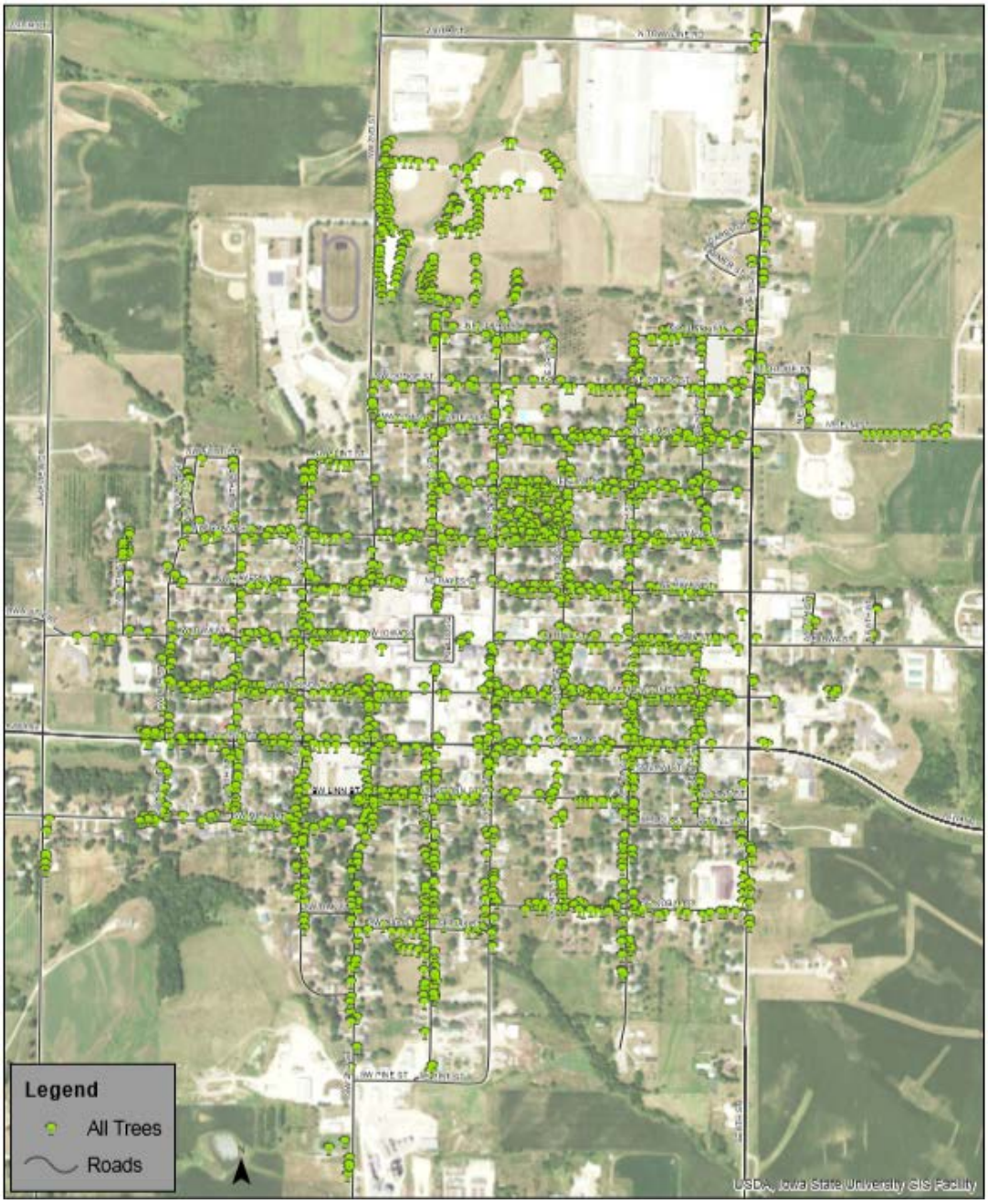
# Greenfield, IA




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 Greenfield 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 10.1% of Greenfield'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 1734 trees inventoried.

- Greenfield's trees provide $287,375 of benefits annually, an average of $166 a tree
- There are over 50 species of trees
- The top three genera are: Maple 38.2%, Oak 11.4%, and Ash 10.1%.
- 34.5% of trees are in need of some type of management
- 242 (148 ash) 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 242 trees needing removal, 128 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*
- 154 of the 176 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 current budget it could take 40 years to remove ash – Suggestion: request a budget increase to $10,000 annually and apply for grants to plant replacement trees

# Introduction

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

Trees are an important component of Greenfield'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 Greenfield 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 Greenfield'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 1734 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. Greenfield's trees reduce energy related costs by approximately $76,354 annually (Appendix A, Table 1). These savings are both in Electricity (361.83 MWh) and in Natural Gas (49,888.77) Therms).

### Annual Stormwater Benefits

Greenfield's trees intercept about 3,824,497 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $103,644 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 Greenfield it is estimated that trees remove 4,629 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 $13,019 (Appendix A, Table 3).

### Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Greenfield trees sequester about 1,378,396 lbs of carbon a year with an associated value of $10,338 (Appendix A, Table 5). In addition, the trees store 14,712,105 lbs of carbon, with a yearly benefit of $110,341 (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. Greenfield receives $84,319 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, Greenfield's trees provide $287,375 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 1734 trees in Greenfield provide approximately $166 annually (Appendix A, Table 7).

# Forest Structure

## Species Distribution

Greenfield has over 50 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

| | | |
|---|---|---|
| Maple | 662 | 38.2% |
| Oak | 198 | 11.4% |
| Ash | 176 | 10.1% |
| Linden/Basswood | 150 | 8.7% |
| Locust | 135 | 7.8% |
| Hackberry | 100 | 5.8% |
| Apple | 74 | 4.3% |
| Broadleaf Small | 49 | 2.8% |
| Spruce | 25 | 1.4% |
| Walnut | 23 | 1.3% |
| Others | 142 | 8.2% |

## Age Class

Most of Greenfield's trees (53%) are equal or less than 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Greenfield'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 Greenfield indicate that 85% of the trees are in good health, with only 5.13% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 86% of Greenfield'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 14% of the population. This 14% 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 | 306 | 17.6% |
| Crown Raising | 14 | .8% |
| Tree Staking | 19 | 1.1% |
| Tree Removal | 242 | 14% |
| Crown Reduction | 18 | 1% |

**Canopy Cover**

The total canopy with both private and public trees is 8%, 95.11 acres. The canopy cover included in the Greenfield inventory includes approximately 41 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 85 trees need to be planted annually.

**Land Use and Location**

The majority of Greenfield'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 | 78% |
| Park/vacant/other | 15% |
| Industrial/Large commercial | <1% |
| Small commercial | 5.9% |
| Multifamily residential | <1% |

| Location | |
|---|---|
| Planting strip | 99.3% |
| Other maintained locations | 0% |
| Cutout (surrounded by pavement) | .2% |
| Front yard | .5% |

# 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

Greenfield has 22 critical concern trees that need of 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 15 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 599 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 242 removals, 148 are ash trees. There are a total of 176 ash trees, and 154 of those have signs and symptoms that have been associated with EAB. In

addition, there are 53 ash 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 Greenfield.

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 (37%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut. All trees planted must meet the restrictions in city ordinance 150.11 and .12 (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: 4 largest critical concern trees
- Planting and Replacement: 7 trees to be planted in open locations
- Young Tree Pruning & Maintenance:
- Visual Survey for signs and symptoms of EAB

Year 2

- Removal: 2 critical concern trees and 2 additional ash trees with poor health
- *Or saving for ash tree treatment and/or future ash removal

Planting and Replacement: 3 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: 2 critical concern trees and 2 additional ash trees with poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 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: 2 critical concern trees and 2 additional ash trees with poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 3 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: 2 critical concern trees and 2 additional ash trees with poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 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: 2 critical concern trees and 2 additional ash trees with poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 3 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: Approximately 10 ash trees removed (approximately 5.7% of ash). It will take approximately 40 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 to 15 years of its arrival.
**To remove all ash trees within 6 years, the budget would need to be increased to $24,000 a year. If the budget were increased to $10,000 a year all ash could be removed in 15 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 city ordinance 150.11 and 150.12 (Appendix C).

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

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

### Private Ash Trees
It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used. City Code 150.10 states:

2. Removal from Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees within the City is imminent, the Council shall immediately 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 nuisance to be removed and the cost assessed against the property.

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

# Budget

**<u>Current Budget</u>**
Total $24,000 over 6 years ($4,000/year)

**FY 2019 Budget**
- Removal: $2,800
- *Or saving for ash tree treatment and/or future ash removal
- Planting: $700
- Watering & Maintenance: $500

**FY 2020 Budget**
- Removal: $2,800
- *Or saving for ash tree treatment and/or future ash removal
- Planting: $300
- Routine trimming: $400
- Watering & Maintenance: $500

**FY 2021 Budget**
- Removal: $2,800
- *Or saving for ash tree treatment and/or future ash removal
- Planting: $700

Watering & Maintenance: $500

**FY 2022 Budget**

Removal: $2,800
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $400
Watering & Maintenance: $500

**FY 2023 Budget**

Removal: $2,800
*Or saving for ash tree treatment and/or future ash removal
Planting: $700
Watering & Maintenance: $500

**FY 2024 Budget**

Removal: $2,800
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $400
Watering & Maintenance: $500

*Reduction of ash over 6 years: approximately 10 ash trees removed (approximately 5.7% of ash). **It will take approximately 40 years to remove all ash with the current budget.**

<u>Purposed Budget Increase</u>

EAB could potentially kill all ash trees in Greenfield within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $24,000 a year. If the budget were increased to $10,000 a year all ash could be removed within 13 years. Additionally, it is recommended that Greenfield 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 $12 per inch, about 13 trees could be treated ($3,120) per year (1/2 treatable ash every other year). This would be 26 total trees selected for treatment, and Greenfield would still need to find $2,800 for removal. Alternatively, if there are 26 treated trees every other year, it would cost approximately $6,240 every 2 years for treatment and leave $0 for removal and $0 for planting those years. 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 when EAB is found in Greenfield. 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 | | | 12/10/2018 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Species | Total Electricity (MWh) | Electricity ($) | Total Natural Gas (Therms) | Natural Gas ($) | Total ($) | Stand. Error | % of Total Trees | % of Total $ | Avg. $/tree |
| Sugar maple | 61.98 | 4,704.56 | 8,287.62 | 8,121.86 | 12,826.42 | (N/A) | 13.73 | 16.80 | 53.89 |
| Norway maple | 44.45 | 3,373.70 | 6,311.37 | 6,185.14 | 9,558.84 | (N/A) | 12.35 | 12.52 | 44.67 |
| Green ash | 50.98 | 3,869.15 | 6,971.30 | 6,831.87 | 10,701.03 | (N/A) | 9.17 | 14.01 | 67.30 |
| Silver maple | 45.77 | 3,474.25 | 6,070.37 | 5,948.96 | 9,423.21 | (N/A) | 8.54 | 12.34 | 63.67 |
| Honeylocust | 27.44 | 2,082.89 | 3,652.26 | 3,579.21 | 5,662.11 | (N/A) | 7.73 | 7.42 | 42.25 |
| Northern hackberry | 18.93 | 1,437.16 | 2,722.28 | 2,667.83 | 4,104.99 | (N/A) | 5.77 | 5.38 | 41.05 |
| Littleleaf linden | 15.00 | 1,138.64 | 2,069.18 | 2,027.80 | 3,166.43 | (N/A) | 4.56 | 4.15 | 40.08 |
| Apple | 6.73 | 510.94 | 1,044.30 | 1,023.41 | 1,534.35 | (N/A) | 4.27 | 2.01 | 20.73 |
| American basswood | 18.25 | 1,384.86 | 2,664.82 | 2,611.52 | 3,996.38 | (N/A) | 4.10 | 5.23 | 56.29 |
| Northern red oak | 8.67 | 658.40 | 1,152.33 | 1,129.28 | 1,787.68 | (N/A) | 3.64 | 2.34 | 28.38 |
| Broadleaf Deciduous Small | 2.30 | 174.86 | 361.83 | 354.59 | 529.46 | (N/A) | 2.83 | 0.69 | 10.81 |
| Bur oak | 4.28 | 325.16 | 571.62 | 560.19 | 885.35 | (N/A) | 2.71 | 1.16 | 18.84 |
| Northern pin oak | 10.31 | 782.68 | 1,512.07 | 1,481.83 | 2,264.51 | (N/A) | 2.02 | 2.97 | 64.70 |
| Swamp white oak | 2.48 | 187.95 | 348.93 | 341.95 | 529.90 | (N/A) | 1.56 | 0.69 | 19.63 |
| Maple | 4.15 | 314.99 | 579.61 | 568.02 | 883.01 | (N/A) | 1.56 | 1.16 | 32.70 |
| Broadleaf Deciduous Medium | 4.57 | 346.83 | 649.44 | 636.45 | 983.28 | (N/A) | 1.44 | 1.29 | 39.33 |
| Black walnut | 6.79 | 515.10 | 937.55 | 918.80 | 1,433.90 | (N/A) | 1.33 | 1.88 | 62.34 |
| Red maple | 1.35 | 102.72 | 187.76 | 184.00 | 286.72 | (N/A) | 1.27 | 0.38 | 13.03 |
| White oak | 0.48 | 36.53 | 63.26 | 62.00 | 98.53 | (N/A) | 0.87 | 0.13 | 6.57 |
| Blue spruce | 1.71 | 130.02 | 225.91 | 221.39 | 351.41 | (N/A) | 0.75 | 0.46 | 27.03 |
| Others | 25.19 | 1,911.81 | 3,504.97 | 3,434.87 | 5,346.67 | | 9.81 | 7.00 | 35.13 |
| Total | 361.83 | 27,463.20 | 49,888.77 | 48,890.99 | 76,354.19 | (N/A) | 100.00 | 100.00 | 44.06 |

## Table 2: Annual Stormwater Benefits

| Annual Stormwater Benefits of All Trees by Species | | | | 12/10/2018 | | |
|---|---|---|---|---|---|---|
| Species | Total Rainfall Interception (Gal) | Total ($) | Stand. Error | % of Total Trees | % of Total $ | Avg. $/tree |
| Sugar maple | 673,209.55 | 18,243.98 | (N/A) | 13.73 | 17.60 | 76.66 |
| Norway maple | 363,628.20 | 9,854.32 | (N/A) | 12.35 | 9.51 | 46.05 |
| Green ash | 616,961.49 | 16,719.66 | (N/A) | 9.17 | 16.13 | 105.16 |
| Silver maple | 705,745.40 | 19,125.70 | (N/A) | 8.54 | 18.45 | 129.23 |
| Honeylocust | 246,195.27 | 6,671.89 | (N/A) | 7.73 | 6.44 | 49.79 |
| Northern hackberry | 157,729.64 | 4,274.47 | (N/A) | 5.77 | 4.12 | 42.74 |
| Littleleaf linden | 138,646.11 | 3,757.31 | (N/A) | 4.56 | 3.63 | 47.56 |
| Apple | 31,747.75 | 860.36 | (N/A) | 4.27 | 0.83 | 11.63 |
| American basswood | 185,278.49 | 5,021.05 | (N/A) | 4.10 | 4.84 | 70.72 |
| Northern red oak | 62,309.99 | 1,688.60 | (N/A) | 3.64 | 1.63 | 26.80 |
| Broadleaf Deciduous Small | 9,414.35 | 255.13 | (N/A) | 2.83 | 0.25 | 5.21 |
| Bur oak | 34,351.27 | 930.92 | (N/A) | 2.71 | 0.90 | 19.81 |
| Northern pin oak | 113,223.82 | 3,068.37 | (N/A) | 2.02 | 2.96 | 87.67 |
| Swamp white oak | 14,175.66 | 384.16 | (N/A) | 1.56 | 0.37 | 14.23 |
| Maple | 34,734.26 | 941.30 | (N/A) | 1.56 | 0.91 | 34.86 |
| Broadleaf Deciduous Medium | 33,217.55 | 900.20 | (N/A) | 1.44 | 0.87 | 36.01 |
| Black walnut | 78,549.58 | 2,128.69 | (N/A) | 1.33 | 2.05 | 92.55 |
| Red maple | 11,279.78 | 305.68 | (N/A) | 1.27 | 0.29 | 13.89 |
| White oak | 3,049.63 | 82.64 | (N/A) | 0.87 | 0.08 | 5.51 |
| Blue spruce | 25,119.91 | 680.75 | (N/A) | 0.75 | 0.66 | 52.37 |
| Others | 285,929.94 | 7,748.70 | | 9.81 | 7.48 | 51.18 |
| Citywide total | 3,824,497.65 | 103,643.89 | (N/A) | 100.00 | 100.00 | 59.81 |

## Table 3: Annual Air Quality Benefits

| Annual Air Quality Benefits of All Trees by Species | | | | | 12/10/2018 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| Sugar maple | 92.59 | 15.76 | 46.12 | 4.10 | 501.32 | 293.83 | 42.92 | 40.95 | 280.74 | 1,835.19 | - 72.92 | - 273.46 | 744.10 | 2,063.05 | (N/A) | 13.73 | 8.67 |
| Norway maple | 68.22 | 11.77 | 34.37 | 3.02 | 370.98 | 214.66 | 31.10 | 29.61 | 201.70 | 1,331.81 | - 16.53 | - 61.99 | 577.91 | 1,640.80 | (N/A) | 12.35 | 7.67 |
| Green ash | 85.10 | 13.61 | 39.53 | 3.81 | 449.82 | 243.36 | 35.43 | 33.78 | 231.03 | 1,516.06 | 0.00 | 0.00 | 685.66 | 1,965.88 | (N/A) | 9.17 | 12.36 |
| Silver maple | 130.98 | 22.20 | 63.45 | 5.81 | 703.79 | 216.22 | 31.62 | 30.18 | 207.05 | 1,351.65 | - 69.20 | - 259.51 | 638.30 | 1,795.93 | (N/A) | 8.54 | 12.13 |
| Honeylocust | 45.57 | 7.51 | 21.30 | 2.07 | 242.05 | 129.86 | 18.98 | 18.12 | 124.26 | 811.58 | - 33.26 | - 124.73 | 334.42 | 928.91 | (N/A) | 7.73 | 6.93 |
| Northern hackberry | 22.29 | 3.86 | 11.83 | 1.00 | 122.99 | 91.71 | 13.26 | 12.63 | 85.89 | 568.27 | 0.00 | 0.00 | 242.47 | 691.27 | (N/A) | 5.77 | 6.91 |
| Littleleaf linden | 22.42 | 3.87 | 11.25 | 0.99 | 121.81 | 71.90 | 10.46 | 9.97 | 68.09 | 447.47 | - 11.07 | - 41.50 | 187.88 | 527.78 | (N/A) | 4.56 | 6.68 |
| Apple | 10.19 | 1.68 | 4.76 | 0.46 | 54.13 | 33.21 | 4.76 | 4.52 | 30.50 | 204.20 | - 0.06 | - 0.21 | 90.02 | 258.11 | (N/A) | 4.27 | 3.49 |
| American basswood | 23.36 | 3.98 | 11.79 | 1.03 | 126.93 | 88.77 | 12.81 | 12.19 | 82.79 | 549.14 | - 20.47 | - 76.75 | 216.26 | 599.33 | (N/A) | 4.10 | 8.44 |
| Northern red oak | 11.35 | 1.96 | 5.85 | 0.50 | 62.10 | 41.04 | 6.00 | 5.73 | 39.30 | 256.57 | - 15.91 | - 59.66 | 95.83 | 259.01 | (N/A) | 3.64 | 4.11 |
| Broadleaf Deciduous Small | 2.55 | 0.42 | 1.25 | 0.12 | 13.73 | 11.41 | 1.63 | 1.55 | 10.44 | 70.03 | - 0.01 | - 0.05 | 29.35 | 83.71 | (N/A) | 2.83 | 1.71 |
| Bur oak | 3.00 | 0.48 | 1.67 | 0.13 | 16.67 | 20.30 | 2.97 | 2.83 | 19.41 | 126.84 | 0.00 | 0.00 | 50.81 | 143.51 | (N/A) | 2.71 | 3.05 |
| Northern pin oak | 25.20 | 4.35 | 12.11 | 1.12 | 135.39 | 50.21 | 7.24 | 6.89 | 46.78 | 310.47 | - 5.73 | - 21.49 | 148.17 | 424.37 | (N/A) | 2.02 | 12.12 |
| Swamp white oak | 1.83 | 0.32 | 1.06 | 0.08 | 10.35 | 11.94 | 1.73 | 1.65 | 11.24 | 74.13 | - 0.53 | - 1.97 | 29.32 | 82.51 | (N/A) | 1.56 | 3.06 |
| Maple | 8.05 | 1.37 | 3.81 | 0.36 | 43.02 | 19.88 | 2.89 | 2.75 | 18.80 | 123.66 | - 2.72 | - 10.20 | 55.19 | 156.48 | (N/A) | 1.56 | 5.80 |
| Broadleaf Deciduous Medium | 5.60 | 0.97 | 2.92 | 0.25 | 30.72 | 22.07 | 3.20 | 3.04 | 20.74 | 136.95 | - 1.42 | - 5.31 | 57.37 | 162.35 | (N/A) | 1.44 | 6.49 |
| Black walnut | 10.40 | 1.66 | 4.90 | 0.47 | 55.17 | 32.48 | 4.72 | 4.50 | 30.76 | 202.14 | 0.00 | 0.00 | 89.89 | 257.31 | (N/A) | 1.33 | 11.19 |
| Red maple | 2.66 | 0.45 | 1.25 | 0.12 | 14.22 | 6.47 | 0.94 | 0.90 | 6.13 | 40.29 | - 0.89 | - 3.34 | 18.05 | 51.18 | (N/A) | 1.27 | 2.33 |
| White oak | 0.16 | 0.03 | 0.12 | 0.01 | 0.97 | 2.27 | 0.33 | 0.32 | 2.18 | 14.22 | 0.00 | 0.00 | 5.41 | 15.19 | (N/A) | 0.87 | 1.01 |
| Blue spruce | 3.69 | 0.73 | 3.01 | 0.45 | 24.26 | 8.08 | 1.18 | 1.13 | 7.75 | 50.54 | - 9.39 | - 35.22 | 16.64 | 39.58 | (N/A) | 0.75 | 3.04 |
| Others | 49.80 | 8.58 | 27.10 | 3.08 | 278.32 | 120.72 | 17.54 | 16.72 | 114.14 | 750.84 | - 41.62 | - 156.09 | 316.06 | 873.07 | | 9.81 | 5.73 |
| Citywide Total | 625.04 | 105.55 | 309.46 | 28.99 | 3,378.74 | 1,730.39 | 251.73 | 239.95 | 1,639.73 | 10,772.06 | - 301.73 | - 1,131.48 | 4,629.10 | 13,019.32 | (N/A) | 100.00 | 7.51 |

## Table 4: Annual Carbon Stored

| Stored CO2 Benefits of All Trees by Species | | | 12/10/2018 | | | |
|---|---|---|---|---|---|---|
| Species | Total stored CO2 (lbs) | Total ($) | Stand. Error | % of Total Trees | % of Total $ | Avg. $/tree |
| Sugar maple | 2,699,190.46 | 20,243.93 | (N/A) | 13.73 | 18.35 | 85.06 |
| Norway maple | 1,128,859.49 | 8,466.45 | (N/A) | 12.35 | 7.67 | 39.56 |
| Green ash | 2,814,724.06 | 21,110.43 | (N/A) | 9.17 | 19.13 | 132.77 |
| Silver maple | 3,185,321.48 | 23,889.91 | (N/A) | 8.54 | 21.65 | 161.42 |
| Honeylocust | 575,062.26 | 4,312.97 | (N/A) | 7.73 | 3.91 | 32.19 |
| Northern hackberry | 326,648.83 | 2,449.87 | (N/A) | 5.77 | 2.22 | 24.50 |
| Littleleaf linden | 483,388.13 | 3,625.41 | (N/A) | 4.56 | 3.29 | 45.89 |
| Apple | 161,517.50 | 1,211.38 | (N/A) | 4.27 | 1.10 | 16.37 |
| American basswood | 843,420.84 | 6,325.66 | (N/A) | 4.10 | 5.73 | 89.09 |
| Northern red oak | 215,131.36 | 1,613.49 | (N/A) | 3.64 | 1.46 | 25.61 |
| Broadleaf Deciduous Small | 42,404.79 | 318.04 | (N/A) | 2.83 | 0.29 | 6.49 |
| Bur oak | 104,575.46 | 784.32 | (N/A) | 2.71 | 0.71 | 16.69 |
| Northern pin oak | 415,564.71 | 3,116.74 | (N/A) | 2.02 | 2.82 | 89.05 |
| Swamp white oak | 32,256.30 | 241.92 | (N/A) | 1.56 | 0.22 | 8.96 |
| Maple | 88,704.09 | 665.28 | (N/A) | 1.56 | 0.60 | 24.64 |
| Broadleaf Deciduous Medium | 92,970.36 | 697.28 | (N/A) | 1.44 | 0.63 | 27.89 |
| Black walnut | 342,850.18 | 2,571.38 | (N/A) | 1.33 | 2.33 | 111.80 |
| Red maple | 29,250.20 | 219.38 | (N/A) | 1.27 | 0.20 | 9.97 |
| White oak | 6,060.16 | 45.45 | (N/A) | 0.87 | 0.04 | 3.03 |
| Blue spruce | 27,425.47 | 205.69 | (N/A) | 0.75 | 0.19 | 15.82 |
| Others | 1,096,779.14 | 8,225.84 | | 9.81 | 7.45 | 53.42 |
| Citywide total | 14,712,105.27 | 110,340.79 | (N/A) | 100.00 | 100.00 | 63.67 |

## Table 5: Annual Carbon Sequestered

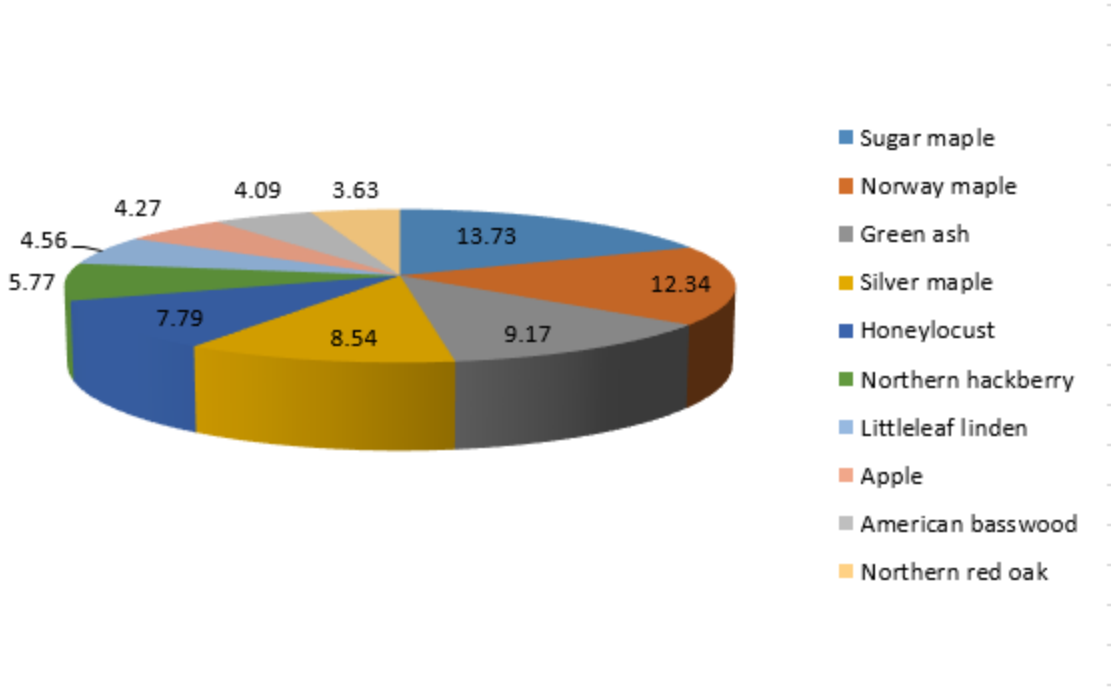
| Annual CO2 Benefits of All Trees by Species | | | 12/10/2018 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | Sequestered (lb) | Sequestered ($) | Decomposition Release(lb) | Maintenance Release (lb) | Total Release ($) | Avoided (lb) | Avoided ($) | Net Total (lb) | Total ($) | Stand. Error | % of Total Trees | % of Total $ | Avg. $/tree |
| Sugar maple | 138,795.09 | 1,040.96 | - 12,962.78 | - 668.08 | - 102.23 | 103,969.51 | 779.77 | 229,133.73 | 1,718.50 | (N/A) | 13.73 | 16.62 | 7.22 |
| Norway maple | 72,514.48 | 543.86 | - 5,431.92 | - 441.68 | - 44.05 | 74,557.87 | 559.18 | 141,198.75 | 1,058.99 | (N/A) | 12.35 | 10.24 | 4.95 |
| Green ash | 116,215.66 | 871.62 | - 13,510.68 | - 542.49 | - 105.40 | 85,507.26 | 641.30 | 187,669.74 | 1,407.52 | (N/A) | 9.17 | 13.62 | 8.85 |
| Silver maple | 214,363.55 | 1,607.73 | - 15,294.65 | - 536.06 | - 118.73 | 76,780.01 | 575.85 | 275,312.84 | 2,064.85 | (N/A) | 8.54 | 19.97 | 13.95 |
| Honeylocust | 60,446.74 | 453.35 | - 2,763.46 | - 225.03 | - 22.41 | 46,031.37 | 345.24 | 103,489.62 | 776.17 | (N/A) | 7.73 | 7.51 | 5.79 |
| Northern hackberry | 21,293.65 | 159.70 | - 1,570.49 | - 179.01 | - 13.12 | 31,760.90 | 238.21 | 51,305.05 | 384.79 | (N/A) | 5.77 | 3.72 | 3.85 |
| Littleleaf linden | 43,573.15 | 326.80 | - 2,323.29 | - 175.89 | - 18.74 | 25,163.55 | 188.73 | 66,237.52 | 496.78 | (N/A) | 4.56 | 4.81 | 6.29 |
| Apple | 11,321.10 | 84.91 | - 776.03 | - 98.67 | - 6.56 | 11,291.67 | 84.69 | 21,738.06 | 163.04 | (N/A) | 4.27 | 1.58 | 2.20 |
| American basswood | 52,580.28 | 394.35 | - 4,048.46 | - 209.63 | - 31.94 | 30,605.03 | 229.54 | 78,927.22 | 591.95 | (N/A) | 4.10 | 5.73 | 8.34 |
| Northern red oak | 11,906.29 | 89.30 | - 1,032.91 | - 100.43 | - 8.50 | 14,550.41 | 109.13 | 25,323.36 | 189.93 | (N/A) | 3.64 | 1.84 | 3.01 |
| Broadleaf Deciduous Small | 2,686.36 | 20.15 | - 204.43 | - 39.78 | - 1.83 | 3,864.44 | 28.98 | 6,306.60 | 47.30 | (N/A) | 2.83 | 0.46 | 0.97 |
| Bur oak | 9,205.80 | 69.04 | - 502.51 | - 49.73 | - 4.14 | 7,185.97 | 53.89 | 15,839.54 | 118.80 | (N/A) | 2.71 | 1.15 | 2.53 |
| Northern pin oak | 6,943.11 | 52.07 | - 1,994.76 | - 123.44 | - 15.89 | 17,297.05 | 129.73 | 22,121.97 | 165.91 | (N/A) | 2.02 | 1.60 | 4.74 |
| Swamp white oak | 4,576.64 | 34.32 | - 156.77 | - 25.35 | - 1.37 | 4,153.70 | 31.15 | 8,548.23 | 64.11 | (N/A) | 1.56 | 0.62 | 2.37 |
| Maple | 10,800.75 | 81.01 | - 425.94 | - 41.34 | - 3.50 | 6,961.17 | 52.21 | 17,294.63 | 129.71 | (N/A) | 1.56 | 1.25 | 4.80 |
| Broadleaf Deciduous Medium | 8,231.46 | 61.74 | - 448.36 | - 44.66 | - 3.70 | 7,664.78 | 57.49 | 15,403.23 | 115.52 | (N/A) | 1.44 | 1.12 | 4.62 |
| Black walnut | 15,687.97 | 117.66 | - 1,645.68 | - 72.15 | - 12.88 | 11,383.59 | 85.38 | 25,353.73 | 190.15 | (N/A) | 1.33 | 1.84 | 8.27 |
| Red maple | 2,614.85 | 19.61 | - 141.21 | - 15.41 | - 1.17 | 2,269.99 | 17.02 | 4,728.23 | 35.46 | (N/A) | 1.27 | 0.34 | 1.61 |
| White oak | 965.64 | 7.24 | - 29.52 | - 7.02 | - 0.27 | 807.36 | 6.06 | 1,736.46 | 13.02 | (N/A) | 0.87 | 0.13 | 0.87 |
| Blue spruce | 1,548.09 | 11.61 | - 131.64 | - 30.81 | - 1.22 | 2,873.34 | 21.55 | 4,258.98 | 31.94 | (N/A) | 0.75 | 0.31 | 2.46 |
| Others | 39,819.48 | 298.65 | - 5,268.17 | - 333.26 | - 42.01 | 42,250.42 | 316.88 | 76,468.47 | 573.51 | | 9.81 | 5.55 | 3.78 |
| Citywide Total | 846,090.12 | 6,345.68 | - 70,663.65 | - 3,959.90 | - 559.68 | 606,929.39 | 4,551.97 | 1,378,395.96 | 10,337.97 | (N/A) | 100.00 | 100.00 | 5.97 |

## Table 6: Annual Social and Aesthetic Benefits

| Annual Aesthetic/Other Benefit of All Trees by Species | | | | 12/10/2018 | |
|---|---|---|---|---|---|
| Species | Total ($) | Stand. Error | % of Total Trees | % of Total $ | Avg. $/tree |
| Sugar maple | 14,405.52 | (N/A) | 13.73 | 17.15 | 60.53 |
| Norway maple | 7,167.97 | (N/A) | 12.35 | 8.53 | 33.50 |
| Green ash | 9,093.65 | (N/A) | 9.17 | 10.82 | 57.19 |
| Silver maple | 15,910.71 | (N/A) | 8.54 | 18.94 | 107.50 |
| Honeylocust | 13,175.23 | (N/A) | 7.73 | 15.68 | 98.32 |
| Northern hackberry | 3,330.93 | (N/A) | 5.77 | 3.96 | 33.31 |
| Littleleaf linden | 4,580.77 | (N/A) | 4.56 | 5.45 | 57.98 |
| Apple | 656.71 | (N/A) | 4.27 | 0.78 | 8.87 |
| American basswood | 3,983.62 | (N/A) | 4.10 | 4.74 | 56.11 |
| Northern red oak | 1,071.47 | (N/A) | 3.64 | 1.28 | 17.01 |
| Broadleaf Deciduous Small | 142.64 | (N/A) | 2.83 | 0.17 | 2.91 |
| Bur oak | 1,119.01 | (N/A) | 2.71 | 1.33 | 23.81 |
| Northern pin oak | 630.25 | (N/A) | 2.02 | 0.75 | 18.01 |
| Swamp white oak | 524.08 | (N/A) | 1.56 | 0.62 | 19.41 |
| Maple | 1,388.67 | (N/A) | 1.56 | 1.65 | 51.43 |
| Broadleaf Deciduous Medium | 836.85 | (N/A) | 1.44 | 1.00 | 33.47 |
| Black walnut | 1,271.85 | (N/A) | 1.33 | 1.51 | 55.30 |
| Red maple | 329.00 | (N/A) | 1.27 | 0.39 | 14.95 |
| White oak | 175.59 | (N/A) | 0.87 | 0.21 | 11.71 |
| Blue spruce | 277.95 | (N/A) | 0.75 | 0.33 | 21.38 |
| Others | 3,946.98 | | 9.81 | 4.70 | 26.17 |
| Citywide Total | 84,019.44 | (N/A) | 100.00 | 100.00 | 48.48 |

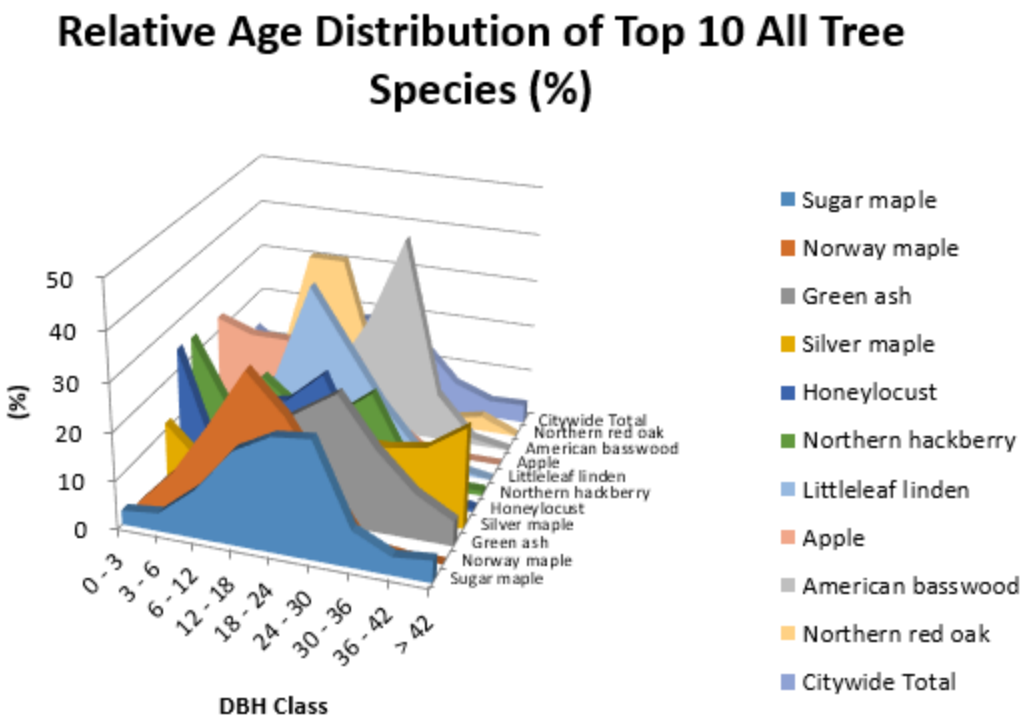
## Table 7: Summary of Benefits in Dollars

| Average Annual Benefits of All Tree by Species ($/tree) | | | | 12/10/2018 | | | |
|---|---|---|---|---|---|---|---|
| Species | Energy | CO2 | Air Quality | Stormwater | Aesthetic/Other | Total | Stand. Error |
| Sugar maple | 53.89 | 7.22 | 8.67 | 76.66 | 60.53 | 206.96 | (N/A) |
| Norway maple | 44.67 | 4.95 | 7.67 | 46.05 | 33.50 | 136.83 | (N/A) |
| Green ash | 67.30 | 8.85 | 12.36 | 105.16 | 57.19 | 250.87 | (N/A) |
| Silver maple | 63.67 | 13.95 | 12.13 | 129.23 | 107.50 | 326.49 | (N/A) |
| Honeylocust | 42.25 | 5.79 | 6.93 | 49.79 | 98.32 | 203.09 | (N/A) |
| Northern hackberry | 41.05 | 3.85 | 6.91 | 42.74 | 33.31 | 127.86 | (N/A) |
| Littleleaf linden | 40.08 | 6.29 | 6.68 | 47.56 | 57.98 | 158.60 | (N/A) |
| Apple | 20.73 | 2.20 | 3.49 | 11.63 | 8.87 | 46.93 | (N/A) |
| American basswood | 56.29 | 8.34 | 8.44 | 70.72 | 56.11 | 199.89 | (N/A) |
| Northern red oak | 28.38 | 3.01 | 4.11 | 26.80 | 17.01 | 79.31 | (N/A) |
| Broadleaf Deciduous Small | 10.81 | 0.97 | 1.71 | 5.21 | 2.91 | 21.60 | (N/A) |
| Bur oak | 18.84 | 2.53 | 3.05 | 19.81 | 23.81 | 68.03 | (N/A) |
| Northern pin oak | 64.70 | 4.74 | 12.12 | 87.67 | 18.01 | 187.24 | (N/A) |
| Swamp white oak | 19.63 | 2.37 | 3.06 | 14.23 | 19.41 | 58.69 | (N/A) |
| Maple | 32.70 | 4.80 | 5.80 | 34.86 | 51.43 | 129.60 | (N/A) |
| Broadleaf Deciduous Medium | 39.33 | 4.62 | 6.49 | 36.01 | 33.47 | 119.93 | (N/A) |
| Black walnut | 62.34 | 8.27 | 11.19 | 92.55 | 55.30 | 229.65 | (N/A) |
| Red maple | 13.03 | 1.61 | 2.33 | 13.89 | 14.95 | 45.82 | (N/A) |
| White oak | 6.57 | 0.87 | 1.01 | 5.51 | 11.71 | 25.66 | (N/A) |
| Blue spruce | 27.03 | 2.46 | 3.04 | 52.37 | 21.38 | 106.28 | (N/A) |
| Others | 1,229.44 | 132.43 | 200.57 | 1,791.21 | 916.01 | 4,269.65 | |
| Citywide Total | 44.06 | 5.97 | 7.51 | 59.81 | 48.48 | 165.83 | (N/A) |




| Species Distribution of All Trees for 1 | |
|---|---|
| 12/10/2018 | |
| Species | Percent |
| Sugar maple | 13.73 |
| Norway maple | 12.34 |
| Green ash | 9.17 |
| Silver maple | 8.54 |
| Honeylocust | 7.79 |
| Northern hackberry | 5.77 |
| Littleleaf linden | 4.56 |
| Apple | 4.27 |
| American basswood | 4.09 |
| Northern red oak | 3.63 |
| Other Species | 26.12 |

**Figure 1: Species Distribution**




| | DBH class (in) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Species | 0 - 3 | 3 - 6 | 6 - 12 | 12 - 18 | 18 - 24 | 24 - 30 | 30 - 36 | 36 - 42 | >42 |
| Sugar maple | 2.94 | 3.78 | 10.08 | 19.33 | 23.53 | 24.37 | 7.56 | 3.78 | 4.62 |
| Norway maple | 0.93 | 8.88 | 20.09 | 32.24 | 24.30 | 12.62 | 0.93 | 0.00 | 0.00 |
| Green ash | 0.00 | 0.00 | 2.52 | 16.98 | 22.01 | 27.04 | 16.98 | 9.43 | 5.03 |
| Silver maple | 11.49 | 4.05 | 2.70 | 4.73 | 12.16 | 14.19 | 14.19 | 15.54 | 20.95 |
| Honeylocust | 24.44 | 2.22 | 15.56 | 17.04 | 23.70 | 7.41 | 6.67 | 1.48 | 0.74 |
| Northern hackberry | 24.00 | 10.00 | 18.00 | 12.00 | 12.00 | 18.00 | 4.00 | 1.00 | 1.00 |
| Littleleaf linden | 1.27 | 6.33 | 15.19 | 35.44 | 24.05 | 12.66 | 3.80 | 1.27 | 0.00 |
| Apple | 22.97 | 20.27 | 20.27 | 13.51 | 17.57 | 5.41 | 0.00 | 0.00 | 0.00 |
| American basswood | 1.41 | 2.82 | 7.04 | 11.27 | 23.94 | 42.25 | 9.86 | 1.41 | 0.00 |
| Northern red oak | 11.11 | 6.35 | 33.33 | 33.33 | 7.94 | 3.17 | 1.59 | 3.17 | 0.00 |
| Citywide Total | 12.63 | 6.92 | 14.82 | 17.99 | 18.80 | 14.59 | 6.57 | 3.69 | 3.92 |

**Figure 2: Relative Age Class**

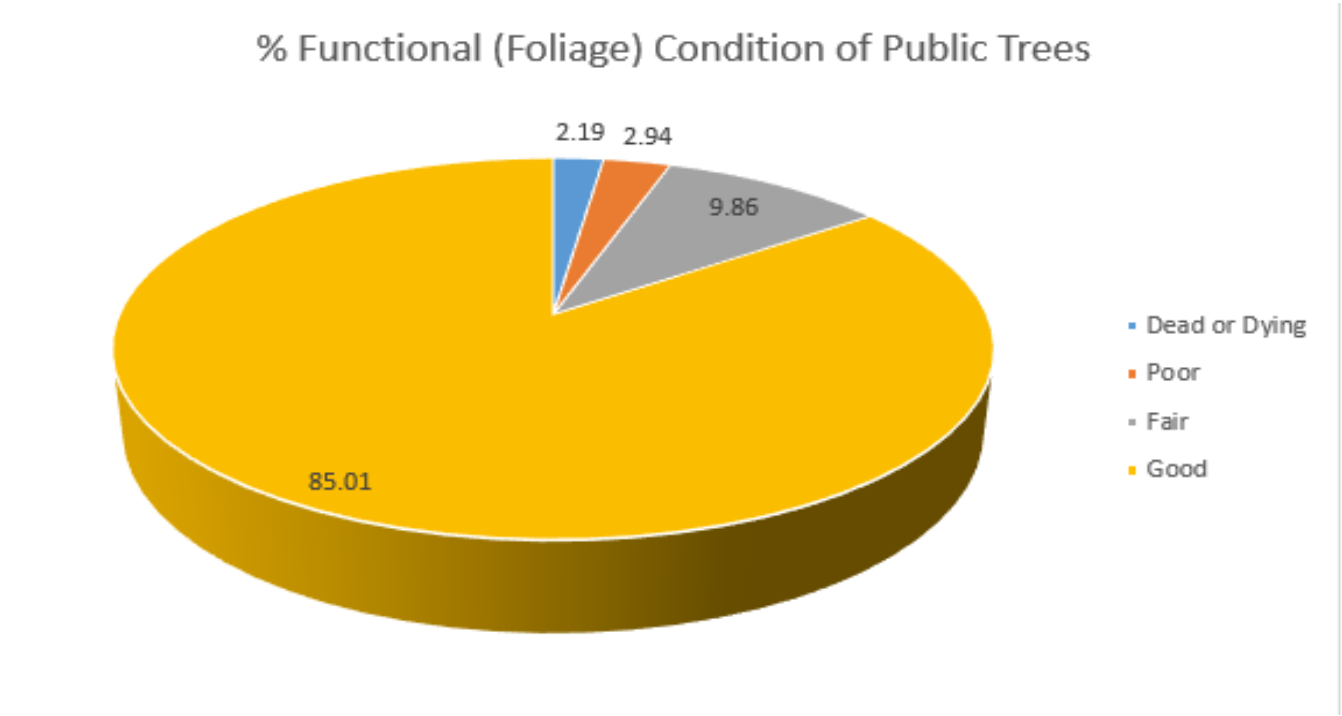



**Figure 3: Foliage Condition**

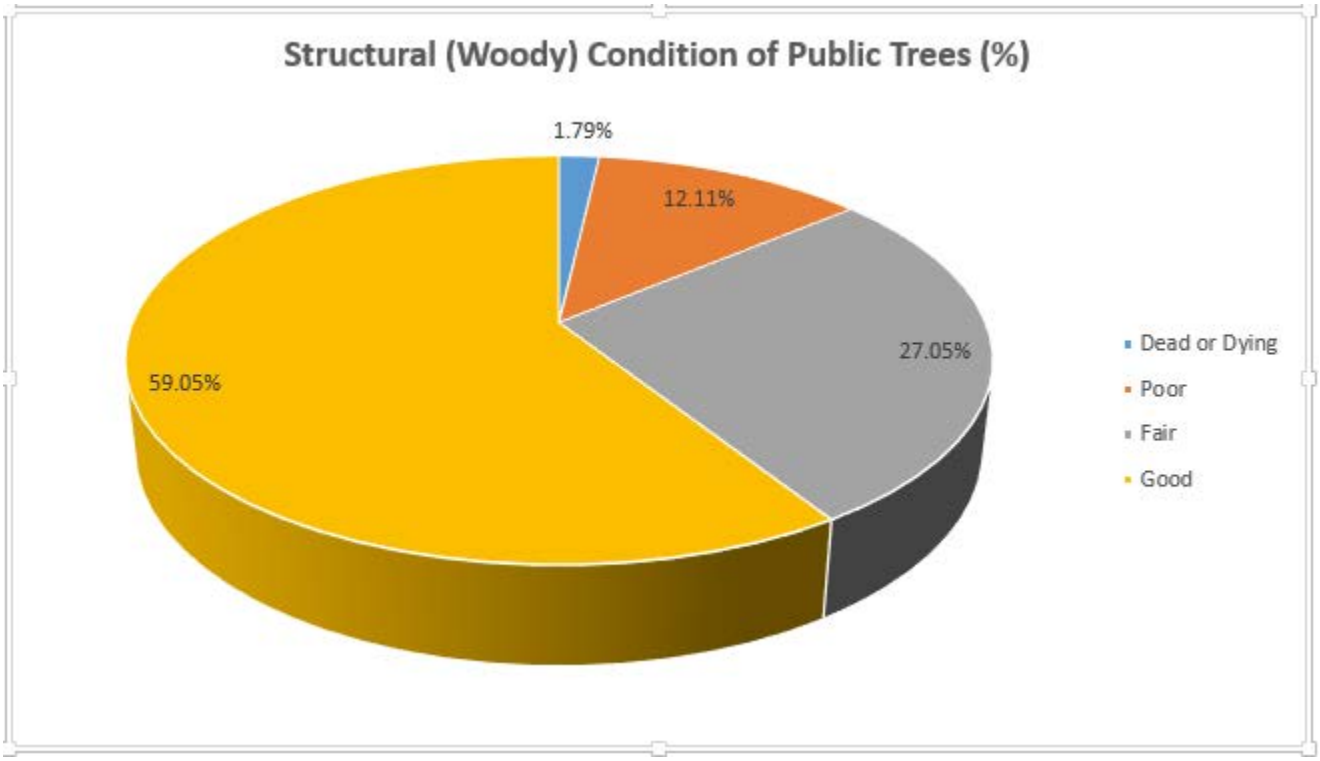
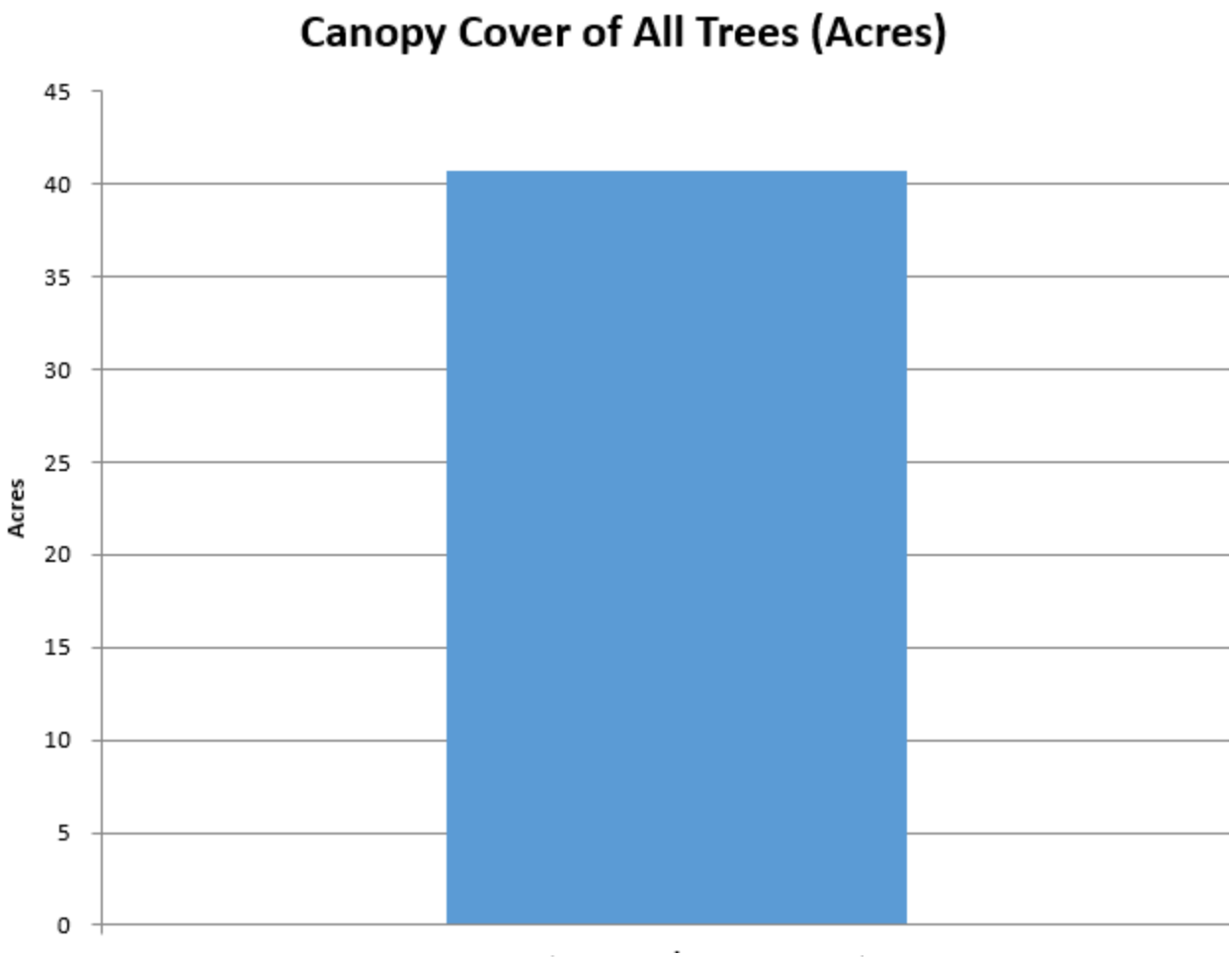



**Figure 4: Wood Condition**




| Canopy Cover of All Trees (Acres) | | 12/10/2018 |
|---|---|---|
| Zone | Acres | % of Total Canopy |
| 1 | 40.69 | 42.80 |
| Citywide Total | 95.11 | 100.00 |

**Figure 5: Canopy Cover in Acres**


| | | | | |
|---|---|---|---|---|
| Citywide | Single family residential | 1349 | (N/A) | 77.80 |
| | Multi-family residential | 12 | (N/A) | 0.69 |
| | Industrial/Large commercial | 6 | (N/A) | 0.35 |
| | Park/vacant/other | 265 | (N/A) | 15.28 |
| | Small commercial | 102 | (N/A) | 5.88 |
| | Total | 1734 | (N/A) | 100.00 |

**Figure 6: Land Use of city/park trees**


| | | | | | |
|---|---|---|---|---|---|
| Citywide | Front yard | 9 | (N/A) | 0.52 | 0.52 |
| | Planting strip | 1722 | (N/A) | 99.31 | 99.31 |
| | Cutout | 3 | (N/A) | 0.17 | 0.17 |
| | Median | 0 | (N/A) | 0.00 | 0.00 |
| | Other maintained locations | 0 | (N/A) | 0.00 | 0.00 |
| | Other un-maintained locations | 0 | (N/A) | 0.00 | 0.00 |
| | Backyard | 0 | (N/A) | 0.00 | 0.00 |
| | Total | 1734 | (N/A) | 100.00 | 100.00 |

**Figure 7: Location of city/park trees**

# Appendix B: ArcGIS Mapping

**Figure 1:**

Location of Ash Trees
2018 Community Tree Inventory
Greenfield, IA

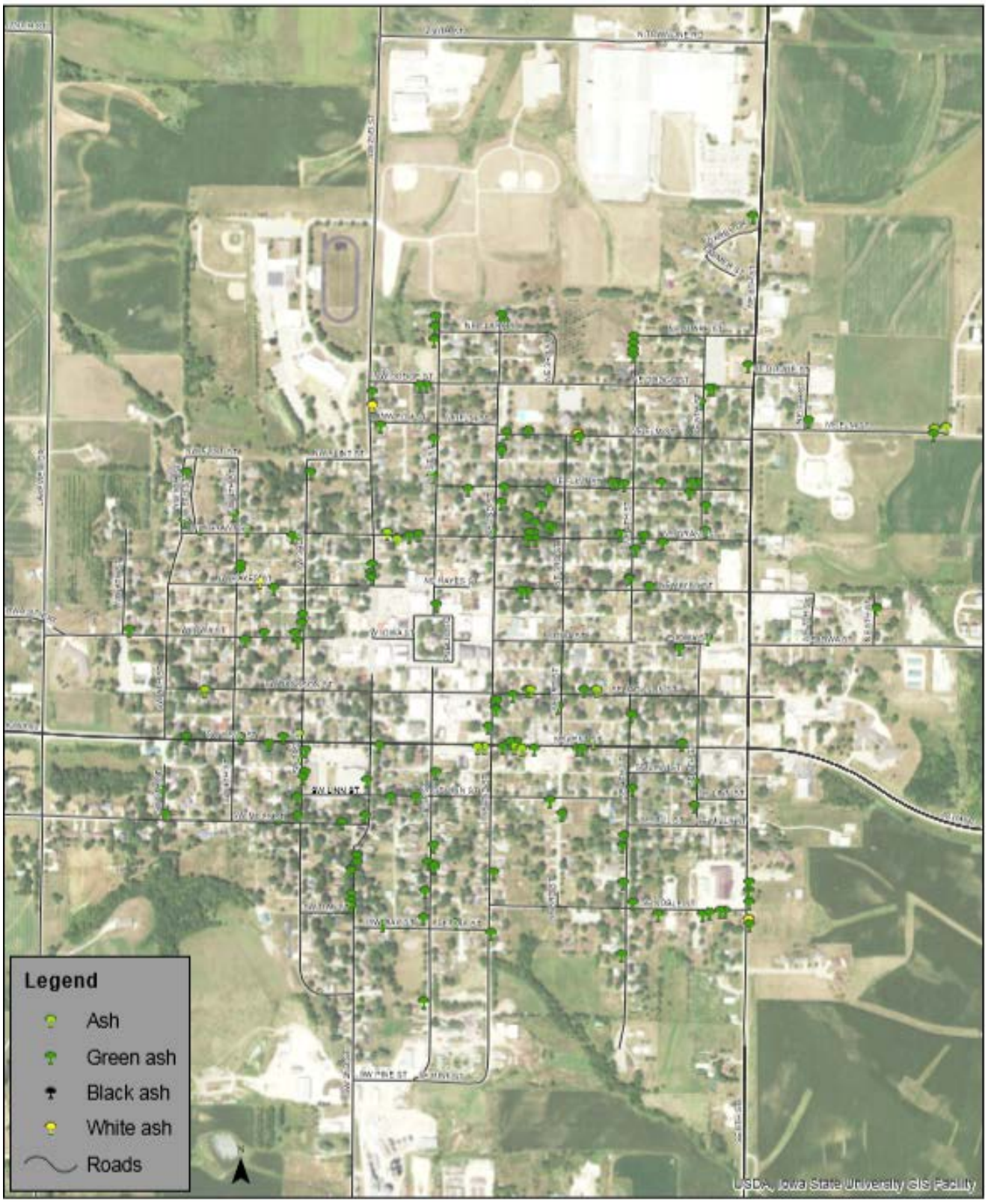


**Figure 2:**

Location of EAB Symptoms
2018 Community Tree Inventory
Greenfield, IA

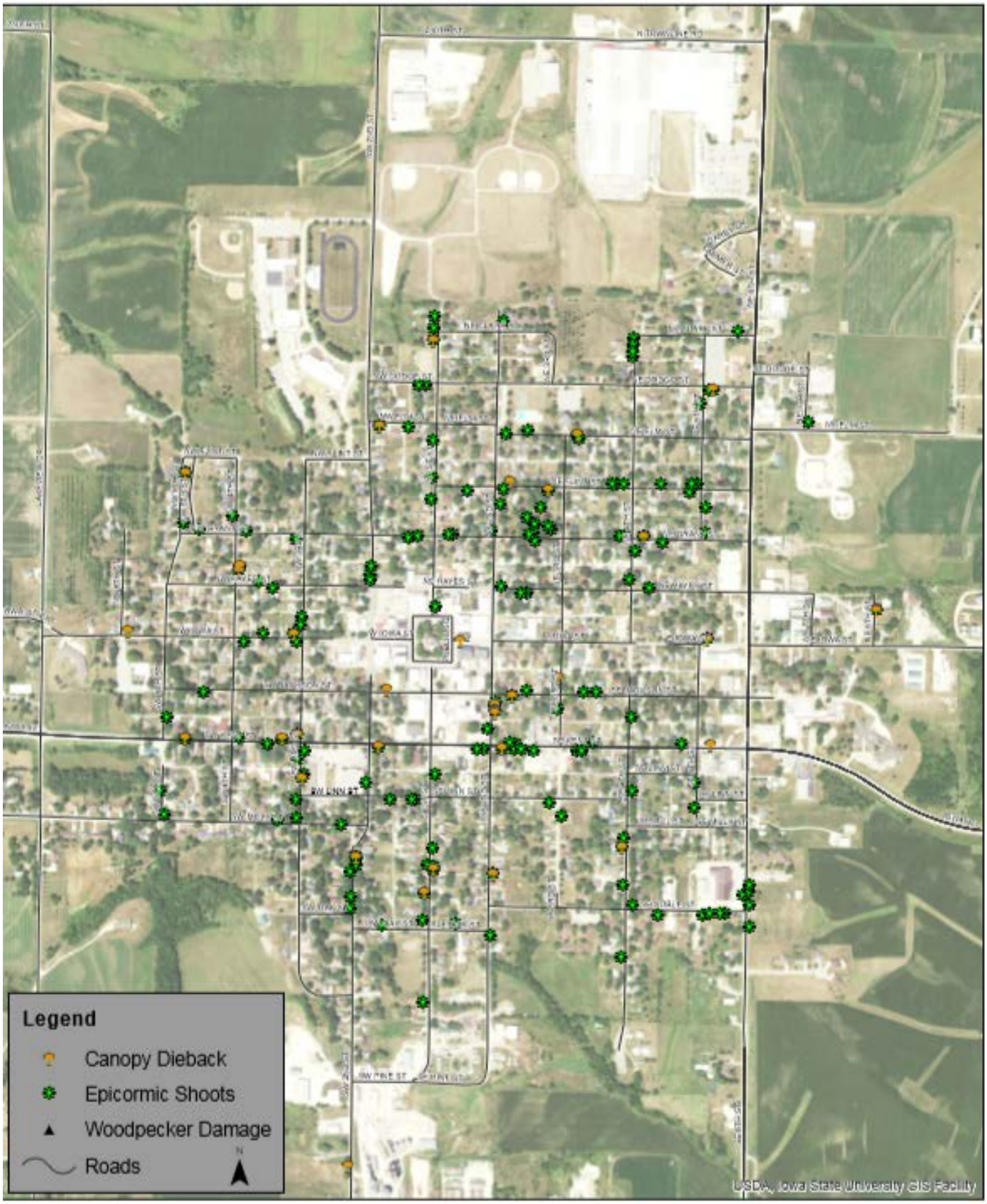


**Figure 3a:**

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

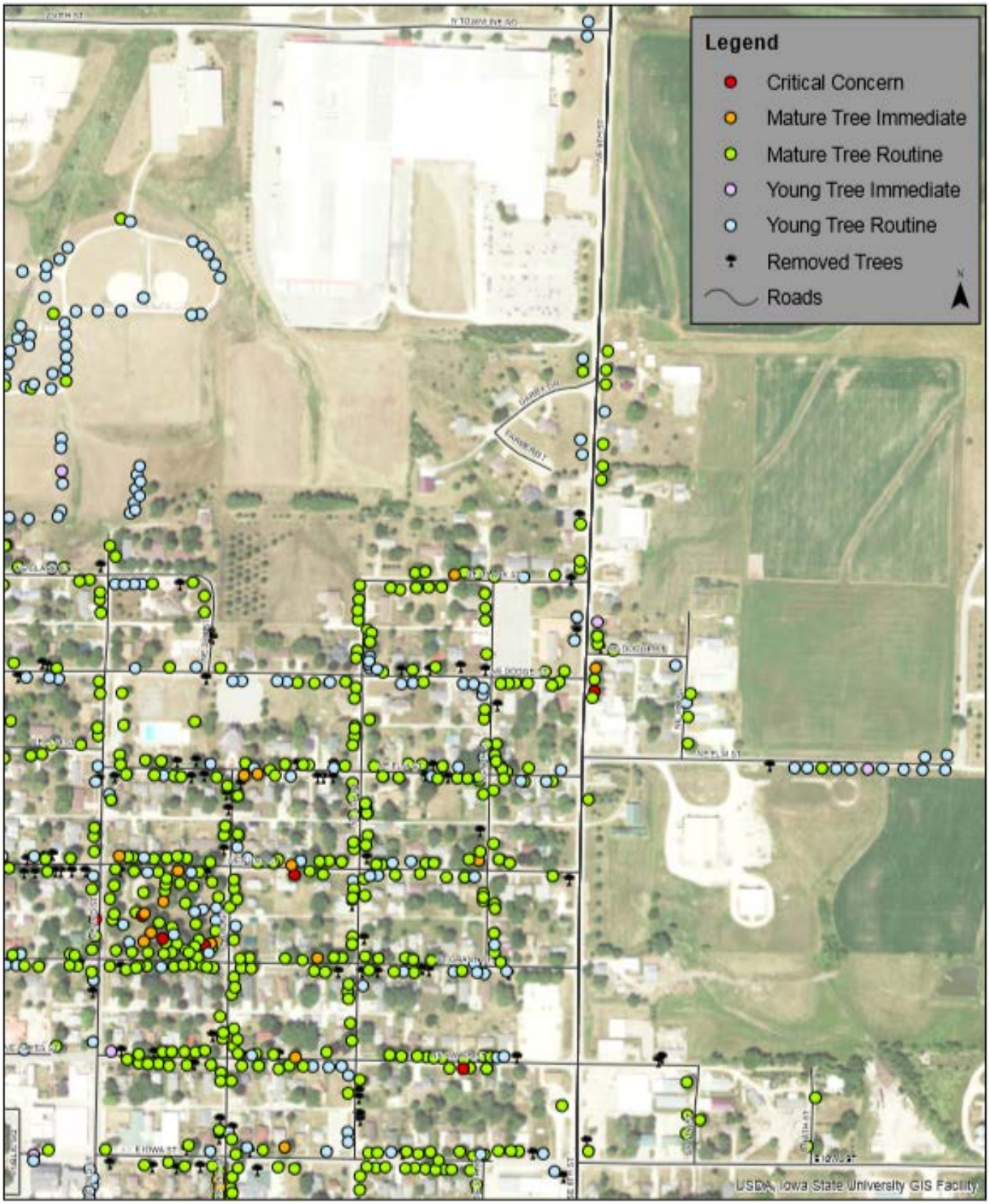


**Figure 3b:**

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

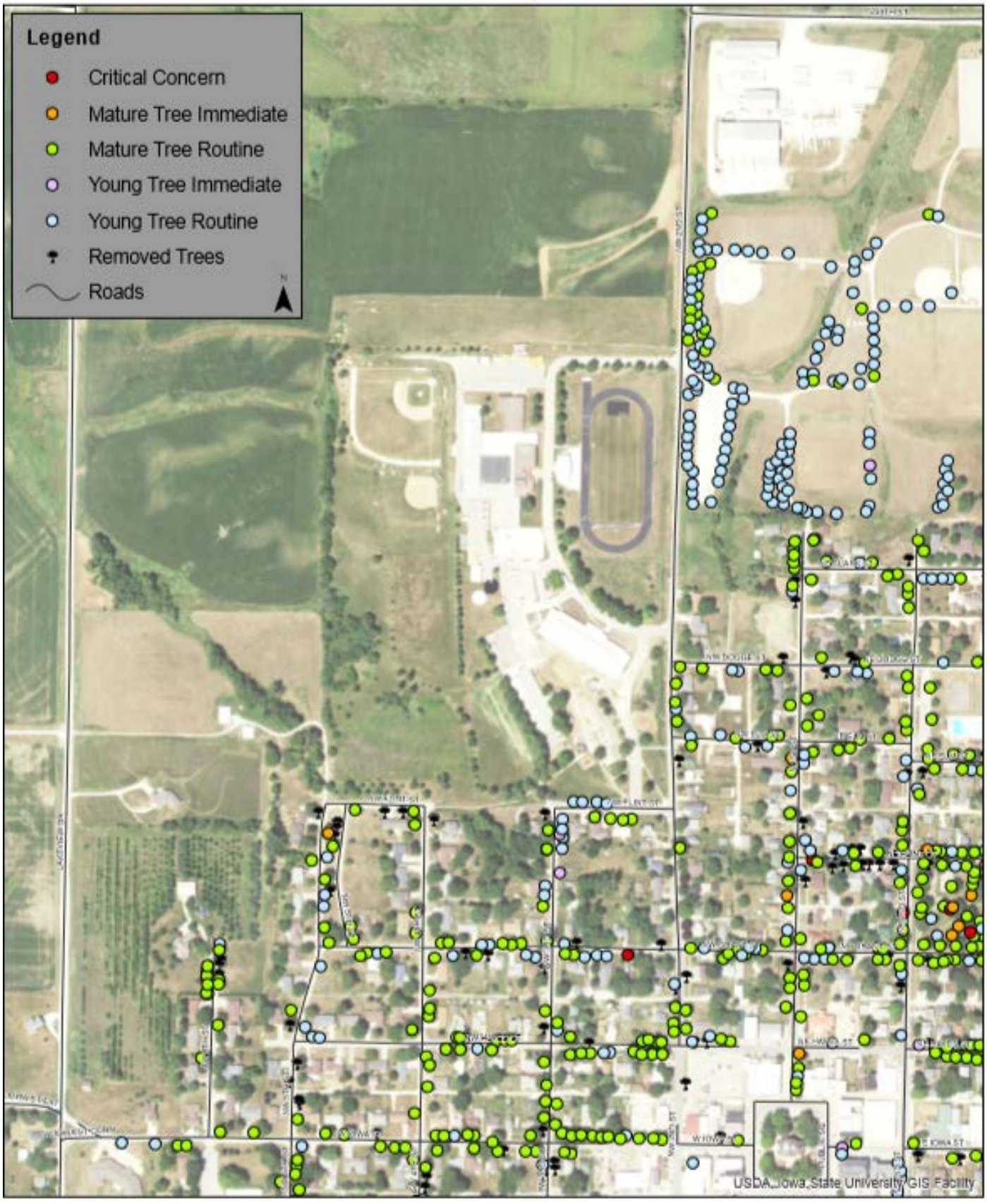


**Figure 3c:**

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

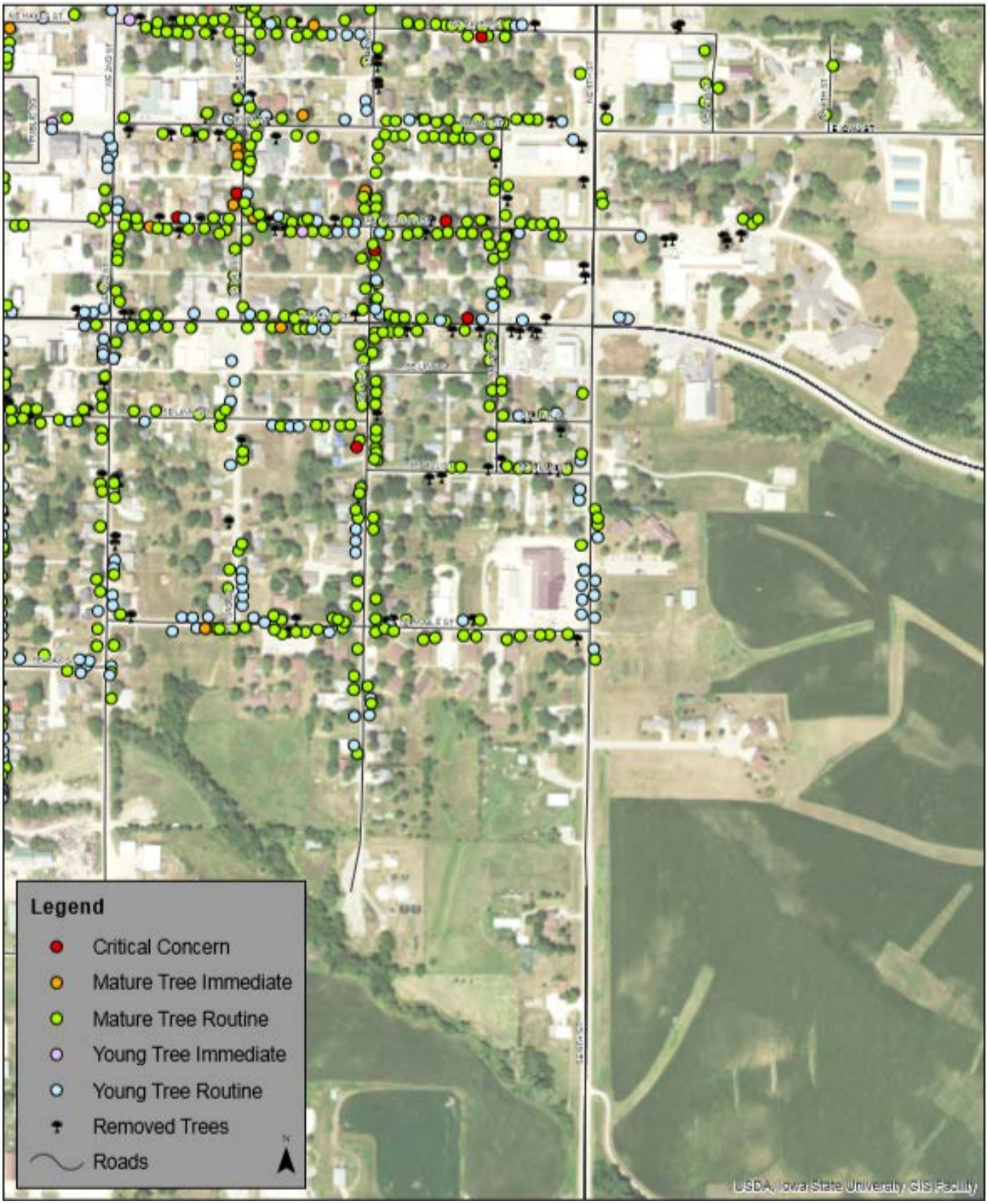


**Figure 3d:**

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

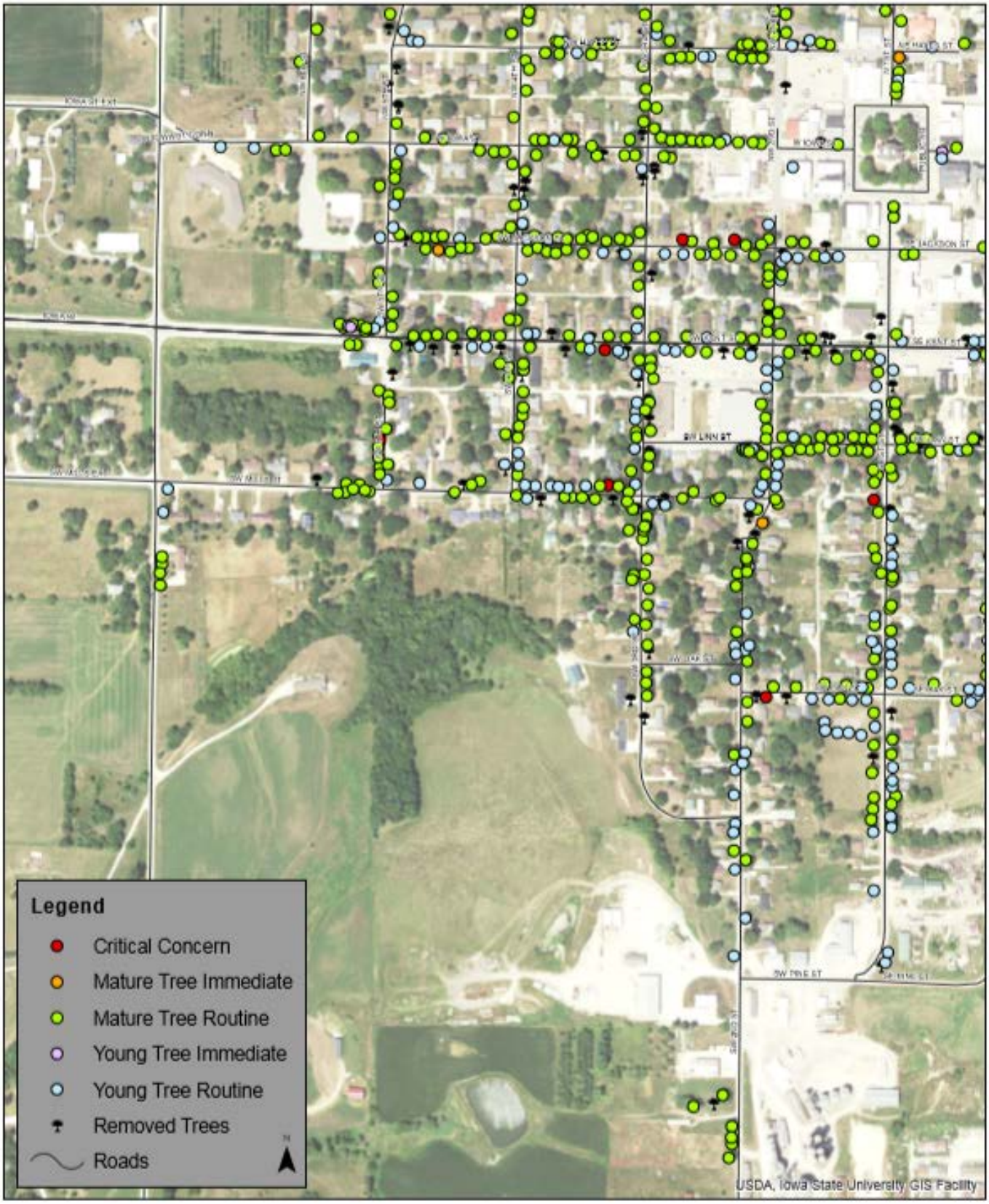


**Figure 4:**

Maintenance Tasks
2018 Community Tree Inventory
Greenfield, IA

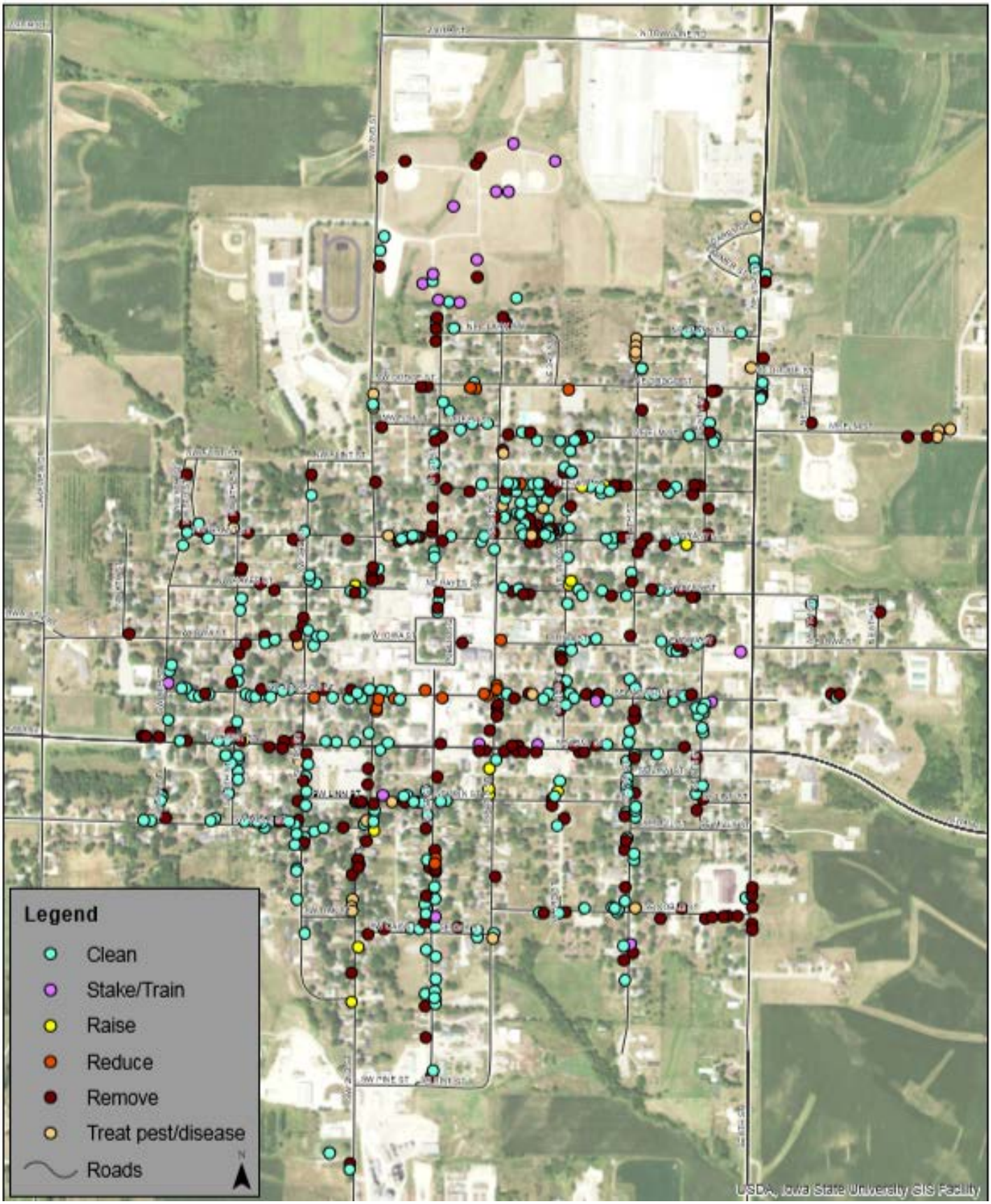


**Figure 5:**

Locaiton of Treatable Ash Trees
2018 Community Tree Inventory
Greenfield, IA

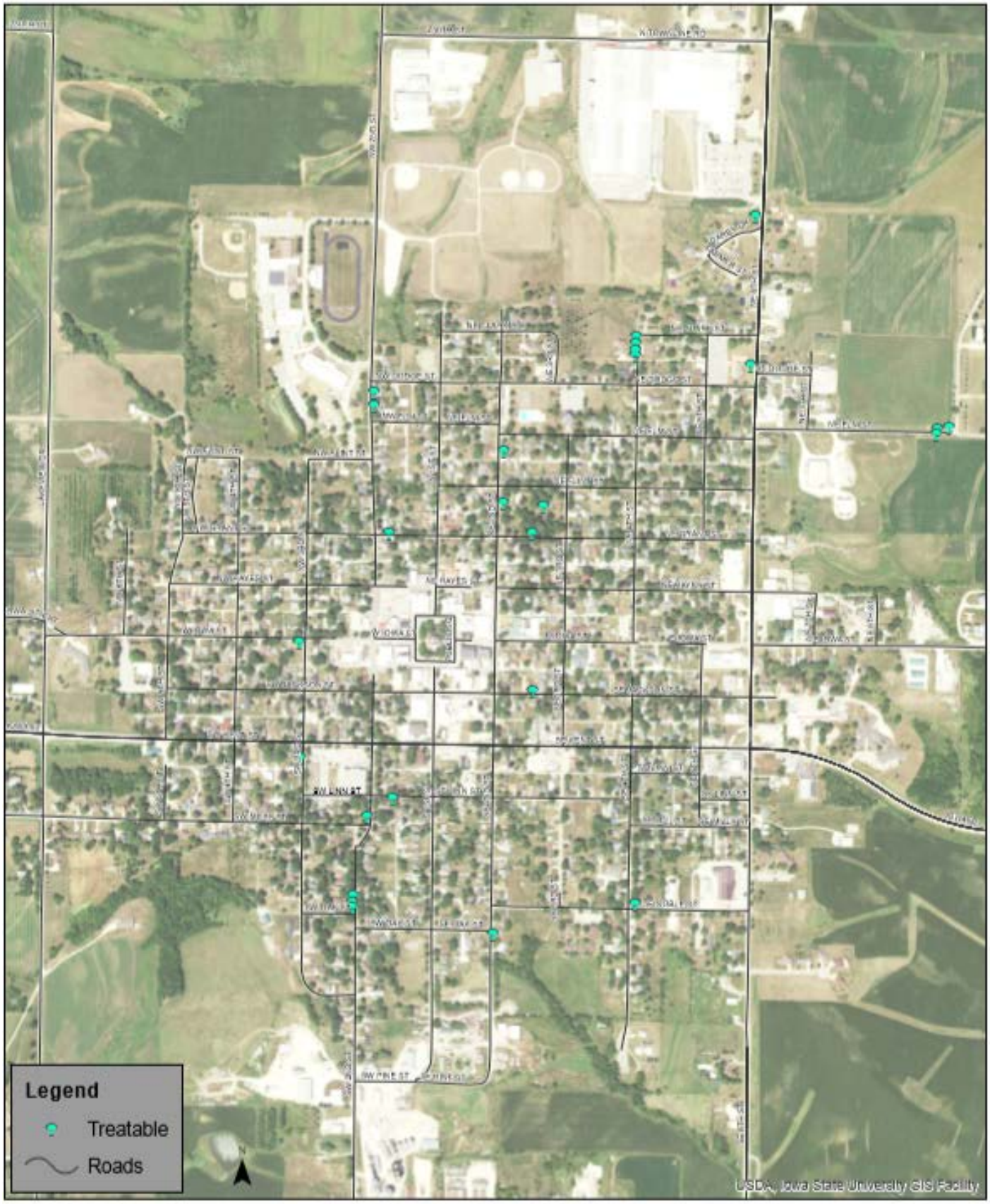
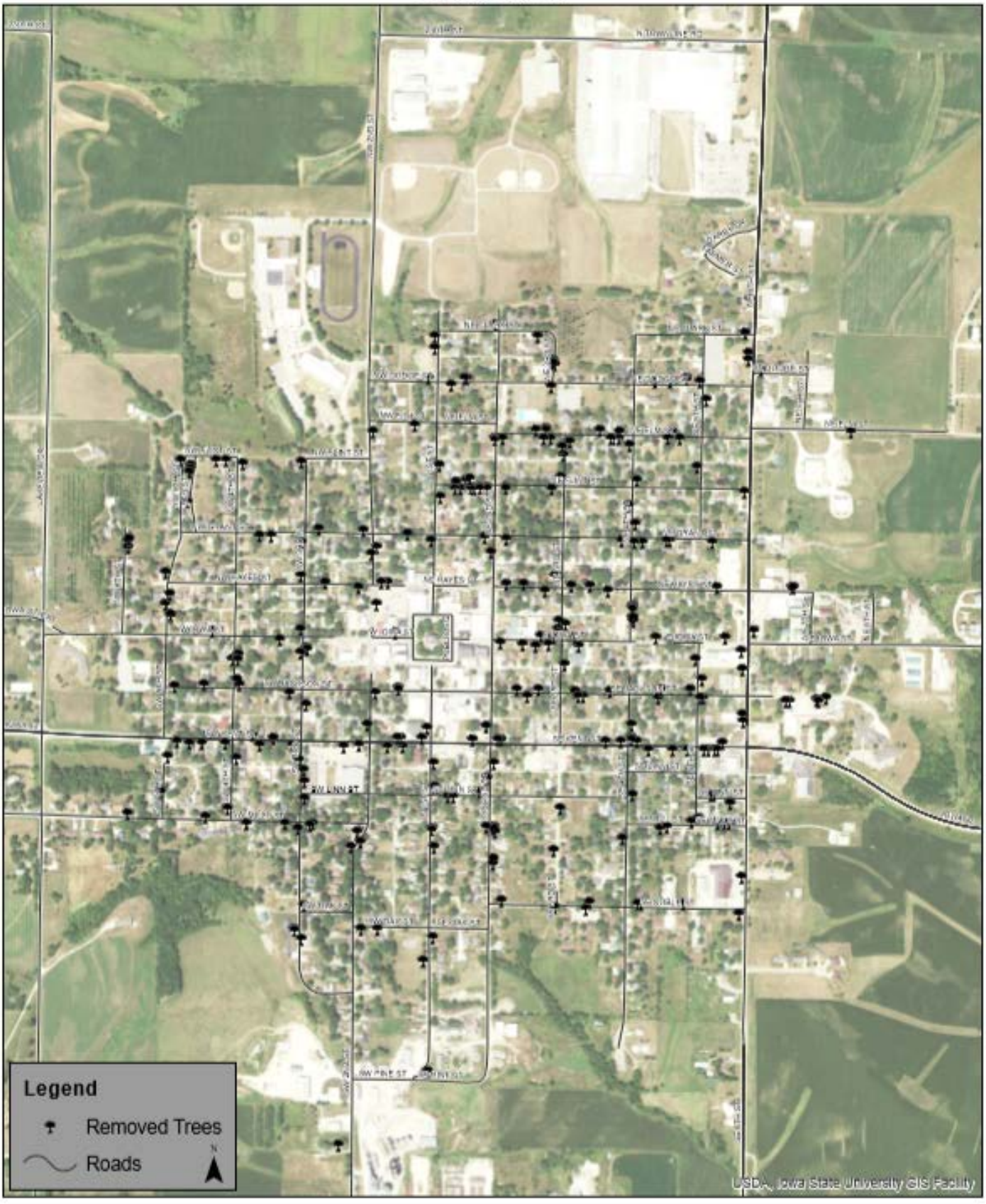


**Figure 6:**

Removed Trees
2018 Community Tree Inventory
Greenfield, IA



# CHAPTER 150

# TREES



**150.01 PURPOSE.** The purpose of this chapter is to beautify the City and enhance environmental quality by the planting of shade trees and to provide for their proper placement, care, and maintenance. The primary responsibility for maintaining street trees is placed upon the abutting property owner; however, the City Public Works Department, or its authorized agent, shall personally supervise the cutting, pruning, or trimming of said trees, and may, in its sole discretion, undertake the same itself or by its authorized agent.

**150.02 DEFINITIONS.** For the purpose of this chapter, the following terms are defined:

1. "Agent" means any and all persons, including volunteers and civic organizations, that may be designated by the City, in its sole discretion, for planting, trimming, pruning, and removal of trees in the City.

2. "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.

3. "Property owner" means any person owning private property in the City as shown by the County Auditor's plats of the City.

4. "Public property" means any and all property located within the confines of the City and owned by the City or held in the name of the City by any of the departments, commissions or agencies within the City government.

5. "Street" means the entire width between property lines of avenues, highways, or alleys.

**150.03 ARBORICULTURAL SPECIFICATIONS AND STANDARDS OF PRACTICE.**

1. Spacing. All trees planted in any street shall be planted midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line between the outer line of the sidewalk (or property line) and the edge of the vehicular travelway, and at a place reasonably consistent with the pattern of those plantings that are adjacent to hard-surface streets.

2. Planting.

A. Size. All trees planted on the streets shall be of sufficient size to warrant satisfactory results and stand the abuse common to street trees.

B. Grade. Unless otherwise allowed for substantial reasons, all standard sized trees shall have comparatively straight trunks, well-developed leaders, and top and root characteristics of the species or variety showing evidence of proper nursery pruning. All trees must be free of insect, disease, mechanical injuries and other objectionable features at the time of planting. To compensate for any serious loss of roots, the top of the tree should be reduced by thinning or cutting back as determined by the growth characteristics of the tree species. The leader shall not be cut off in such trimming.

C. Planting. Trees shall not be planted on the parking if it is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface. Trees shall not be planted closer than twenty (20) feet to street intersections (property lines extended) and ten (10) feet to driveways. Where parkings are inadequate in size for the planting of trees, trees should be planted inside the property lines, with the property owner's consent and cooperation as to species, placement, and continued maintenance. Within the constraints of budget and time, the City Public Works Department, or its agents, may plant shade trees for streets and thoroughfares in the City.

D. Method of Support. Trees may be guyed or supported in an upright position according to accepted arboricultural practices. The guys or supports shall be fastened in such a way that they will not girdle or cause serious injury to the trees or endanger public safety.

Trimming or Pruning.

A. Property owners are responsible for trimming and pruning trees. The City or its agents may give property owners written notice to trim or prune their trees. If such trimming or pruning is not completed within forty-eight (48) hours of receipt of the written notice, the City or its agents may complete such trimming and pruning and assess the cost to the abutting property owners.

B. Trimming and pruning techniques should be obtained from the Iowa State University Extension Service or State Forester, or another credible consultant, as should proper methods of planting and maintenance.

C. All cuts are to be made at a proper proximity to the parent stem so that healing can readily start under normal conditions.

D. All dead and diseased wood shall be removed.

E. All limbs one inch in diameter or more must be precut to prevent splitting. All branches in danger of injuring the tree in falling shall be lowered by ropes.

F. A crossed or rubbing branch shall be removed where practicable, but removal shall not leave large holes in the general outline of the tree. Crossed or rubbing branches may be cabled apart.

G. All cuts, old or new, one inch in diameter or more, shall be attended to with proper care, as recommended by the extension service or other credible consultant to the City.

H. Improperly healed scars, where callous growth is not established, are to be traced and treated, unless the City Public Works Director designates other treatment.

I. No topping or dehorning of trees shall be permitted except by special written permission of the City Public Works Director. Trees becoming stag-headed may have the dead portions removed back to sound green wood, with a proper 45-degree cut only. Utility companies that must top or dehorn trees to maintain overhead transmission lines are exempt from this subparagraph and need not seek permission of the Public Works Department to proceed.

**150.04 REMOVAL OF TREES.** The City Public Works Department, or its designated agent, shall remove, on the order of the Council, any tree on the streets of the City which has become diseased, or which constitutes a danger to the public, or which may otherwise be declared a nuisance.

**150.05 REPLACEMENT OF REMOVED TREES.** In keeping with the purpose of this chapter, the City Public Works Department or its agents may replace removed trees with new trees.

**150.06 DUTY TO TRIM TREES.** Property owners shall keep trees on, or overhanging, the street trimmed so that all branches will be at least twelve (12) feet above the surface of the street and nine (9) feet above the surface of sidewalks and lawns. Trees with double leaders shall be timely pruned so as to avoid loss as a result of wind and/or ice. The City may at any time, through its Public Works Department or by its agents, maintain and prune trees planted on parkings.

**150.07 TRIMMING TREES.** Except as allowed in Section 150.03, no person may trim or cut any tree in a street or public place unless the work is done under the personal supervision of a designated employee or other agent of the Public Works Department.

**150.08 DESIGNATION OF AGENTS.** The Council may designate any person or organization as its agent to assist the Public Works Department in the planting, caring, and trimming of street shade trees.

**150.09 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.

**150.10 INSPECTION AND REMOVAL.** The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:

1. Removal from 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, and that danger to other trees within the City is imminent, the Council shall immediately cause such condition to be corrected by treatment or removal so as to destroy or prevent as fully as possible the spread of the disease or the insect or disease pests. 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. Removal from Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees within the City is imminent, the Council shall immediately 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 nuisance to be removed and the cost assessed against the property.

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

**150.11 CITY SHADE TREE PLAN.** The City Public Works Department or its designated agent may establish a pattern of species and size for street shade tree plantings and replacements. The proper size of trees at maturity shall be taken into consideration so they will be compatible with adjacent vegetation and structures. A list of recommended tree varieties is on file in the office of the Clerk.

**150.12 DIVERSIFICATION AND DESIRABILITY.** The City Public Works Department or its agents shall develop goals and plans for long-term tree planting and reforestation and shall encourage public awareness of the aesthetic and ecological importance of tree planting, development, and care. As new trees are planted, no single tree species should represent more than 15 percent of the reforestation effort.

[The next page is 675]

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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.