Hedrick, IA

2021 Urban Forest Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Hedrick 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 4.8% of Hedrick'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 2020, 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 124 trees inventoried.

- Hedrick's trees provide $27,405 of benefits annually, an average of $221 a tree
- There are over 27 species of trees
- The top three genera are: Maple 41%, Oak 16%, and Elm 10%
- 43% of trees are in need of some type of management
- 11 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 11 trees needing removal, 7 trees are over 18 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*
- All 6 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
- The proposed budget removes all 6 ash trees within 6 years. We also suggest you apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2020, 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 124 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. Hedrick's trees reduce energy related costs by approximately $6,797 annually (Appendix A, Table 1). These savings are both in Electricity (32.4 MWh) and in Natural Gas (4,430.1 Therms).

Annual Stormwater Benefits

Hedrick's trees intercept about 411,649 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $11,156 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 Hedrick, it is estimated that trees remove 433 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $1,225 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Hedrick, trees sequester about 87,902 lbs of carbon a year with an associated value of $659 (Appendix A, Table 5). In addition, the trees store 1,780,572 lbs of carbon, with a yearly benefit of $13,354 (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. Hedrick receives $7,228 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, Hedrick's trees provide $27,405 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 124 trees in Hedrick provide approximately $221 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Hedrick has over 27 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	52	41%
Oak	21	16%
Elm	13	10%
Cedar	7	5%
Ash	6	4%
Hackberry	4	3%
Sycamore	4	3%
Mulberry	3	2%
Catalpa	3	2%
Cottonwood	2	1%
Pear	2	1%
Apple	2	1%
Willow	1	<1%
Buckeye	1	<1%
Walnut	1	<1%
Linden/Basswood	1	<1%
Broadleaf Deciduous Medium	1	<1%

Age Class

The canopy of Hedrick is evenly split between small, medium, and large canopy size classes (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. Hedrick's size curve is evenly split which suggests more new trees should be planted to skew towards the smaller category.

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 Hedrick indicate that 36% of the trees are in good health, with only 15% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 74% of Hedrick'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 4% is an estimate of trees that need management follow up.

Management Needs

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

Crown Cleaning	29	23%
Tree Removal	11	8%
Crown Reduction	11	8%
Crown Raising	3	2%

Canopy Cover

The total canopy with both private and public trees is 9%, 85.86 acres. The canopy cover on city own properties included in the Hedrick inventory includes approximately 4 acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 3%, in 30 years on all lands. To achieve this goal it is estimated that 72 trees need to be planted annually on public and/or private lands.

Land Use and Location

The majority of Hedrick'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	66%
Park/vacant/other	33%

Location	
Planting strip	83%
Front yard	16%

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

Hedrick has 1 critical concern tree that needs 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 7 trees over 12 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 54 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 11 removals, 6 are ash trees. There are a total of 6 ash trees, and all of those have signs and symptoms that have been associated with EAB. *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 Hedrick.

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 (41%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Continual Monitoring

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: Average $3,080 annually

FY 2021: $2,900

Removal: 2 trees, one critical concern and 1 recommended removal	$1,400
Planting and Replacement: 10 trees to be planted in open locations	$1,000
Young Tree Pruning & Maintenance:	$500
Visual Survey for signs and symptoms of EAB	

FY 2022: $3,260

Removal: 2 trees recommended for removal	$1,400
Planting and Replacement: 5 trees in open locations	$500
Young Tree Pruning & Maintenance:	$250
Routine trimming: Contract to trim 1/3 of the city trees	$1,110
Visual Survey for signs and symptoms of EAB	

FY 2023: $2,900

Removal: 2 trees recommended for removal	$1,400
Planting and Replacement: 10 trees in open locations	$1,000
Young Tree Pruning & Maintenance:	$500
Visual Survey for signs and symptoms of EAB	

FY 2024: $3,260

Removal: 2 trees recommended for removal	$1,400
Planting and Replacement: 5 trees in open locations	$500
Routine trimming: Contract to trim 1/3 of the city trees	$1,110
Young Tree Pruning & Maintenance:	$250
Visual Survey for signs and symptoms of EAB	

FY 2025: $2,900

Removal: 2 trees recommended for removal	$1,400
Planting and Replacement: 10 trees to be planted in open locations	$1,000
Young Tree Pruning & Maintenance:	$500
Visual Survey for signs and symptoms of EAB	

FY 2026: $3,260

Removal: 2 trees recommended for removal	$1,400
Planting and Replacement: 5 trees in open locations from previous removals	$500
Routine trimming: Contract to trim 1/3 of the city trees	$1,110
Young Tree Pruning & Maintenance:	$250
Visual Survey for signs and symptoms of EAB	

*Reduction of ash over 6 years: the proposed budget removes all 6 ash trees from Hedrick within 6 years. EAB could potentially kill all ash within 4 to 15 years of its arrival.

Estimates based on the following costs: tree removal $700/tree, planting and replacement $100/tree, young tree pruning and maintenance $50/tree, routine trimming $30/tree. Actual costs could be different.

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. 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.

<u>Proposed Budget Increase</u>

EAB could potentially kill all ash trees in Hedrick within 4 years of its arrival. The proposed budget removes all 6 ash trees from Hedrick within 6 years. Additionally, it is recommended that Hedrick 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. Unfortunately, none of the ash trees in Hedrick would be good candidates for treatment since the canopies are either dead, dying, or in poor condition.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Hedrick

Annual Energy Benefits of Public Trees

3/17/2021

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	9.9	751	1,308.8	1,283	2,033	(N/A)	25.8	29.9	63.54
Sugar maple	4.7	353	627.3	615	968	(N/A)	11.3	14.2	69.12
Bur oak	4.3	323	596.1	584	907	(N/A)	11.3	13.3	64.81
Siberian elm	1.8	136	249.5	244	381	(N/A)	6.5	5.6	47.61
Eastern red cedar	0.6	47	92.6	91	138	(N/A)	5.6	2.0	19.71
Northern pin oak	1.8	133	248.6	244	377	(N/A)	4.8	5.5	62.82
Northern hackberry	0.9	67	124.2	122	188	(N/A)	3.2	2.8	47.07
Norway maple	0.8	57	112.5	110	167	(N/A)	3.2	2.5	41.81
American sycamore	1.8	136	238.9	234	370	(N/A)	3.2	5.4	92.58
Green ash	0.8	60	114.3	112	172	(N/A)	2.4	2.5	57.32
Ash	0.8	60	106.4	104	164	(N/A)	2.4	2.4	54.80
White mulberry	0.3	21	45.1	44	65	(N/A)	2.4	1.0	21.73
Chinese elm	0.9	66	121.1	119	185	(N/A)	2.4	2.7	61.56
Eastern cottonwood	0.4	32	57.4	56	88	(N/A)	1.6	1.3	43.92
Callery pear	0.2	16	33.7	33	49	(N/A)	1.6	0.7	24.47
American elm	0.2	12	23.4	23	35	(N/A)	1.6	0.5	17.66
Catalpa	0.7	57	101.2	99	156	(N/A)	1.6	2.3	77.98
Apple	0.0	1	1.2	1	2	(N/A)	1.6	0.0	0.87
Red maple	0.0	3	5.2	5	8	(N/A)	0.8	0.1	7.85
Willow	0.0	0	0.8	1	1	(N/A)	0.8	0.0	1.10
Broadleaf Deciduous Mediu	0.0	3	6.2	6	9	(N/A)	0.8	0.1	8.99
Ohio buckeye	0.2	18	29.5	29	47	(N/A)	0.8	0.7	46.78
Black walnut	0.4	33	59.0	58	91	(N/A)	0.8	1.3	91.02
Northern catalpa	0.4	29	53.7	53	82	(N/A)	0.8	1.2	82.02
Oak	0.3	25	46.9	46	71	(N/A)	0.8	1.0	70.91
American basswood	0.2	16	26.1	26	42	(N/A)	0.8	0.6	41.84
Japanese maple	0.0	0	0.6	1	1	(N/A)	0.8	0.0	0.87
Total	32.4	2,456	4,430.1	4,342	6,797	(N/A)	100.0	100.0	54.82

Table 2: Annual Stormwater Benefits

Hedrick

Annual Stormwater Benefits of Public Trees

3/17/2021

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	151,533	4,107	(N/A)	25.8	36.8	128.33
Sugar maple	61,188	1,658	(N/A)	11.3	14.9	118.44
Bur oak	48,297	1,309	(N/A)	11.3	11.7	93.49
Siberian elm	17,577	476	(N/A)	6.5	4.3	59.54
Eastern red cedar	9,015	244	(N/A)	5.6	2.2	34.90
Northern pin oak	17,876	484	(N/A)	4.8	4.3	80.74
Northern hackberry	6,308	171	(N/A)	3.2	1.5	42.73
Norway maple	8,127	220	(N/A)	3.2	2.0	55.06
American sycamore	27,207	737	(N/A)	3.2	6.6	184.33
Green ash	7,772	211	(N/A)	2.4	1.9	70.21
Ash	6,583	178	(N/A)	2.4	1.6	59.46
White mulberry	1,446	39	(N/A)	2.4	0.4	13.06
Chinese elm	11,589	314	(N/A)	2.4	2.8	104.69
Eastern cottonwood	5,662	153	(N/A)	1.6	1.4	76.72
Callery pear	1,172	32	(N/A)	1.6	0.3	15.88
American elm	865	23	(N/A)	1.6	0.2	11.72
Catalpa	9,830	266	(N/A)	1.6	2.4	133.19
Apple	15	0	(N/A)	1.6	0.0	0.20
Red maple	137	4	(N/A)	0.8	0.0	3.72
Willow	12	0	(N/A)	0.8	0.0	0.33
Broadleaf Deciduous Medium	163	4	(N/A)	0.8	0.0	4.41
Ohio buckeye	1,409	38	(N/A)	0.8	0.3	38.19
Black walnut	7,239	196	(N/A)	0.8	1.8	196.17
Northern catalpa	5,491	149	(N/A)	0.8	1.3	148.79
Oak	3,943	107	(N/A)	0.8	1.0	106.85
American basswood	1,189	32	(N/A)	0.8	0.3	32.21
Japanese maple	7	0	(N/A)	0.8	0.0	0.20
Citywide total	411,649	11,156	(N/A)	100.0	100.0	89.97

Table 3: Annual Air Quality Benefits

Hedrick

Annual Air Quality Benefits of Public Trees

3/17/2021

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($) Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2							
Silver maple	27.8	4.7	13.5	1.2	149	46.7	6.8	6.5	44.7	292	-14.7	-55	137.3	386 (N/A)	25.8	12.07
Sugar maple	8.7	1.5	4.2	0.4	47	22.1	3.2	3.1	21.1	138	-6.7	-25	57.5	159 (N/A)	11.3	11.38
Bur oak	6.4	1.0	3.0	0.3	34	20.4	3.0	2.8	19.3	127	0.0	0	56.3	161 (N/A)	11.3	11.51
Siberian elm	2.6	0.4	1.3	0.1	14	8.6	1.3	1.2	8.1	54	0.0	0	23.6	68 (N/A)	6.5	8.45
Eastern red cedar	1.8	0.4	1.4	0.2	12	3.0	0.4	0.4	2.8	19	-5.0	-19	5.5	12 (N/A)	5.6	1.68
Northern pin oak	3.9	0.7	1.9	0.2	21	8.5	1.2	1.2	8.0	53	-0.9	-3	24.6	70 (N/A)	4.8	11.69
Northern hackberry	0.8	0.1	0.4	0.0	4	4.2	0.6	0.6	4.0	26	0.0	0	10.8	30 (N/A)	3.2	7.62
Norway maple	1.8	0.3	0.9	0.1	10	3.7	0.5	0.5	3.4	23	-0.4	-2	10.7	31 (N/A)	3.2	7.69
American sycamore	5.1	0.8	2.2	0.2	27	8.5	1.2	1.2	8.1	53	0.0	0	27.5	80 (N/A)	3.2	19.96
Green ash	0.8	0.1	0.4	0.0	4	3.8	0.6	0.5	3.6	24	0.0	0	9.9	28 (N/A)	2.4	9.34
Ash	1.3	0.2	0.6	0.1	7	3.8	0.6	0.5	3.6	24	-0.3	-1	10.4	29 (N/A)	2.4	9.81
White mulberry	0.5	0.1	0.2	0.0	3	1.4	0.2	0.2	1.3	8	0.0	0	3.8	11 (N/A)	2.4	3.67
Chinese elm	1.6	0.3	0.7	0.1	8	4.2	0.6	0.6	3.9	26	0.0	0	12.0	34 (N/A)	2.4	11.47
Eastern cottonwood	0.8	0.1	0.4	0.0	4	2.0	0.3	0.3	1.9	12	0.0	0	5.8	17 (N/A)	1.6	8.29
Callery pear	0.1	0.0	0.1	0.0	1	1.0	0.1	0.1	1.0	6	0.0	0	2.5	7 (N/A)	1.6	3.47
American elm	0.0	0.0	0.0	0.0	0	0.8	0.1	0.1	0.7	5	0.0	0	1.8	5 (N/A)	1.6	2.54
Catalpa	1.9	0.3	0.8	0.1	10	3.6	0.5	0.5	3.4	22	0.0	0	11.0	32 (N/A)	1.6	15.94
Apple	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	1.6	0.11
Red maple	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)	0.8	1.12
Willow	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.8	0.14
Broadleaf Deciduous Medium	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)	0.8	1.21
Ohio buckeye	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8 (N/A)	0.8	7.92
Black walnut	1.2	0.2	0.5	0.1	6	2.1	0.3	0.3	2.0	13	0.0	0	6.6	19 (N/A)	0.8	19.04
Northern catalpa	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16 (N/A)	0.8	15.71
Oak	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	12 (N/A)	0.8	12.48
American basswood	0.1	0.0	0.1	0.0	1	1.0	0.1	0.1	1.0	6	-0.1	0	2.3	6 (N/A)	0.8	6.46
Japanese maple	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.8	0.11
Citywide total	68.6	11.5	33.5	3.2	369	154.3	22.5	21.4	146.5	962	-28.2	-106	433.3	1,225 (N/A)	100.0	9.88

Table 4: Annual Carbon Stored

Hedrick

Stored CO2 Benefits of Public Trees

3/17/2021

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	674,212	5,057	(N/A)	25.8	37.9	158.02
Sugar maple	254,021	1,905	(N/A)	11.3	14.3	136.08
Bur oak	210,747	1,581	(N/A)	11.3	11.8	112.90
Siberian elm	63,820	479	(N/A)	6.5	3.6	59.83
Eastern red cedar	5,830	44	(N/A)	5.6	0.3	6.25
Northern pin oak	64,369	483	(N/A)	4.8	3.6	80.46
Northern hackberry	9,968	75	(N/A)	3.2	0.6	18.69
Norway maple	29,678	223	(N/A)	3.2	1.7	55.65
American sycamore	177,166	1,329	(N/A)	3.2	9.9	332.19
Green ash	25,373	190	(N/A)	2.4	1.4	63.43
Ash	21,528	161	(N/A)	2.4	1.2	53.82
White mulberry	7,664	57	(N/A)	2.4	0.4	19.16
Chinese elm	52,921	397	(N/A)	2.4	3.0	132.30
Eastern cottonwood	26,129	196	(N/A)	1.6	1.5	97.98
Callery pear	2,201	17	(N/A)	1.6	0.1	8.26
American elm	1,816	14	(N/A)	1.6	0.1	6.81
Catalpa	64,440	483	(N/A)	1.6	3.6	241.65
Apple	28	0	(N/A)	1.6	0.0	0.10
Red maple	218	2	(N/A)	0.8	0.0	1.64
Willow	17	0	(N/A)	0.8	0.0	0.13
Broadleaf Deciduous	218	2	(N/A)	0.8	0.0	1.64
Ohio buckeye	3,624	27	(N/A)	0.8	0.2	27.18
Black walnut	39,259	294	(N/A)	0.8	2.2	294.44
Northern catalpa	25,943	195	(N/A)	0.8	1.5	194.57
Oak	15,773	118	(N/A)	0.8	0.9	118.30
American basswood	3,595	27	(N/A)	0.8	0.2	26.96
Japanese maple	14	0	(N/A)	0.8	0.0	0.10
Citywide total	1,780,572	13,354	(N/A)	100.0	100.0	107.70

Table 5: Annual Carbon Sequestered

Hedrick

Annual CO Benefits of Public Trees

3/17/2021

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	45,743	343	-3,238	-115	-25	16,587	124	58,977	442 (N/A)	25.8	44.3	13.82
Sugar maple	11,750	88	-1,219	-52	-10	7,800	59	18,279	137 (N/A)	11.3	13.7	9.79
Bur oak	9,835	74	-1,012	-45	-8	7,141	54	15,919	119 (N/A)	11.3	11.9	8.53
Siberian elm	3,385	25	-307	-20	-2	3,015	23	6,073	46 (N/A)	6.5	4.6	5.69
Eastern red cedar	267	2	-28	-12	0	1,043	8	1,271	10 (N/A)	5.6	1.0	1.36
Northern pin oak	772	6	-309	-21	-2	2,944	22	3,386	25 (N/A)	4.8	2.5	4.23
Northern hackberry	911	7	-48	-8	0	1,471	11	2,327	17 (N/A)	3.2	1.7	4.36
Norway maple	969	7	-143	-8	-1	1,260	9	2,079	16 (N/A)	3.2	1.6	3.90
American sycamore	2,829	21	-850	-21	-7	3,010	23	4,968	37 (N/A)	3.2	3.7	9.32
Green ash	1,979	15	-122	-8	-1	1,324	10	3,173	24 (N/A)	2.4	2.4	7.93
Ash	772	6	-103	-8	-1	1,329	10	1,989	15 (N/A)	2.4	1.5	4.97
White mulberry	123	1	-37	-5	0	465	3	545	4 (N/A)	2.4	0.4	1.36
Chinese elm	2,128	16	-254	-10	-2	1,459	11	3,323	25 (N/A)	2.4	2.5	8.31
Eastern cottonwood	1,034	8	-125	-5	-1	699	5	1,602	12 (N/A)	1.6	1.2	6.01
Callery pear	448	3	-11	-2	0	352	3	787	6 (N/A)	1.6	0.6	2.95
American elm	222	2	-9	-2	0	274	2	485	4 (N/A)	1.6	0.4	1.82
Catalpa	1,139	9	-309	-9	-2	1,254	9	2,075	16 (N/A)	1.6	1.6	7.78
Apple	17	0	0	0	0	11	0	28	0 (N/A)	1.6	0.0	0.10
Red maple	39	0	-1	-1	0	60	0	97	1 (N/A)	0.8	0.1	0.73
Willow	5	0	0	0	0	7	0	12	0 (N/A)	0.8	0.0	0.09
Broadleaf Deciduous Medi	96	1	-2	-1	0	65	0	158	1 (N/A)	0.8	0.1	1.18
Ohio buckeye	386	3	-17	-2	0	395	3	762	6 (N/A)	0.8	0.6	5.71
Black walnut	912	7	-188	-5	-1	734	6	1,453	11 (N/A)	0.8	1.1	10.90
Northern catalpa	960	7	-125	-4	-1	650	5	1,481	11 (N/A)	0.8	1.1	11.11
Oak	857	6	-76	-4	-1	552	4	1,330	10 (N/A)	0.8	1.0	9.97
American basswood	316	2	-17	-2	0	360	3	657	5 (N/A)	0.8	0.5	4.93
Japanese maple	9	0	0	0	0	6	0	14	0 (N/A)	0.8	0.0	0.10
Citywide total	87,902	659	-8,550	-370	-67	54,268	407	133,250	999 (N/A)	100.0	100.0	8.06

Table 6: Annual Social and Aesthetic Benefits

Hedrick

Annual Aesthetic/Other Benefits of Public Trees

3/17/2021

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	3,425	(N/A)	25.8	47.4	107.02
Sugar maple	1,161	(N/A)	11.3	16.1	82.93
Bur oak	800	(N/A)	11.3	11.1	57.16
Siberian elm	278	(N/A)	6.5	3.8	34.71
Eastern red cedar	103	(N/A)	5.6	1.4	14.73
Northern pin oak	78	(N/A)	4.8	1.1	13.05
Northern hackberry	148	(N/A)	3.2	2.0	36.95
Norway maple	92	(N/A)	3.2	1.3	22.97
American sycamore	182	(N/A)	3.2	2.5	45.52
Green ash	173	(N/A)	2.4	2.4	57.69
Ash	78	(N/A)	2.4	1.1	26.11
White mulberry	6	(N/A)	2.4	0.1	2.15
Chinese elm	162	(N/A)	2.4	2.2	53.92
Eastern cottonwood	81	(N/A)	1.6	1.1	40.67
Callery pear	52	(N/A)	1.6	0.7	26.22
American elm	40	(N/A)	1.6	0.6	19.89
Catalpa	86	(N/A)	1.6	1.2	43.13
Apple	0	(N/A)	1.6	0.0	0.03
Red maple	7	(N/A)	0.8	0.1	7.28
Willow	3	(N/A)	0.8	0.0	2.74
Broadleaf Deciduous Medium	13	(N/A)	0.8	0.2	12.89
Ohio buckeye	39	(N/A)	0.8	0.5	39.16
Black walnut	58	(N/A)	0.8	0.8	58.34
Northern catalpa	67	(N/A)	0.8	0.9	66.60
Oak	66	(N/A)	0.8	0.9	65.59
American basswood	29	(N/A)	0.8	0.4	28.70
Japanese maple	0	(N/A)	0.8	0.0	0.03
Citywide total	7,228	(N/A)	100.0	100.0	58.29

Table 7: Summary of Benefits in Dollars

Hedrick

Total Annual Benefits of Public Trees by Species ($)

3/17/2021

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	2,033	442	386	4,107	3,425	10,393	(N/A)	37.9
Sugar maple	968	137	159	1,658	1,161	4,083	(N/A)	14.9
Bur oak	907	119	161	1,309	800	3,297	(N/A)	12.0
Siberian elm	381	46	68	476	278	1,248	(N/A)	4.6
Eastern red cedar	138	10	12	244	103	507	(N/A)	1.8
Northern pin oak	377	25	70	484	78	1,035	(N/A)	3.8
Northern hackberry	188	17	30	171	148	555	(N/A)	2.0
Norway maple	167	16	31	220	92	526	(N/A)	1.9
American sycamore	370	37	80	737	182	1,407	(N/A)	5.1
Green ash	172	24	28	211	173	607	(N/A)	2.2
Ash	164	15	29	178	78	465	(N/A)	1.7
White mulberry	65	4	11	39	6	126	(N/A)	0.5
Chinese elm	185	25	34	314	162	720	(N/A)	2.6
Eastern cottonwood	88	12	17	153	81	351	(N/A)	1.3
Callery pear	49	6	7	32	52	146	(N/A)	0.5
American elm	35	4	5	23	40	107	(N/A)	0.4
Catalpa	156	16	32	266	86	556	(N/A)	2.0
Apple	2	0	0	0	0	3	(N/A)	0.0
Red maple	8	1	1	4	7	21	(N/A)	0.1
Willow	1	0	0	0	3	4	(N/A)	0.0
Broadleaf Deciduous M	9	1	1	4	13	29	(N/A)	0.1
Ohio buckeye	47	6	8	38	39	138	(N/A)	0.5
Black walnut	91	11	19	196	58	375	(N/A)	1.4
Northern catalpa	82	11	16	149	67	324	(N/A)	1.2
Oak	71	10	12	107	66	266	(N/A)	1.0
American basswood	42	5	6	32	29	114	(N/A)	0.4
Japanese maple	1	0	0	0	0	1	(N/A)	0.0
Citywide Total	6,797	999	1,225	11,156	7,228	27,405	(N/A)	100.0

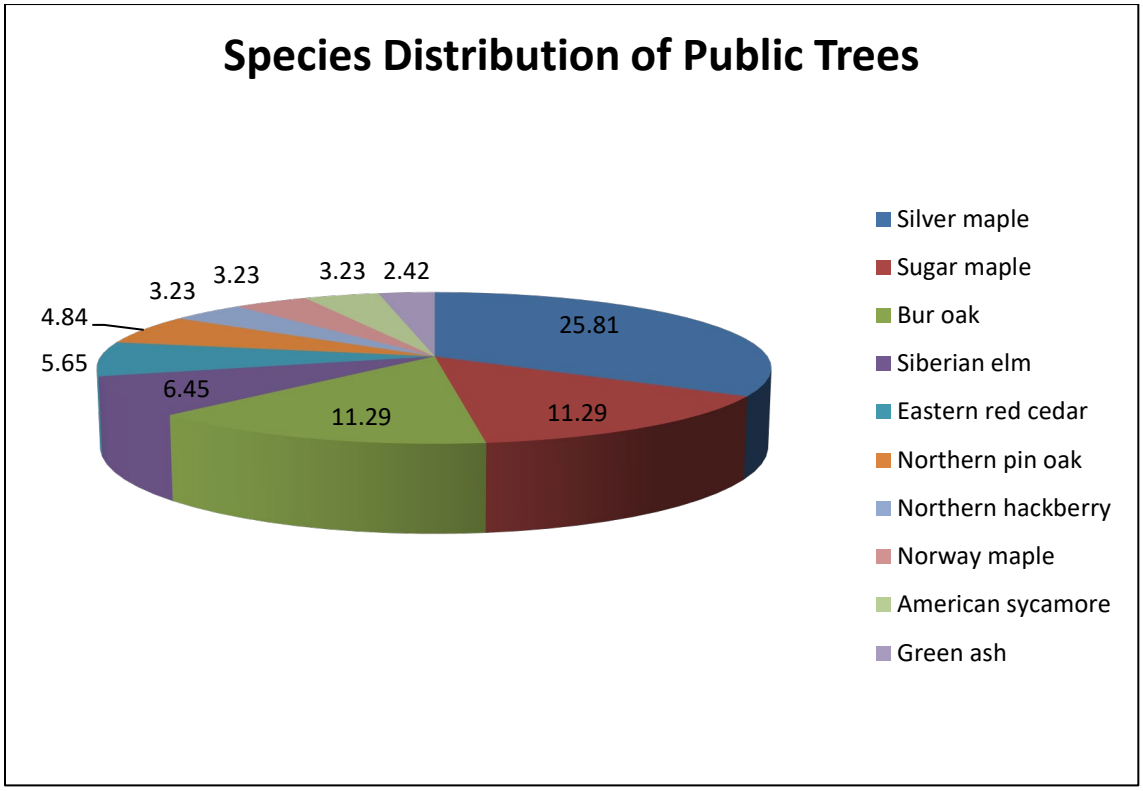

Figure 1: Species Distribution

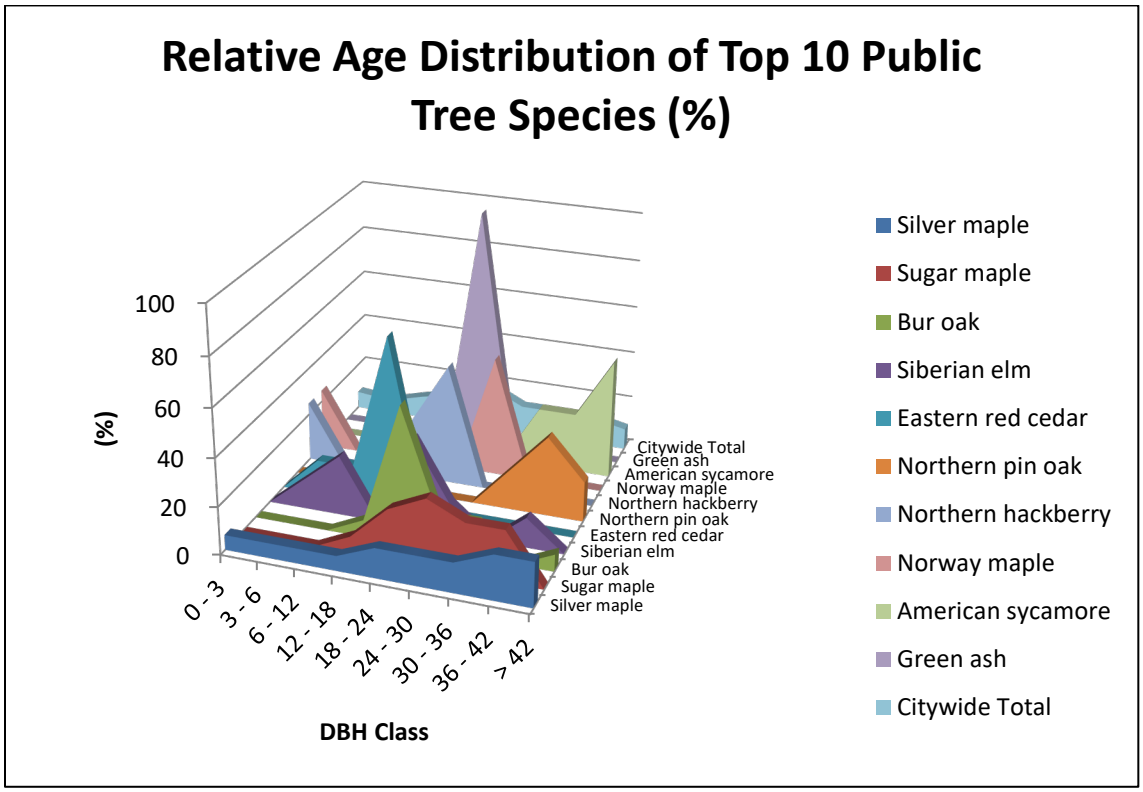

Figure 2: Relative Age Class

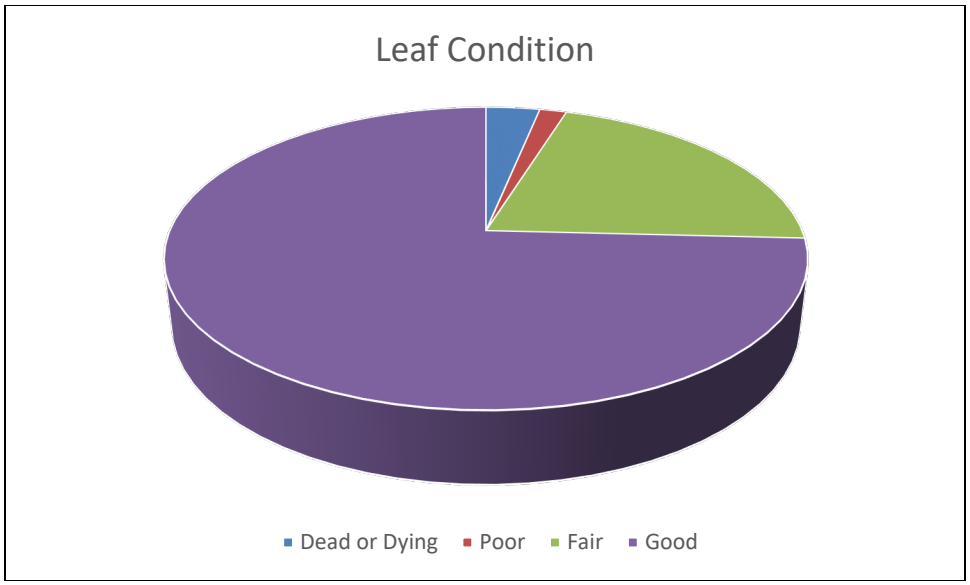

Figure 3: Foliage Condition

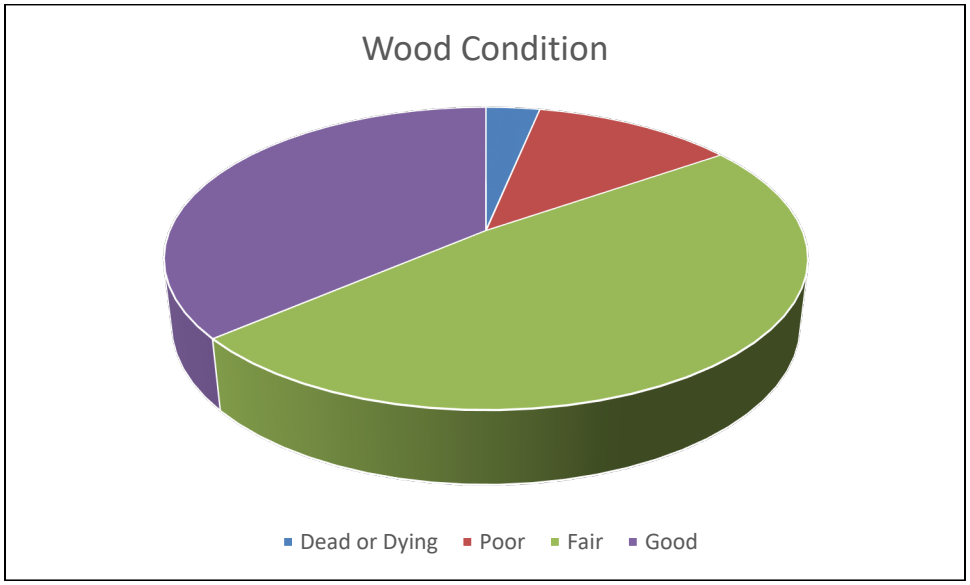

Figure 4: Wood Condition

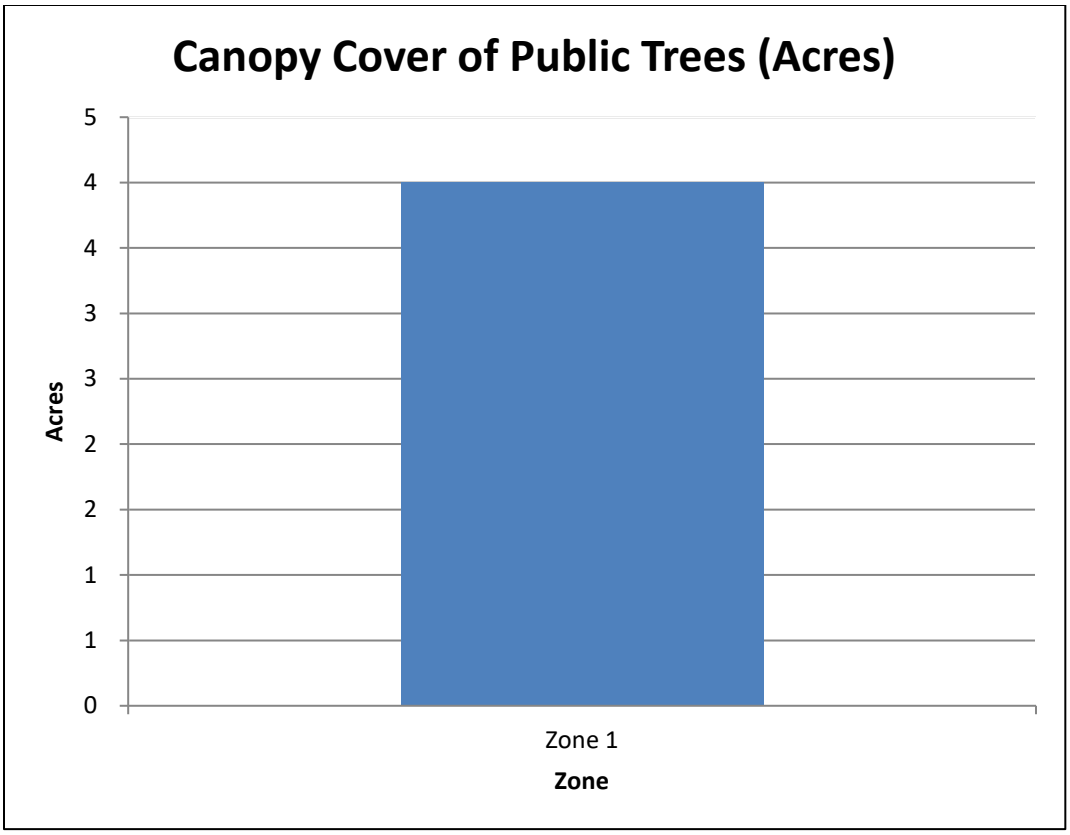

Figure 5: Canopy Cover in Acres

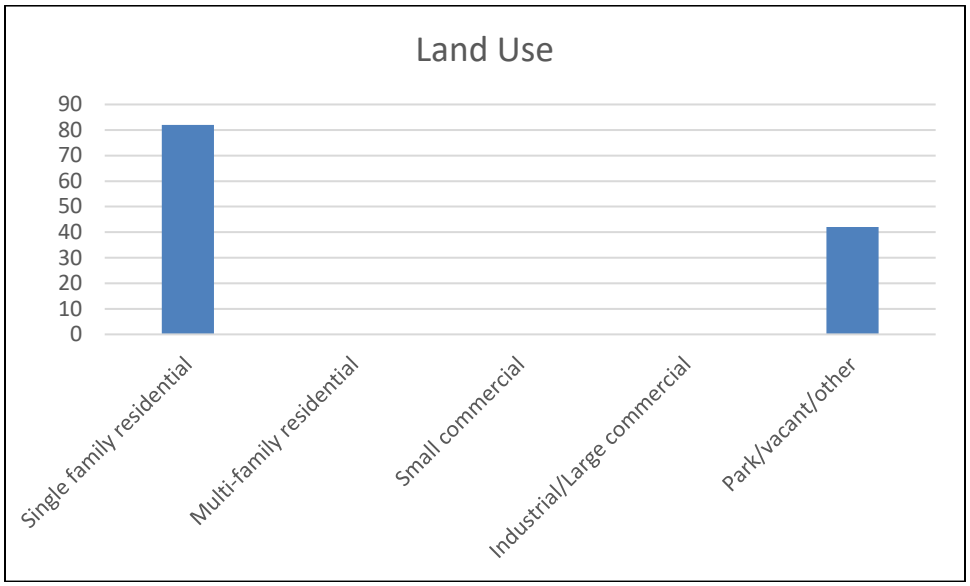

Figure 6: Land Use of city/park trees

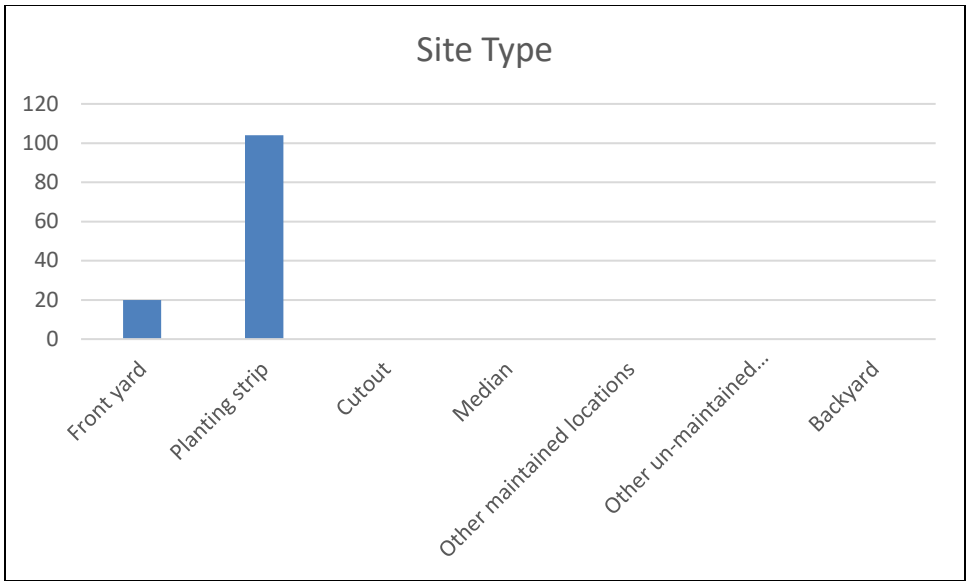

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

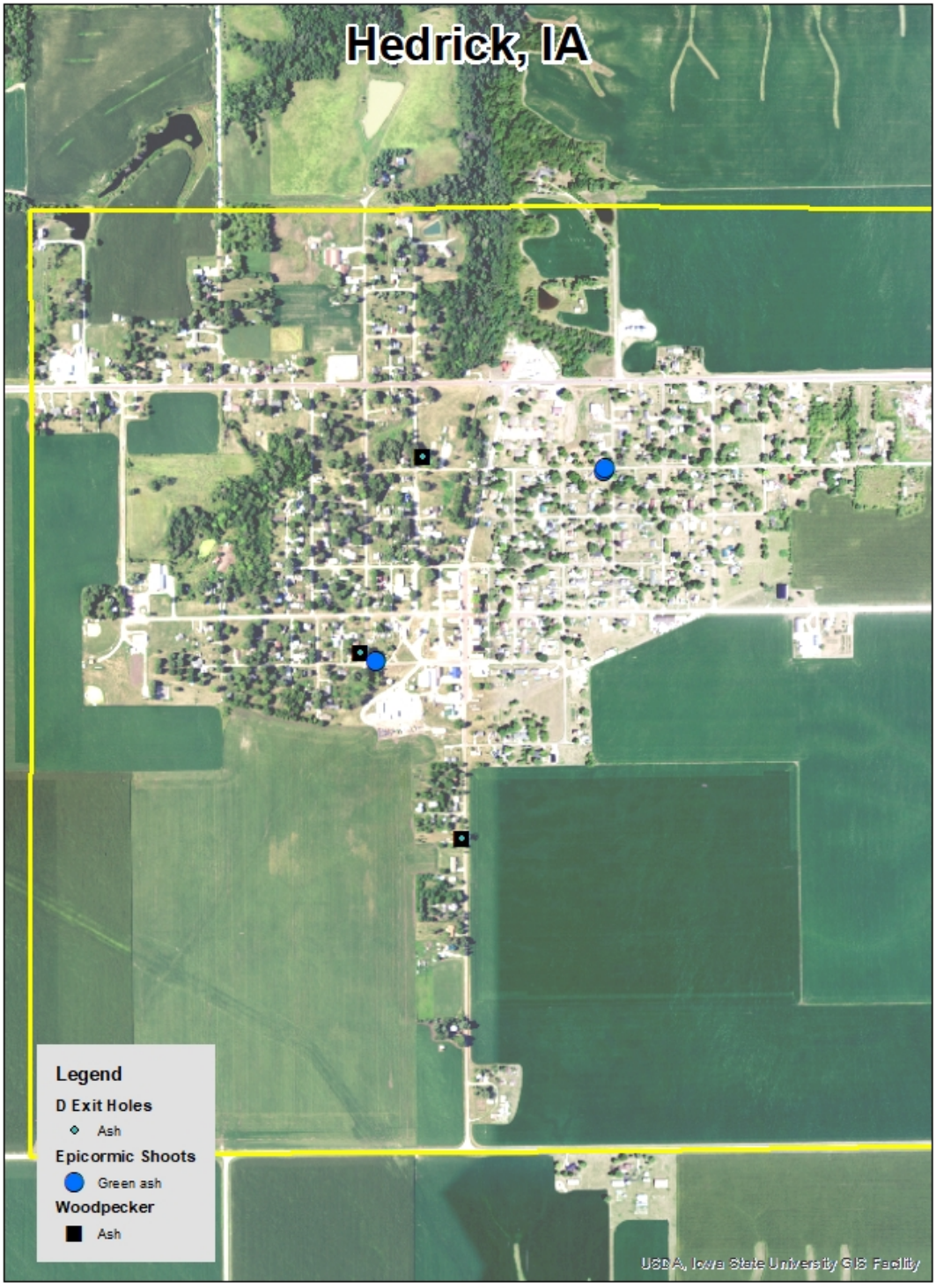

Figure 2: Location of EAB symptoms

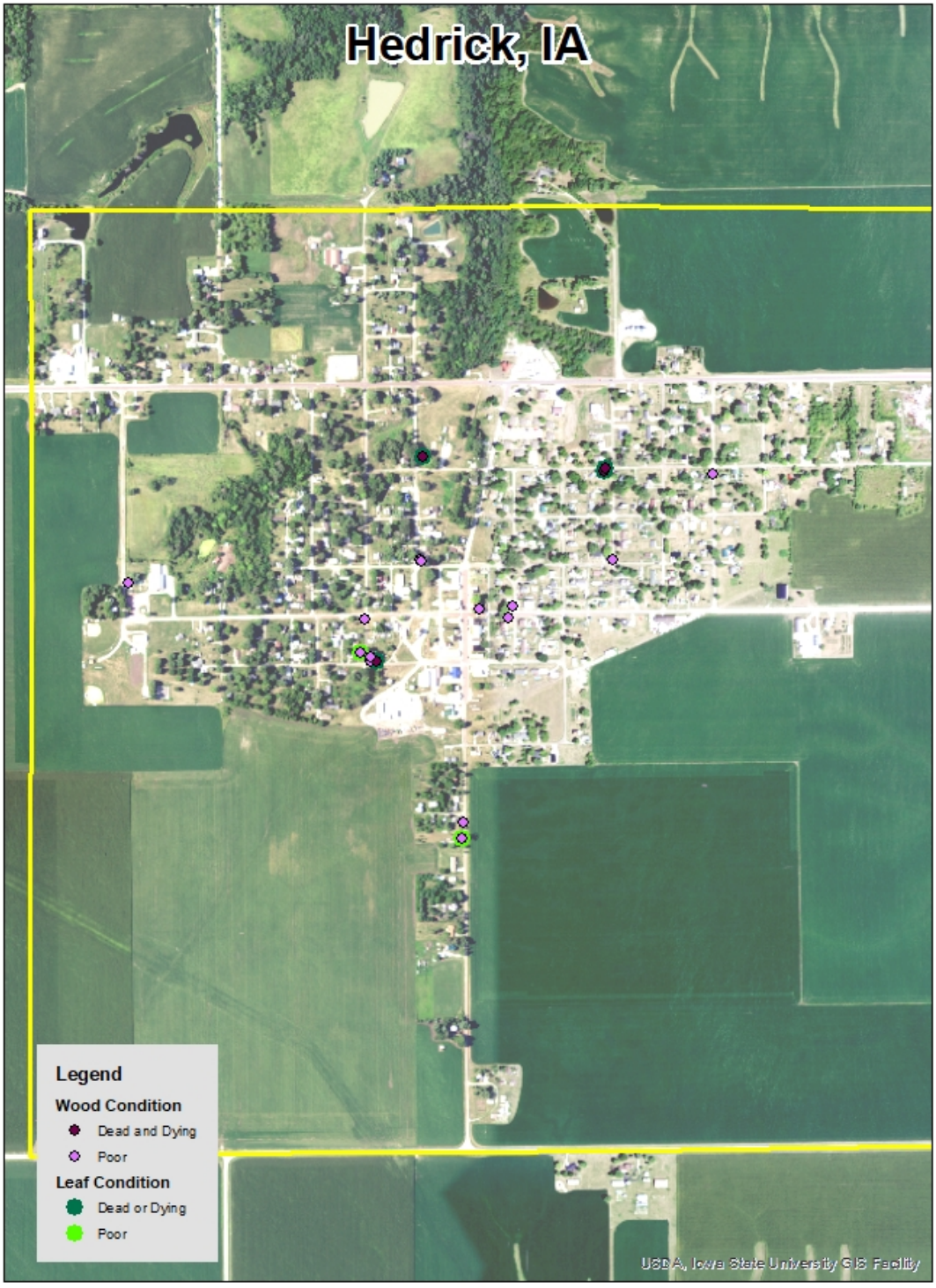

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

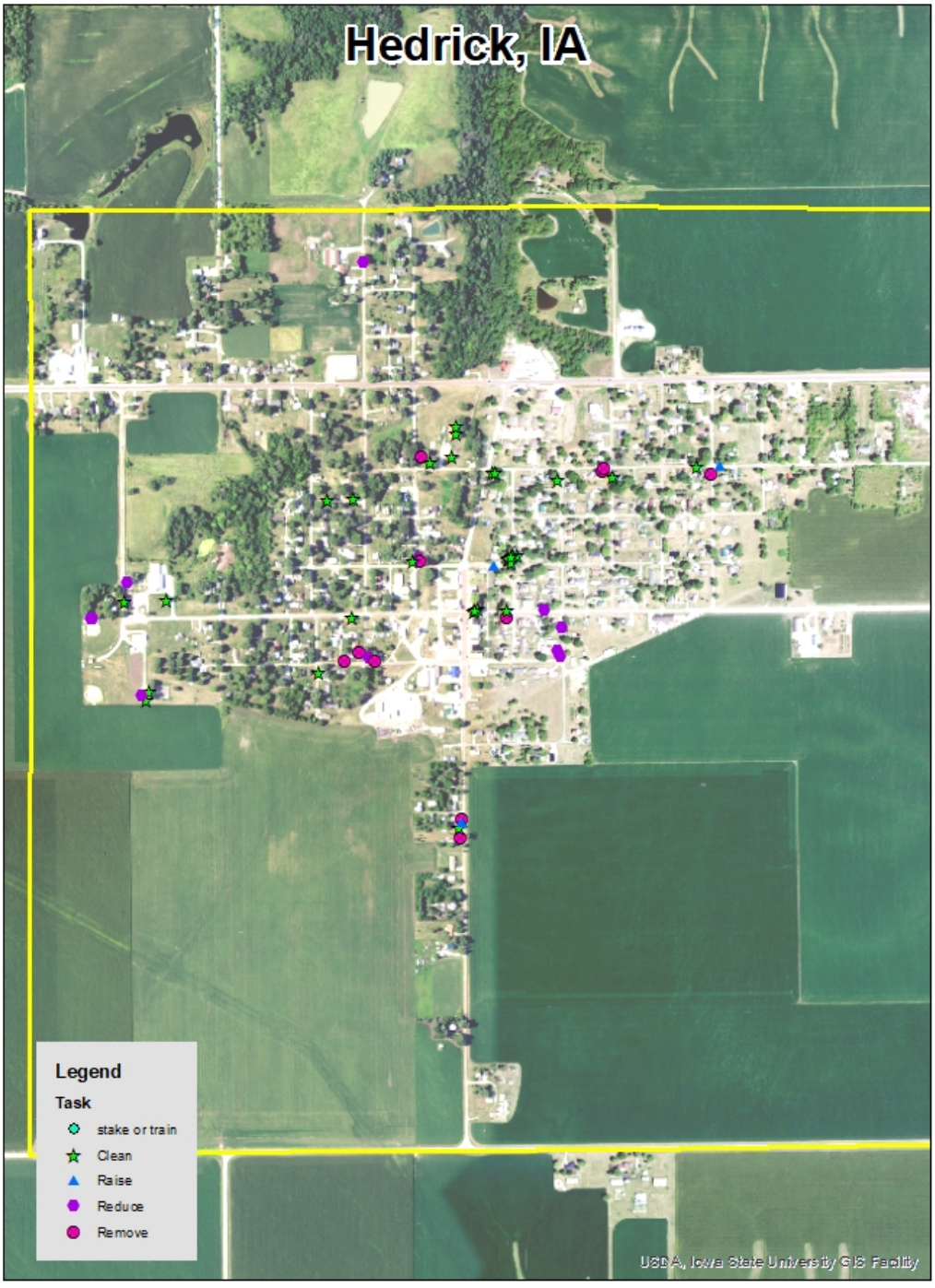

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Hedrick Tree Ordinances

None

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