	82.4	81	124	(N/A)	0.3	0.1	20.64
Eastern hophornbeam	0.2	14	31.8	31	45	(N/A)	0.3	0.0	7.53
Broadleaf Deciduous Mediu	1.0	79	134.8	132	212	(N/A)	0.2	0.2	42.32
Eastern white pine	0.7	53	93.5	92	145	(N/A)	0.2	0.1	36.25
Cherry plum	0.3	22	51.3	50	73	(N/A)	0.2	0.1	18.19
Ohio buckeye	1.1	80	146.0	143	223	(N/A)	0.2	0.2	55.77
Birch	0.4	33	66.0	65	98	(N/A)	0.2	0.1	24.45
Eastern redbud	0.0	1	1.9	2	3	(N/A)	0.1	0.0	0.87
Paper birch	0.7	53	81.0	79	133	(N/A)	0.1	0.1	44.23
Mulberry	0.3	25	50.3	49	75	(N/A)	0.1	0.1	24.84
Eastern red cedar	0.0	1	2.0	2	3	(N/A)	0.1	0.0	0.93
Willow	0.4	28	57.2	56	84	(N/A)	0.1	0.1	28.09
Kwanzan cherry	0.3	25	50.3	49	75	(N/A)	0.1	0.1	24.84
Broadleaf Evergreen Mediur	0.5	38	60.5	59	97	(N/A)	0.1	0.1	48.64
Broadleaf Deciduous Small	0.1	11	25.7	25	36	(N/A)	0.1	0.0	18.19
Ash	0.3	21	35.7	35	56	(N/A)	0.1	0.1	27.88
River birch	0.5	38	69.1	68	105	(N/A)	0.1	0.1	52.73
Conifer Evergreen Large	0.3	24	39.2	38	62	(N/A)	0.1	0.1	31.15
Southern magnolia	0.0	3	5.6	5	8	(N/A)	0.0	0.0	8.11
Broadleaf Evergreen Large	0.5	37	62.3	61	98	(N/A)	0.0	0.1	97.67
UNKNOWN	0.0	0	0.0	0	0	(N/A)	0.0	0.0	0.00

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Black cherry	0.2	15	31.6	31	46	(N/A)	0.0	0.0	46.14
Total	471.9	35,817	63,488.6	62,219	98,036	(N/A)	100.0	100.0	42.09

Table 2: Annual Stormwater Benefits

Grundy Center

Annual Stormwater Benefits of Public Trees

4/4/2022

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	714,841	19,372	(N/A)	14.6	15.8	56.98
Green ash	808,381	21,907	(N/A)	12.7	17.9	74.26
Apple	70,762	1,918	(N/A)	11.4	1.6	7.24
Sugar maple	480,215	13,014	(N/A)	7.5	10.6	74.36
Honeylocust	299,271	8,110	(N/A)	4.9	6.6	70.52
Northern red oak	130,697	3,542	(N/A)	4.3	2.9	35.42
Silver maple	456,493	12,371	(N/A)	4.0	10.1	131.61
Maple	101,888	2,761	(N/A)	4.0	2.3	29.69
White ash	184,087	4,989	(N/A)	3.7	4.1	58.01
Amur maple	34,023	922	(N/A)	3.0	0.8	13.17
Red maple	61,067	1,655	(N/A)	2.5	1.4	28.05
Spruce	94,517	2,561	(N/A)	2.3	2.1	48.33
Northern hackberry	74,450	2,018	(N/A)	2.2	1.6	38.80
Littleleaf linden	69,607	1,886	(N/A)	2.0	1.5	41.01
Bur oak	36,174	980	(N/A)	1.7	0.8	25.14
Pin oak	175,223	4,749	(N/A)	1.7	3.9	121.76
Japanese tree lilac	10,896	295	(N/A)	1.5	0.2	8.44
Austrian pine	37,551	1,018	(N/A)	1.4	0.8	30.84
Swamp white oak	25,286	685	(N/A)	1.3	0.6	22.84
Black maple	37,166	1,007	(N/A)	1.3	0.8	33.57
Norway spruce	96,430	2,613	(N/A)	1.2	2.1	93.33
Northern pin oak	97,782	2,650	(N/A)	1.2	2.2	98.14
Black spruce	20,463	555	(N/A)	1.1	0.5	22.18
American basswood	55,136	1,494	(N/A)	1.0	1.2	62.26
Black walnut	93,357	2,530	(N/A)	0.9	2.1	126.50
Blue spruce	20,500	556	(N/A)	0.8	0.5	30.86
Elm	9,534	258	(N/A)	0.5	0.2	21.53
Scotch pine	9,380	254	(N/A)	0.5	0.2	23.11
White oak	13,798	374	(N/A)	0.4	0.3	37.39
Ginkgo	3,601	98	(N/A)	0.4	0.1	10.84
Broadleaf Deciduous Large	37,124	1,006	(N/A)	0.4	0.8	111.78
American sycamore	48,018	1,301	(N/A)	0.3	1.1	162.66
Pear	3,065	83	(N/A)	0.3	0.1	10.38
Eastern hemlock	27,628	749	(N/A)	0.3	0.6	124.79
Quaking aspen	3,647	99	(N/A)	0.3	0.1	16.47
Eastern hophornbeam	608	16	(N/A)	0.3	0.0	2.75
Broadleaf Deciduous Medium	6,222	169	(N/A)	0.2	0.1	33.73
Eastern white pine	16,783	455	(N/A)	0.2	0.4	113.71
Cherry plum	1,058	29	(N/A)	0.2	0.0	7.17
Ohio buckeye	9,062	246	(N/A)	0.2	0.2	61.39
Birch	4,252	115	(N/A)	0.2	0.1	28.81
Eastern redbud	22	1	(N/A)	0.1	0.0	0.20
Paper birch	4,397	119	(N/A)	0.1	0.1	39.72
Mulberry	1,196	32	(N/A)	0.1	0.0	10.80
Eastern red cedar	73	2	(N/A)	0.1	0.0	0.66
Willow	3,077	83	(N/A)	0.1	0.1	27.80
Kwanzan cherry	1,196	32	(N/A)	0.1	0.0	10.80
Broadleaf Evergreen Medium	4,963	134	(N/A)	0.1	0.1	67.24

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Broadleaf Deciduous Small	529	14	(N/A)	0.1	0.0	7.17
Ash	1,572	43	(N/A)	0.1	0.0	21.30
River birch	3,888	105	(N/A)	0.1	0.1	52.69
Conifer Evergreen Large	6,143	166	(N/A)	0.1	0.1	83.24
Southern magnolia	155	4	(N/A)	0.0	0.0	4.21
Broadleaf Evergreen Large	7,920	215	(N/A)	0.0	0.2	214.64
UNKNOWN	0	0	(N/A)	0.0	0.0	0.00
Black cherry	1,174	32	(N/A)	0.0	0.0	31.82
Citywide total	4,516,349	122,393	(N/A)	100.0	100.0	52.55

Table 3: Annual Air Quality Benefits

Grundy Center

Annual Air Quality Benefits of Public Trees

4/4/2022

Species	Deposition (lb) O_3	NO_2	PM_{10}	SO_2	Total Depos. ($)	Avoided (lb) NO_2	PM_{10}	VOC	SO_2	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
Norway maple	143.0	24.7	70.7	6.3	774	388.5	56.3	53.6	365.5	2,412	-33.8	-127	1,074.9	3,059	(N/A)	14.6	9.00
Green ash	104.0	16.6	50.1	4.7	555	376.8	55.1	52.6	361.2	2,356	0.0	0	1,021.1	2,911	(N/A)	12.7	9.87
Apple	16.6	2.7	8.5	0.8	91	96.4	13.8	13.1	88.4	593	-0.1	0	240.4	683	(N/A)	11.4	2.58
Sugar maple	67.7	11.5	33.7	3.0	366	213.0	31.2	29.8	205.0	1,334	-53.4	-200	541.6	1,500	(N/A)	7.5	8.57
Honeylocust	55.7	9.2	26.0	2.5	296	160.7	23.6	22.5	154.9	1,007	-40.2	-151	414.9	1,152	(N/A)	4.9	10.02
Northern red oak	25.0	4.3	12.6	1.1	136	80.2	11.7	11.2	77.0	502	-35.1	-131	188.1	506	(N/A)	4.3	5.06
Silver maple	81.5	13.8	39.9	3.6	439	149.6	21.9	20.9	143.6	936	-43.6	-164	431.3	1,212	(N/A)	4.0	12.89
Maple	20.2	3.4	9.9	0.9	109	72.2	10.6	10.1	69.7	453	-7.4	-28	189.7	534	(N/A)	4.0	5.74
White ash	26.5	4.2	12.9	1.2	142	96.3	14.3	13.7	95.2	610	0.0	0	264.4	752	(N/A)	3.7	8.74
Amur maple	9.6	1.6	4.6	0.4	51	42.5	6.1	5.8	39.4	262	-0.1	0	109.9	313	(N/A)	3.0	4.47
Red maple	11.5	2.0	5.7	0.5	62	44.1	6.4	6.1	42.1	275	-4.3	-16	114.2	322	(N/A)	2.5	5.45
Spruce	10.5	2.1	8.9	1.3	70	30.0	4.4	4.2	29.2	189	-38.0	-142	52.8	117	(N/A)	2.3	2.20
Northern hackberry	10.4	1.8	5.7	0.5	58	48.6	7.0	6.7	45.8	302	0.0	0	126.4	359	(N/A)	2.2	6.91
Littleleaf linden	10.6	1.8	5.4	0.5	58	39.0	5.7	5.4	36.9	243	-5.4	-20	99.9	280	(N/A)	2.0	6.09
Bur oak	3.1	0.5	1.7	0.1	17	22.4	3.3	3.1	21.6	140	0.0	0	55.9	158	(N/A)	1.7	4.04
Pin oak	33.0	5.8	16.6	1.5	180	66.7	9.8	9.3	63.8	417	-60.5	-227	145.9	370	(N/A)	1.7	9.48
Japanese tree lilac	2.5	0.4	1.3	0.1	14	15.1	2.2	2.0	13.8	93	0.0	0	37.4	106	(N/A)	1.5	3.03
Austrian pine	4.2	0.8	3.7	0.5	29	14.7	2.1	2.1	14.1	92	-12.9	-48	29.5	72	(N/A)	1.4	2.19
Swamp white oak	3.5	0.6	2.0	0.2	20	20.3	2.9	2.8	19.1	126	-1.0	-4	50.3	142	(N/A)	1.3	4.73
Black maple	8.2	1.4	3.9	0.4	44	24.0	3.5	3.4	23.2	151	-2.9	-11	65.1	184	(N/A)	1.3	6.12
Norway spruce	11.6	2.3	9.3	1.4	76	21.4	3.1	3.0	20.7	134	-54.9	-206	18.1	5	(N/A)	1.2	0.16
Northern pin oak	22.2	3.8	10.6	1.0	119	41.5	6.0	5.7	38.5	256	-5.0	-19	124.3	356	(N/A)	1.2	13.20
Black spruce	2.0	0.4	1.9	0.2	14	8.4	1.2	1.1	7.7	52	-6.5	-24	16.5	41	(N/A)	1.1	1.64
American basswood	7.6	1.3	3.7	0.3	41	24.9	3.6	3.4	23.5	155	-6.5	-24	62.0	172	(N/A)	1.0	7.15
Black walnut	14.1	2.3	6.4	0.6	74	33.9	4.9	4.7	32.3	211	0.0	0	99.2	285	(N/A)	0.9	14.27
Blue spruce	2.4	0.5	2.1	0.3	16	7.8	1.1	1.1	7.4	48	-7.1	-26	15.6	38	(N/A)	0.8	2.13
Elm	0.9	0.1	0.5	0.0	5	5.7	0.8	0.8	5.5	36	0.0	0	14.4	41	(N/A)	0.5	3.39
Scotch pine	0.9	0.2	0.9	0.1	6	4.0	0.6	0.6	3.8	25	-3.0	-11	8.1	20	(N/A)	0.5	1.84
White oak	1.0	0.2	0.6	0.0	6	10.1	1.5	1.4	10.0	64	0.0	0	24.9	70	(N/A)	0.4	6.98
Ginkgo	0.6	0.1	0.3	0.0	4	3.5	0.5	0.5	3.3	22	-0.2	-1	8.7	24	(N/A)	0.4	2.71
Broadleaf Deciduous Large	5.9	0.9	2.7	0.3	31	14.7	2.1	2.0	14.0	91	0.0	0	42.5	122	(N/A)	0.4	13.59
American sycamore	8.1	1.3	3.6	0.4	43	15.6	2.3	2.2	14.8	97	0.0	0	48.2	140	(N/A)	0.3	17.46
Pear	0.8	0.1	0.4	0.0	4	4.1	0.6	0.6	3.9	26	0.0	0	10.5	30	(N/A)	0.3	3.74
Eastern hemlock	3.4	0.7	2.7	0.4	22	5.3	0.8	0.7	5.0	33	-17.2	-64	1.8	-9	(N/A)	0.3	-1.58
Quaking aspen	0.1	0.0	0.1	0.0	1	2.7	0.4	0.4	2.6	17	0.0	0	6.4	18	(N/A)	0.3	2.99
Eastern hophornbeam	0.1	0.0	0.0	0.0	0	0.9	0.1	0.1	0.8	6	0.0	0	2.2	6	(N/A)	0.3	1.02
Broadleaf Deciduous Medium	0.9	0.2	0.5	0.0	5	4.9	0.7	0.7	4.8	31	-0.2	-1	12.5	35	(N/A)	0.2	7.03
Eastern white pine	2.0	0.4	1.6	0.3	13	3.3	0.5	0.5	3.2	21	-10.0	-37	1.8	-3	(N/A)	0.2	-0.82
Cherry plum	0.2	0.0	0.1	0.0	1	1.5	0.2	0.2	1.3	9	0.0	0	3.6	10	(N/A)	0.2	2.55
Ohio buckeye	1.8	0.3	0.9	0.1	10	5.1	0.7	0.7	4.8	31	-0.4	-2	13.9	40	(N/A)	0.2	9.89
Birch	0.9	0.2	0.4	0.0	5	2.1	0.3	0.3	2.0	13	-0.2	-1	6.0	17	(N/A)	0.2	4.30
Eastern redbud	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.0	0	0.0	0	0.1	0	(N/A)	0.1	0.11
Paper birch	0.3	0.1	0.2	0.0	2	3.2	0.5	0.5	3.2	20	0.0	0	7.9	22	(N/A)	0.1	7.42
Mulberry	0.3	0.0	0.2	0.0	2	1.6	0.2	0.2	1.5	10	0.0	0	4.1	12	(N/A)	0.1	3.88
Eastern red cedar	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.0	0	0.0	0	0.1	0	(N/A)	0.1	0.09
Willow	0.5	0.1	0.3	0.0	3	1.8	0.3	0.2	1.7	11	-0.1	-1	4.8	14	(N/A)	0.1	4.59
Kwanzan cherry	0.3	0.0	0.2	0.0	2	1.6	0.2	0.2	1.5	10	0.0	0	4.1	12	(N/A)	0.1	3.88
Broadleaf Evergreen Medium	0.4	0.1	0.4	0.1	3	2.3	0.3	0.3	2.2	15	-1.4	-5	4.8	12	(N/A)	0.1	6.06
Broadleaf Deciduous Small	0.1	0.0	0.1	0.0	1	0.8	0.1	0.1	0.7	5	0.0	0	1.8	5	(N/A)	0.1	2.55
Ash	0.2	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	-0.1	0	3.2	9	(N/A)	0.1	4.56
River birch	0.7	0.1	0.4	0.0	4	2.4	0.3	0.3	2.3	15	-0.2	-1	6.4	18	(N/A)	0.1	9.04
Conifer Evergreen Large	0.7	0.1	0.6	0.1	5	1.5	0.2	0.2	1.4	9	-3.4	-13	1.5	1	(N/A)	0.1	0.62
Southern magnolia	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)	0.0	1.05
Broadleaf Evergreen Large	1.5	0.3	1.1	0.2	9	2.3	0.3	0.3	2.2	14	-3.7	-14	4.4	10	(N/A)	0.0	9.68
UNKNOWN	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)	0.0	0.00
Black cherry	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)	0.0	8.35
Citywide total	740.4	125.6	377.0	36.2	4,038	2,242.7	327.3	312.2	2,138.6	13,996	-458.6	-1,720	5,841.3	16,314	(N/A)	100.0	7.00

Table 4: Annual Carbon Stored

Grundy Center

Stored CO2 Benefits of Public Trees

4/4/2022

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	2,362,607	17,720	(N/A)	14.6	14.7	52.12
Green ash	3,479,321	26,095	(N/A)	12.7	21.7	88.46
Apple	281,674	2,113	(N/A)	11.4	1.8	7.97
Sugar maple	2,001,523	15,011	(N/A)	7.5	12.5	85.78
Honeylocust	697,960	5,235	(N/A)	4.9	4.3	45.52
Northern red oak	486,775	3,651	(N/A)	4.3	3.0	36.51
Silver maple	1,960,206	14,702	(N/A)	4.0	12.2	156.40
Maple	231,153	1,734	(N/A)	4.0	1.4	18.64
White ash	490,191	3,676	(N/A)	3.7	3.1	42.75
Amur maple	151,794	1,138	(N/A)	3.0	0.9	16.26
Red maple	134,724	1,010	(N/A)	2.5	0.8	17.13
Spruce	86,388	648	(N/A)	2.3	0.5	12.22
Northern hackberry	157,844	1,184	(N/A)	2.2	1.0	22.77
Littleleaf linden	230,599	1,729	(N/A)	2.0	1.4	37.60
Bur oak	105,984	795	(N/A)	1.7	0.7	20.38
Pin oak	894,418	6,708	(N/A)	1.7	5.6	172.00
Japanese tree lilac	42,301	317	(N/A)	1.5	0.3	9.06
Austrian pine	22,723	170	(N/A)	1.4	0.1	5.16
Swamp white oak	60,285	452	(N/A)	1.3	0.4	15.07
Black maple	90,294	677	(N/A)	1.3	0.6	22.57
Norway spruce	140,405	1,053	(N/A)	1.2	0.9	37.61
Northern pin oak	366,559	2,749	(N/A)	1.2	2.3	101.82
Black spruce	8,773	66	(N/A)	1.1	0.1	2.63
American basswood	289,007	2,168	(N/A)	1.0	1.8	90.31
Black walnut	471,345	3,535	(N/A)	0.9	2.9	176.75
Blue spruce	14,729	110	(N/A)	0.8	0.1	6.14
Elm	28,428	213	(N/A)	0.5	0.2	17.77
Scotch pine	5,564	42	(N/A)	0.5	0.0	3.79
White oak	34,081	256	(N/A)	0.4	0.2	25.56
Ginkgo	9,213	69	(N/A)	0.4	0.1	7.68
Broadleaf Deciduous	198,171	1,486	(N/A)	0.4	1.2	165.14
American sycamore	276,768	2,076	(N/A)	0.3	1.7	259.47
Pear	12,757	96	(N/A)	0.3	0.1	11.96
Eastern hemlock	44,942	337	(N/A)	0.3	0.3	56.18
Quaking aspen	6,207	47	(N/A)	0.3	0.0	7.76
Eastern hophornbeam	1,797	13	(N/A)	0.3	0.0	2.25
Broadleaf Deciduous	15,597	117	(N/A)	0.2	0.1	23.40
Eastern white pine	25,814	194	(N/A)	0.2	0.2	48.40
Cherry plum	3,632	27	(N/A)	0.2	0.0	6.81
Ohio buckeye	29,474	221	(N/A)	0.2	0.2	55.26
Birch	14,936	112	(N/A)	0.2	0.1	28.00
Eastern redbud	41	0	(N/A)	0.1	0.0	0.10
Paper birch	11,016	83	(N/A)	0.1	0.1	27.54
Mulberry	4,853	36	(N/A)	0.1	0.0	12.13
Eastern red cedar	8	0	(N/A)	0.1	0.0	0.02
Willow	9,063	68	(N/A)	0.1	0.1	22.66
Kwanzan cherry	4,853	36	(N/A)	0.1	0.0	12.13
Broadleaf Evergreen !	6,247	47	(N/A)	0.1	0.0	23.43
Broadleaf Deciduous	1,816	14	(N/A)	0.1	0.0	6.81
Ash	3,843	29	(N/A)	0.1	0.0	14.41
River birch	11,569	87	(N/A)	0.1	0.1	43.39
Conifer Evergreen La	8,661	65	(N/A)	0.1	0.1	32.48
Southern magnolia	73	1	(N/A)	0.0	0.0	0.55
Broadleaf Evergreen !	15,239	114	(N/A)	0.0	0.1	114.29

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
UNKNOWN	0	0	(N/A)	0.0	0.0	0.00
Black cherry	6,743	51	(N/A)	0.0	0.0	50.57
Citywide total	16,050,985	120,382	(N/A)	100.0	100.0	51.69

Table 5: Annual Carbon Sequestered

Grundy Center

Annual CO Benefits of Public Trees

4/4/2022

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
Norway maple	107,398	805	-11,345	-831	-91	135,129	1,013	230,351	1,728 (N/A)	14.6	13.9	5.08
Green ash	168,133	1,261	-16,701	-805	-131	133,661	1,002	284,288	2,132 (N/A)	12.7	17.2	7.23
Apple	29,703	223	-1,354	-283	-12	32,732	245	60,799	456 (N/A)	11.4	3.7	1.72
Sugar maple	99,496	746	-9,608	-479	-76	75,915	569	165,323	1,240 (N/A)	7.5	10.0	7.09
Honeylocust	75,240	564	-3,350	-266	-27	57,375	430	128,998	967 (N/A)	4.9	7.8	8.41
Northern red oak	22,246	167	-2,337	-195	-19	28,504	214	48,218	362 (N/A)	4.3	2.9	3.62
Silver maple	138,460	1,038	-9,410	-356	-73	53,259	399	181,953	1,365 (N/A)	4.0	11.0	14.52
Maple	28,559	214	-1,110	-136	-9	25,808	194	53,122	398 (N/A)	4.0	3.2	4.28
White ash	30,685	230	-2,353	-181	-19	35,259	264	63,410	476 (N/A)	3.7	3.8	5.53
Amur maple	13,524	101	-729	-112	-6	14,563	109	27,247	204 (N/A)	3.0	1.6	2.92
Red maple	15,153	114	-647	-86	-5	15,597	117	30,018	225 (N/A)	2.5	1.8	3.82
Spruce	6,635	50	-415	-108	-4	10,824	81	16,936	127 (N/A)	2.3	1.0	2.40
Northern hackberry	9,714	73	-758	-92	-6	16,925	127	25,788	193 (N/A)	2.2	1.6	3.72
Littleleaf linden	21,780	163	-1,107	-96	-9	13,640	102	34,217	257 (N/A)	2.0	2.1	5.58
Bur oak	10,028	75	-509	-51	-4	7,994	60	17,463	131 (N/A)	1.7	1.1	3.36
Pin oak	70,588	529	-4,293	-155	-33	23,632	177	89,772	673 (N/A)	1.7	5.4	17.26
Japanese tree lilac	4,606	35	-203	-43	-2	5,114	38	9,474	71 (N/A)	1.5	0.6	2.03
Austrian pine	2,108	16	-109	-51	-1	5,211	39	7,158	54 (N/A)	1.4	0.4	1.63
Swamp white oak	7,762	58	-292	-41	-2	7,060	53	14,490	109 (N/A)	1.3	0.9	3.62
Black maple	10,496	79	-434	-44	-4	8,604	65	18,622	140 (N/A)	1.3	1.1	4.66
Norway spruce	4,675	35	-674	-87	-6	7,663	57	11,577	87 (N/A)	1.2	0.7	3.10
Northern pin oak	2,150	16	-1,759	-110	-14	14,246	107	14,527	109 (N/A)	1.2	0.9	4.04
Black spruce	1,070	8	-42	-31	-1	2,868	22	3,865	29 (N/A)	1.1	0.2	1.16
American basswood	16,686	125	-1,387	-61	-11	8,699	65	23,936	180 (N/A)	1.0	1.4	7.48
Black walnut	15,376	115	-2,262	-77	-18	11,951	90	24,987	187 (N/A)	0.9	1.5	9.37
Blue spruce	1,158	9	-71	-28	-1	2,725	20	3,784	28 (N/A)	0.8	0.2	1.58
Elm	2,635	20	-137	-13	-1	2,053	15	4,538	34 (N/A)	0.5	0.3	2.84
Scotch pine	768	6	-27	-15	0	1,405	11	2,130	16 (N/A)	0.5	0.1	1.45
White oak	4,217	32	-164	-19	-1	3,695	28	7,729	58 (N/A)	0.4	0.5	5.80
Ginkgo	673	5	-44	-11	0	1,234	9	1,852	14 (N/A)	0.4	0.1	1.54
Broadleaf Deciduous Large	6,133	46	-951	-33	-7	5,173	39	10,321	77 (N/A)	0.4	0.6	8.60
American sycamore	6,320	47	-1,328	-37	-10	5,486	41	10,441	78 (N/A)	0.3	0.6	9.79
Pear	1,267	10	-61	-11	-1	1,428	11	2,623	20 (N/A)	0.3	0.2	2.46
Eastern hemlock	0	0	-216	-27	-2	1,866	14	1,623	12 (N/A)	0.3	0.1	2.03
Quaking aspen	1,253	9	-30	-7	0	953	7	2,168	16 (N/A)	0.3	0.1	2.71
Eastern hophornbeam	304	2	-9	-4	0	310	2	601	5 (N/A)	0.3	0.0	0.75
Broadleaf Deciduous Medi	1,768	13	-75	-9	-1	1,756	13	3,440	26 (N/A)	0.2	0.2	5.16
Eastern white pine	443	3	-124	-16	-1	1,179	9	1,483	11 (N/A)	0.2	0.1	2.78
Cherry plum	455	3	-17	-5	0	497	4	930	7 (N/A)	0.2	0.1	1.74
Ohio buckeye	1,612	12	-141	-10	-1	1,769	13	3,229	24 (N/A)	0.2	0.2	6.05
Birch	657	5	-74	-5	-1	732	5	1,310	10 (N/A)	0.2	0.1	2.46
Eastern redbud	26	0	0	-1	0	17	0	42	0 (N/A)	0.1	0.0	0.10
Paper birch	1,336	10	-53	-6	0	1,179	9	2,456	18 (N/A)	0.1	0.1	6.14
Mulberry	495	4	-23	-4	0	557	4	1,025	8 (N/A)	0.1	0.1	2.56
Eastern red cedar	2	0	0	-1	0	18	0	19	0 (N/A)	0.1	0.0	0.05
Willow	699	5	-44	-4	0	623	5	1,275	10 (N/A)	0.1	0.1	3.19
Kwanzan cherry	495	4	-23	-4	0	557	4	1,025	8 (N/A)	0.1	0.1	2.56
Broadleaf Evergreen Medi	403	3	-30	-5	0	839	6	1,207	9 (N/A)	0.1	0.1	4.53
Broadleaf Deciduous Smal	228	2	-9	-2	0	248	2	465	3 (N/A)	0.1	0.0	1.74
Ash	482	4	-19	-3	0	460	3	919	7 (N/A)	0.1	0.1	3.45
River birch	856	6	-56	-5	0	835	6	1,631	12 (N/A)	0.1	0.1	6.12
Conifer Evergreen Large	116	1	-42	-6	0	527	4	595	4 (N/A)	0.1	0.0	2.23
Southern magnolia	16	0	0	-1	0	59	0	74	1 (N/A)	0.0	0.0	0.55
Broadleaf Evergreen Large	0	0	-73	-4	-1	810	6	732	5 (N/A)	0.0	0.0	5.49
UNKNOWN	0	0	0	0	0	0	0	0	0 (N/A)	0.0	0.0	0.00
Black cherry	478	4	-32	-3	0	335	3	778	6 (N/A)	0.0	0.0	5.84
Citywide total	947,563	7,107	-77,061	-5,072	-616	791,555	5,937	1,656,985	12,427 (N/A)	100.0	100.0	5.34

Table 6: Annual Social and Aesthetic Benefits

Grundy Center

Annual Aesthetic/Other Benefits of Public Trees

4/4/2022

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	10,454	(N/A)	14.6	10.4	30.75
Green ash	14,698	(N/A)	12.7	14.6	49.83
Apple	1,673	(N/A)	11.4	1.7	6.31
Sugar maple	10,333	(N/A)	7.5	10.3	59.04
Honeylocust	16,720	(N/A)	4.9	16.6	145.39
Northern red oak	1,896	(N/A)	4.3	1.9	18.96
Silver maple	10,462	(N/A)	4.0	10.4	111.30
Maple	4,040	(N/A)	4.0	4.0	43.44
White ash	4,182	(N/A)	3.7	4.2	48.63
Amur maple	781	(N/A)	3.0	0.8	11.15
Red maple	2,279	(N/A)	2.5	2.3	38.63
Spruce	1,782	(N/A)	2.3	1.8	33.63
Northern hackberry	1,732	(N/A)	2.2	1.7	33.31
Littleleaf linden	2,381	(N/A)	2.0	2.4	51.77
Bur oak	1,144	(N/A)	1.7	1.1	29.34
Pin oak	5,251	(N/A)	1.7	5.2	134.64
Japanese tree lilac	262	(N/A)	1.5	0.3	7.47
Austrian pine	762	(N/A)	1.4	0.8	23.09
Swamp white oak	846	(N/A)	1.3	0.8	28.20
Black maple	1,383	(N/A)	1.3	1.4	46.09
Norway spruce	747	(N/A)	1.2	0.7	26.68
Northern pin oak	192	(N/A)	1.2	0.2	7.12
Black spruce	535	(N/A)	1.1	0.5	21.42
American basswood	1,166	(N/A)	1.0	1.2	48.57
Black walnut	1,138	(N/A)	0.9	1.1	56.88
Blue spruce	396	(N/A)	0.8	0.4	22.01
Elm	297	(N/A)	0.5	0.3	24.75
Scotch pine	220	(N/A)	0.5	0.2	20.03
White oak	441	(N/A)	0.4	0.4	44.13
Ginkgo	63	(N/A)	0.4	0.1	7.00
Broadleaf Deciduous Large	477	(N/A)	0.4	0.5	52.98
American sycamore	431	(N/A)	0.3	0.4	53.91
Pear	72	(N/A)	0.3	0.1	9.01
Eastern hemlock	0	(N/A)	0.3	0.0	0.00
Quaking aspen	171	(N/A)	0.3	0.2	28.56
Eastern hophornbeam	17	(N/A)	0.3	0.0	2.78
Broadleaf Deciduous Medium	183	(N/A)	0.2	0.2	36.57
Eastern white pine	73	(N/A)	0.2	0.1	18.33
Cherry plum	26	(N/A)	0.2	0.0	6.40
Ohio buckeye	153	(N/A)	0.2	0.2	38.21
Birch	70	(N/A)	0.2	0.1	17.53
Eastern redbud	0	(N/A)	0.1	0.0	0.03
Paper birch	138	(N/A)	0.1	0.1	45.86
Mulberry	28	(N/A)	0.1	0.0	9.43
Eastern red cedar	13	(N/A)	0.1	0.0	4.27
Willow	72	(N/A)	0.1	0.1	24.00
Kwanzan cherry	28	(N/A)	0.1	0.0	9.43

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Broadleaf Evergreen Medium	76	(N/A)	0.1	0.1	38.10
Broadleaf Deciduous Small	13	(N/A)	0.1	0.0	6.40
Ash	52	(N/A)	0.1	0.1	26.02
River birch	82	(N/A)	0.1	0.1	41.11
Conifer Evergreen Large	32	(N/A)	0.1	0.0	16.16
Southern magnolia	9	(N/A)	0.0	0.0	9.46
Broadleaf Evergreen Large	0	(N/A)	0.0	0.0	0.00
UNKNOWN	0	(N/A)	0.0	0.0	0.00
Black cherry	29	(N/A)	0.0	0.0	28.80
Citywide total	100,504	(N/A)	100.0	100.0	43.15

Table 7: Summary of Benefits in Dollars

Grundy Center

Total Annual Benefits of Public Trees by Species ($)

4/4/2022

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Norway maple	17,266	1,728	3,059	19,372	10,454	51,879	(N/A)	14.8
Green ash	16,327	2,132	2,911	21,907	14,698	57,976	(N/A)	16.6
Apple	4,461	456	683	1,918	1,673	9,191	(N/A)	2.6
Sugar maple	9,198	1,240	1,500	13,014	10,333	35,285	(N/A)	10.1
Honeylocust	6,926	967	1,152	8,110	16,720	33,876	(N/A)	9.7
Northern red oak	3,477	362	506	3,542	1,896	9,783	(N/A)	2.8
Silver maple	6,494	1,365	1,212	12,371	10,462	31,904	(N/A)	9.1
Maple	3,106	398	534	2,761	4,040	10,840	(N/A)	3.1
White ash	3,980	476	752	4,989	4,182	14,378	(N/A)	4.1
Amur maple	1,940	204	313	922	781	4,160	(N/A)	1.2
Red maple	1,923	225	322	1,655	2,279	6,404	(N/A)	1.8
Spruce	1,279	127	117	2,561	1,782	5,867	(N/A)	1.7
Northern hackberry	2,155	193	359	2,018	1,732	6,458	(N/A)	1.8
Littleleaf linden	1,717	257	280	1,886	2,381	6,522	(N/A)	1.9
Bur oak	964	131	158	980	1,144	3,378	(N/A)	1.0
Pin oak	2,910	673	370	4,749	5,251	13,953	(N/A)	4.0
Japanese tree lilac	700	71	106	295	262	1,434	(N/A)	0.4
Austrian pine	644	54	72	1,018	762	2,549	(N/A)	0.7
Swamp white oak	898	109	142	685	846	2,680	(N/A)	0.8
Black maple	1,023	140	184	1,007	1,383	3,736	(N/A)	1.1
Norway spruce	919	87	5	2,613	747	4,371	(N/A)	1.3
Northern pin oak	1,876	109	356	2,650	192	5,184	(N/A)	1.5
Black spruce	389	29	41	555	535	1,549	(N/A)	0.4
American basswood	1,104	180	172	1,494	1,166	4,115	(N/A)	1.2
Black walnut	1,480	187	285	2,530	1,138	5,620	(N/A)	1.6
Blue spruce	345	28	38	556	396	1,364	(N/A)	0.4
Elm	244	34	41	258	297	874	(N/A)	0.3
Scotch pine	181	16	20	254	220	692	(N/A)	0.2
White oak	419	58	70	374	441	1,362	(N/A)	0.4
Ginkgo	149	14	24	98	63	348	(N/A)	0.1
Broadleaf Deciduous La	640	77	122	1,006	477	2,323	(N/A)	0.7
American sycamore	683	78	140	1,301	431	2,633	(N/A)	0.8
Pear	188	20	30	83	72	393	(N/A)	0.1
Eastern hemlock	229	12	-9	749	0	981	(N/A)	0.3
Quaking aspen	124	16	18	99	171	428	(N/A)	0.1
Eastern hophornbeam	45	5	6	16	17	89	(N/A)	0.0
Broadleaf Deciduous M	212	26	35	169	183	624	(N/A)	0.2
Eastern white pine	145	11	-3	455	73	681	(N/A)	0.2
Cherry plum	73	7	10	29	26	144	(N/A)	0.0
Ohio buckeye	223	24	40	246	153	685	(N/A)	0.2
Birch	98	10	17	115	70	310	(N/A)	0.1
Eastern redbud	3	0	0	1	0	4	(N/A)	0.0
Paper birch	133	18	22	119	138	430	(N/A)	0.1
Mulberry	75	8	12	32	28	155	(N/A)	0.0
Eastern red cedar	3	0	0	2	13	18	(N/A)	0.0
Willow	84	10	14	83	72	263	(N/A)	0.1
Kwanzan cherry	75	8	12	32	28	155	(N/A)	0.0

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Broadleaf Evergreen Me	97	9	12	134	76	329	(N/A)	0.1
Broadleaf Deciduous Sm	36	3	5	14	13	72	(N/A)	0.0
Ash	56	7	9	43	52	166	(N/A)	0.0
River birch	105	12	18	105	82	323	(N/A)	0.1
Conifer Evergreen Large	62	4	1	166	32	267	(N/A)	0.1
Southern magnolia	8	1	1	4	9	23	(N/A)	0.0
Broadleaf Evergreen Lar	98	5	10	215	0	327	(N/A)	0.1
UNKNOWN	0	0	0	0	0	0	(N/A)	0.0
Black cherry	46	6	8	32	29	121	(N/A)	0.0
Citywide Total	98,036	12,427	16,314	122,393	100,504	349,675	(N/A)	100.0

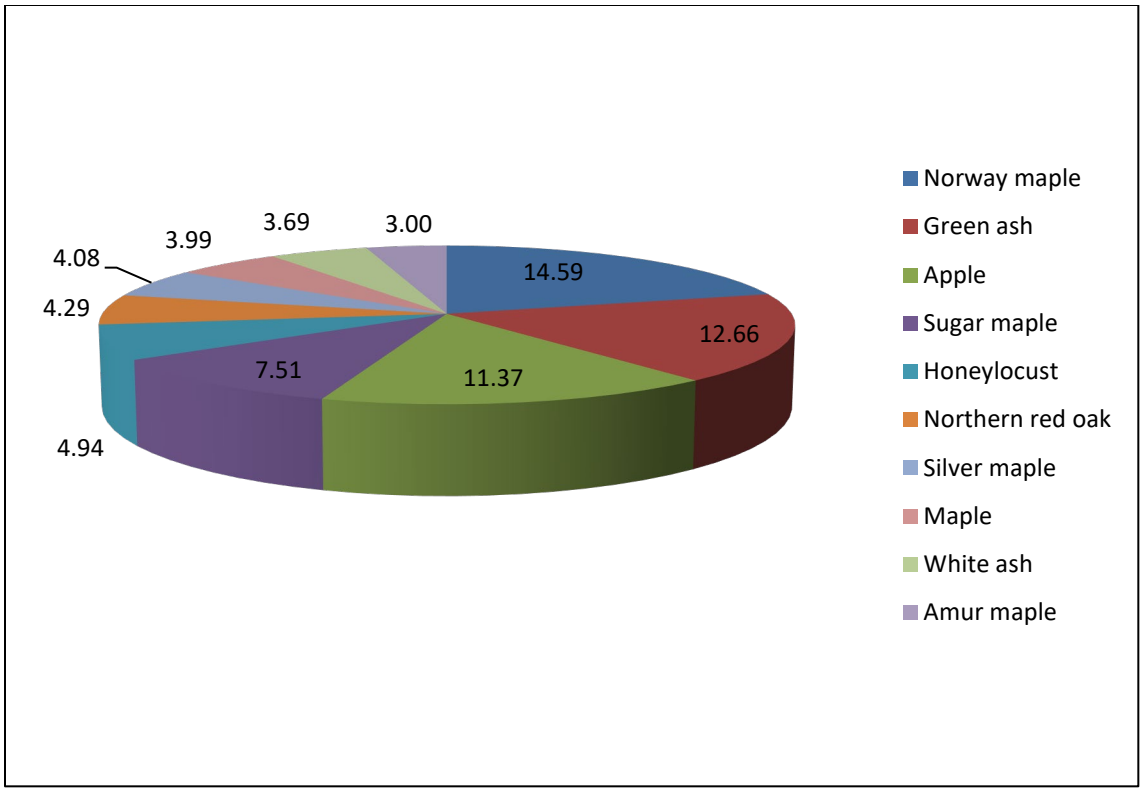

Figure 1: Species Distribution

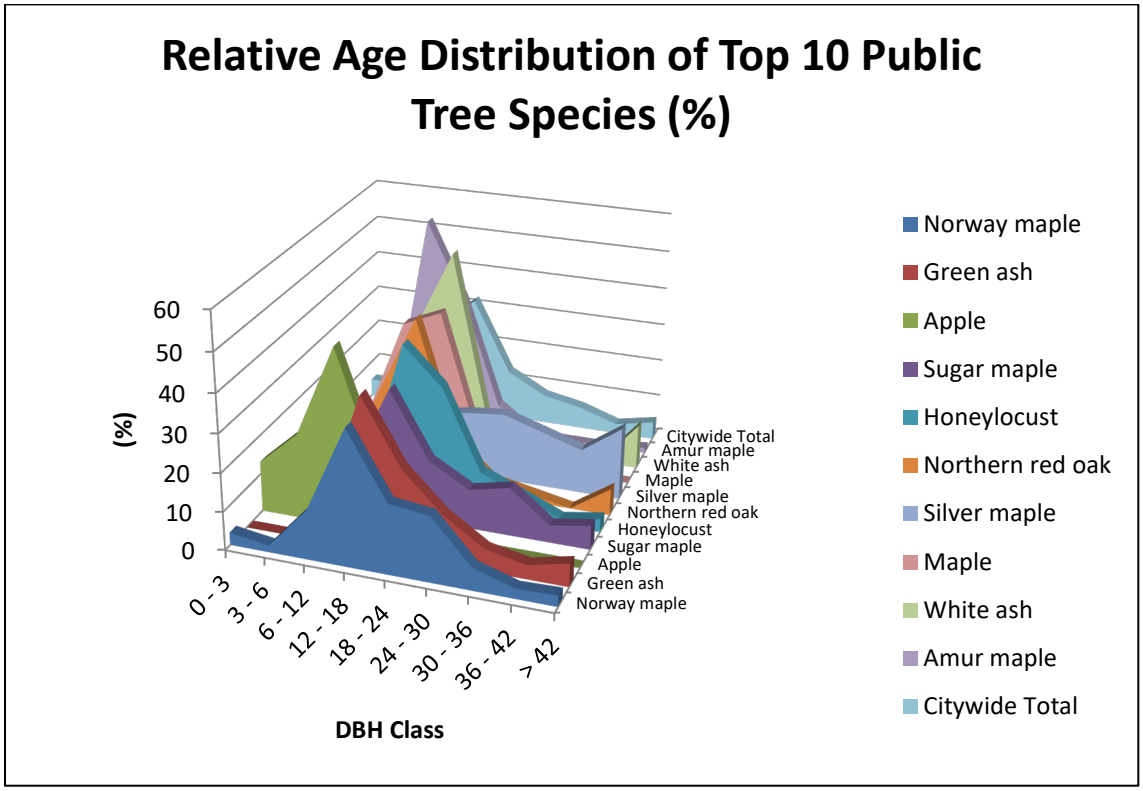

Figure 2: Relative Age Class

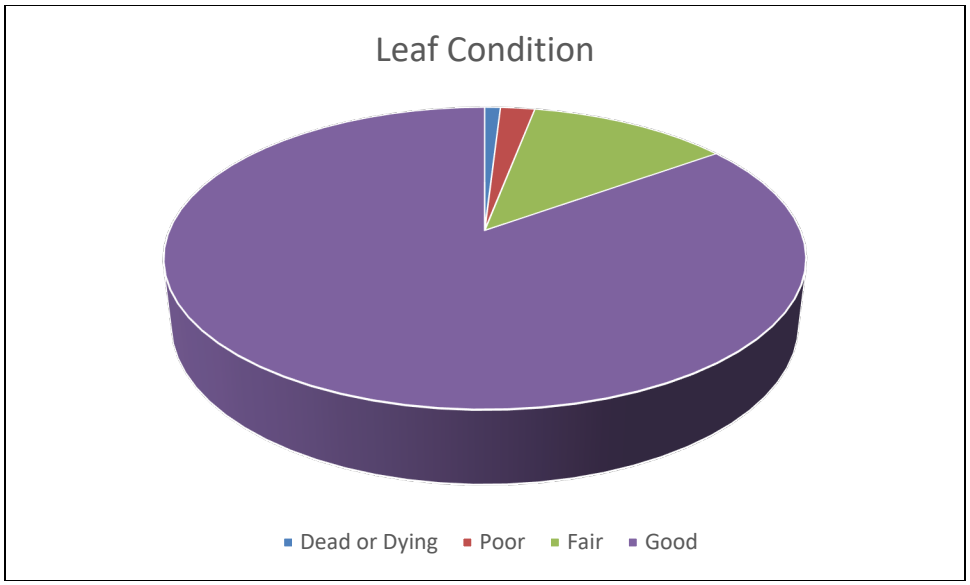

Figure 3: Foliage Condition

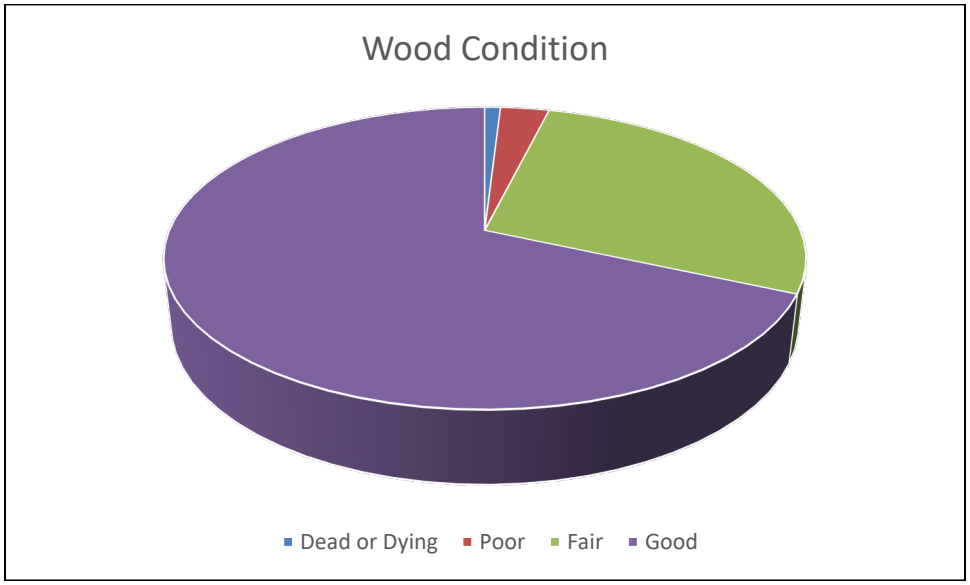

Figure 4: Wood Condition

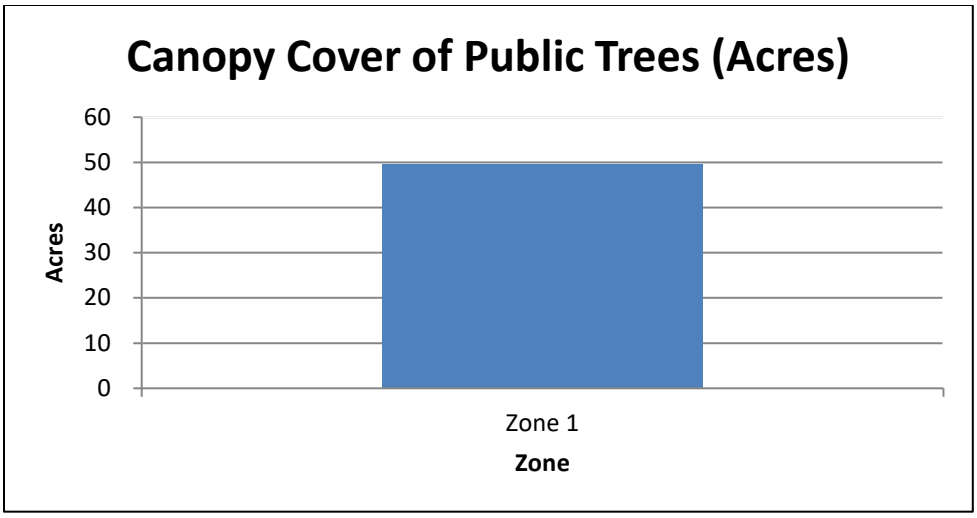

Figure 5: Canopy Cover in Acres

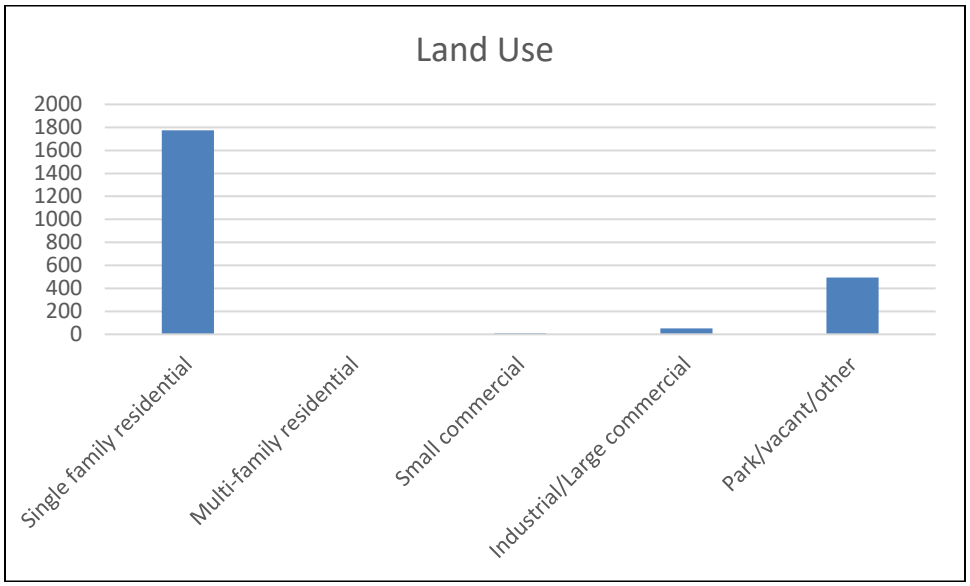

Figure 6: Land Use of city/park trees

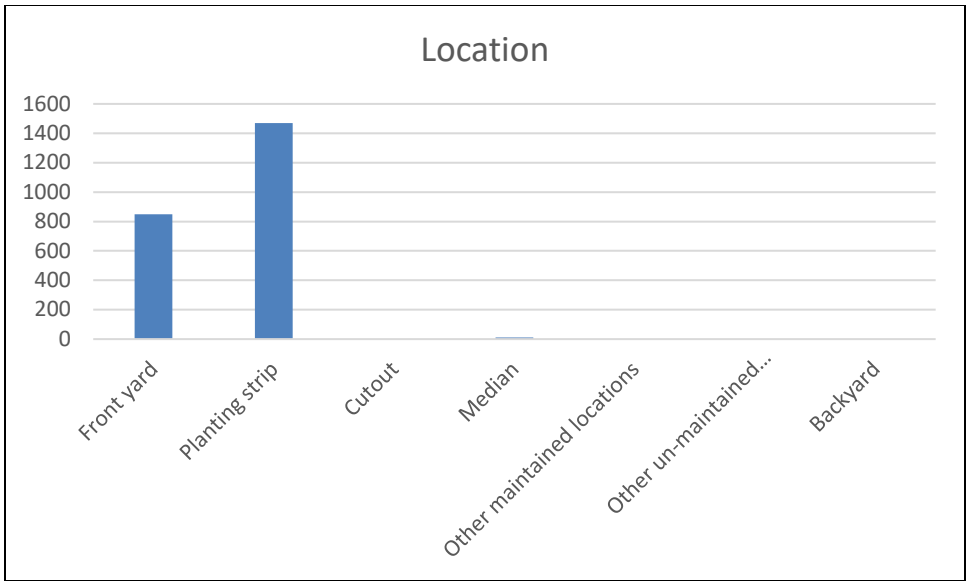

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

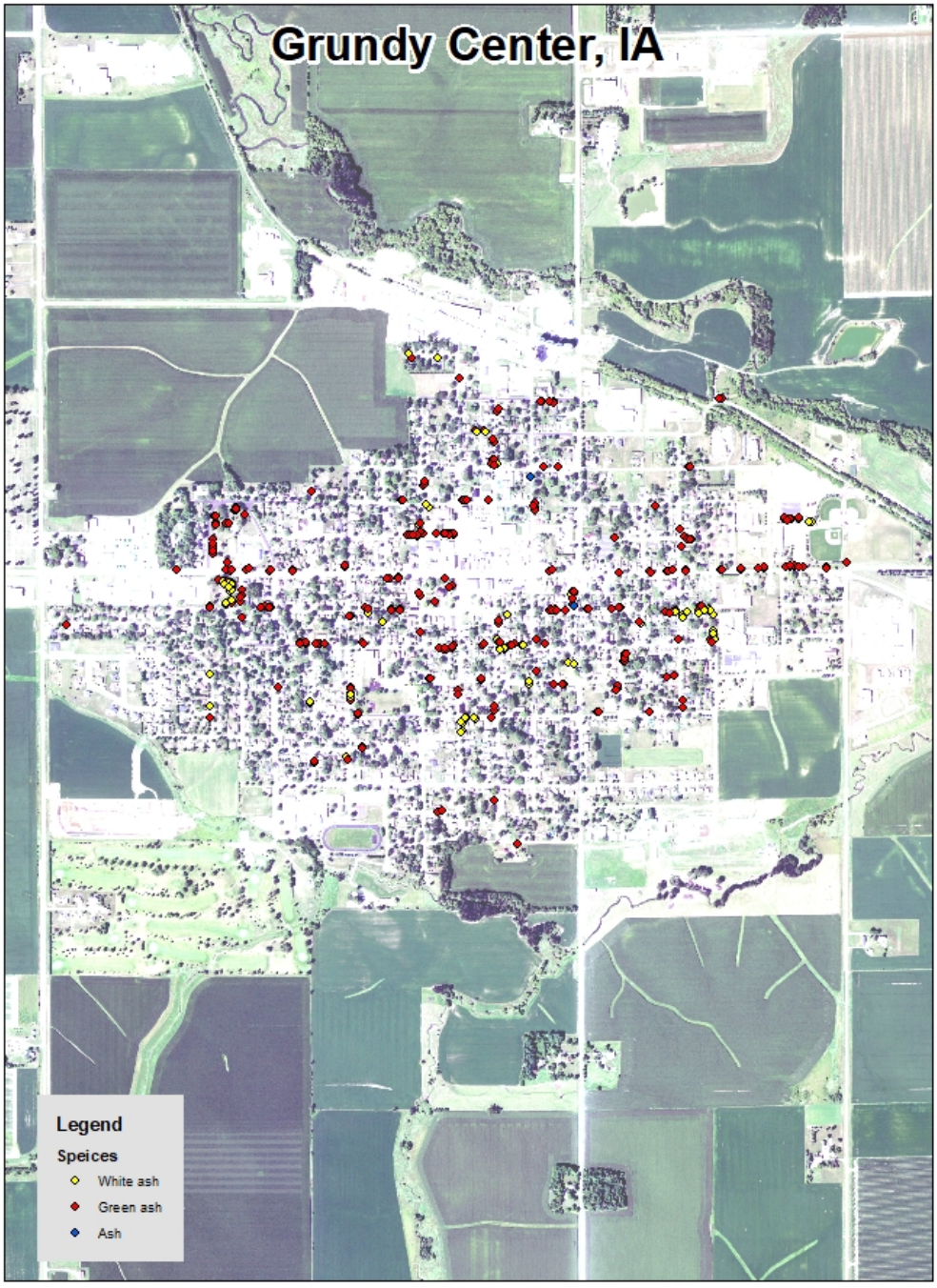

Figure 1: Location of Ash Trees

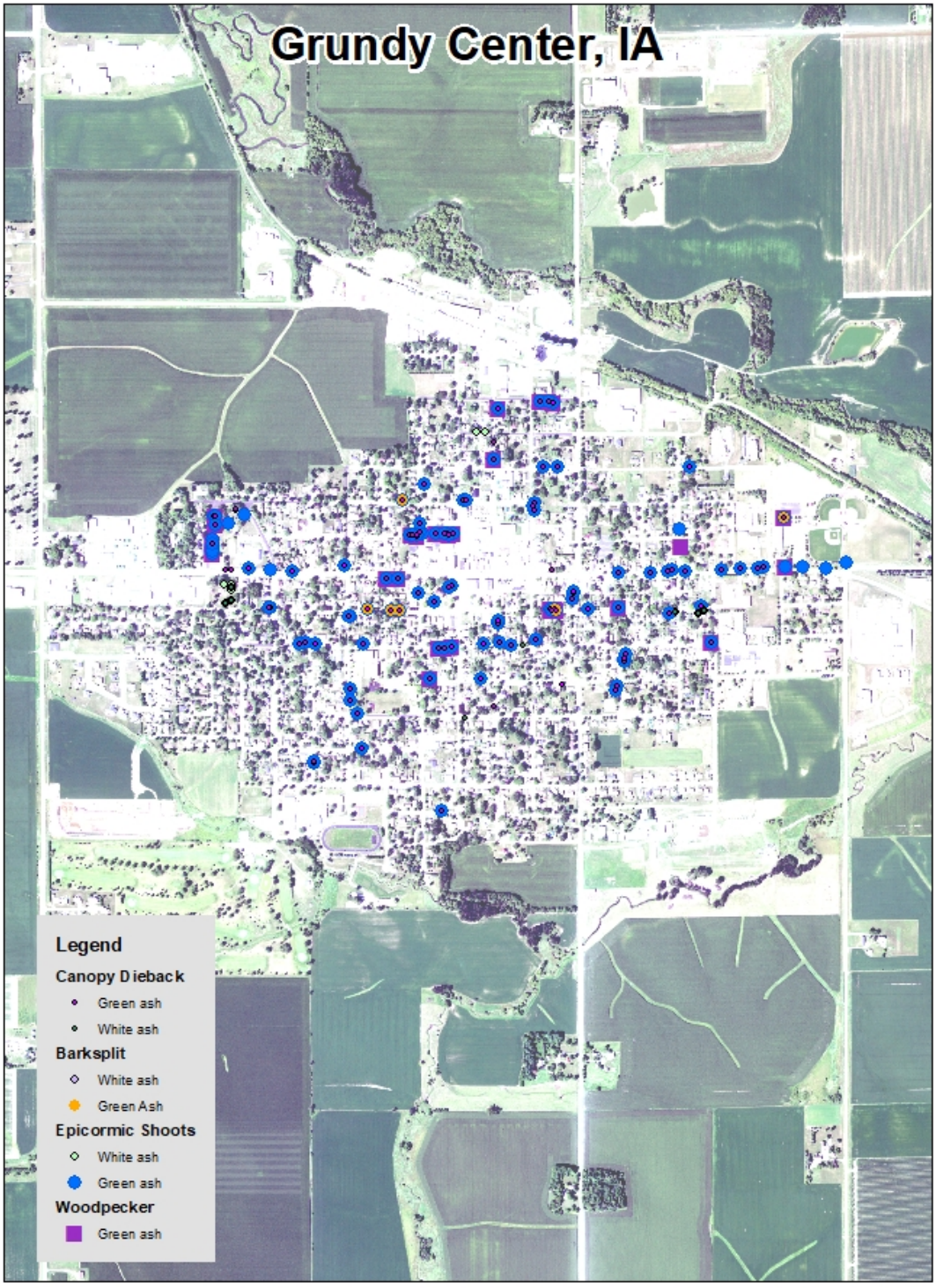

Figure 2: Location of EAB symptoms

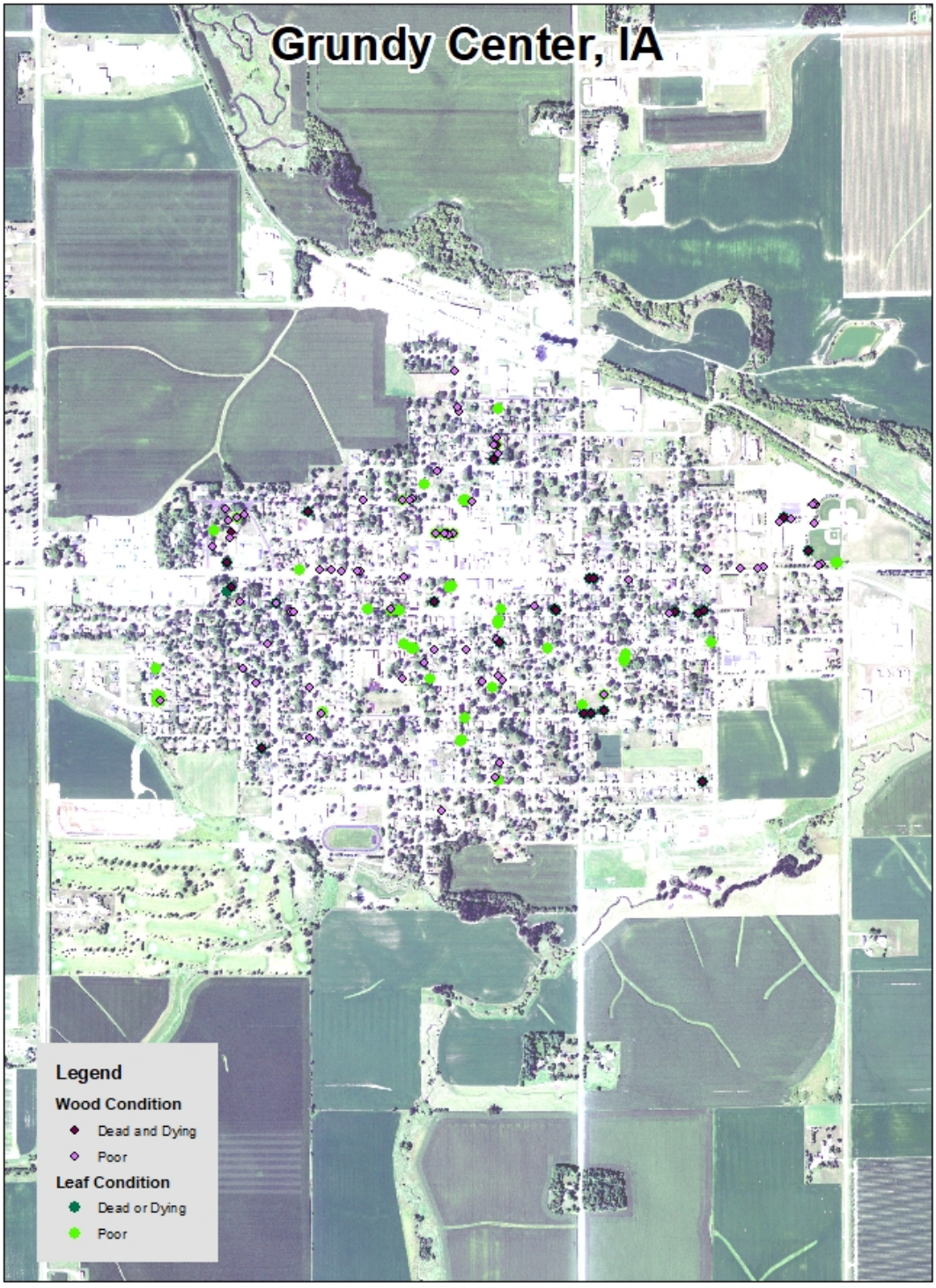

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

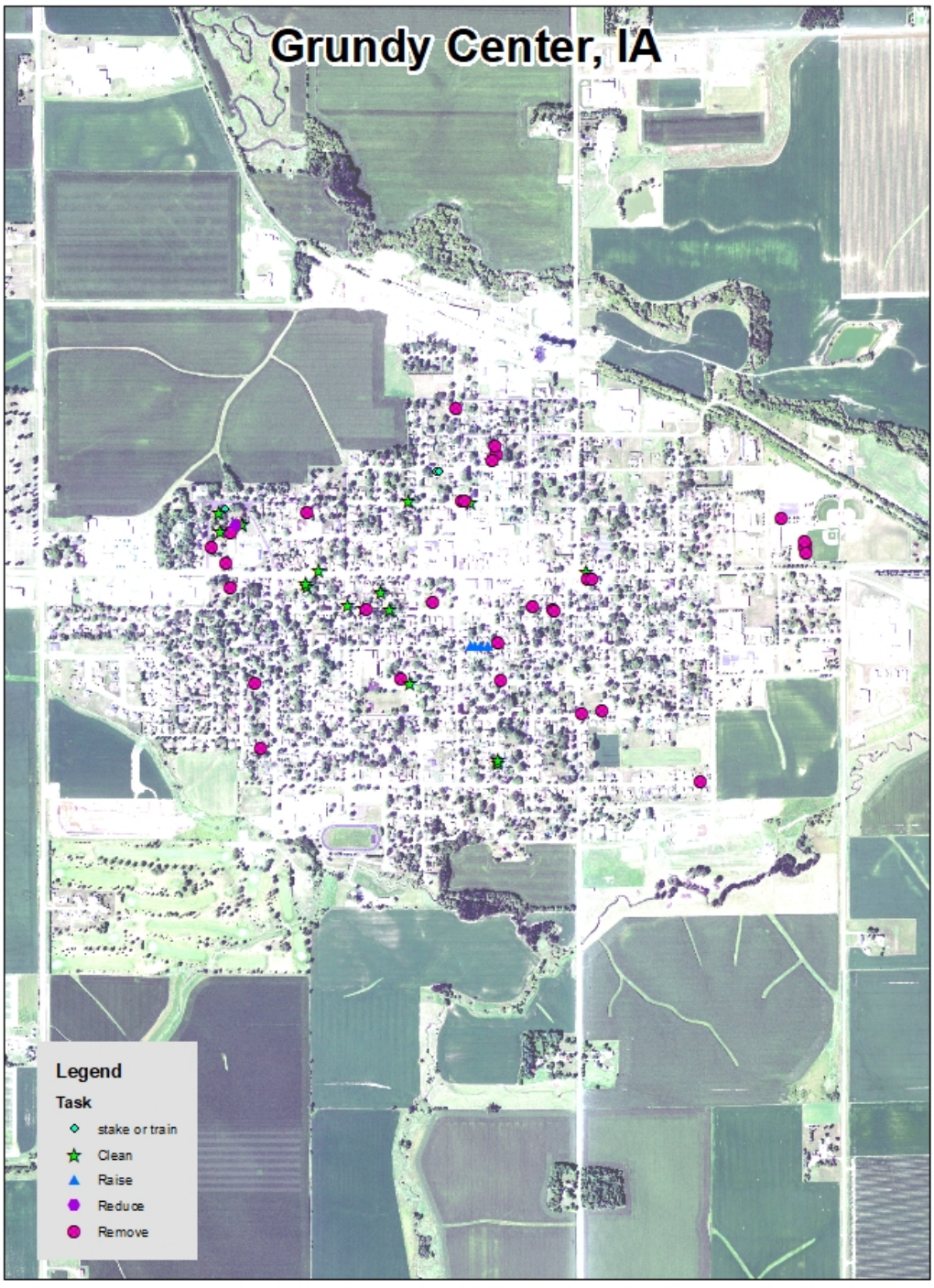

Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

TREES

150.01 PURPOSE. The purpose of this chapter is to beautify and preserve the appearance of the City.

150.02 DEFINITIONS. For use in this chapter, the following definitions are given.

1. "Park trees" are trees, shrubs, bushes and all other woody vegetation in public parks and other areas owned by the City to which the public has free access as a park.

2. "Street trees" are trees, shrubs, bushes and all other woody vegetation on land owned by the City and lying between property lines on either side of all streets, avenues or ways within the City.

150.03 PLANTING RESTRICTIONS. No tree shall be planted on any City or State right-of-way unless the planting conforms with this chapter, and a valid permit for said planting has been issued by the Tree Board.

150.04 REMOVAL OF TREES PROHIBITED. Any tree currently existing on publicly owned right-of-way shall not be removed by an adjoining property owner or anyone else without first obtaining permission of the Tree Board.

150.05 STREET TREE CLASSIFICATIONS. The following list constitutes the official Street Tree Classifications for the City. Although other species are not prohibited, property owners are encouraged to plant these species as street trees:

SMALL TREES Mature Height of Less than 25 Feet	MEDIUM TREES Mature Height between 25 Feet and 50 Feet	LARGE TREES Mature Height of More than 50 Feet
Amur Maple, tree form	Ash, Green	Coffeetree, Kentucky
Flowering Crab, fruitless	Birch, Red, single	Cottonwood (cottonless, male)
Golden Rain Tree	Hackberry	Oak, Bur
Japanese Lilac, tree form	Honey Locust (thornless)	Sycamore
Pear, Bradford	Linden or Basswood	
Pear, Ornamental	Mulberry, Red (fruitless, male)	
Purpleleaf Plum	Oak, English	
Redbud	Oak, Red	
Soapberry	Osage Orange (male, thornless)	
Serviceberry	Pagoda Tree, Japanese	
	Sassafras	
	Persimmon	

150.06 DISTANCE FROM CURB AND SIDEWALK. The distance trees may be planted from curbs or curb lines and sidewalks will be in accordance with the tree species size classes and no trees may be planted closer to any curb or sidewalk than the following: small trees, two (2) feet; medium trees, three (3) feet; and large trees, four (4) feet, unless in conformity with Section 150.03.

150.07 DISTANCE FROM STREET CORNERS AND FIRE PLUGS. No street tree shall be planted closer than twenty (20) feet from any street corner, measured from the point of nearest intersecting curbs or curb lines. No street tree shall be planted closer than ten (10) feet from any fireplug.

150.08 UTILITIES. No street trees other than those species listed as small trees may be planted under or within ten (10) lateral feet of any overhead electrical wire, or over or within ten (10) lateral feet of any underground electrical utility line, water line or sewer line. However, the Tree Board may allow a variance of this section if it is not detrimental to the public utilities and in the judgment of the Tree Board is an enhancement to the property and community.

150.09 PUBLIC TREE CARE. The City has the right to plant, prune, maintain and remove trees, plants and shrubs within the lines of all streets, alleys, avenues, lanes, squares and public grounds, as may be necessary to insure public safety or to preserve or enhance the symmetry and beauty of such public grounds. The City may remove or cause or order to be removed any tree or part thereof which is in an unsafe condition or which by reason of its nature is injurious to sewers, electric power lines, gas lines, water lines or other public improvements, or is affected with any injurious fungus, insect or other pest; provided, however, such removal shall be conducted in accordance with tree removal policies of the tree plan. This section does not prohibit the planting of street trees by adjacent property owners providing that the selection and location of said trees is in accordance with this chapter, and that a valid permit for said planting has been obtained from the City Tree Board.

150.10 TREE TOPPING. It is unlawful as a normal practice for any person or City department to top any street tree, park tree or other tree on public property. Topping is defined as the severe cutting back of limbs to stubs larger than three (3) inches in diameter within the tree's crown to such a degree so as to remove the normal canopy and disfigure the tree. Trees severely damaged by storms or other causes, or certain trees under utility wires or other obstructions where other pruning practices are impractical, may be exempted from this section at the determination of the Tree Board. The Tree Board shall adopt a tree topping policy in its tree plan to be followed by the City in pruning or topping trees.

150.11 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on private property trimmed so that all branches will be at least eight (8) 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 (5) 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, d & e])

150.12 REMOVAL OF DEAD OR DISEASED TREES. The City has the right to cause the removal of any dead or diseased trees on private property within the City when such trees constitute a hazard to life and property, or harbor insects or diseases which constitute a

potential threat to other trees within the City. The Tree Board will notify in writing the owners of such trees. Removal shall be done by said owners at their own expense within sixty (60) days after the date of service of notice. In the event of failure of owners to comply with such provisions, the City shall have the authority to remove such trees and charge the cost of removal on the owner's property tax notice.

150.13 REMOVAL OF STUMPS. All stumps of street and park trees shall be removed below the surface of the ground so that the top of the stump does not project above the surface of the ground. When the City causes a tree on City property to be removed, the City shall remove the stump to six inches (6") below ground level.

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.