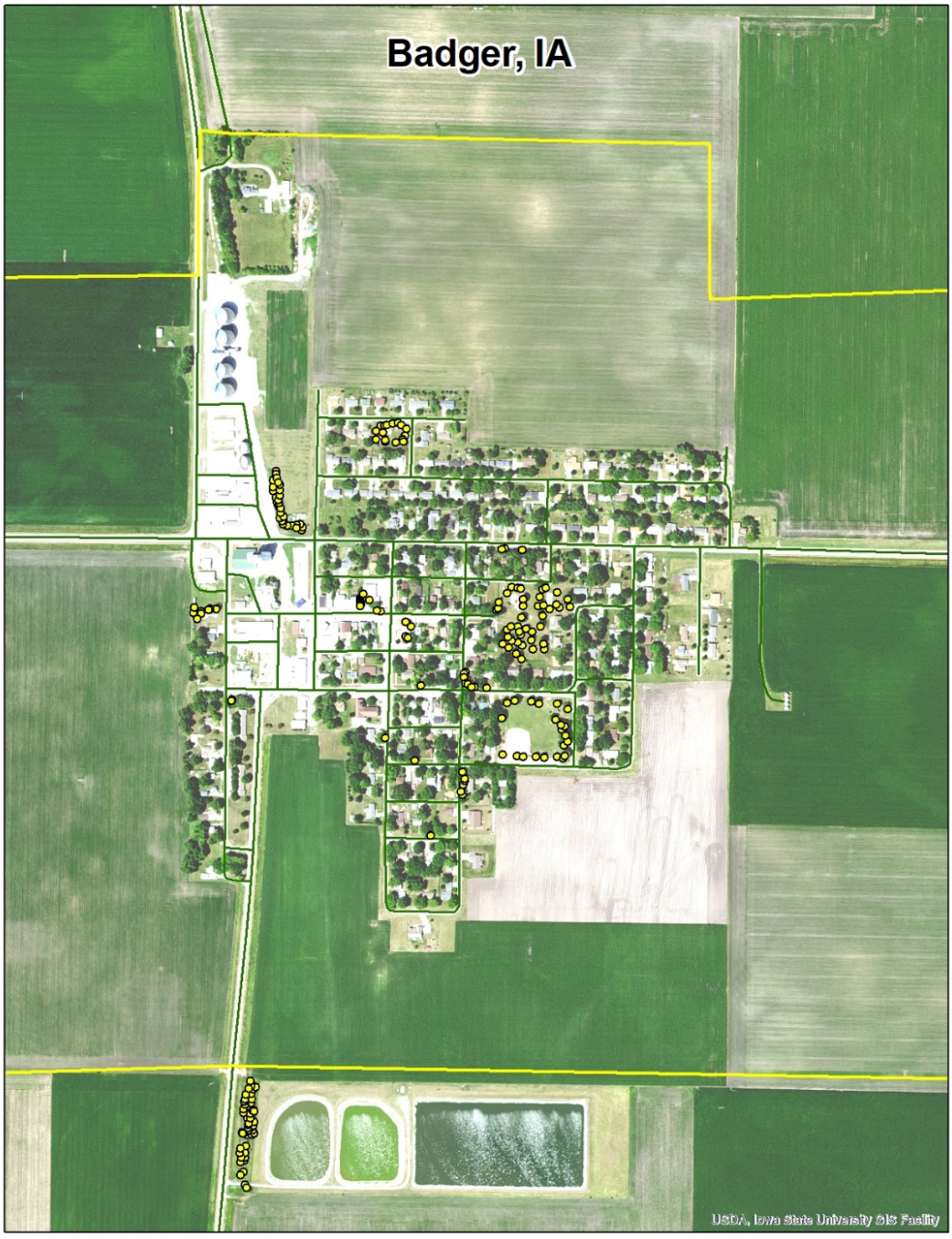
Badger, IA



2020 Urban Forest Management Plan
Prepared by Vince Grube
Iowa Department of Natural Resources

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Executive Summary

Overview

This plan was developed to assist the City of Badger 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 7% of Badger'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 208 trees inventoried.

- Badger's trees provide $19,115 of benefits annually, an average of $90.17 a tree
- There are over 33 species of trees from at least 21 different genera
- The top three genera are: Spruce 26%, Maple 20%, and Apple 15%
- 15% of trees are in need of some type of management
- 6 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.

- None of the ash trees in Badger displayed overwhelming evidence of EAB infection, however, all ash trees should be carefully monitored with a visual inspection every year.
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees species and revisit ordinance to assess community benefits
- With the current budget it could take 8 years to remove ash – Suggestion: request a budget increase to $4,000 annually and apply for grants to plant replacement trees

Introduction

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

Trees are an important component of Badger'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 Badger 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 Badger'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 208 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. Badger's trees reduce energy related costs by approximately $5,165 annually (Appendix A, Table 1). These savings are both in Electricity (24.3 MWh) and in Natural Gas (3,388.6 Therms).

Annual Stormwater Benefits

Badger's trees intercept about 227,826 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $6,174 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 Badger, it is estimated that trees remove 301 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 $843 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Badger, trees sequester about 52,603 lbs of carbon a year with an associated value of $395 (Appendix A, Table 5). In addition, the trees store 700,411 lbs of carbon, with a yearly benefit of $5,253 (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. Badger receives $6,261 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, Badger's trees provide $19,115 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 212 trees in Badger provide approximately $90.17 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Badger has over 33 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Genus	Count	Percent
Spruce	55	26%
Maple	42	20%
Apple	32	15%
Ash	14	7%
Cedar	12	6%
Basswood	9	4%
Elm	6	3%
Lilac	6	3%
Broadleaf Deciduous S/M/L	5	2%
Honeylocust	5	2%
Mulberry	4	2%
Hackberry	4	2%
Oak	4	2%
Pear	3	1%
Birch	1	<1%
Walnut	1	<1%
Dogwood	1	<1%
Pine	1	<1%
Kentucky Coffeetree	1	<1%
Cherry	1	<1%
Aspen	1	<1%

Age Class

Most of Badger's trees (48%) are between 3 and 12 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. Badger'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 Badger indicate that 90% 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, 45% of Badger'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 12% of the population. This 12% 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	21	10%
Crown Raising	3	1%
Tree Staking	1	<1%
Tree Removal	6	2%

Canopy Cover

The total canopy with both private and public trees is 4%, 29.96 acres. The canopy cover included in the Badger inventory includes approximately 2.63 acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 3%, in 30 years. To achieve this goal, it is estimated that 51 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Badger'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	
Park/vacant/other	82%
Single family residential	17%
Small commercial	<1%

Location	
Planting strip	14%
Front yard	86%

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

No hazardous trees were recorded in Badger.

Poor tree species

There are 25 trees that were recorded to be are in poor health. These trees should be addressed quickly. *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 Badger.

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, maples make up 20% of the trees in Badger (Apendix A, Figure 1). It is recommended that other species be planted before the city plants any more maples. Also, ash trees have not been recommended since 2002, due to the threat of EAB. At this time the ordinance does not allow for replanting on city streets. This ordinance should be revisited to consider its

Continual Monitoring

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

Six Year Maintenance Plan with <u>No Additional Funding</u>

Year 1

- Removal: 3 most critical trees
- Planting and Replacement: 5 trees to be planted in open locations
- Young Tree Pruning & Maintenance
- Visual Survey for signs and symptoms of EAB

Year 2

- Removal: 2 additional noted removal
- Planting and Replacement: 3 trees in open locations from year one removals
- Young Tree Pruning & Maintenance
- Routine trimming: a portion of the city trees
- Visual Survey for signs and symptoms of EAB

Year 3

- Removal: 3 trees – 1 noted and removal of any new critical concern trees and ash in poor health *Or ash tree treatment
- Planting and Replacement: 5 trees to be planted in open locations
- Young Tree Pruning & Maintenance
- Visual Survey for signs and symptoms of EAB

Year 4

Removal: 2 trees - removal of any new critical concern trees and ash in poor health
*Or ash tree treatment
Planting and Replacement: 3 trees in open locations
Routine trimming: trim a portion of the city trees
Young Tree Pruning & Maintenance
Visual Survey for signs and symptoms of EAB

Year 5

Removal: 3 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 5 trees to be planted in open locations
Young Tree Pruning & Maintenance
Visual Survey for signs and symptoms of EAB

Year 6

Removal: 2 trees - removal of any new critical concern trees and ash in poor health
*Or ash tree treatment
Planting and Replacement: 3 trees in open locations
Routine trimming: trim a portion of the city trees
Young Tree Pruning & Maintenance
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: Approximately 10 trees removed (approximately 71% of ash). It will take approximately 8 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 years of its arrival.

Emerald Ash Borer Plan

Ash Tree Removal

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

Treatment of Ash Trees

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

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust

as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

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

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

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

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. At this time no replacement are allowed on the parking. This does not aid in reaching canopy goals or when providing benefits the community. This ordinance should be revisited to assess the impact on the community (Appendix C). It is recommend that new plantings be planted on all property types and contain a diverse species mix.

Postponed Work

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

Monitoring

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

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used. City Code 151.06 states "If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the

Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant, or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property."

Budget

Current Budget
Total $20,400 over 6 years ($3,400/year)

FY 2021 Budget
Removal: $2,700
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Watering & Maintenance: $200

FY 2022 Budget
Removal: $1800
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $1,200
Watering & Maintenance: $100

FY 2023 Budget
Removal: $2,700
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Watering & Maintenance: $200

FY 2024 Budget
Removal: $1800
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $1,200
Watering & Maintenance: $100

FY 2025 Budget
Removal: $2,700
*Or saving for ash tree treatment and/or future ash removal
Planting: $500
Watering & Maintenance: $200

FY 2025 Budget
Removal: $1800

*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $1,200
Watering & Maintenance: $100

*Reduction of ash over 6 years: Approximately 10 trees removed (approximately 71% of ash). It will take approximately 8 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 years of its arrival.

Proposed Budget Increase

EAB could potentially kill all ash trees in Badger within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $4,000 a year. Additionally, it is recommended that Badger 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). This would be 8 trees selected for treatment for $1,200, and Badger would still need to find $5,400 for removal. Alternatively, if all 12 are treatable trees (2 in poor condition), it would cost approximately $1,800 a year for treatment and leave $1,800 for removal. These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Badger. It is suggested to consider increasing the budget to plan for this.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Badger

Annual Energy Benefits of Public Trees

8/3/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Spruce	1.6	119	241.2	236	356	(N/A)	20.7	6.9	8.27
Apple	2.5	189	385.6	378	567	(N/A)	15.4	11.0	17.73
Green ash	3.0	231	417.3	409	640	(N/A)	6.7	12.4	45.69
Northern white cedar	0.0	3	8.0	8	11	(N/A)	5.8	0.2	0.93
Norway maple	2.4	186	338.3	332	517	(N/A)	4.8	10.0	51.74
Silver maple	3.3	253	438.1	429	682	(N/A)	4.8	13.2	68.20
Maple	0.4	31	53.2	52	83	(N/A)	3.8	1.6	10.43
Littleleaf linden	1.7	125	233.2	228	354	(N/A)	3.4	6.9	50.54
Norway spruce	0.4	33	67.2	66	98	(N/A)	2.9	1.9	16.39
Blue spruce	0.5	39	63.1	62	101	(N/A)	2.9	2.0	16.89
Broadleaf Deciduous Small	0.0	1	3.1	3	4	(N/A)	2.4	0.1	0.87
Red maple	0.6	42	73.5	72	114	(N/A)	2.4	2.2	22.76
Honeylocust	1.7	128	217.9	214	341	(N/A)	2.4	6.6	68.28
Siberian elm	0.6	45	75.4	74	118	(N/A)	2.4	2.3	23.69
Mulberry	0.3	22	51.3	50	73	(N/A)	1.9	1.4	18.19
Northern hackberry	1.4	105	195.3	191	296	(N/A)	1.9	5.7	74.11
Japanese tree lilac	0.1	11	24.2	24	34	(N/A)	1.9	0.7	8.60
Amur maple	0.3	23	48.9	48	71	(N/A)	1.9	1.4	17.65
Sugar maple	0.6	47	88.6	87	134	(N/A)	1.9	2.6	33.55
Pear	0.2	11	26.3	26	37	(N/A)	1.4	0.7	12.42
Northern red oak	0.4	29	51.7	51	80	(N/A)	1.4	1.5	26.65
Lilac	0.2	14	25.3	25	39	(N/A)	1.0	0.8	19.50
Basswood	0.5	36	54.0	53	88	(N/A)	1.0	1.7	44.23
Kentucky coffeetree	0.3	25	46.9	46	71	(N/A)	0.5	1.4	70.91
Black maple	0.0	3	5.2	5	8	(N/A)	0.5	0.2	7.85
Dogwood	0.0	2	3.8	4	5	(N/A)	0.5	0.1	5.40
Eastern white pine	0.0	0	0.7	1	1	(N/A)	0.5	0.0	0.93
American elm	0.5	35	61.1	60	94	(N/A)	0.5	1.8	94.34
Birch	0.2	18	29.5	29	47	(N/A)	0.5	0.9	46.78
Swamp white oak	0.2	18	29.5	29	47	(N/A)	0.5	0.9	46.78
Kwanzan cherry	0.0	0	0.6	1	1	(N/A)	0.5	0.0	0.87
Black walnut	0.2	18	27.0	26	44	(N/A)	0.5	0.9	44.23
Quaking aspen	0.0	2	3.7	4	6	(N/A)	0.5	0.1	5.82
Total	24.3	1,844	3,388.6	3,321	5,165	(N/A)	100.0	100.0	24.83

Table 2: Annual Stormwater Benefits

Badger

Annual Stormwater Benefits of Public Trees

8/3/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Spruce	16,694	452	(N/A)	20.7	7.3	10.52
Apple	9,313	252	(N/A)	15.4	4.1	7.89
Green ash	38,240	1,036	(N/A)	6.7	16.8	74.02
Northern white cedar	585	16	(N/A)	5.8	0.3	1.32
Norway maple	20,119	545	(N/A)	4.8	8.8	54.52
Silver maple	45,062	1,221	(N/A)	4.8	19.8	122.12
Maple	2,188	59	(N/A)	3.8	1.0	7.41
Littleleaf linden	17,106	464	(N/A)	3.4	7.5	66.22
Norway spruce	5,947	161	(N/A)	2.9	2.6	26.86
Blue spruce	6,254	169	(N/A)	2.9	2.7	28.25
Broadleaf Deciduous Small	37	1	(N/A)	2.4	0.0	0.20
Red maple	3,129	85	(N/A)	2.4	1.4	16.96
Honeylocust	18,516	502	(N/A)	2.4	8.1	100.36
Siberian elm	4,269	116	(N/A)	2.4	1.9	23.14
Mulberry	1,058	29	(N/A)	1.9	0.5	7.17
Northern hackberry	12,285	333	(N/A)	1.9	5.4	83.23
Japanese tree lilac	470	13	(N/A)	1.9	0.2	3.19
Amur maple	1,515	41	(N/A)	1.9	0.7	10.26
Sugar maple	5,435	147	(N/A)	1.9	2.4	36.82
Pear	536	15	(N/A)	1.4	0.2	4.85
Northern red oak	2,251	61	(N/A)	1.4	1.0	20.33
Lilac	674	18	(N/A)	1.0	0.3	9.13
Basswood	2,931	79	(N/A)	1.0	1.3	39.72
Kentucky coffeetree	3,943	107	(N/A)	0.5	1.7	106.85
Black maple	137	4	(N/A)	0.5	0.1	3.72
Dogwood	69	2	(N/A)	0.5	0.0	1.86
Eastern white pine	49	1	(N/A)	0.5	0.0	1.32
American elm	4,551	123	(N/A)	0.5	2.0	123.33
Birch	1,409	38	(N/A)	0.5	0.6	38.19
Swamp white oak	1,409	38	(N/A)	0.5	0.6	38.19
Kwanzan cherry	7	0	(N/A)	0.5	0.0	0.20
Black walnut	1,466	40	(N/A)	0.5	0.6	39.72
Quaking aspen	172	5	(N/A)	0.5	0.1	4.65
Citywide total	227,826	6,174	(N/A)	100.0	100.0	29.68

Table 3: Annual Air Quality Benefits

Badger

Annual Air Quality Benefits of Public Trees

8/3/2020

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2								
Spruce	1.3	0.3	1.4	0.2	9	7.7	1.1	1.1	7.1	48	-5.1	-19	15.0	38	(N/A)	20.7	0.88
Apple	2.3	0.4	1.2	0.1	13	12.3	1.8	1.7	11.3	76	0.0	0	31.0	88	(N/A)	15.4	2.75
Green ash	5.2	0.8	2.4	0.2	27	14.5	2.1	2.0	13.8	90	0.0	0	41.1	118	(N/A)	6.7	8.42
Northern white cedar	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	-0.2	-1	0.3	1	(N/A)	5.8	0.05
Norway maple	3.9	0.7	1.9	0.2	21	11.7	1.7	1.6	11.1	73	-0.9	-3	31.9	91	(N/A)	4.8	9.05
Silver maple	7.3	1.2	3.6	0.3	40	15.7	2.3	2.2	15.1	98	-3.8	-14	44.0	124	(N/A)	4.8	12.36
Maple	0.4	0.1	0.2	0.0	2	1.9	0.3	0.3	1.9	12	-0.1	0	4.9	14	(N/A)	3.8	1.70
Littleleaf linden	2.9	0.5	1.4	0.1	16	8.0	1.2	1.1	7.5	49	-1.4	-5	21.3	60	(N/A)	3.4	8.56
Norway spruce	0.6	0.1	0.6	0.1	4	2.1	0.3	0.3	1.9	13	-2.2	-8	3.8	9	(N/A)	2.9	1.47
Blue spruce	0.8	0.2	0.7	0.1	5	2.4	0.4	0.3	2.4	15	-2.2	-8	4.9	12	(N/A)	2.9	1.99
Broadleaf Deciduous Small	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.2	1	(N/A)	2.4	0.11
Red maple	0.5	0.1	0.3	0.0	3	2.6	0.4	0.4	2.5	16	-0.2	-1	6.5	18	(N/A)	2.4	3.65
Honeylocust	3.6	0.6	1.6	0.2	19	7.9	1.2	1.1	7.6	50	-2.8	-11	21.0	58	(N/A)	2.4	11.63
Siberian elm	0.4	0.1	0.2	0.0	2	2.8	0.4	0.4	2.7	17	0.0	0	6.9	19	(N/A)	2.4	3.89
Mulberry	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)	1.9	2.55
Northern hackberry	1.8	0.3	0.9	0.1	10	6.7	1.0	0.9	6.3	41	0.0	0	18.0	51	(N/A)	1.9	12.82
Japanese tree lilac	0.1	0.0	0.0	0.0	0	0.7	0.1	0.1	0.6	4	0.0	0	1.7	5	(N/A)	1.9	1.17
Amur maple	0.5	0.1	0.2	0.0	3	1.5	0.2	0.2	1.4	9	0.0	0	4.1	12	(N/A)	1.9	2.93
Sugar maple	0.6	0.1	0.3	0.0	3	3.0	0.4	0.4	2.8	19	-0.5	-2	7.2	20	(N/A)	1.9	5.02
Pear	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)	1.4	1.73
Northern red oak	0.3	0.1	0.2	0.0	2	1.8	0.3	0.3	1.8	11	-0.5	-2	4.2	12	(N/A)	1.4	3.86
Lilac	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	6	0.0	0	2.3	7	(N/A)	1.0	3.33
Basswood	0.2	0.0	0.1	0.0	1	2.1	0.3	0.3	2.1	14	0.0	0	5.3	15	(N/A)	1.0	7.42
Kentucky coffeetree	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	12	(N/A)	0.5	12.48
Black 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)	0.5	1.12
Dogwood	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1	(N/A)	0.5	0.71
Eastern white pine	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)	0.5	0.05
American elm	0.9	0.2	0.5	0.0	5	2.2	0.3	0.3	2.1	13	0.0	0	6.4	19	(N/A)	0.5	18.52
Birch	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)	0.5	7.92
Swamp white oak	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)	0.5	7.92
Kwanzan cherry	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)	0.5	0.11
Black walnut	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7	(N/A)	0.5	7.42
Quaking aspen	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1	(N/A)	0.5	0.87
Citywide total	35.1	6.0	18.6	1.8	194	116.5	16.9	16.1	110.1	724	-20.1	-75	301.0	843	(N/A)	100.0	4.05

Table 4: Annual Carbon Stored

Badger

Stored CO2 Benefits of Public Trees

8/3/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Spruce	7,739	58	(N/A)	20.7	1.1	1.35
Apple	38,574	289	(N/A)	15.4	5.5	9.04
Green ash	174,136	1,306	(N/A)	6.7	24.9	93.29
Northern white cedar	30	0	(N/A)	5.8	0.0	0.02
Norway maple	63,672	478	(N/A)	4.8	9.1	47.75
Silver maple	155,921	1,169	(N/A)	4.8	22.3	116.94
Maple	4,549	34	(N/A)	3.8	0.6	4.26
Littleleaf linden	62,322	467	(N/A)	3.4	8.9	66.77
Norway spruce	4,626	35	(N/A)	2.9	0.7	5.78
Blue spruce	4,477	34	(N/A)	2.9	0.6	5.60
Broadleaf Deciduous	69	1	(N/A)	2.4	0.0	0.10
Red maple	6,262	47	(N/A)	2.4	0.9	9.39
Honeylocust	46,514	349	(N/A)	2.4	6.6	69.77
Siberian elm	10,313	77	(N/A)	2.4	1.5	15.47
Mulberry	3,632	27	(N/A)	1.9	0.5	6.81
Northern hackberry	25,821	194	(N/A)	1.9	3.7	48.42
Japanese tree lilac	1,441	11	(N/A)	1.9	0.2	2.70
Amur maple	7,842	59	(N/A)	1.9	1.1	14.70
Sugar maple	17,582	132	(N/A)	1.9	2.5	32.97
Pear	1,830	14	(N/A)	1.4	0.3	4.57
Northern red oak	5,644	42	(N/A)	1.4	0.8	14.11
Lilac	3,051	23	(N/A)	1.0	0.4	11.44
Basswood	7,344	55	(N/A)	1.0	1.0	27.54
Kentucky coffeetree	15,773	118	(N/A)	0.5	2.3	118.30
Black maple	218	2	(N/A)	0.5	0.0	1.64
Dogwood	178	1	(N/A)	0.5	0.0	1.33
Eastern white pine	2	0	(N/A)	0.5	0.0	0.02
American elm	19,728	148	(N/A)	0.5	2.8	147.96
Birch	3,624	27	(N/A)	0.5	0.5	27.18
Swamp white oak	3,624	27	(N/A)	0.5	0.5	27.18
Kwanzan cherry	14	0	(N/A)	0.5	0.0	0.10
Black walnut	3,672	28	(N/A)	0.5	0.5	27.54
Quaking aspen	185	1	(N/A)	0.5	0.0	1.39
Citywide total	700,411	5,253	(N/A)	100.0	100.0	25.26

Table 5: Annual Carbon Sequestered

Badger

Annual CO_2 Benefits of Public Trees

8/3/2020

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
Spruce	1,369	10	-37	-33	-1	2,635	20	3,933	29 (N/A)	20.7	4.4	0.69
Apple	3,961	30	-185	-36	-2	4,183	31	7,923	59 (N/A)	15.4	8.8	1.86
Green ash	6,873	52	-836	-34	-7	5,099	38	11,102	83 (N/A)	6.7	12.4	5.95
Northern white cedar	42	0	0	-2	0	73	1	113	1 (N/A)	5.8	0.1	0.07
Norway maple	3,834	29	-306	-23	-2	4,108	31	7,613	57 (N/A)	4.8	8.5	5.71
Silver maple	12,645	95	-748	-35	-6	5,583	42	17,444	131 (N/A)	4.8	19.4	13.08
Maple	647	5	-22	-5	0	693	5	1,312	10 (N/A)	3.8	1.5	1.23
Littleleaf linden	5,633	42	-299	-19	-2	2,769	21	8,084	61 (N/A)	3.4	9.0	8.66
Norway spruce	451	3	-22	-9	0	718	5	1,138	9 (N/A)	2.9	1.3	1.42
Blue spruce	366	3	-22	-8	0	872	7	1,209	9 (N/A)	2.9	1.3	1.51
Broadleaf Deciduous Smal	43	0	-1	-1	0	28	0	70	1 (N/A)	2.4	0.1	0.10
Red maple	891	7	-30	-5	0	923	7	1,778	13 (N/A)	2.4	2.0	2.67
Honeylocust	5,868	44	-223	-13	-2	2,825	21	8,457	63 (N/A)	2.4	9.4	12.69
Siberian elm	972	7	-51	-6	0	985	7	1,899	14 (N/A)	2.4	2.1	2.85
Mulberry	455	3	-17	-5	0	497	4	930	7 (N/A)	1.9	1.0	1.74
Northern hackberry	1,697	13	-124	-12	-1	2,322	17	3,883	29 (N/A)	1.9	4.3	7.28
Japanese tree lilac	228	2	-7	-3	0	236	2	454	3 (N/A)	1.9	0.5	0.85
Amur maple	639	5	-38	-5	0	502	4	1,098	8 (N/A)	1.9	1.2	2.06
Sugar maple	1,206	9	-84	-7	-1	1,046	8	2,160	16 (N/A)	1.9	2.4	4.05
Pear	236	2	-9	-3	0	254	2	479	4 (N/A)	1.4	0.5	1.20
Northern red oak	576	4	-27	-4	0	648	5	1,193	9 (N/A)	1.4	1.3	2.98
Lilac	276	2	-15	-2	0	314	2	574	4 (N/A)	1.0	0.6	2.15
Basswood	891	7	-35	-4	0	786	6	1,637	12 (N/A)	1.0	1.8	6.14
Kentucky coffeetree	857	6	-76	-4	-1	552	4	1,330	10 (N/A)	0.5	1.5	9.97
Black maple	39	0	-1	-1	0	60	0	97	1 (N/A)	0.5	0.1	0.73
Dogwood	38	0	-1	-1	0	37	0	74	1 (N/A)	0.5	0.1	0.55
Eastern white pine	4	0	0	0	0	6	0	9	0 (N/A)	0.5	0.0	0.07
American elm	566	4	-95	-4	-1	762	6	1,230	9 (N/A)	0.5	1.4	9.22
Birch	386	3	-17	-2	0	395	3	762	6 (N/A)	0.5	0.8	5.71
Swamp white oak	386	3	-17	-2	0	395	3	762	6 (N/A)	0.5	0.8	5.71
Kwanzan cherry	9	0	0	0	0	6	0	14	0 (N/A)	0.5	0.0	0.10
Black walnut	445	3	-18	-2	0	393	3	819	6 (N/A)	0.5	0.9	6.14
Quaking aspen	74	1	-1	-1	0	49	0	121	1 (N/A)	0.5	0.1	0.91
Citywide total	52,603	395	-3,365	-291	-27	40,753	306	89,700	673 (N/A)	100.0	100.0	3.23

Table 6: Annual Social and Aesthetic Benefits

Badger

Annual Aesthetic/Other Benefits of Public Trees

8/3/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Spruce	459	(N/A)	20.7	7.3	10.68
Apple	226	(N/A)	15.4	3.6	7.05
Green ash	580	(N/A)	6.7	9.3	41.46
Northern white cedar	69	(N/A)	5.8	1.1	5.76
Norway maple	371	(N/A)	4.8	5.9	37.10
Silver maple	1,023	(N/A)	4.8	16.3	102.28
Maple	95	(N/A)	3.8	1.5	11.89
Littleleaf linden	567	(N/A)	3.4	9.1	80.96
Norway spruce	124	(N/A)	2.9	2.0	20.70
Blue spruce	111	(N/A)	2.9	1.8	18.49
Broadleaf Deciduous Small	0	(N/A)	2.4	0.0	0.03
Red maple	140	(N/A)	2.4	2.2	28.03
Honeylocust	1,464	(N/A)	2.4	23.4	292.80
Siberian elm	115	(N/A)	2.4	1.8	22.93
Mulberry	26	(N/A)	1.9	0.4	6.40
Northern hackberry	230	(N/A)	1.9	3.7	57.56
Japanese tree lilac	13	(N/A)	1.9	0.2	3.14
Amur maple	37	(N/A)	1.9	0.6	9.32
Sugar maple	140	(N/A)	1.9	2.2	35.09
Pear	13	(N/A)	1.4	0.2	4.28
Northern red oak	57	(N/A)	1.4	0.9	18.86
Lilac	16	(N/A)	1.0	0.2	7.76
Basswood	92	(N/A)	1.0	1.5	45.86
Kentucky coffeetree	66	(N/A)	0.5	1.0	65.59
Black maple	7	(N/A)	0.5	0.1	7.28
Dogwood	2	(N/A)	0.5	0.0	2.06
Eastern white pine	6	(N/A)	0.5	0.1	5.76
American elm	74	(N/A)	0.5	1.2	74.47
Birch	39	(N/A)	0.5	0.6	39.16
Swamp white oak	39	(N/A)	0.5	0.6	39.16
Kwanzan cherry	0	(N/A)	0.5	0.0	0.03
Black walnut	46	(N/A)	0.5	0.7	45.86
Quaking aspen	15	(N/A)	0.5	0.2	14.73
Citywide total	6,261	(N/A)	100.0	100.0	30.10

Table 7: Summary of Benefits in Dollars

Badger

Total Annual Benefits of Public Trees by Species ($)

8/3/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Spruce	356	29	38	452	459	1,334	(N/A)	7.0
Apple	567	59	88	252	226	1,193	(N/A)	6.2
Green ash	640	83	118	1,036	580	2,458	(N/A)	12.9
Northern white cedar	11	1	1	16	69	98	(N/A)	0.5
Norway maple	517	57	91	545	371	1,581	(N/A)	8.3
Silver maple	682	131	124	1,221	1,023	3,180	(N/A)	16.6
Maple	83	10	14	59	95	261	(N/A)	1.4
Littleleaf linden	354	61	60	464	567	1,505	(N/A)	7.9
Norway spruce	98	9	9	161	124	401	(N/A)	2.1
Blue spruce	101	9	12	169	111	403	(N/A)	2.1
Broadleaf Deciduous Sn	4	1	1	1	0	7	(N/A)	0.0
Red maple	114	13	18	85	140	370	(N/A)	1.9
Honeylocust	341	63	58	502	1,464	2,429	(N/A)	12.7
Siberian elm	118	14	19	116	115	383	(N/A)	2.0
Mulberry	73	7	10	29	26	144	(N/A)	0.8
Northern hackberry	296	29	51	333	230	940	(N/A)	4.9
Japanese tree lilac	34	3	5	13	13	68	(N/A)	0.4
Amur maple	71	8	12	41	37	169	(N/A)	0.9
Sugar maple	134	16	20	147	140	458	(N/A)	2.4
Pear	37	4	5	15	13	73	(N/A)	0.4
Northern red oak	80	9	12	61	57	218	(N/A)	1.1
Lilac	39	4	7	18	16	84	(N/A)	0.4
Basswood	88	12	15	79	92	287	(N/A)	1.5
Kentucky coffeetree	71	10	12	107	66	266	(N/A)	1.4
Black maple	8	1	1	4	7	21	(N/A)	0.1
Dogwood	5	1	1	2	2	11	(N/A)	0.1
Eastern white pine	1	0	0	1	6	8	(N/A)	0.0
American elm	94	9	19	123	74	320	(N/A)	1.7
Birch	47	6	8	38	39	138	(N/A)	0.7
Swamp white oak	47	6	8	38	39	138	(N/A)	0.7
Kwanzan cherry	1	0	0	0	0	1	(N/A)	0.0
Black walnut	44	6	7	40	46	143	(N/A)	0.7
Quaking aspen	6	1	1	5	15	27	(N/A)	0.1
Citywide Total	5,165	673	843	6,174	6,261	19,115	(N/A)	100.0

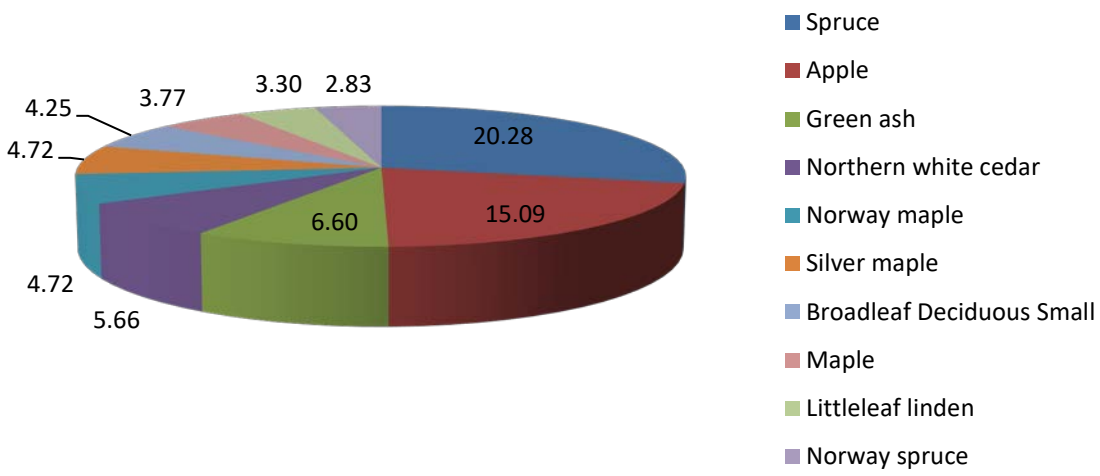

Figure 1: Species Distribution

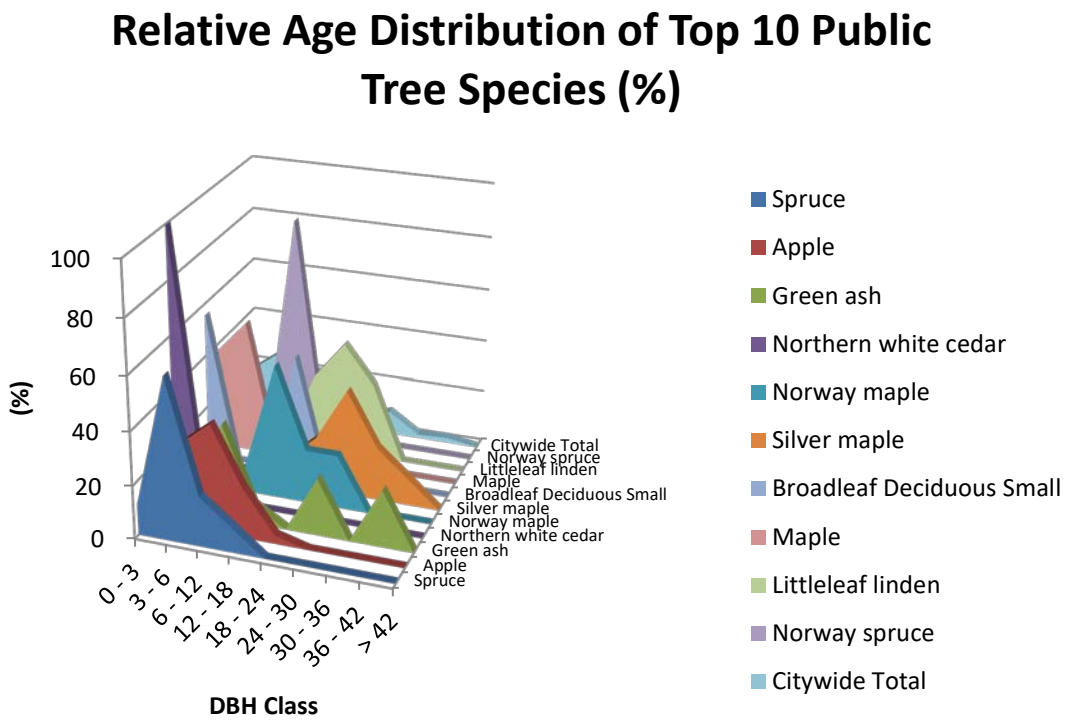

Figure 2: Relative Age Class

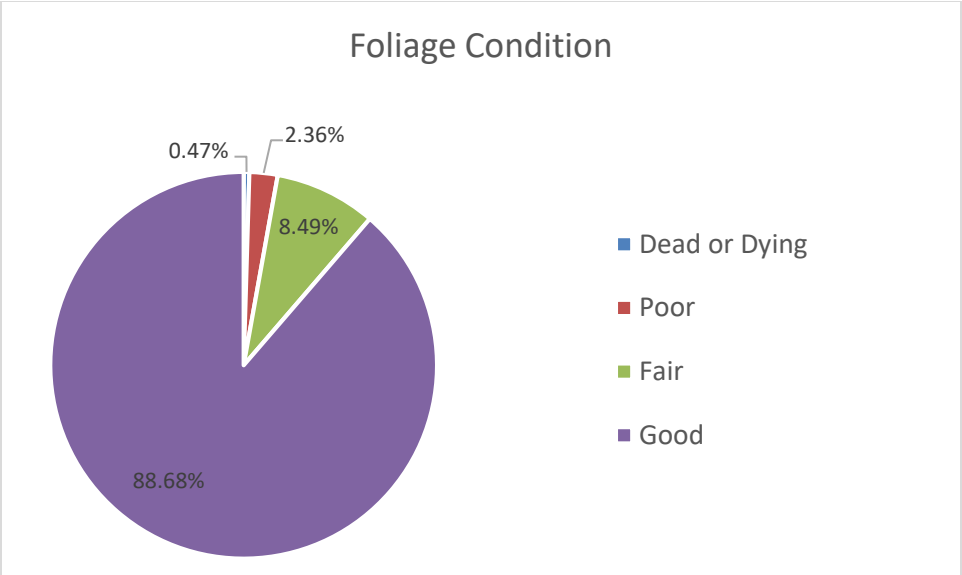

Figure 3: Foliage Condition

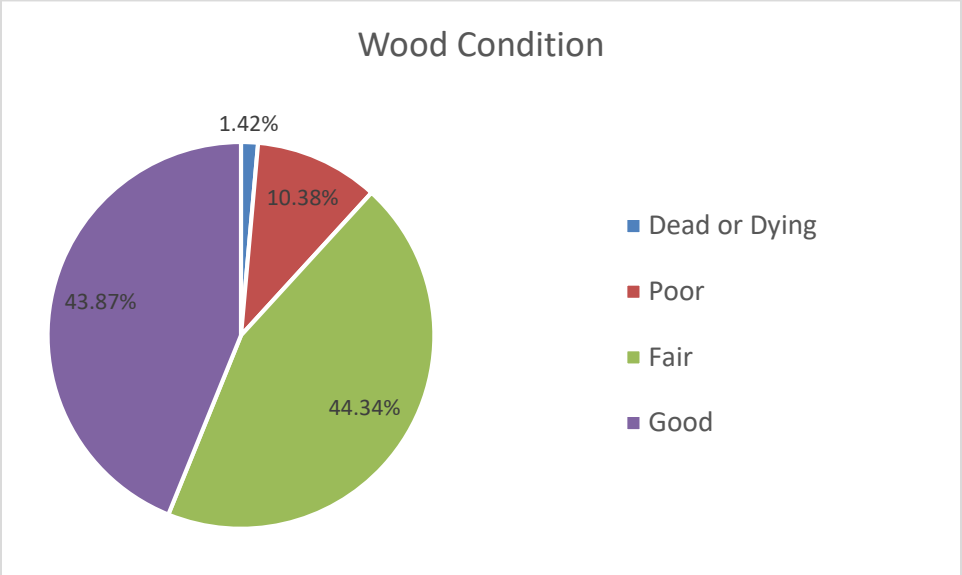

Figure 4: Wood Condition

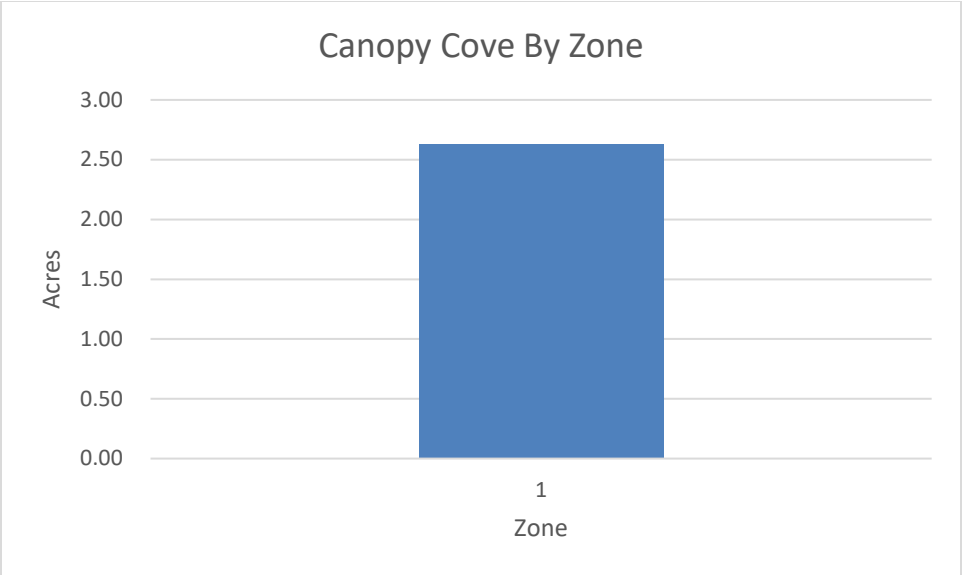

Figure 5: Canopy Cover in Acres

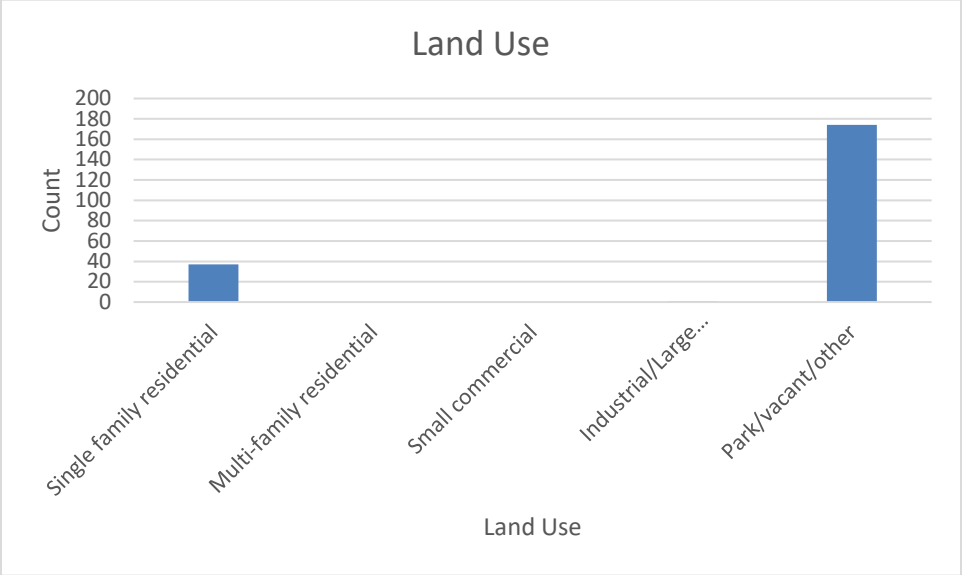

Figure 6: Land Use of city/park trees

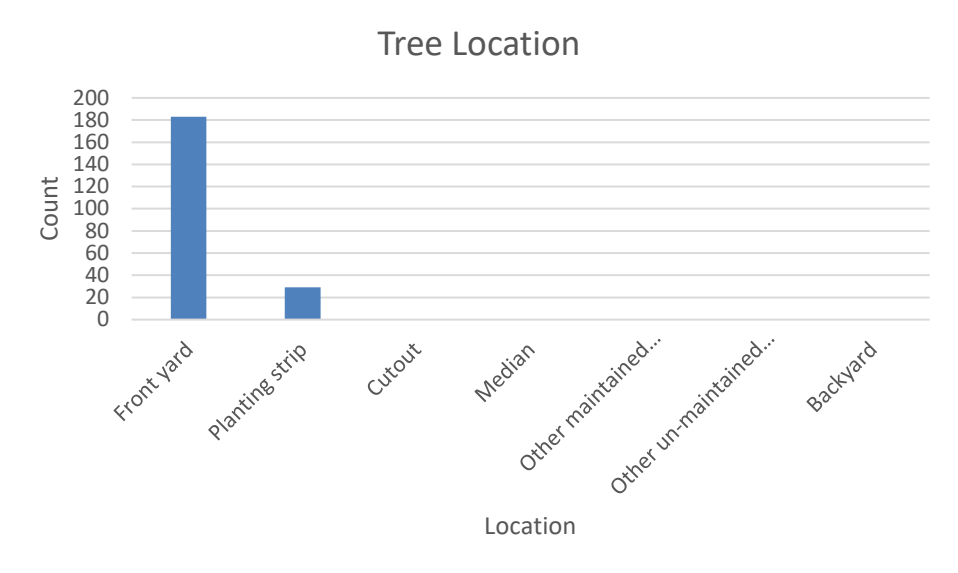

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

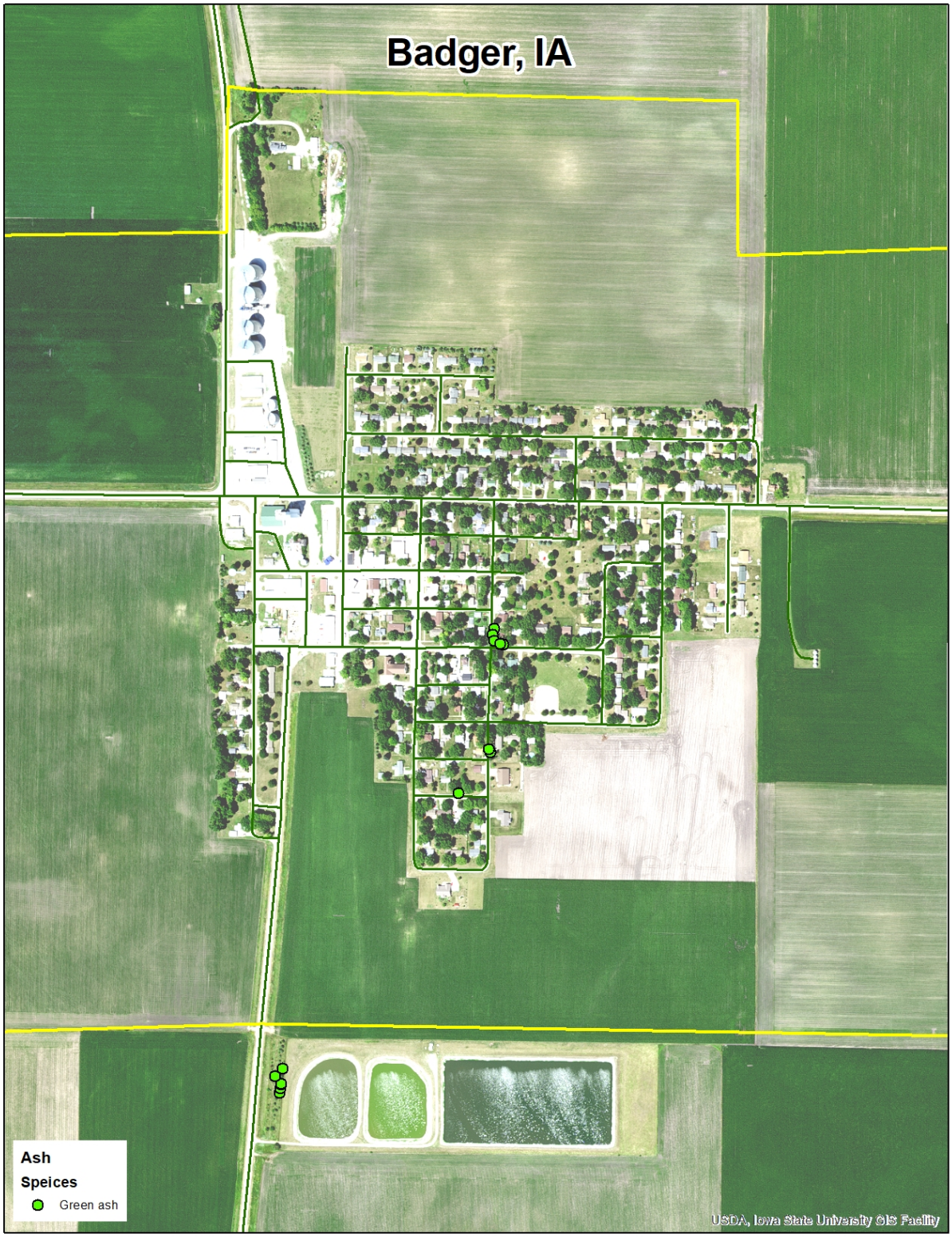

Figure 1: Location of Ash Trees

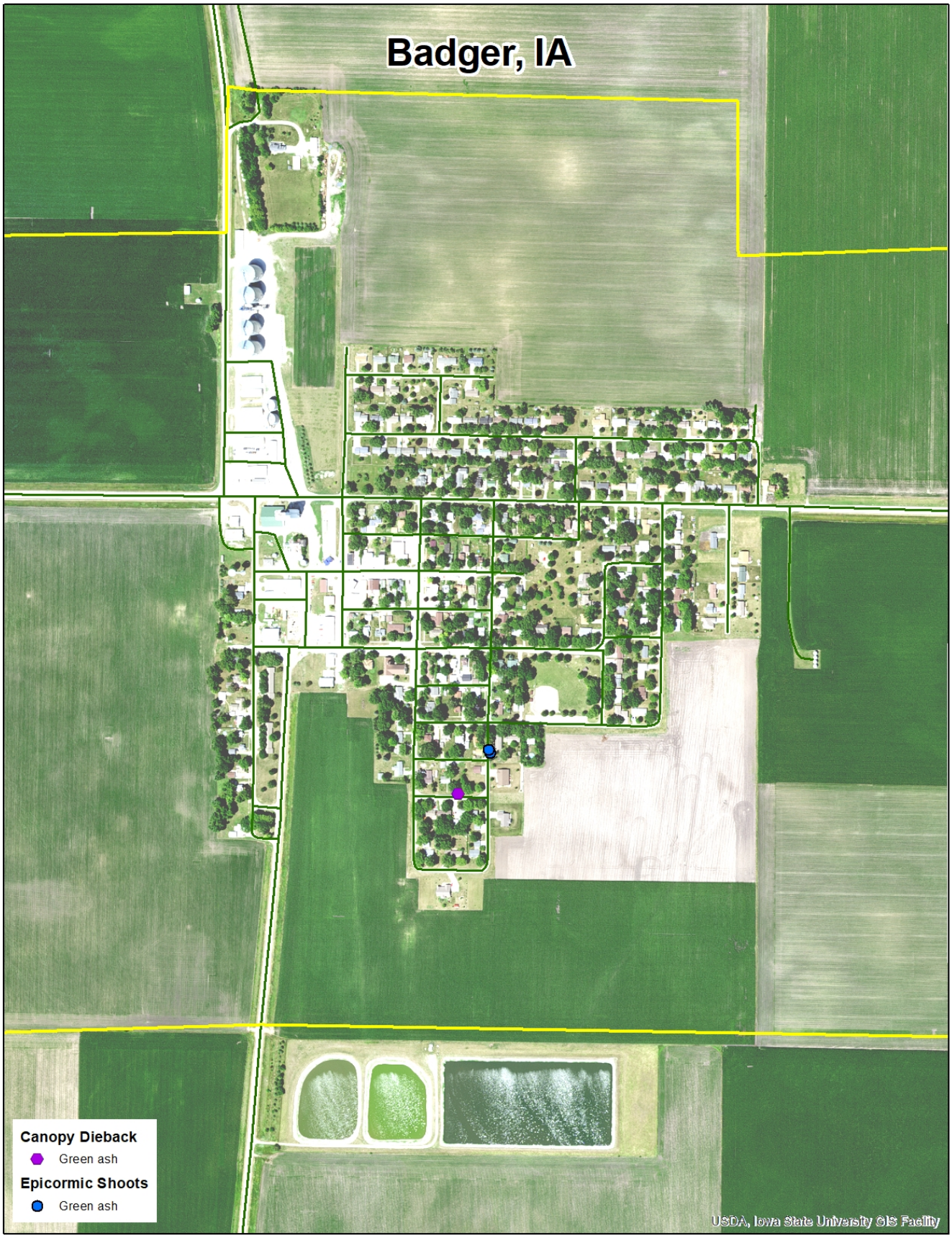

Figure 2: Location of EAB symptoms

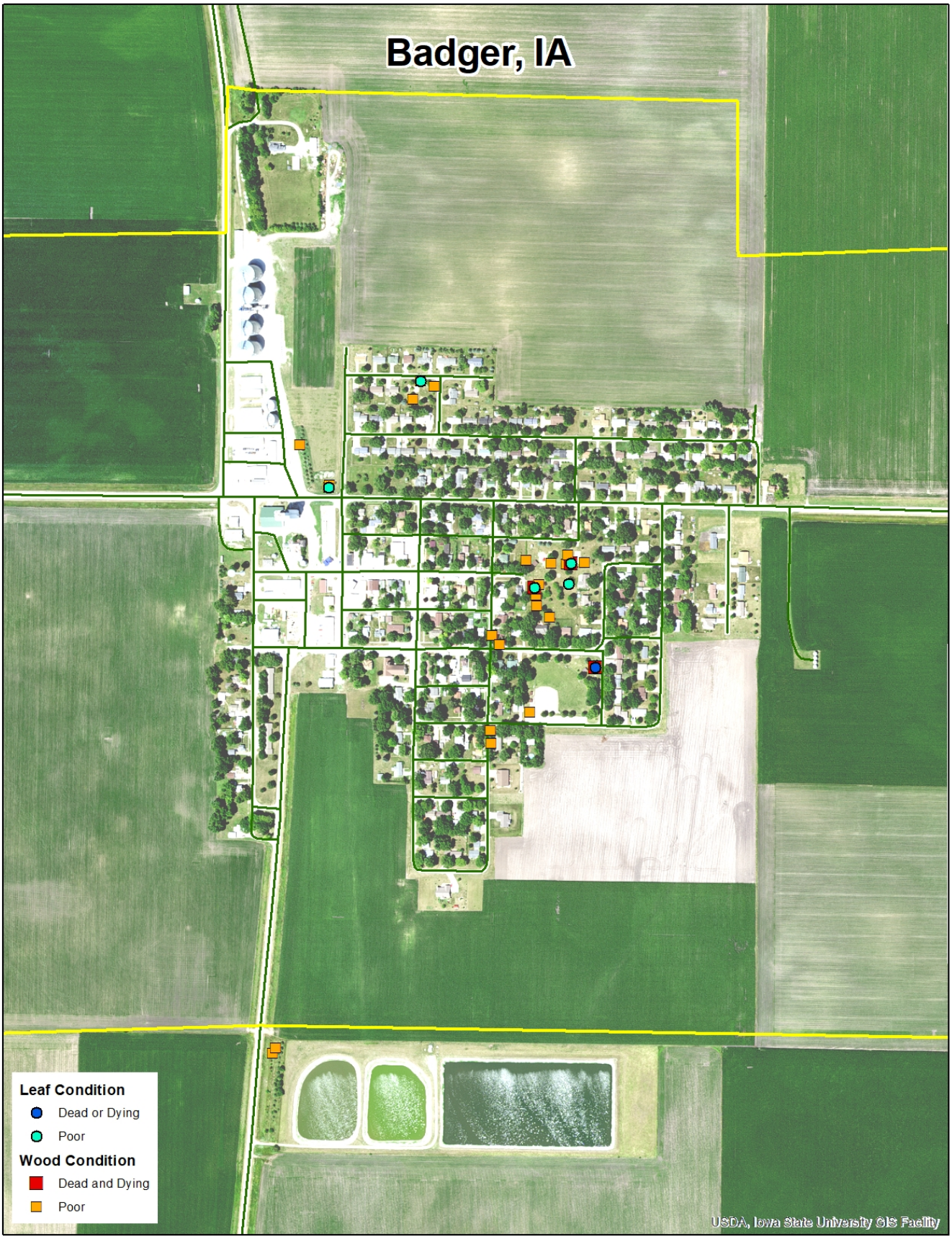

Figure 3: Location of Poor Condition Trees

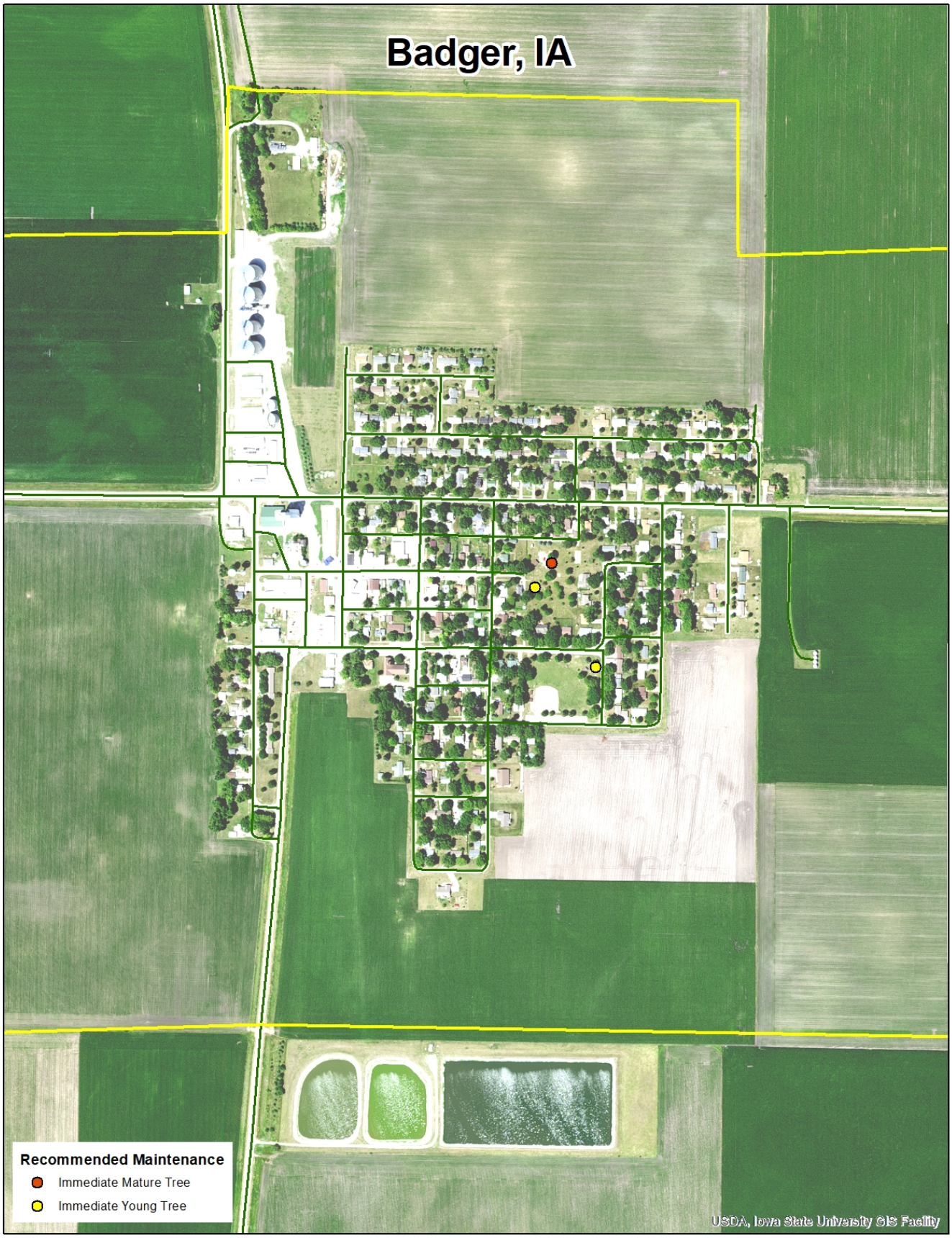

Figure 4: Location of Trees with Recommended Maintenance

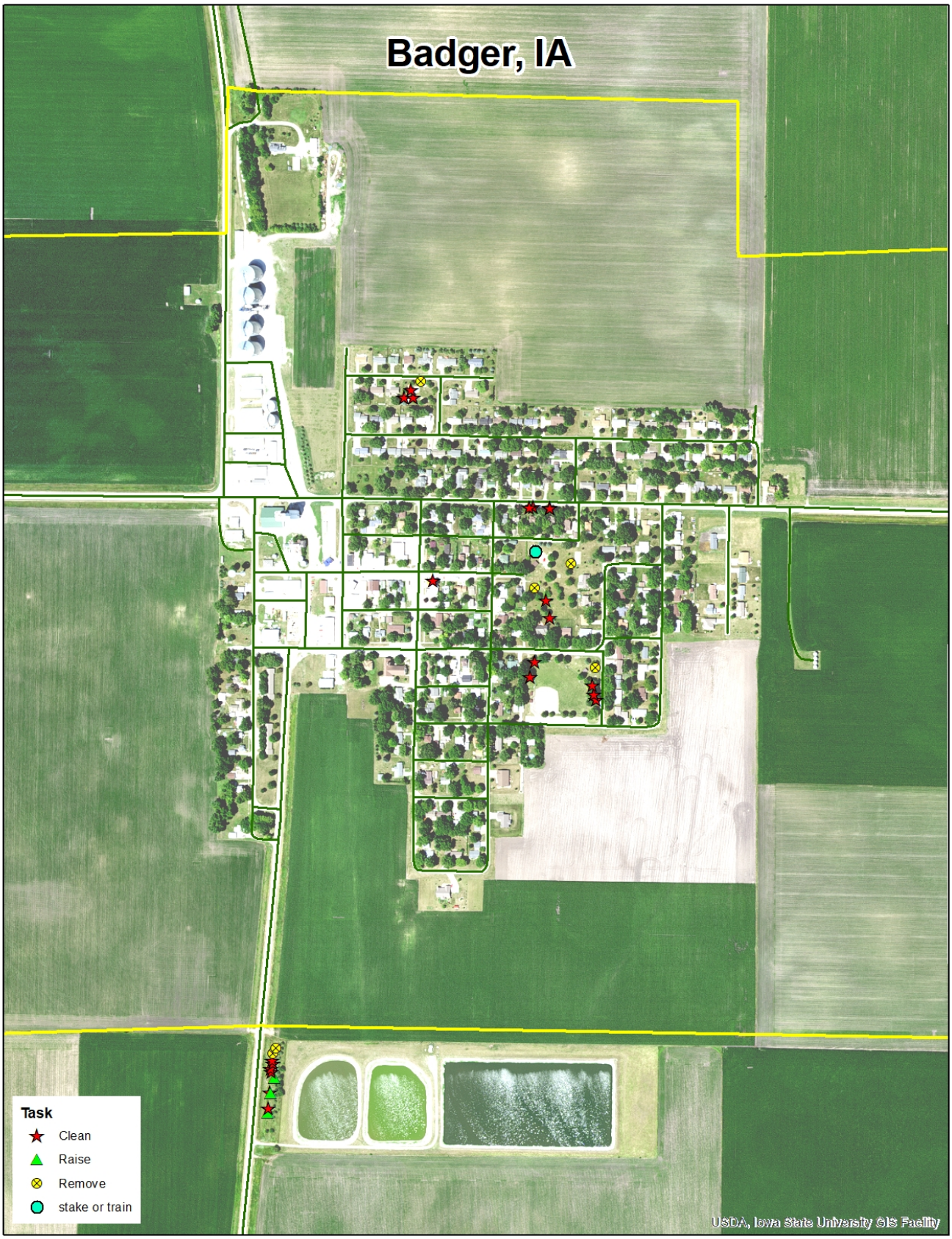

Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

CHAPTER 151

TREES

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

151.02 PLANTING RESTRICTIONS. No tree shall be planted in any parking.

151.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and 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])

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

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

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

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

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

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

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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.