Mitchellville, IA

2018 Urban Forest Management Plan
Prepared by Richard Kittelson
Iowa Department of Natural Resources

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Executive Summary

Overview

This plan was developed to assist the City of Mitchellville 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 13.4% of Mitchellville'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 2018, 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 253 trees inventoried.

- Mitchellville's trees provide $58,255.30 of benefits annually, an average of $231 a tree
- There are over 20 species of trees
- The top three genera are: Maple 42%, Ash 13.4%, and Hackberry 8.7%
- 62% of trees are in need of some type of management
- 59 trees (31 ash) 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 59 trees needing removal, 26 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*
- 28 of the 34 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With the example budget it could take 6 years to remove ash – Suggestion: request a budget increase to $6,500 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2018, 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 253 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. Mitchellville's trees reduce energy related costs by approximately $14,693.70 annually (Appendix A, Table 1). These savings are both in Electricity (70.38 MWh) and in Natural Gas (9,542.38 Therms).

Annual Stormwater Benefits

Mitchellville's trees intercept about 839,400.50 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $22,747.75 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 Mitchellville it is estimated that trees remove 935.09 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 $2,635.72 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Mitchellville trees sequester about 180,199 lbs of carbon a year with an associated value of $1,351.49 (Appendix A, Table 5). In addition, the trees store 3,299.50 lbs of carbon, with a yearly benefit of $24,748.36 (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. Mitchellville receives $16,065.79 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, Mitchellville's trees provide $58,255.30 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 253 trees in Mitchellville provide approximately $231 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Mitchellville has over 20 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	106	41.9%
Ash	34	13.4%
Hackberry	22	8.7%
Oak	14	5.5%
Walnut	10	3.9%
Apple	8	3.2%
Spruce	8	3.2%
Linden	6	2.4%
Redbud	5	2%
Honeylucost	4	1.6%
Elm	4	1.6%
Others	32	12.6%

Age Class

Most of Mitchellville's trees (60%) are between 18 and 42 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. Mitchellville's size curve is on the larger side, indicating an older 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 Mitchellville indicate that 93% of the trees are in fair to good health, with only 7% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 73% of Mitchellville's trees are in fair to 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 27% of the population. This 27% 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	88	34.8%
Crown Raising	5	2%
Tree Staking	0	0.0%
Tree Removal	59	23.3%
Crown Reduction	2	0.8%
Treat Ash Trees	2	0.8%

Canopy Cover

The total canopy with both private and public trees is 15%, 219 acres. The canopy cover included in the Mitchellville inventory includes approximately 8.54 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 109 trees need to be planted annually.

Land Use and Location

The majority of Mitchellville'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	71.94%
Park/vacant/other	18.58%
Industrial/Large commercial	1.58%
Small commercial	7.51%
Multifamily residential	0.40%

Location	
Planting strip	95.26%
Other maintained locations	0.0%
Cutout (surrounded by pavement)	4.74%
Front yard	0.0%

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

Mitchellville has 13 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 26 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 97 trees with these needs.

Poor tree species

After the removal of the critical concern trees, ash trees (17) in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 59 removals, 31 are ash trees. There are a total of 34 ash trees, and 28 of those have signs and symptoms that have been associated with EAB.

In addition, there are 39 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 Mitchellville.

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 (42%) (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. (Appendix C). All trees planted must meet the restrictions in the city ordinances to be codified in 2019 (Appendix C).

Continual Monitoring

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

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

Year 1

Removal: 8 largest critical concern trees
Planting and Replacement: 9 trees to be planted in open locations
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 5 critical concern trees and 3 additional ash trees with poor health

*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 6 trees in open locations from year one removals
Young Tree Pruning & Maintenance:
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 3
Removal: 8 trees-ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 4
Removal: 8 trees-ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 5
Removal: 8 trees-ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 6
Removal: 7 trees-ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: All 34 ash trees removed (100% of ash). EAB could potentially kill all ash within 4 to 15 years of its arrival.
If the budget were increased to $10,000 a year all ash could be removed in 4 years.

Emerald Ash Borer Plan

Ash Tree Removal

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

Treatment of Ash Trees

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

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

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

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

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

Wood Disposal

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

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in the city ordinances to be codified in 2019 (Appendix C). The new plantings will be a diverse mix and should 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.

Budget

Example Budget
Total $39,000 over 6 years ($6,500/year)

FY 2019 Budget
Removal: $5,100

*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2020 Budget
Removal: $3,700
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $1,700
Watering & Maintenance: $500

FY 2021 Budget
Removal: $5,100
*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2022 Budget
Removal: $3,700
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $1,700
Watering & Maintenance: $500

FY 2023 Budget
Removal: $5,100
*Or saving for ash tree treatment and/or future ash removal
Planting: $900
Watering & Maintenance: $500

FY 2024 Budget
Removal: $3,700
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Routine trimming: $1,700
Watering & Maintenance: $500

*Reduction of ash over 6 years: All 34 ash trees removed (100% of ash).

<u>Purposed Budget Increase</u>
EAB could potentially kill all ash trees in Mitchellville within 4 years of its arrival. If the budget were increased to $10,000 a year all ash could be removed within 4 years. Additionally, it is recommended that Mitchellville 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 18 inches and at $12 per inch, 2 trees could be treated every other year. This would be 2 trees selected for treatment, and Mitchellville would still need to find $5,100 for removal. Alternatively, if there are 2 treatable trees, it would cost approximately $432 for a 2-year treatment and leave $4,670 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 Mitchellville. 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

Annual Energy Benefits of All Trees by Species					12/12/2018				
Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	17.68	1,341.67	2,319.14	2,272.76	3,614.43	(N/A)	19.84	24.60	72.29
Green ash	6.65	504.64	874.87	857.37	1,362.02	(N/A)	10.32	9.27	52.39
Northern hackberry	8.79	666.86	1,241.95	1,217.11	1,883.97	(N/A)	8.73	12.82	85.64
Norway maple	5.15	390.88	742.63	727.78	1,118.66	(N/A)	7.94	7.61	55.93
Sugar maple	5.49	416.84	721.24	706.82	1,123.66	(N/A)	7.14	7.65	62.43
Red maple	2.90	220.35	396.55	388.62	608.97	(N/A)	4.76	4.14	50.75
Black walnut	2.83	214.44	370.31	362.90	577.34	(N/A)	3.97	3.93	57.73
Apple	1.07	80.92	161.46	158.23	239.14	(N/A)	3.17	1.63	29.89
Northern red oak	0.94	71.25	129.12	126.54	197.78	(N/A)	2.38	1.35	32.96
Littleleaf linden	1.39	105.63	201.14	197.12	302.75	(N/A)	2.38	2.06	50.46
Ash	1.67	126.73	230.73	226.11	352.85	(N/A)	2.38	2.40	58.81
Black maple	1.25	94.73	176.11	172.59	267.31	(N/A)	1.98	1.82	53.46
Eastern redbud	0.45	34.04	63.41	62.15	96.19	(N/A)	1.98	0.65	19.24
Blue spruce	0.58	44.22	75.27	73.76	117.99	(N/A)	1.98	0.80	23.60
Honeylocust	1.47	111.27	189.63	185.84	297.11	(N/A)	1.59	2.02	74.28
American sycamore	1.37	103.79	192.33	188.48	292.27	(N/A)	1.59	1.99	73.07
Pin oak	1.60	121.42	211.54	207.30	328.73	(N/A)	1.59	2.24	82.18
Siberian elm	1.45	110.09	198.02	194.06	304.15	(N/A)	1.59	2.07	76.04
Cottonwood	1.94	147.14	252.43	247.38	394.52	(N/A)	1.59	2.68	98.63
Pear	0.58	44.26	87.91	86.15	130.41	(N/A)	1.19	0.89	43.47
Others	5.15	390.99	706.60	692.47	1,083.46		11.90	7.37	34.02
Total	70.38	5,342.17	9,542.38	9,351.53	14,693.70	(N/A)	100.00	100.00	58.31

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of All Trees by Species				12/12/2018		
Species	Total Rainfall Interception (Gal)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	274,069.02	7,427.27	(N/A)	19.84	32.65	148.55
Green ash	58,829.95	1,594.29	(N/A)	10.32	7.01	61.32
Northern hackberry	95,378.47	2,584.76	(N/A)	8.73	11.36	117.49
Norway maple	48,158.44	1,305.09	(N/A)	7.94	5.74	65.25
Sugar maple	70,276.82	1,904.50	(N/A)	7.14	8.37	105.81
Red maple	26,780.55	725.75	(N/A)	4.76	3.19	60.48
Black walnut	29,676.08	804.22	(N/A)	3.97	3.54	80.42
Apple	5,195.76	140.81	(N/A)	3.17	0.62	17.60
Northern red oak	9,330.77	252.86	(N/A)	2.38	1.11	42.14
Littleleaf linden	14,468.94	392.11	(N/A)	2.38	1.72	65.35
Ash	15,520.32	420.60	(N/A)	2.38	1.85	70.10
Black maple	12,093.21	327.73	(N/A)	1.98	1.44	65.55
Eastern redbud	1,612.45	43.70	(N/A)	1.98	0.19	8.74
Blue spruce	7,700.75	208.69	(N/A)	1.98	0.92	41.74
Honeylocust	18,739.10	507.83	(N/A)	1.59	2.23	126.96
American sycamore	17,514.69	474.65	(N/A)	1.59	2.09	118.66
Pin oak	21,240.36	575.61	(N/A)	1.59	2.53	143.90
Siberian elm	15,980.67	433.08	(N/A)	1.59	1.90	108.27
Cottonwood	28,955.68	784.70	(N/A)	1.59	3.45	196.17
Pear	3,014.60	81.70	(N/A)	1.19	0.36	27.23
Others	64,863.88	1,757.81		11.90	7.73	51.61
Citywide total	839,400.50	22,747.75	(N/A)	100.00	100.00	90.27

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of All Trees by Species				12/12/2018													
Species	Deposition O3 (lb)	Deposition NO2 (lb)	Deposition PM10 (lb)	Deposition SO2 (lb)	Total Deposition ($)	Avoided NO2 (lb)	Avoided PM10 (lb)	Avoided VOC (lb)	Avoided SO2 (lb)	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Stand. Error	% of Total Trees	Avg. $/tree
Silver maple	50.04	8.48	24.24	2.22	268.87	83.25	12.19	11.64	79.95	521.03	- 25.65	- 96.18	246.36	693.72	(N/A)	19.84	13.87
Green ash	6.00	0.96	3.11	0.27	32.64	31.43	4.60	4.39	30.14	196.61	0.00	0.00	80.91	229.25	(N/A)	10.32	8.82
Northern hackberry	17.39	3.01	8.57	0.78	94.06	42.37	6.14	5.85	39.84	262.95	0.00	0.00	123.94	357.02	(N/A)	8.73	16.23
Norway maple	9.83	1.70	4.83	0.44	53.09	24.97	3.61	3.44	23.37	154.66	- 2.30	- 8.64	69.86	199.12	(N/A)	7.94	9.96
Sugar maple	11.22	1.91	5.37	0.50	60.15	25.92	3.79	3.62	24.87	162.16	- 8.72	- 32.71	68.49	189.60	(N/A)	7.14	10.53
Red maple	6.72	1.14	3.10	0.30	35.67	13.84	2.02	1.92	13.15	86.23	- 2.21	- 8.30	39.97	113.60	(N/A)	4.76	9.47
Black walnut	4.09	0.65	1.93	0.18	21.74	13.34	1.95	1.87	12.81	83.49	0.00	0.00	36.84	105.23	(N/A)	3.97	10.52
Apple	1.77	0.29	0.81	0.08	9.34	5.23	0.75	0.71	4.83	32.21	- 0.01	- 0.04	14.46	41.52	(N/A)	3.17	5.19
Northern red oak	1.98	0.34	0.96	0.09	10.64	4.48	0.65	0.62	4.25	27.91	- 2.81	- 10.55	10.56	28.00	(N/A)	2.38	4.67
Littleleaf linden	2.44	0.42	1.20	0.11	13.18	6.75	0.98	0.93	6.32	41.81	- 1.18	- 4.44	17.96	50.56	(N/A)	2.38	8.43
Ash	3.25	0.56	1.59	0.14	17.52	8.01	1.16	1.11	7.58	49.81	- 0.76	- 2.83	22.64	64.50	(N/A)	2.38	10.75
Black maple	3.07	0.52	1.42	0.14	16.32	6.00	0.87	0.83	5.65	37.25	- 1.01	- 3.77	17.49	49.80	(N/A)	1.98	9.96
Eastern redbud	0.46	0.08	0.22	0.02	2.46	2.16	0.31	0.30	2.03	13.41	0.00	- 0.01	5.58	15.87	(N/A)	1.98	3.17
Blue spruce	0.99	0.20	0.84	0.12	6.61	2.73	0.40	0.38	2.64	17.14	- 2.79	- 10.45	5.52	13.30	(N/A)	1.98	2.66
Honeylocust	3.76	0.62	1.69	0.17	19.77	6.88	1.01	0.96	6.63	43.13	- 3.04	- 11.41	18.68	51.50	(N/A)	1.59	12.87
American sycamore	2.35	0.38	1.09	0.11	12.40	6.58	0.95	0.91	6.20	40.84	0.00	0.00	18.55	53.24	(N/A)	1.59	13.31
Pin oak	4.13	0.72	2.06	0.19	22.43	7.56	1.11	1.06	7.24	47.29	- 7.51	- 28.15	16.56	41.56	(N/A)	1.59	10.39
Siberian elm	2.74	0.47	1.32	0.12	14.72	6.92	1.01	0.96	6.57	43.09	0.00	0.00	20.10	57.81	(N/A)	1.59	14.45
Cottonwood	6.34	1.01	2.75	0.28	32.97	9.14	1.34	1.28	8.78	57.23	0.00	0.00	30.94	90.20	(N/A)	1.59	22.55
Pear	1.08	0.18	0.49	0.05	5.67	2.85	0.41	0.39	2.64	17.60	- 0.01	- 0.02	8.08	23.25	(N/A)	1.19	7.75
Others	10.14	1.75	5.69	0.67	57.22	24.58	3.58	3.41	23.34	153.15	- 11.54	- 43.27	61.62	167.10		11.90	5.42
Citywide Total	149.76	25.39	73.28	6.97	807.46	334.99	48.84	46.58	318.83	2,089.03	- 69.54	- 260.77	935.09	2,635.72	(N/A)	100.00	10.46

Table 4: Annual Carbon Stored

Stored CO2 Benefits of All Trees by Species				12/12/2018		
Species	Total stored CO2 (lbs)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	1,161,618.47	8,712.14	(N/A)	19.84	35.20	174.24
Green ash	194,477.10	1,458.58	(N/A)	10.32	5.89	56.10
Northern hackberry	277,054.17	2,077.91	(N/A)	8.73	8.40	94.45
Norway maple	161,620.02	1,212.15	(N/A)	7.94	4.90	60.61
Sugar maple	339,612.92	2,547.10	(N/A)	7.14	10.29	141.51
Red maple	71,928.12	539.46	(N/A)	4.76	2.18	44.96
Black walnut	137,650.21	1,032.38	(N/A)	3.97	4.17	103.24
Apple	27,401.94	205.51	(N/A)	3.17	0.83	25.69
Northern red oak	42,315.96	317.37	(N/A)	2.38	1.28	52.89
Littleleaf linden	51,705.87	387.79	(N/A)	2.38	1.57	64.63
Ash	53,712.92	402.85	(N/A)	2.38	1.63	67.14
Black maple	32,881.81	246.61	(N/A)	1.98	1.00	49.32
Eastern redbud	7,009.79	52.57	(N/A)	1.98	0.21	10.51
Blue spruce	6,300.12	47.25	(N/A)	1.98	0.19	9.45
Honeylocust	48,979.37	367.35	(N/A)	1.59	1.48	91.84
American sycamore	76,116.75	570.88	(N/A)	1.59	2.31	142.72
Pin oak	112,471.05	843.53	(N/A)	1.59	3.41	210.88
Siberian elm	66,087.67	495.66	(N/A)	1.59	2.00	123.91
Cottonwood	223,927.94	1,679.46	(N/A)	1.59	6.79	419.86
Pear	16,522.58	123.92	(N/A)	1.19	0.50	41.31
Others	190,386.70	1,427.90		11.90	5.77	44.04
Citywide total	3,299,781.50	24,748.36	(N/A)	100.00	100.00	98.21

Table 5: Annual Carbon Sequestered

Annual CO2 Benefits of All Trees by Species													
Species	Sequestered (lb)	Sequestered ($)	Decomposition Release(lb)	Maintenance Release (lb)	Total Release ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	80,136.39	601.02	- 5,575.88	- 202.41	- 43.34	29,650.64	222.38	104,008.75	780.07	(N/A)	19.84	36.93	15.60
Green ash	15,020.26	112.65	- 933.49	- 63.96	- 7.48	11,152.45	83.64	25,175.26	188.81	(N/A)	10.32	8.94	7.26
Northern hackberry	11,921.45	89.41	- 1,329.86	- 87.36	- 10.63	14,737.41	110.53	25,241.64	189.31	(N/A)	8.73	8.96	8.61
Norway maple	6,777.17	50.83	- 775.78	- 54.60	- 6.23	8,638.44	64.79	14,585.23	109.39	(N/A)	7.94	5.18	5.47
Sugar maple	14,320.52	107.40	- 1,630.84	- 62.60	- 12.70	9,212.15	69.09	21,839.23	163.79	(N/A)	7.14	7.75	9.10
Red maple	5,751.21	43.13	- 345.31	- 27.11	- 2.79	4,869.76	36.52	10,248.56	76.86	(N/A)	4.76	3.64	6.41
Black walnut	5,802.03	43.52	- 660.72	- 28.86	- 5.17	4,739.10	35.54	9,851.55	73.89	(N/A)	3.97	3.50	7.39
Apple	1,174.23	8.81	- 131.57	- 15.60	- 1.10	1,788.26	13.41	2,815.32	21.11	(N/A)	3.17	1.00	2.64
Northern red oak	673.04	5.05	- 203.20	- 12.09	- 1.61	1,574.54	11.81	2,032.30	15.24	(N/A)	2.38	0.72	2.54
Littleleaf linden	4,789.62	35.92	- 248.19	- 16.38	- 1.98	2,334.41	17.51	6,859.46	51.45	(N/A)	2.38	2.44	8.57
Ash	1,157.85	8.68	- 257.82	- 18.72	- 2.07	2,800.79	21.01	3,682.09	27.62	(N/A)	2.38	1.31	4.60
Black maple	2,011.96	15.09	- 157.83	- 12.09	- 1.27	2,093.42	15.70	3,935.45	29.52	(N/A)	1.98	1.40	5.90
Eastern redbud	666.52	5.00	- 33.74	- 5.46	- 0.29	752.36	5.64	1,379.68	10.35	(N/A)	1.98	0.49	2.07
Blue spruce	457.78	3.43	- 30.24	- 9.75	- 0.30	977.29	7.33	1,395.08	10.46	(N/A)	1.98	0.50	2.09
Honeylocust	2,971.58	22.29	- 235.10	- 10.92	- 1.85	2,459.02	18.44	5,184.57	38.88	(N/A)	1.59	1.84	9.72
American sycamore	3,435.74	25.77	- 365.36	- 14.82	- 2.85	2,293.70	17.20	5,349.26	40.12	(N/A)	1.59	1.90	10.03
Pin oak	9,498.53	71.24	- 539.86	- 17.94	- 4.18	2,683.37	20.13	11,624.11	87.18	(N/A)	1.59	4.13	21.80
Siberian elm	2,829.75	21.22	- 317.22	- 15.60	- 2.50	2,432.93	18.25	4,929.86	36.97	(N/A)	1.59	1.75	9.24
Cottonwood	1,915.46	14.37	- 1,074.85	- 23.40	- 8.24	3,251.76	24.39	4,068.96	30.52	(N/A)	1.59	1.44	7.63
Pear	1,224.55	9.18	- 79.31	- 7.41	- 0.65	978.04	7.34	2,115.87	15.87	(N/A)	1.19	0.75	5.29
Others	7,663.34	57.48	- 914.67	- 67.28	- 7.36	8,640.74	64.81	15,322.14	114.92		11.90	5.44	3.61
Citywide Total	180,199.00	1,351.49	- 15,840.84	- 774.35	- 124.61	118,060.57	885.45	281,644.38	2,112.33	(N/A)	100.00	100.00	8.38

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefit of All Trees by Species					
Species	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	5,957.22	(N/A)	19.84	37.08	119.14
Green ash	1,361.38	(N/A)	10.32	8.47	52.36
Northern hackberry	1,462.34	(N/A)	8.73	9.10	66.47
Norway maple	643.99	(N/A)	7.94	4.01	32.20
Sugar maple	1,392.02	(N/A)	7.14	8.66	77.33
Red maple	707.03	(N/A)	4.76	4.40	58.92
Black walnut	496.02	(N/A)	3.97	3.09	49.60
Apple	68.26	(N/A)	3.17	0.42	8.53
Northern red oak	54.63	(N/A)	2.38	0.34	9.10
Littleleaf linden	487.04	(N/A)	2.38	3.03	81.17
Ash	117.48	(N/A)	2.38	0.73	19.58
Black maple	247.99	(N/A)	1.98	1.54	49.60
Eastern redbud	37.43	(N/A)	1.98	0.23	7.49
Blue spruce	116.74	(N/A)	1.98	0.73	23.35
Honeylocust	777.80	(N/A)	1.59	4.84	194.45
American sycamore	256.48	(N/A)	1.59	1.60	64.12
Pin oak	676.81	(N/A)	1.59	4.21	169.20
Siberian elm	191.51	(N/A)	1.59	1.19	47.88
Cottonwood	114.28	(N/A)	1.59	0.71	28.57
Pear	73.08	(N/A)	1.19	0.45	24.36
Others	826.23		11.90	5.14	25.75
Citywide Total	16,065.79	(N/A)	100.00	100.00	63.75

Table 7: Summary of Benefits in Dollars

Average Annual Benefits of All Tree by Species ($/tree)					12/12/2018		
Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total	Stand.
Silver maple	72.29	15.60	13.87	148.55	119.14	369.45	(N/A)
Green ash	52.39	7.26	8.82	61.32	52.36	182.14	(N/A)
Northern hackberry	85.64	8.61	16.23	117.49	66.47	294.43	(N/A)
Norway maple	55.93	5.47	9.96	65.25	32.20	168.81	(N/A)
Sugar maple	62.43	9.10	10.53	105.81	77.33	265.20	(N/A)
Red maple	50.75	6.41	9.47	60.48	58.92	186.02	(N/A)
Black walnut	57.73	7.39	10.52	80.42	49.60	205.67	(N/A)
Apple	29.89	2.64	5.19	17.60	8.53	63.86	(N/A)
Northern red oak	32.96	2.54	4.67	42.14	9.10	91.42	(N/A)
Littleleaf linden	50.46	8.57	8.43	65.35	81.17	213.98	(N/A)
Ash	58.81	4.60	10.75	70.10	19.58	163.84	(N/A)
Black maple	53.46	5.90	9.96	65.55	49.60	184.47	(N/A)
Eastern redbud	19.24	2.07	3.17	8.74	7.49	40.71	(N/A)
Blue spruce	23.60	2.09	2.66	41.74	23.35	93.43	(N/A)
Honeylocust	74.28	9.72	12.87	126.96	194.45	418.28	(N/A)
American sycamore	73.07	10.03	13.31	118.66	64.12	279.19	(N/A)
Pin oak	82.18	21.80	10.39	143.90	169.20	427.47	(N/A)
Siberian elm	76.04	9.24	14.45	108.27	47.88	255.88	(N/A)
Cottonwood	98.63	7.63	22.55	196.17	28.57	353.55	(N/A)
Pear	43.47	5.29	7.75	27.23	24.36	108.10	(N/A)
Others	714.49	75.81	113.74	1,083.91	540.81	2,528.76	
Citywide Total	58.31	8.38	10.46	90.27	63.75	231.17	(N/A)

Species Distribution of All Trees for 12/12/2018	
Species	Percent
Silver maple	20.40
Green ash	10.40
Northern hackberry	8.80
Sugar maple	7.20
Norway maple	7.20
Red maple	4.80
Black walnut	4.00
Apple	3.20
Ash	2.40
Littleleaf linden	2.40
Other Species	29.20

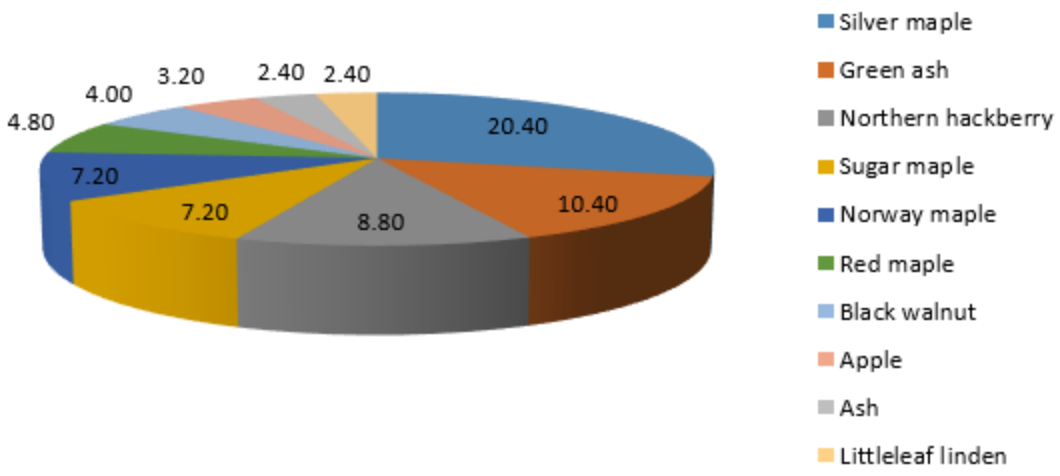
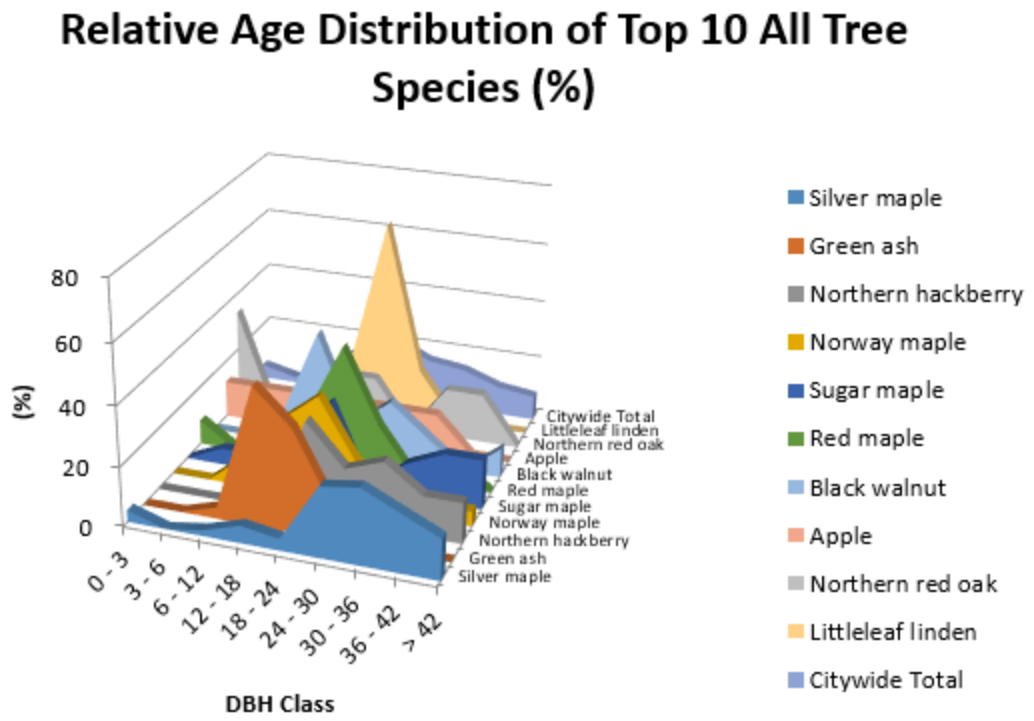


Figure 1: Species Distribution



Relative Age Distribution of Top 10 All Tree Species (%)									
	DBH class (in)			12/12/2018					
Species	0 - 3	3 - 6	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	> 42
Silver maple	3.92	0.00	1.96	5.88	3.92	23.53	25.49	19.61	13.73
Green ash	0.00	0.00	3.85	46.15	34.62	11.54	3.85	0.00	0.00
Northern hackberry	0.00	0.00	0.00	0.00	31.82	18.18	22.73	13.64	13.64
Norway maple	0.00	0.00	10.00	25.00	35.00	15.00	5.00	5.00	5.00
Sugar maple	0.00	5.56	5.56	16.67	27.78	0.00	11.11	16.67	16.67
Red maple	8.33	0.00	8.33	16.67	41.67	16.67	0.00	8.33	0.00
Black walnut	0.00	0.00	10.00	40.00	10.00	20.00	10.00	0.00	10.00
Apple	12.50	12.50	12.50	25.00	12.50	12.50	12.50	0.00	0.00
Northern red oak	33.33	0.00	0.00	16.67	16.67	0.00	16.67	16.67	0.00
Littleleaf linden	0.00	0.00	0.00	16.67	66.67	16.67	0.00	0.00	0.00
Citywide Total	4.74	1.98	5.14	18.58	20.95	15.81	14.23	9.88	8.30

Figure 2: Relative Age Class

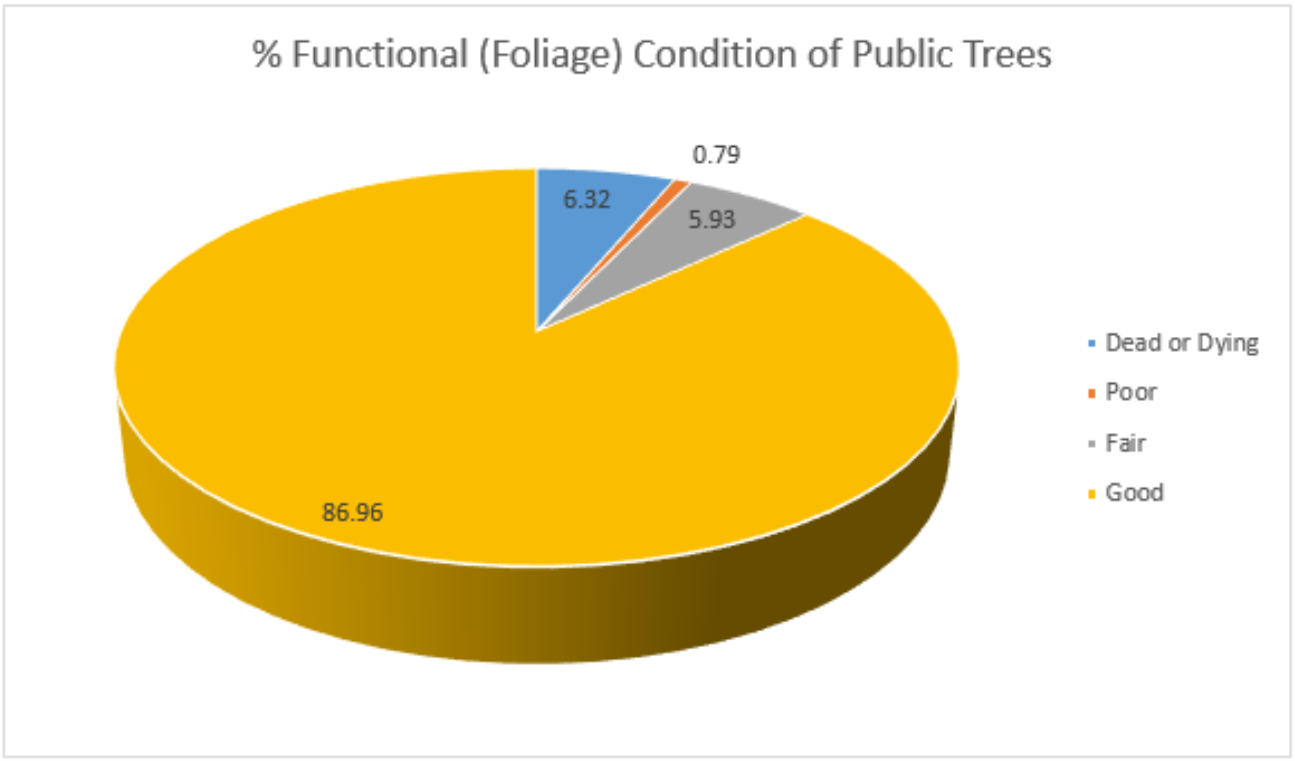


Figure 3: Foliage Condition

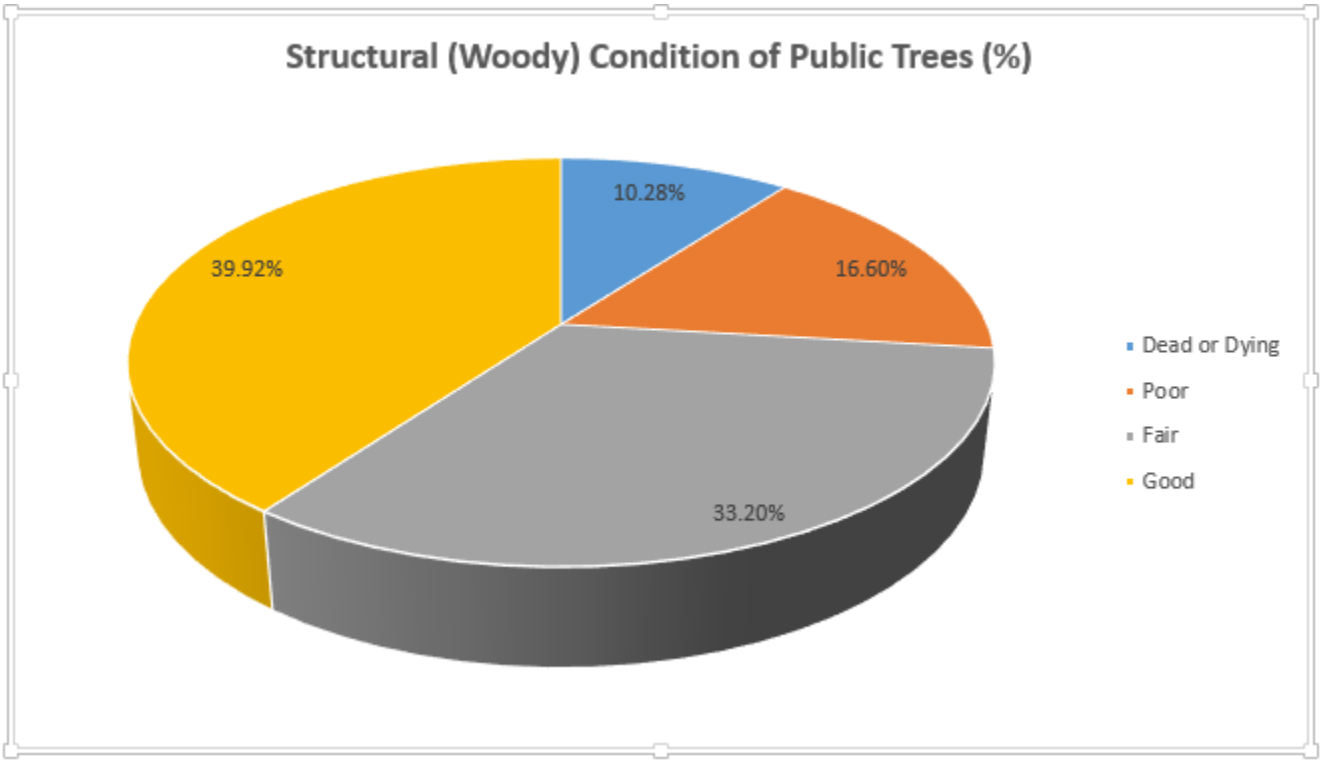
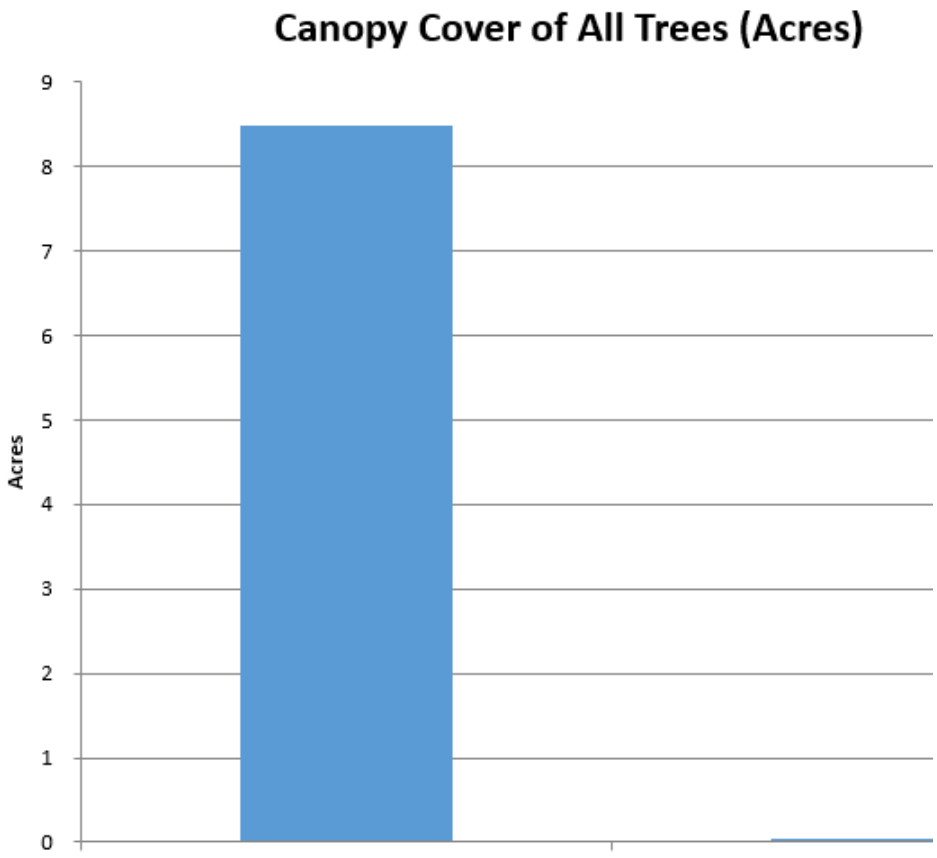
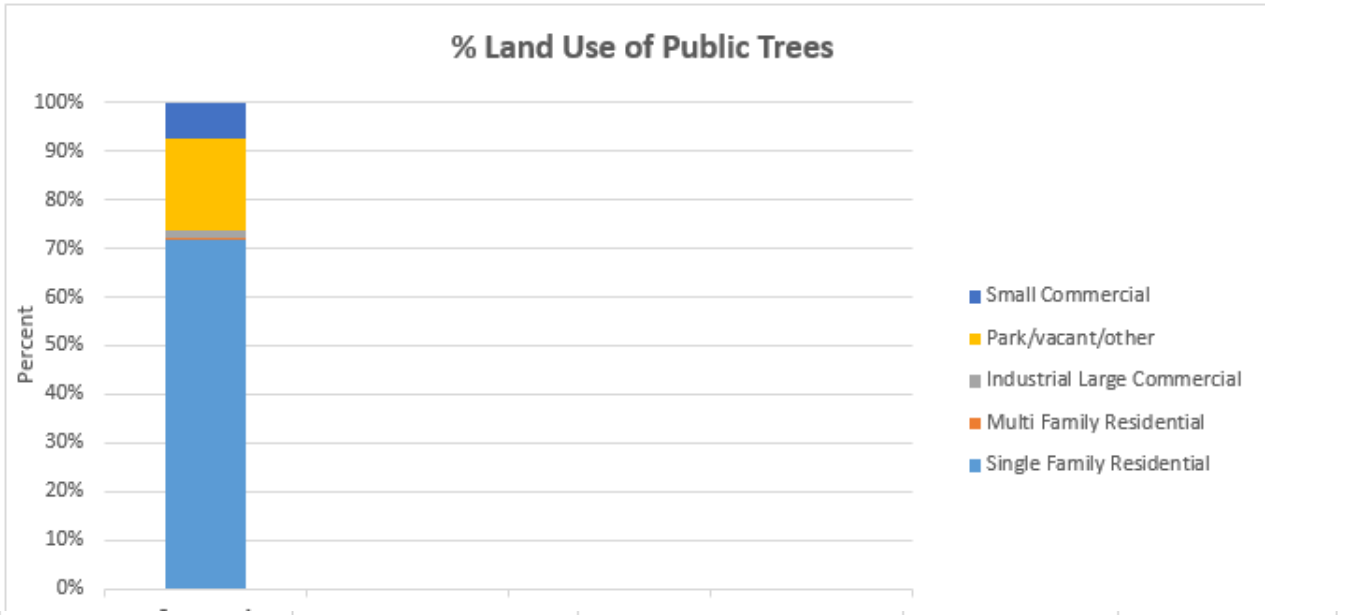


Figure 4: Wood Condition



Canopy Cover of All Trees (Acres)		12/12/2018
Zone	Acres	% of Total Canopy
1	8.54	3.90
Citywide Total	219.00	100.00

Figure 5: Canopy Cover in Acres



Single Family Residential	Multi Family Residential	Industrial Large Commercial	Park/vacant/other	Small Commercial
71%	0.40%	1.58%	19%	7.51%

Figure 6: Land Use of city/park trees

Front Yard	Planting Strip	Cutout	Median	Other maintained	Other un-maintained
0%	95.26%	5%	0.00%	0%	0

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1:

Location of Ash Trees
2018 Community Tree Inventory
Mitchellville, IA

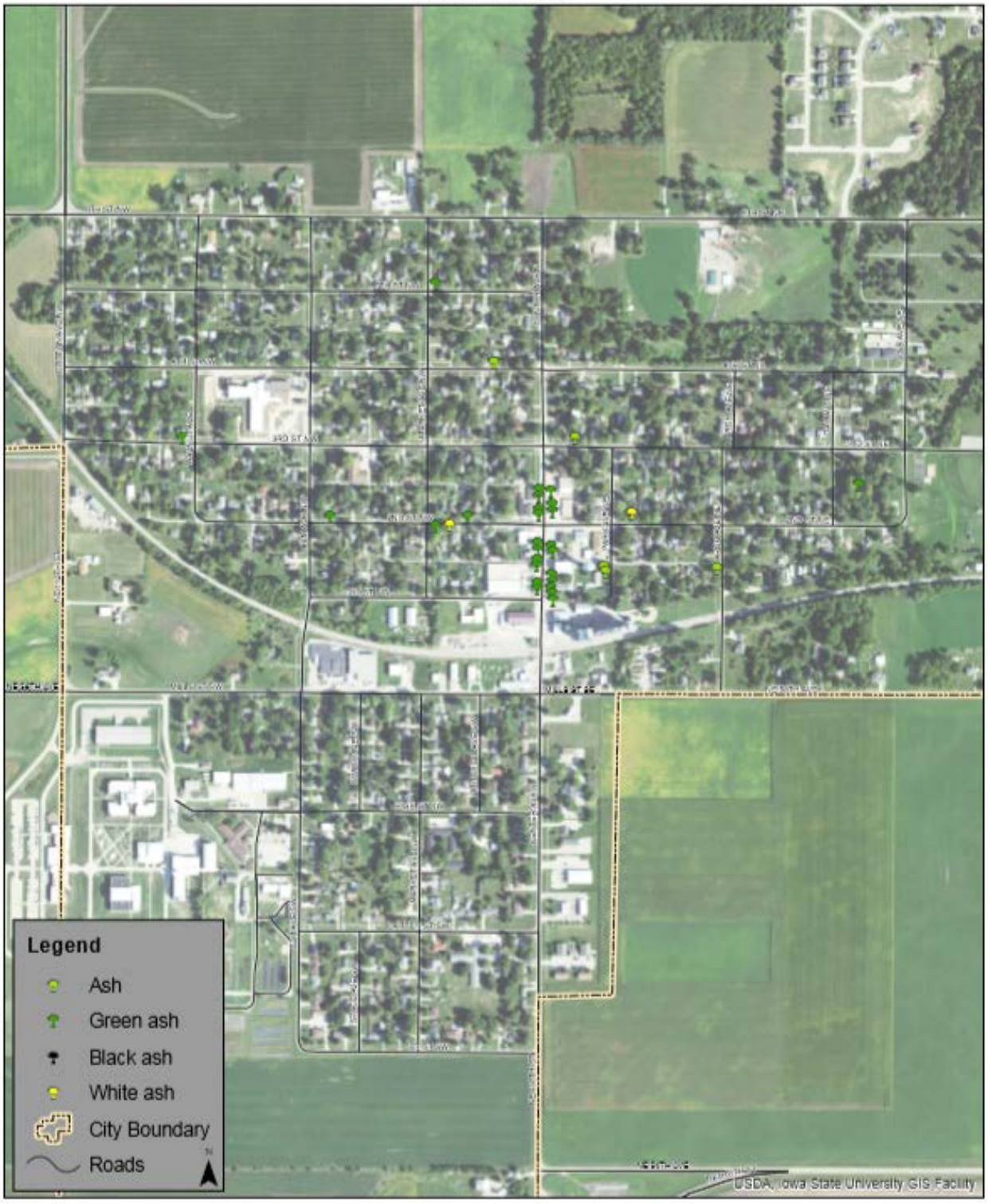


Figure 2:

Location of EAB Symptoms
2018 Community Tree Inventory
Mitchellville, IA

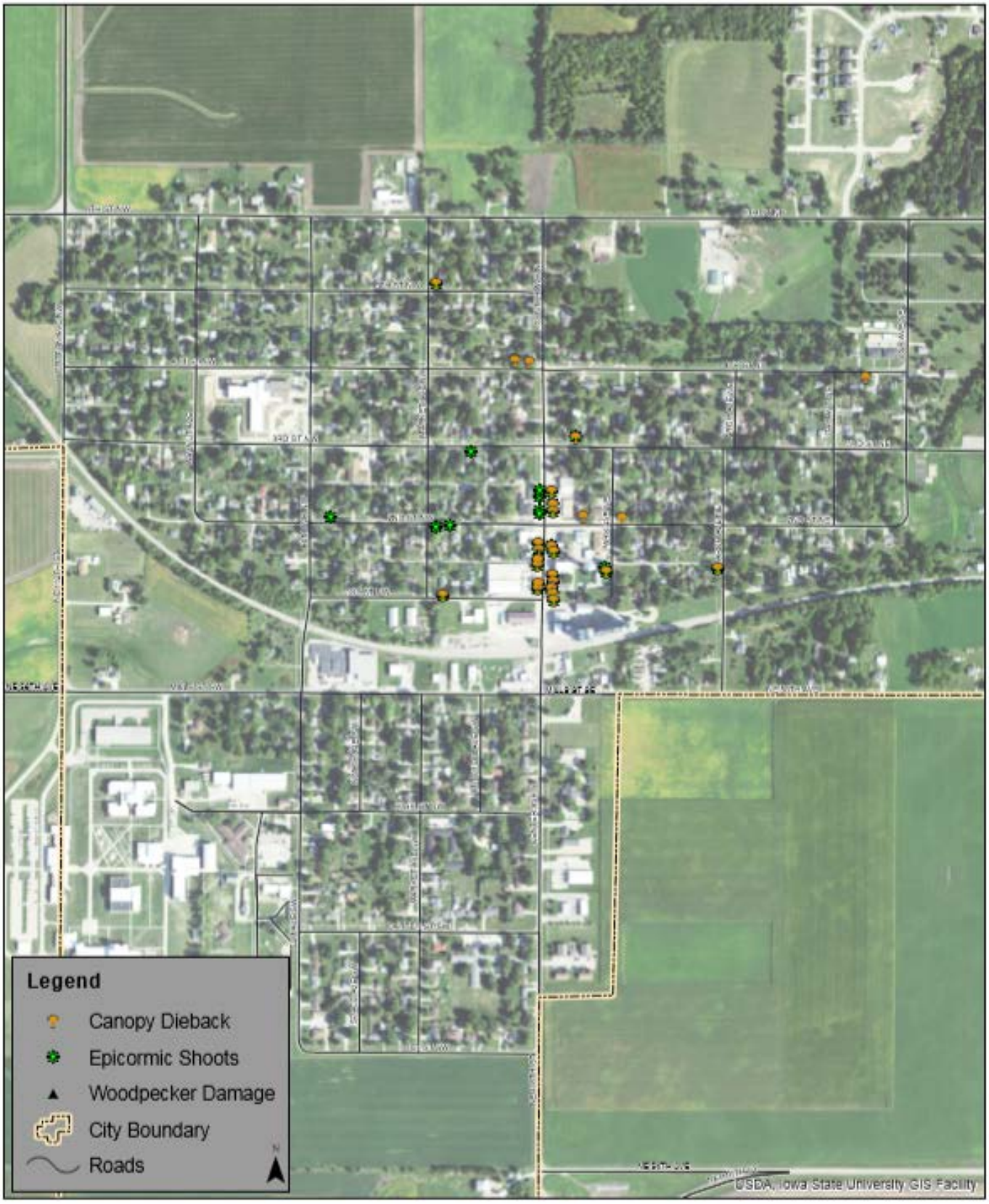


Figure 3:

Location of Poor Condition Trees
2018 Community Tree Inventory
Mitchellville, IA

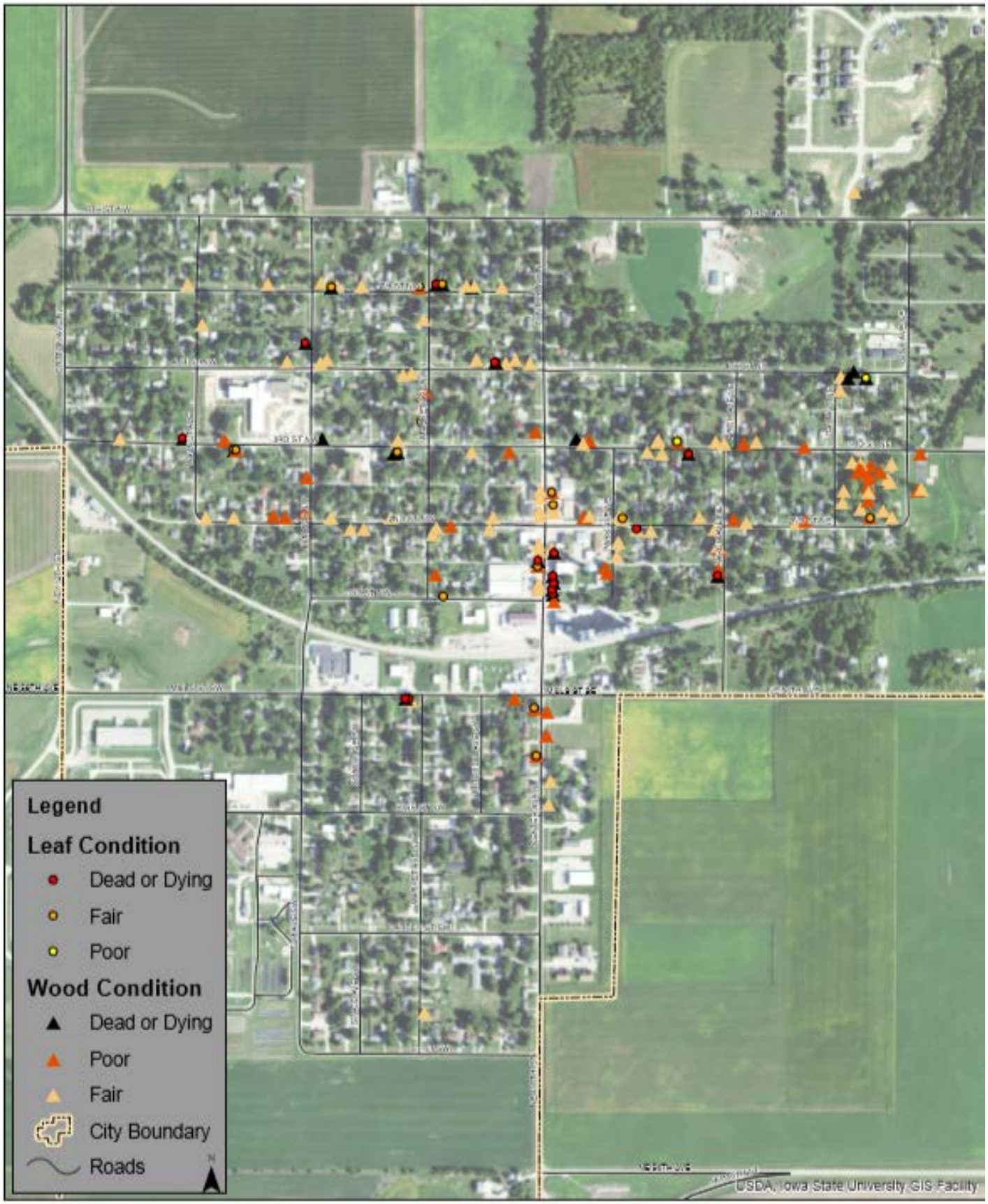


Figure 4:

Location of Trees with Recommended Maintenance
2018 Community Tree Inventory
Mitchellville, IA

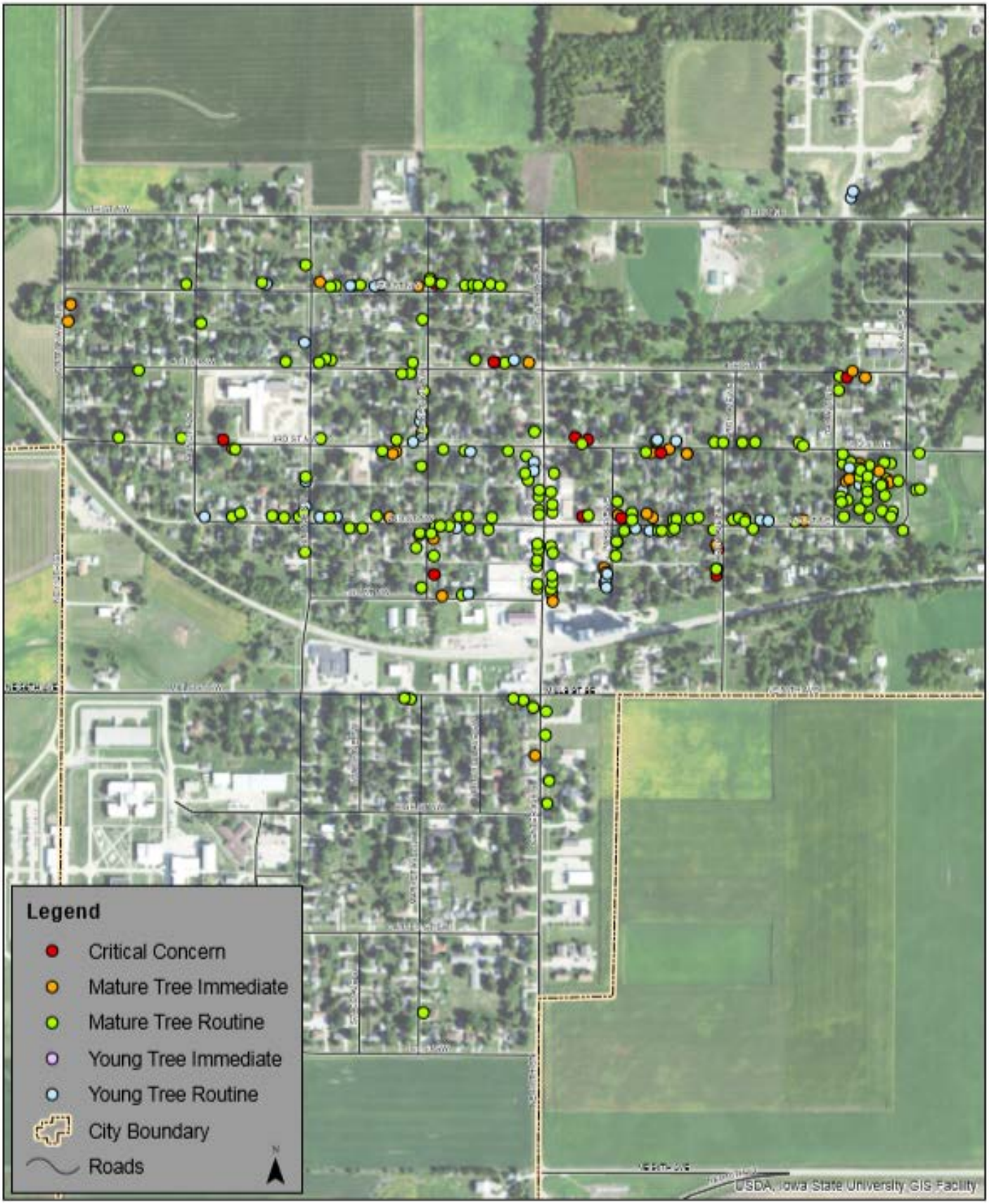


Figure 5:

Maintenance Tasks
2018 Community Tree Inventory
Mitchellville, IA

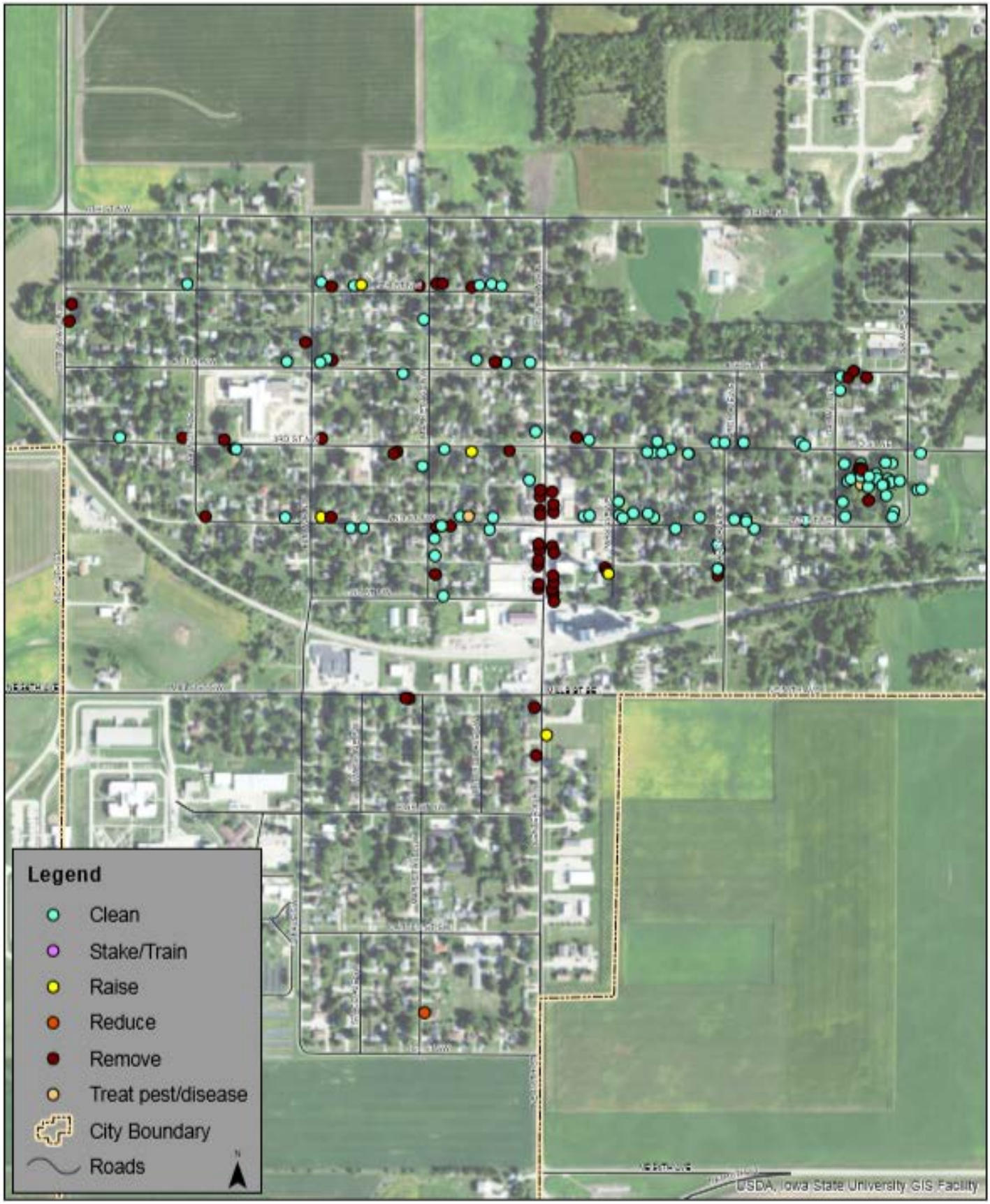
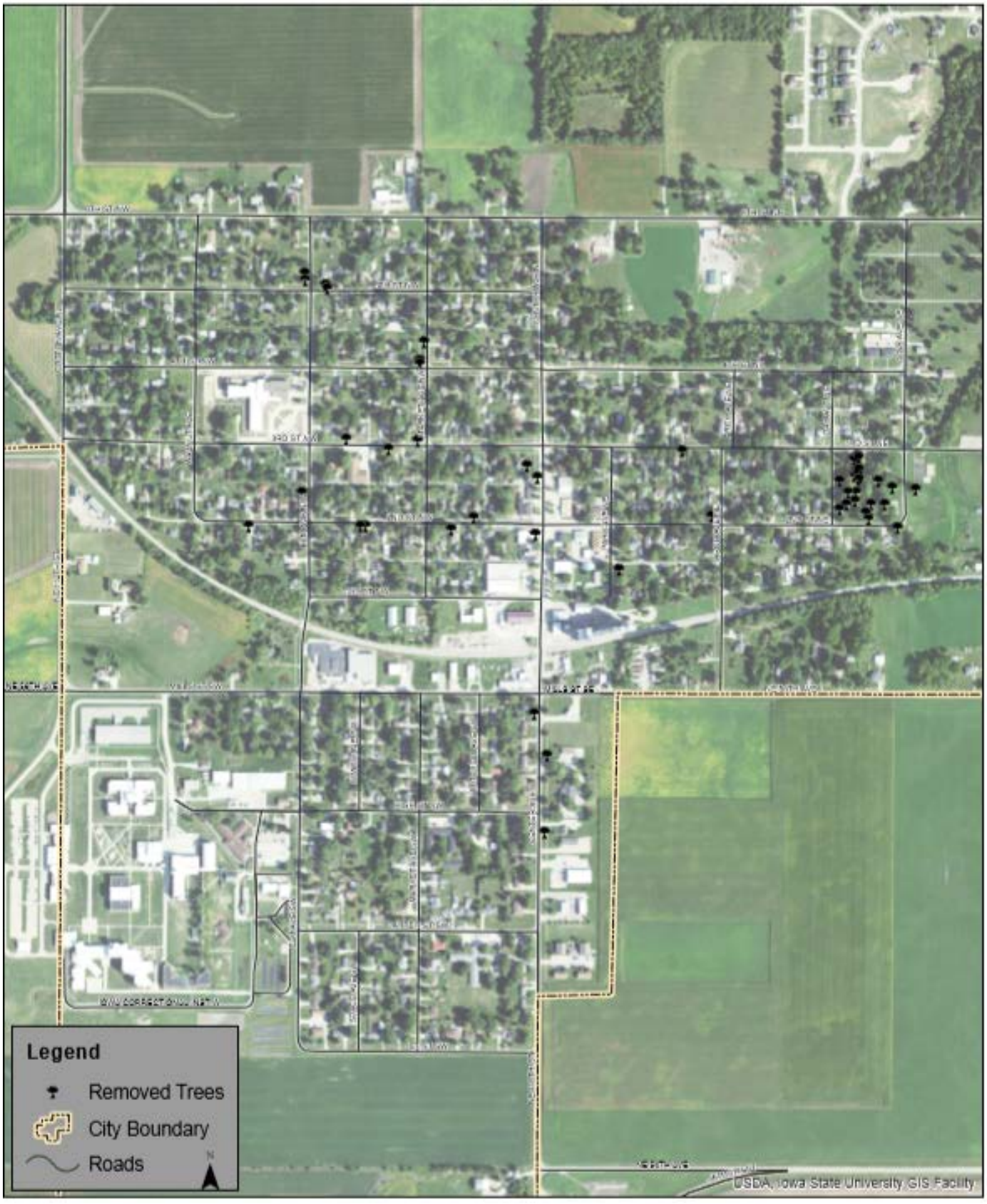


Figure 6:

Location of Treatable Ash Trees
2018 Community Tree Inventory
Mitchellville, IA

Figure 7:

Removed Trees
2018 Community Tree Inventory
Mitchellville, IA



Appendix C: Mitchellville Tree Ordinances-Codified in 2019

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.