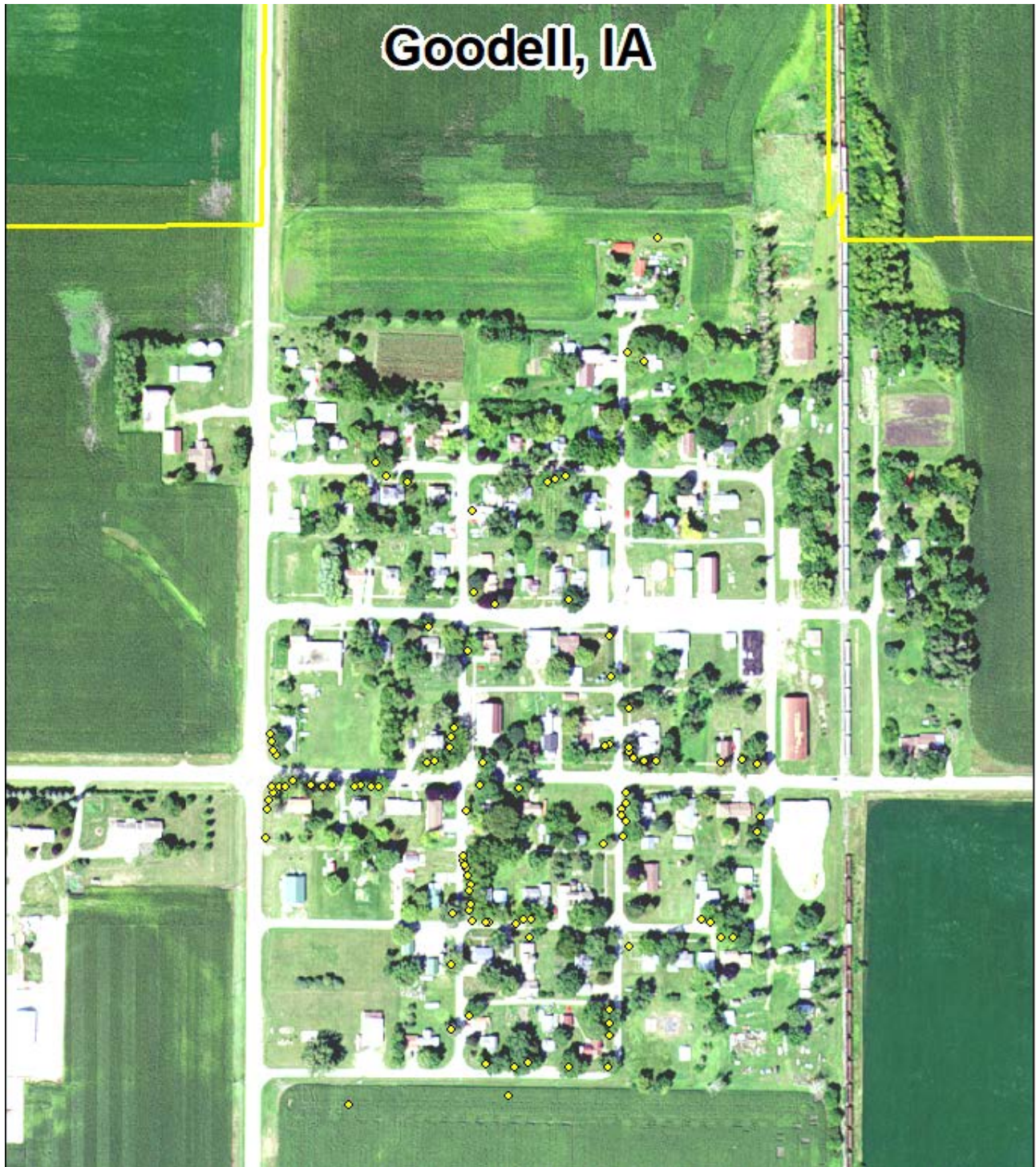# Goodell, IA

Goodell, IA

2019 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Goodell 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 20% of Goodell'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 100 trees inventoried.

- Goodell's trees provide $23,097 of benefits annually, an average of $231 a tree
- There are over 14 species of trees
- The top three genera are: Maple 35%, Black Walnut 24%, and Ash 20%
- 45% of trees are in need of some type of management
- 17 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 17 trees needing removal, 11 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*
- 14 of the 20 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 ($2 per capita = $278 annually) it could take 24 years to remove ash – Suggestion: request a budget increase to $4,695 annually and apply for grants to plant replacement trees
- We suggest creating a city ordinance for the care and maintenance of trees in Goodell.

Introduction

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

Trees are an important component of Goodell'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 Goodell 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 Goodell'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 100 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. Goodell's trees reduce energy related costs by approximately $6,136 annually (Appendix A, Table 1). These savings are both in Electricity (29.2 MWh) and in Natural Gas (3,997.6 Therms).

Annual Stormwater Benefits
Goodell's trees intercept about 342,139 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $9,272 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 Goodell, it is estimated that trees remove 382.3 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $1,081 (Appendix A, Table 3).

Annual Carbon Benefits
Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Goodell, trees sequester about 65,977 lbs of carbon a year with an associated value of $495 (Appendix A, Table 5). In addition, the trees store 1,418,405 lbs of carbon, with a yearly benefit of $10,638 (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. Goodell receives $5,799 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, Goodell's trees provide $23,097 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 100 trees in Goodell provide approximately $231 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Goodell has over 14 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	35	35%
Black Walnut	24	24%
Ash	20	20%
Spruce	7	7%
Linden/Basswood	5	5%
Hackberry	5	5%
Apple	1	1%
Aspen	1	1%
Cottonwood	1	1%
Other	1	1%

Age Class

Most of Goodell's trees (46%) are between 18 and 30 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. Goodell'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 Goodell indicate that 72% of the trees are in good health, with only 10% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 75% of Goodell's trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 15% of the population. This 15% 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	24	24%
Tree Removal	17	17%
Crown Reduction	3	3%
Tree Staking	1	1%

Canopy Cover

The total canopy with both private and public trees is 6%, 17.5 acres. The canopy cover included in the Goodell inventory includes approximately 3.4 acres (Appendix A, Figure 5). The City's Canopy goal is to increase canopy by 3%, in 30 years. To achieve this goal it is estimated that 20 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Goodell'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.

<u>Land Use</u>

Single family residential	99%
Park/vacant/other	1%

<u>Location</u>

Front yard	57%
Planting strip	43%

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.

<u>Hazardous trees</u>

Goodell has 10 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 6 trees over 30 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.

<u>Poor tree species</u>

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 10 removals, 5 are ash trees. There are a total of 20 ash trees, and 14 of those have signs and symptoms that have been associated with EAB. In addition, there are 3 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 Goodell.

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 (35%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Continual Monitoring

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

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. The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

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

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

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

PROPOSED WORK SCHEDULE AND ESTIMATED COSTS

YEAR 1   **ESTIMATED COSTS**

Remove 8 recommended trees $5,600
Trim 2 immediate need tree $200
Inspect ash trees for signs of Emerald Ash Borer

YEAR 2

Remove 3 ash trees and 1 routine recommended $2,800
Plant 10 trees in open locations $1000
Water & Maintenance $500
Prune 1/3 of city owned trees $990
Inspect ash trees for signs of Emerald Ash Borer

YEAR 3

Remove 3 ash trees and 1 routine recommended $2,800
Plant 10 trees in open locations $1,000
Water & Maintenance $500
Inspect ash trees for signs of EAB

YEAR 4

Remove 3 ash trees $2,100
Plant 10 trees in open locations $1,000
Water & Maintenance $500
Prune 1/3 of city owned trees $990
Inspect ash trees for signs of EAB

YEAR 5

Remove 3 ash trees $2,100
Plant 10 trees in open locations $1,000
Water & Maintenance $500
Inspect ash trees for signs of EAB

YEAR 6

Remove 3 ash trees	$2,100
Plant 10 trees in open locations	$1,000
Water & Maintenance	$500
Prune 1/3 of city owned trees	$990

Estimated costs based on average costs of $700/tree for removal, $100/tree for planting, $50/tree for water and maintenance, and $30/tree for pruning.

Purposed Budget Increase

EAB could potentially kill all ash trees in Goodell within 4 years of its arrival. To remove all ash trees within 6 years, as well as reach your canopy cover goals, water and maintain the newly planted trees, and create a routine pruning cycle the budget would need to be increased to $4,695 a year. Additionally, it is recommended that Goodell 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 27 inches and at $17 per inch, about 4 trees could be treated per year (every other year treatment). This would be 8 trees selected for treatment, and Goodell would still need to find $4,900 for removal. Alternatively, if there are 10 treatable trees, it would cost approximately $2,295 a year for treatment and leave $3,500 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 Goodell. 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

Goodell

Annual Energy Benefits of Public Trees

1/11/2019

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Black walnut	7.1	540	1,006.1	986	1,526	(N/A)	24.0	24.9	63.59
Green ash	6.7	508	899.1	881	1,389	(N/A)	20.0	22.6	69.44
Red maple	2.4	180	299.1	293	473	(N/A)	12.0	7.7	39.42
Norway maple	2.3	175	337.9	331	506	(N/A)	8.0	8.2	63.27
Sugar maple	2.7	204	353.0	346	550	(N/A)	8.0	9.0	68.71
Silver maple	2.1	161	276.9	271	432	(N/A)	7.0	7.0	61.75
American basswood	1.7	125	240.7	236	361	(N/A)	5.0	5.9	72.27
Northern hackberry	2.0	151	281.4	276	427	(N/A)	5.0	7.0	85.40
Blue spruce	0.5	39	60.7	60	98	(N/A)	4.0	1.6	24.51
Norway spruce	0.5	36	64.0	63	99	(N/A)	3.0	1.6	33.04
Apple	0.1	6	12.8	13	18	(N/A)	1.0	0.3	18.19
Quaking aspen	0.5	37	63.1	62	99	(N/A)	1.0	1.6	98.63
Eastern cottonwood	0.5	37	63.1	62	99	(N/A)	1.0	1.6	98.63
Broadleaf Deciduous Medium	0.3	20	39.6	39	59	(N/A)	1.0	1.0	58.69
Total	29.2	2,218	3,997.6	3,918	6,136	(N/A)	100.0	100.0	61.36

Table 2: Annual Stormwater Benefits

Goodell

Annual Stormwater Benefits of Public Trees

1/11/2019

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Black walnut	77,506	2,100	(N/A)	24.0	22.7	87.52
Green ash	81,393	2,206	(N/A)	20.0	23.8	110.29
Red maple	16,757	454	(N/A)	12.0	4.9	37.84
Norway maple	23,904	648	(N/A)	8.0	7.0	80.98
Sugar maple	37,618	1,019	(N/A)	8.0	11.0	127.43
Silver maple	28,963	785	(N/A)	7.0	8.5	112.13
American basswood	20,732	562	(N/A)	5.0	6.1	112.37
Northern hackberry	21,325	578	(N/A)	5.0	6.2	115.58
Blue spruce	6,177	167	(N/A)	4.0	1.8	41.85
Norway spruce	10,543	286	(N/A)	3.0	3.1	95.24
Apple	264	7	(N/A)	1.0	0.1	7.17
Quaking aspen	7,239	196	(N/A)	1.0	2.1	196.17
Eastern cottonwood	7,239	196	(N/A)	1.0	2.1	196.17
Broadleaf Deciduous Medium	2,479	67	(N/A)	1.0	0.7	67.19
Citywide total	342,139	9,272	(N/A)	100.0	100.0	92.72

Table 3: Annual Air Quality Benefits

Goodell

Annual Air Quality Benefits of Public Trees

1/11/2019

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2								
Black walnut	9.0	1.4	4.4	0.4	48	34.3	5.0	4.7	32.3	213	0.0	0	91.5	261	(N/A)	24.0	10.88
Green ash	11.8	1.9	5.4	0.5	62	31.8	4.6	4.4	30.3	198	0.0	0	90.9	261	(N/A)	20.0	13.04
Red maple	3.6	0.6	1.7	0.2	19	11.1	1.6	1.6	10.7	70	-1.3	-5	29.8	84	(N/A)	12.0	7.01
Norway maple	5.1	0.9	2.5	0.2	28	11.2	1.6	1.5	10.5	69	-1.2	-4	32.4	93	(N/A)	8.0	11.59
Sugar maple	6.0	1.0	2.8	0.3	32	12.7	1.9	1.8	12.2	79	-4.6	-17	33.9	94	(N/A)	8.0	11.73
Silver maple	5.0	0.9	2.5	0.2	27	10.0	1.5	1.4	9.6	62	-2.7	-10	28.3	80	(N/A)	7.0	11.37
American basswood	3.0	0.5	1.4	0.1	16	8.0	1.2	1.1	7.5	50	-2.5	-9	20.4	56	(N/A)	5.0	11.28
Northern hackberry	4.0	0.7	2.0	0.2	22	9.6	1.4	1.3	9.0	60	0.0	0	28.2	81	(N/A)	5.0	16.26
Blue spruce	0.8	0.2	0.6	0.1	5	2.3	0.3	0.3	2.3	15	-2.2	-8	4.8	12	(N/A)	4.0	2.89
Norway spruce	1.3	0.2	1.0	0.2	8	2.3	0.3	0.3	2.2	14	-5.6	-21	2.1	1	(N/A)	3.0	0.44
Apple	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	1.0	2.55
Quaking aspen	1.6	0.3	0.7	0.1	8	2.3	0.3	0.3	2.2	14	0.0	0	7.7	23	(N/A)	1.0	22.55
Eastern cottonwood	1.6	0.3	0.7	0.1	8	2.3	0.3	0.3	2.2	14	0.0	0	7.7	23	(N/A)	1.0	22.55
Broadleaf Deciduous Medium	0.5	0.1	0.2	0.0	3	1.3	0.2	0.2	1.2	8	-0.1	0	3.6	10	(N/A)	1.0	10.16
Citywide total	53.4	8.9	26.1	2.5	287	139.5	20.3	19.4	132.4	869	-20.2	-76	382.3	1,081	(N/A)	100.0	10.81

Table 4: Annual Carbon Stored

Goodell

Stored CO2 Benefits of Public Trees

1/11/2019

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Black walnut	288,509	2,164	(N/A)	24.0	20.3	90.16
Green ash	395,077	2,963	(N/A)	20.0	27.9	148.15
Red maple	40,072	301	(N/A)	12.0	2.8	25.05
Norway maple	84,581	634	(N/A)	8.0	6.0	79.29
Sugar maple	178,985	1,342	(N/A)	8.0	12.6	167.80
Silver maple	116,509	874	(N/A)	7.0	8.2	124.83
American basswood	110,976	832	(N/A)	5.0	7.8	166.46
Northern hackberry	64,231	482	(N/A)	5.0	4.5	96.35
Blue spruce	4,473	34	(N/A)	4.0	0.3	8.39
Norway spruce	14,176	106	(N/A)	3.0	1.0	35.44
Apple	908	7	(N/A)	1.0	0.1	6.81
Quaking aspen	55,982	420	(N/A)	1.0	3.9	419.86
Eastern cottonwood	55,982	420	(N/A)	1.0	3.9	419.86
Broadleaf Deciduous	7,945	60	(N/A)	1.0	0.6	59.59
Citywide total	1,418,405	10,638	(N/A)	100.0	100.0	106.38

Table 5: Annual Carbon Sequestered

Annual CO Benefits of Public Trees

1/11/2019

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
Black walnut	17,967	135	-1,385	-74	-11	11,938	90	28,446	213 (N/A)	24.0	26.4	8.89
Green ash	14,498	109	-1,896	-71	-15	11,219	84	23,750	178 (N/A)	20.0	22.0	8.91
Red maple	4,195	31	-192	-20	-2	3,977	30	7,959	60 (N/A)	12.0	7.4	4.97
Norway maple	2,166	16	-406	-27	-3	3,869	29	5,603	42 (N/A)	8.0	5.2	5.25
Sugar maple	7,350	55	-859	-31	-7	4,503	34	10,963	82 (N/A)	8.0	10.2	10.28
Silver maple	8,644	65	-560	-23	-4	3,555	27	11,616	87 (N/A)	7.0	10.8	12.45
American basswood	6,192	46	-533	-20	-4	2,772	21	8,411	63 (N/A)	5.0	7.8	12.62
Northern hackberry	2,686	20	-308	-20	-2	3,343	25	5,701	43 (N/A)	5.0	5.3	8.55
Blue spruce	363	3	-21	-8	0	851	6	1,185	9 (N/A)	4.0	1.1	2.22
Norway spruce	375	3	-68	-10	-1	804	6	1,101	8 (N/A)	3.0	1.0	2.75
Apple	114	1	-4	-1	0	124	1	232	2 (N/A)	1.0	0.2	1.74
Quaking aspen	479	4	-269	-6	-2	813	6	1,017	8 (N/A)	1.0	0.9	7.63
Eastern cottonwood	479	4	-269	-6	-2	813	6	1,017	8 (N/A)	1.0	0.9	7.63
Broadleaf Deciduous Medi	470	4	-38	-3	0	440	3	869	7 (N/A)	1.0	0.8	6.52
Citywide total	65,977	495	-6,809	-319	-53	49,022	368	107,871	809 (N/A)	100.0	100.0	8.09

Table 6: Annual Social and Aesthetic Benefits

Goodell

Annual Aesthetic/Other Benefits of Public Trees

1/11/2019

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Black walnut	1,464	(N/A)	24.0	25.2	60.98
Green ash	1,121	(N/A)	20.0	19.3	56.05
Red maple	571	(N/A)	12.0	9.9	47.62
Norway maple	200	(N/A)	8.0	3.4	24.97
Sugar maple	700	(N/A)	8.0	12.1	87.53
Silver maple	686	(N/A)	7.0	11.8	97.93
American basswood	425	(N/A)	5.0	7.3	84.99
Northern hackberry	331	(N/A)	5.0	5.7	66.22
Blue spruce	101	(N/A)	4.0	1.7	25.23
Norway spruce	94	(N/A)	3.0	1.6	31.39
Apple	6	(N/A)	1.0	0.1	6.40
Quaking aspen	29	(N/A)	1.0	0.5	28.57
Eastern cottonwood	29	(N/A)	1.0	0.5	28.57
Broadleaf Deciduous Medium	43	(N/A)	1.0	0.7	43.05
Citywide total	5,799	(N/A)	100.0	100.0	57.99

Table 7: Summary of Benefits in Dollars

Goodell

Total Annual Benefits of Public Trees by Species ($)

1/11/2019

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($) Standard Error	% of Total $
Black walnut	1,526	213	261	2,100	1,464	5,565 (N/A)	24.1
Green ash	1,389	178	261	2,206	1,121	5,155 (N/A)	22.3
Red maple	473	60	84	454	571	1,642 (N/A)	7.1
Norway maple	506	42	93	648	200	1,489 (N/A)	6.4
Sugar maple	550	82	94	1,019	700	2,445 (N/A)	10.6
Silver maple	432	87	80	785	686	2,069 (N/A)	9.0
American basswood	361	63	56	562	425	1,468 (N/A)	6.4
Northern hackberry	427	43	81	578	331	1,460 (N/A)	6.3
Blue spruce	98	9	12	167	101	387 (N/A)	1.7
Norway spruce	99	8	1	286	94	489 (N/A)	2.1
Apple	18	2	3	7	6	36 (N/A)	0.2
Quaking aspen	99	8	23	196	29	354 (N/A)	1.5
Eastern cottonwood	99	8	23	196	29	354 (N/A)	1.5
Broadleaf Deciduous M	59	7	10	67	43	186 (N/A)	0.8
Citywide Total	6,136	809	1,081	9,272	5,799	23,097 (N/A)	100.0
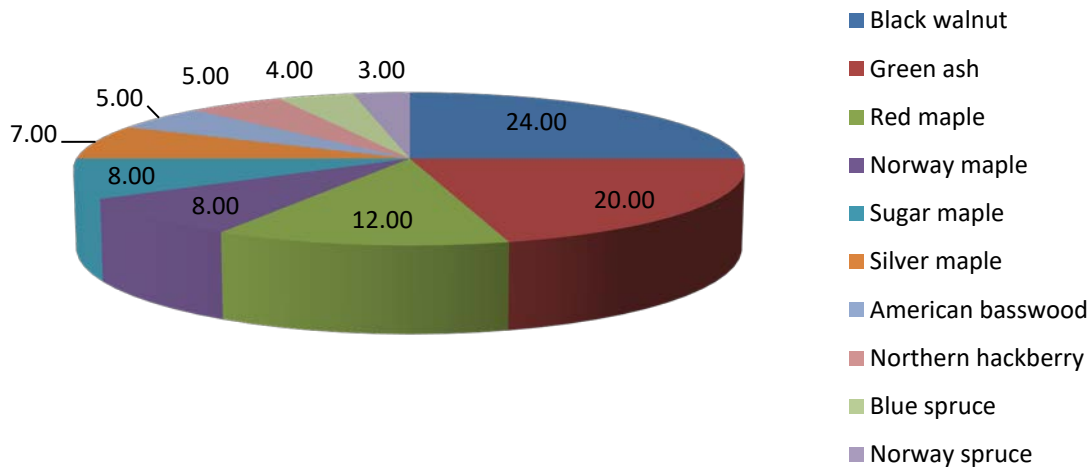
Figure 1: Species Distribution
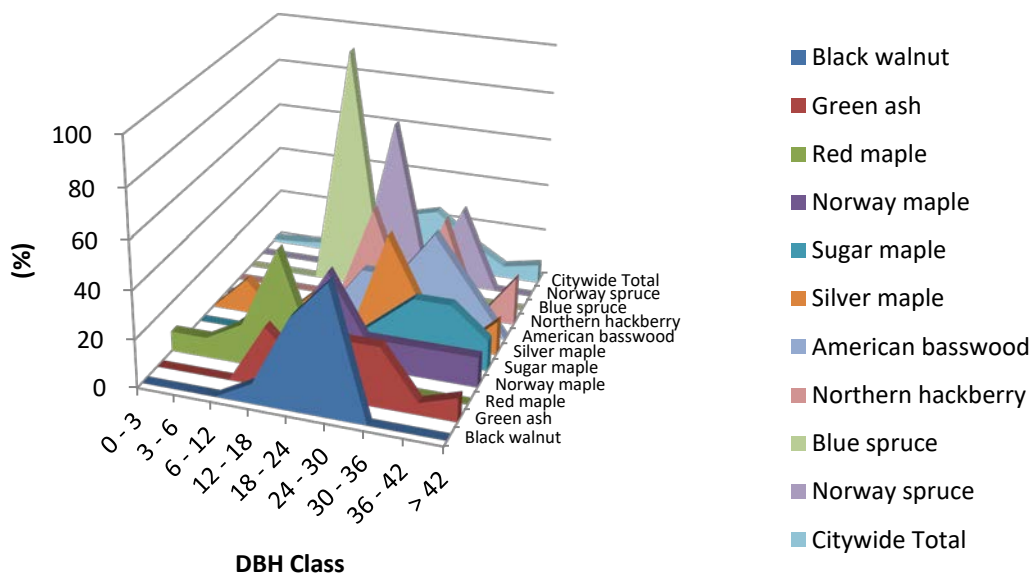
Figure 2: Relative Age Class
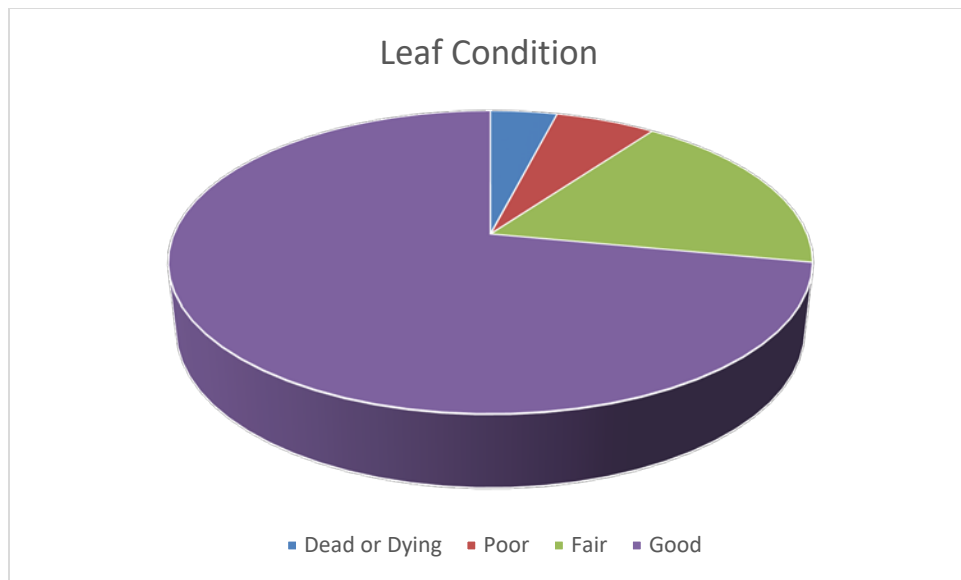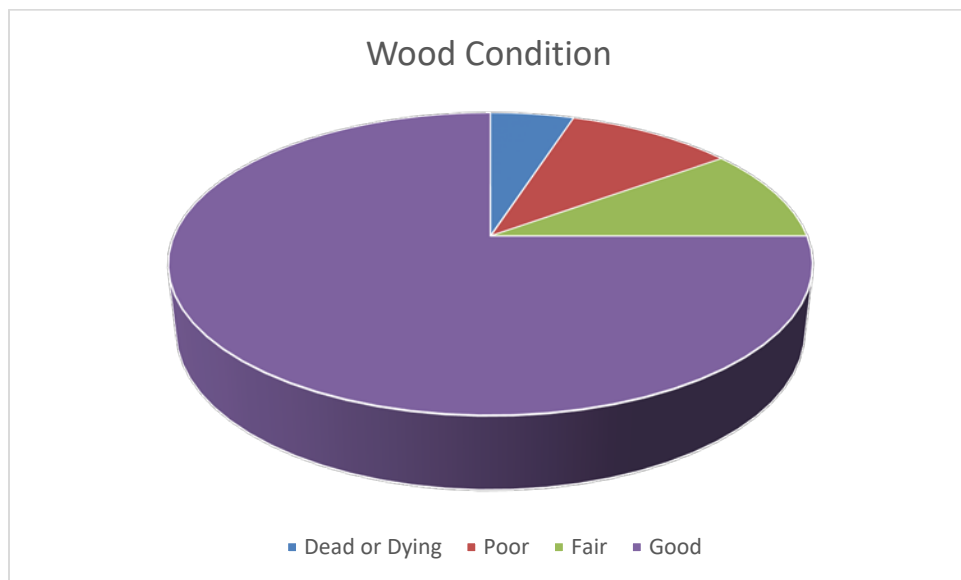
Figure 3: Foliage Condition

Figure 4: Wood Condition
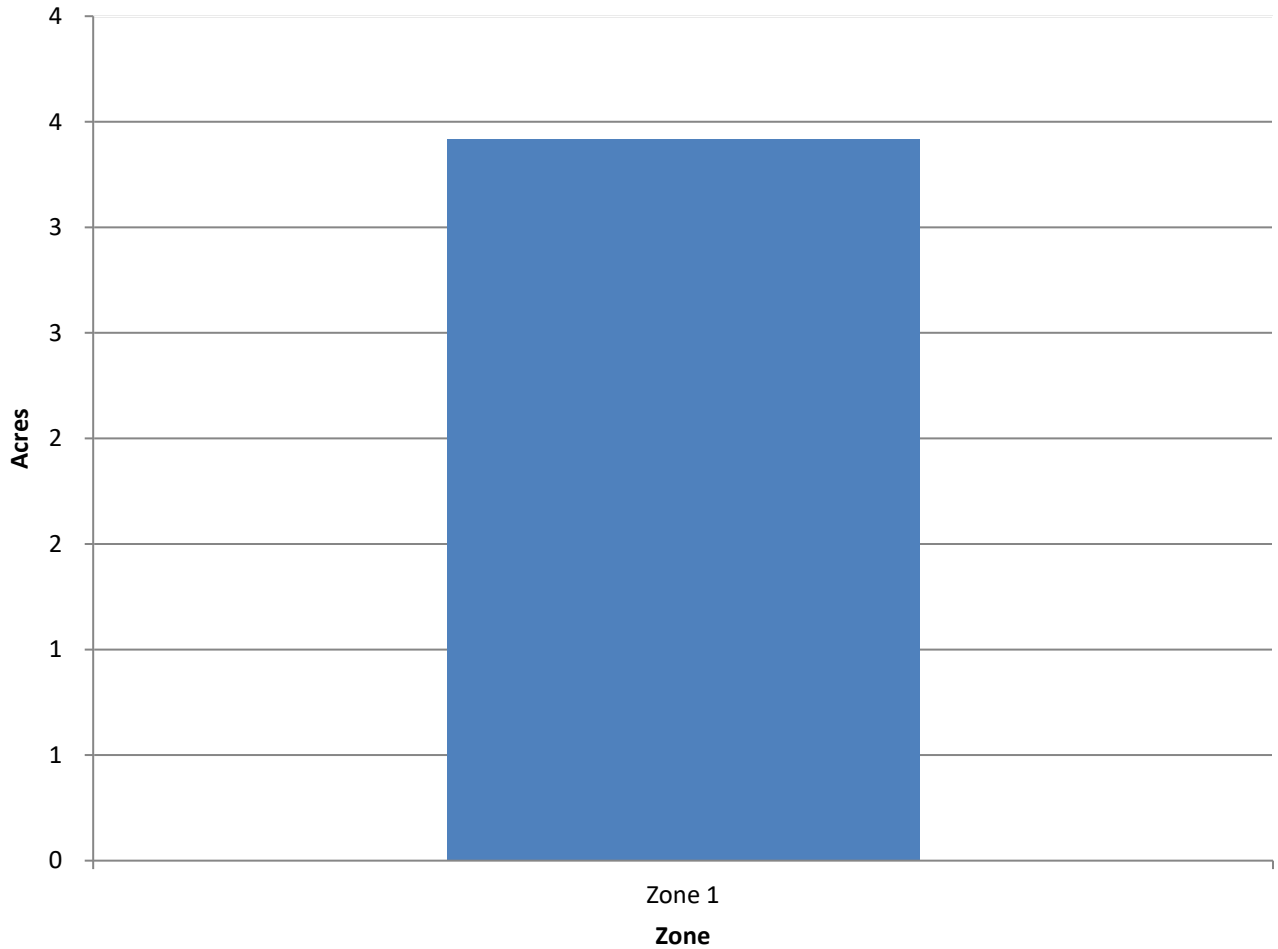
Canopy Cover of Public Trees (Acres)
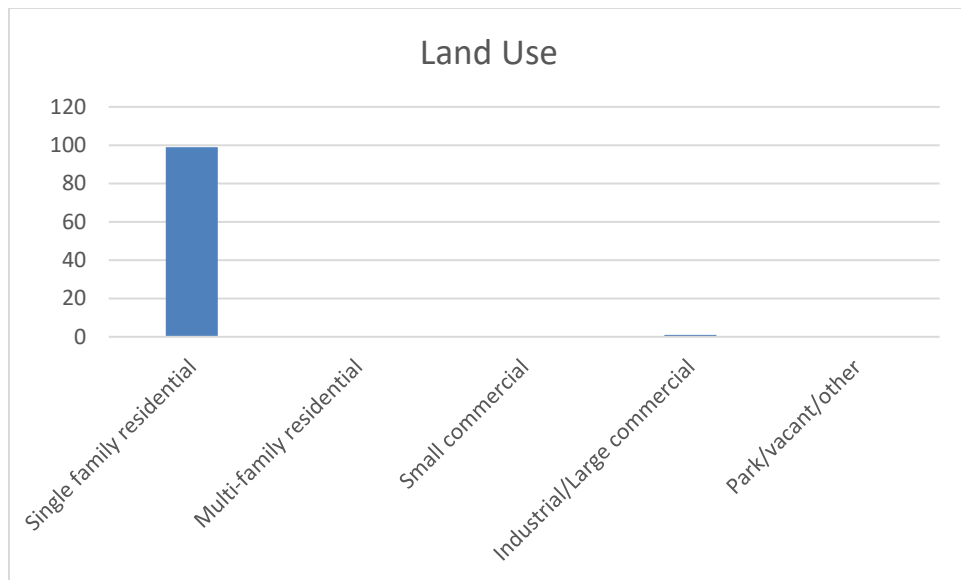

Figure 5: Canopy Cover in Acres

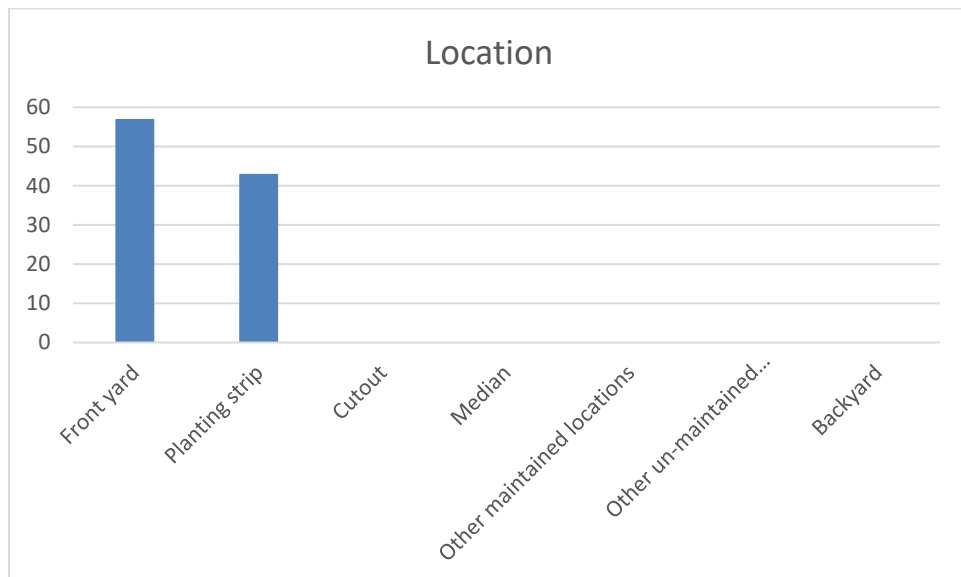**Figure 6: Land Use of city/park trees**

Figure 7: Location of city/park trees

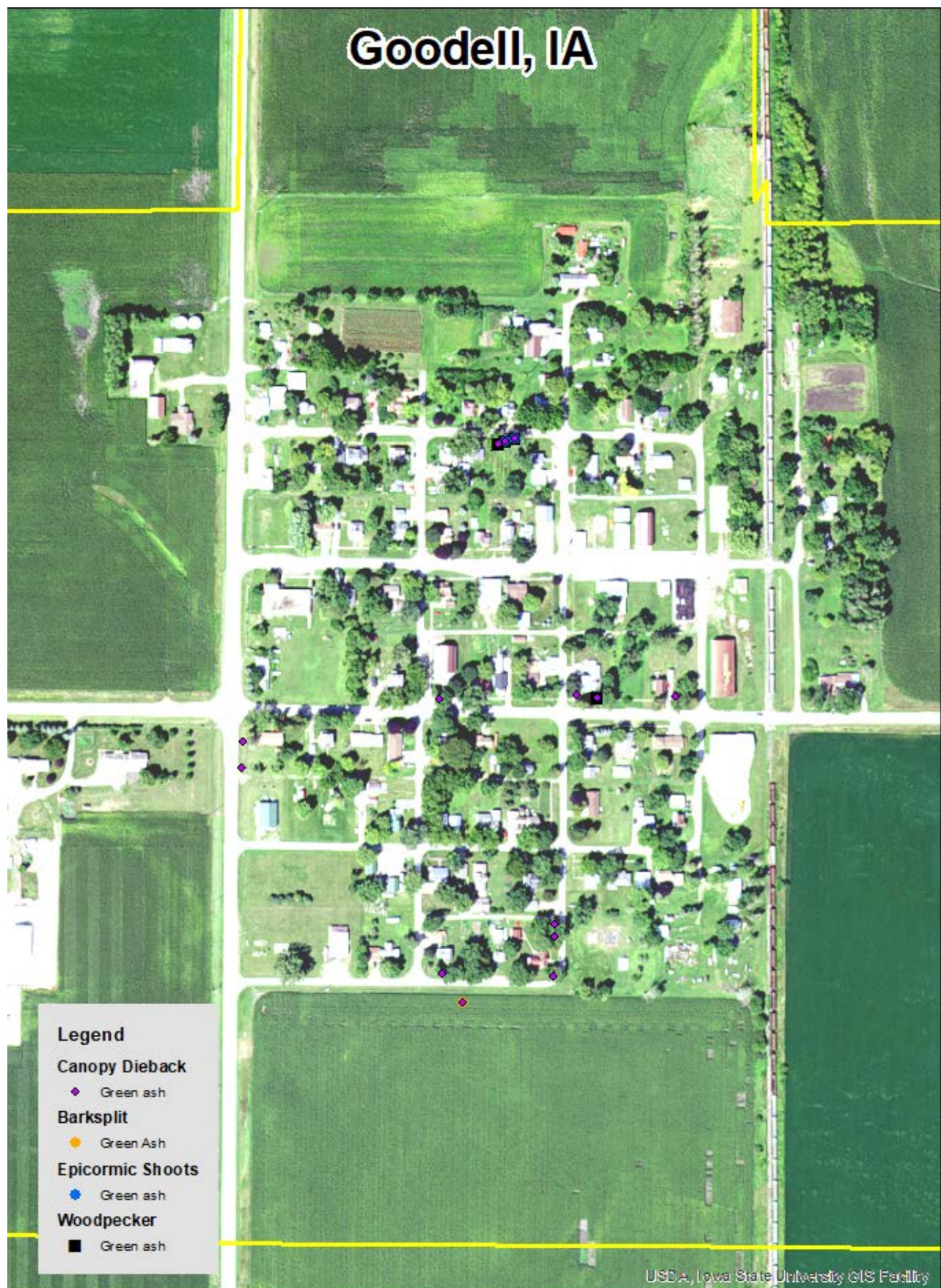# Appendix B: ArcGIS Mapping

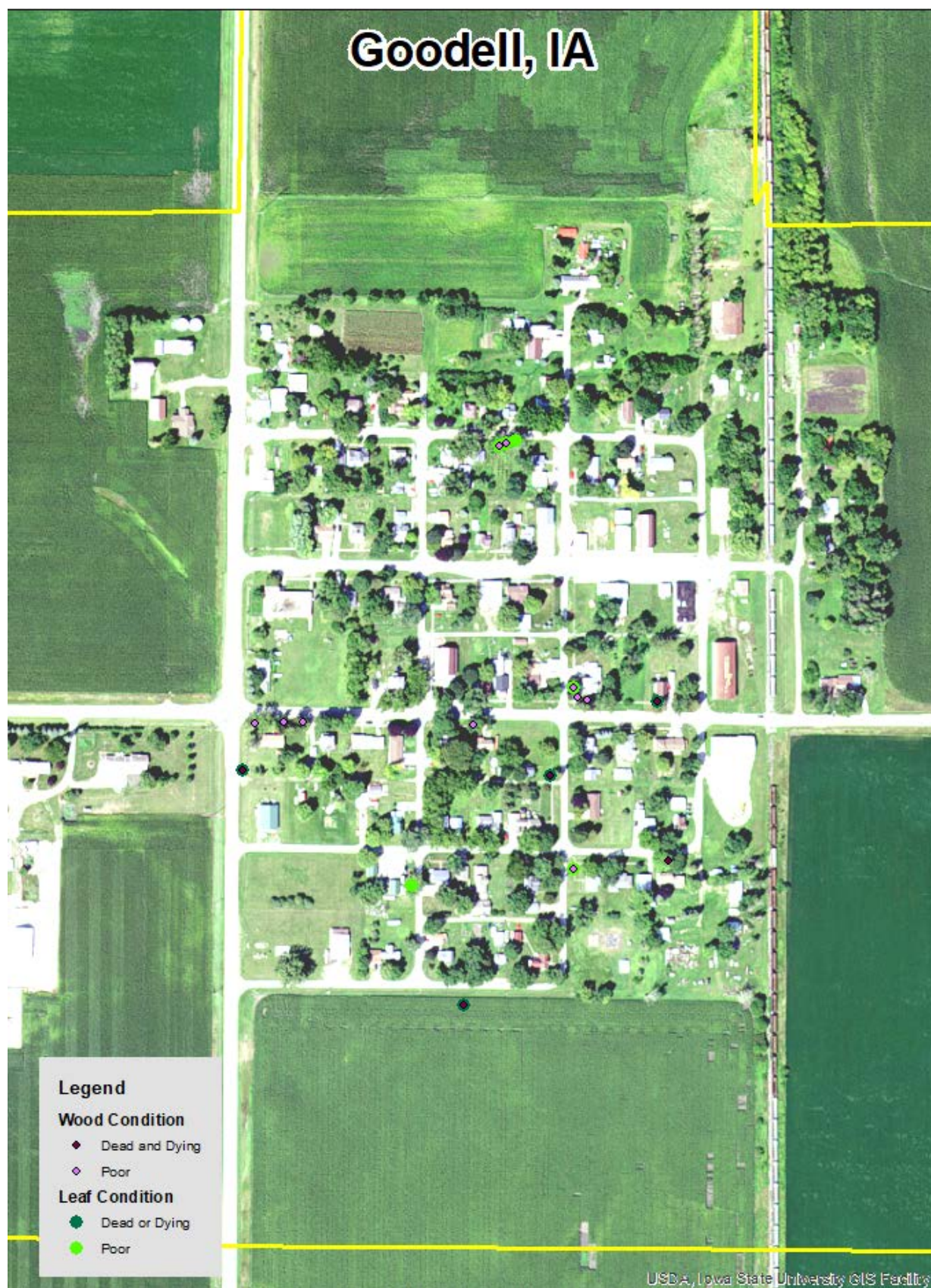**Figure 1: Location of Ash Trees**

Figure 2: Location of EAB symptoms

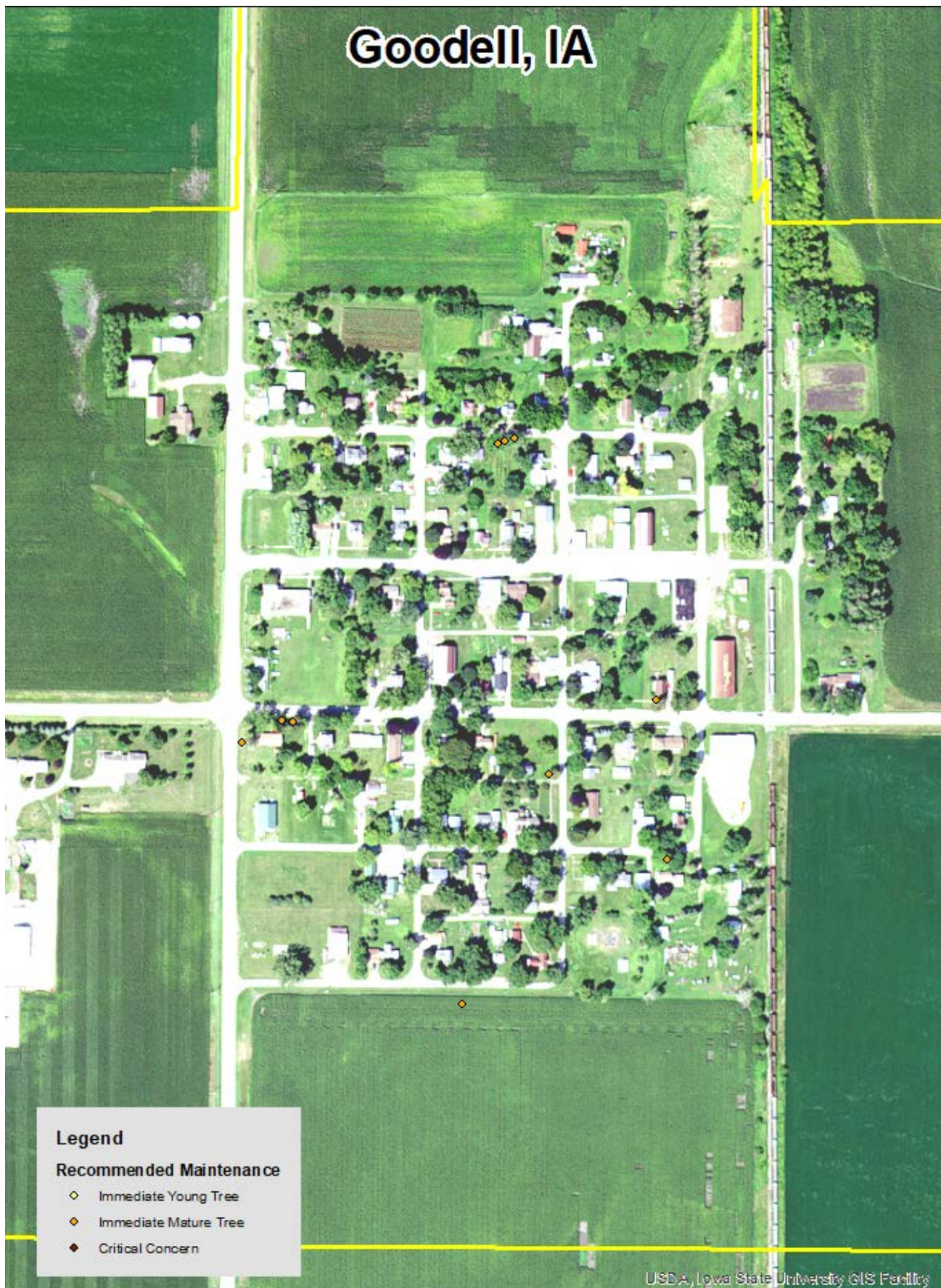**Figure 3: Location of Poor Condition Trees**

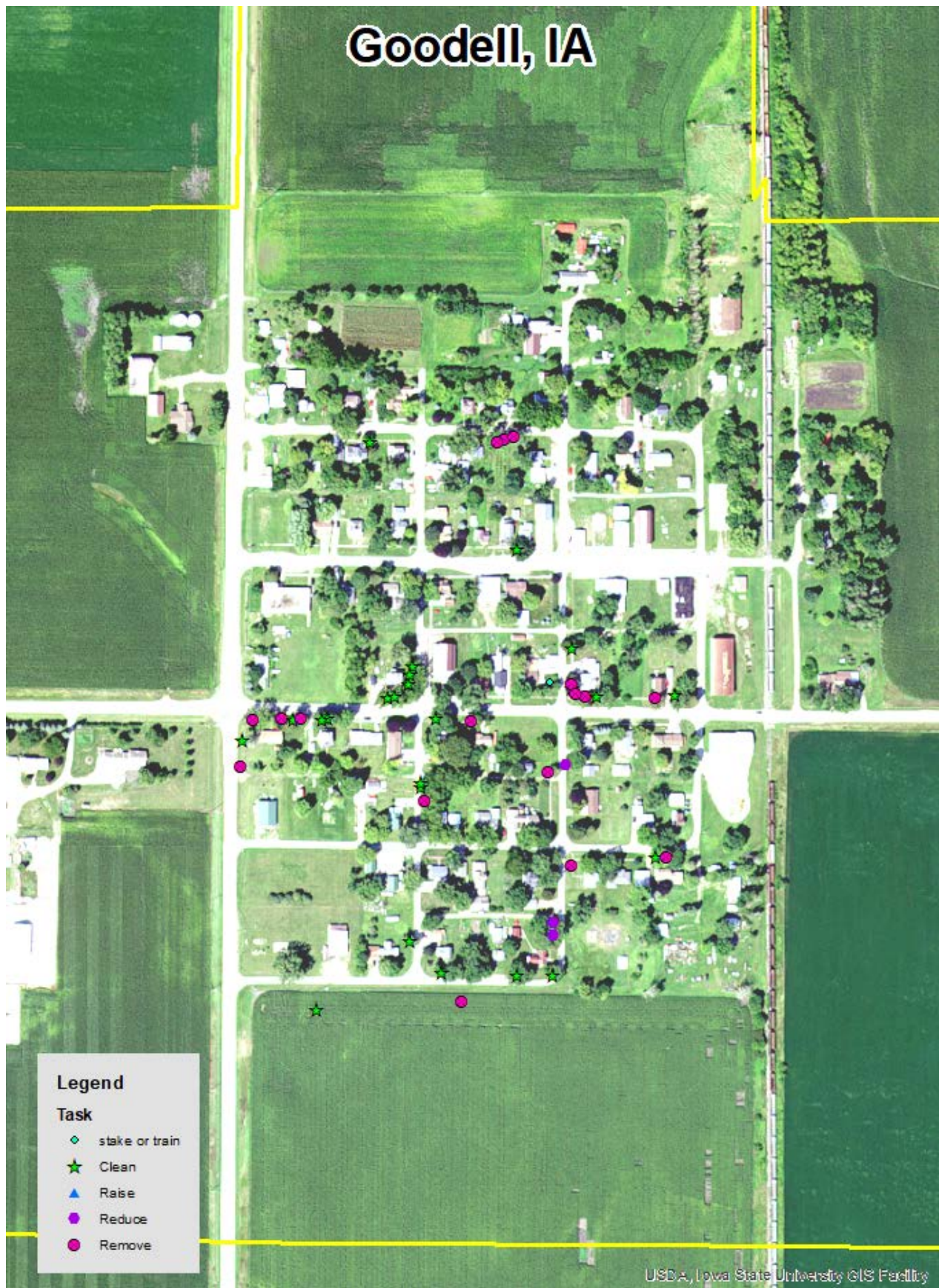**Figure 4: Location of Trees with Recommended Maintenance**

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

Appendix C: Goodell Tree Ordinances

None found.

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