Norway, IA

2015 Urban Forest Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Norway 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 37% (20 trees) of Norway'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 2014, 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 54 trees inventoried.

- Norway's trees provide $11,004 of benefits annually, an average of $203 a tree
- There are 16 species of trees
- The top two genera are: Maple 39% and Ash 37% meaning 76% of the public trees consist of maple and ash
- 22% of trees are in need of some type of management & 1 tree is 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.

- The one tree needing removal is over 24 inches in diameter at 4.5 ft. On 10/9/2014 the city was sent a short list of some trees of concern that need further evaluation. *City ownership of the trees recommended for removal should be verified prior to any removal*
- 6 of the 20 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation. Check all 20 ash trees yearly for symptoms.
- All trees should be pruned on a routine schedule- one third of the city every other year
- If planting plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Siberian elm, evergreens (street trees only), willow (street trees only) or black walnut
- There are 20 ash trees present on public property and with an estimated tree removal cost between $600 to $1,000 per tree the cost to remove these trees could be between $12,000 and $20,000 total

Introduction

This plan was developed to assist Norway 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 and replacement planting. With proper planning and management of the current canopy in Norway, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2014, a tree inventory was conducted that included 100% of the city owned trees on both streets and in the 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 54 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Norway's trees reduce energy related costs by approximately $2,778 annually (Appendix A, Table 1). These savings are both in Electricity (13.2 MWh) and in Natural Gas (1,808.8 Therms).

Annual Stormwater Benefits

Norway's trees intercept about 146,521 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $3,971 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 Norway, it is estimated that trees remove 168.3 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 $473 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Norway, trees sequester about 36,116 lbs of carbon a year with an associated value of $251 (Appendix A, Table 5). In addition, the trees store 525,729 lbs of carbon, with a yearly benefit of $3,943 (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. Norway receives $3,530 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STRATUM analysis, Norway's trees provide $11,004 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 54 trees in Norway provide approximately $203 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Norway has 16 different tree species along city streets and parks (Appendix A, Figure 1). The top two genera are: Maple 39% and ash 37% for a total of 76%

The distribution of the top five tree species is as follows:

Green Ash	19	35%
Norway Maple	7	13%
Silver Maple	6	11%
Sugar Maple	4	7%
Red Maple	3	5%

Age Class

In Norway 35% of the public trees are less than 18 inches in diameter at 4.5 ft., and 65% are greater than 18 inches in diameter (Appendix A, Figure 2). At this point there are only 5 trees 3 inches in diameter or less meaning there is a very limited number of new trees planted on public property.

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 Norway indicate that 93% of the trees are in good health (Appendix A, Figure 3 & Appendix B, Figure 3). Additionally, only 54% of Norway's trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 4% of the population. This 4% is an estimate of trees that need management follow up related to poor wood condition.

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 5).

Crown Cleaning	3	5%
Crown Raising	7	13%
Tree Removal	1	2%
Crown Reduction	1	2%

Canopy Cover

The total canopy with both private and public trees is 12%. The canopy cover included in the Norway inventory includes approximately 1.5 acres (Appendix A, Figure 5).

Land Use and Location

A significant portion of public trees in Norway are in the parks (61 %). (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	30%
Park/vacant/other	61%
Small Commercial	9%

Location	
Planting strip	98%
Front yard	2%

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

Norway has 1 that needs to be considered for removal that is in the park, along with 4 others (3 in the park and 1 along the streets) noted in the 10/9/2014 letter that need further evaluation. These trees are listed as Mature Tree Immediate on the Location of Trees With Recommended Maintenance Map (Appendix B, Figure 4). It is recommended to start with the large diameter trees first.

Poor tree species

Of the 6 trees of concern 3 of them are ash trees in the park. There are a total of 20 ash trees, and 6 of those have signs and symptoms that have been associated with EAB. On 10/9/2014 the city was sent a letter listing a number of trees of concern in different parts of the community that need to be evaluated. The majority of these trees are in the park.

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. Since you have planted a few new trees in the park it will be critical that these trees are trained and maintained with pruning as they develop in the first 5 to 20 years.

Planting

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 Norway.

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 (39%) and ash (37%) (Appendix A, Figure 1). Maples should not be planted until this percentage falls below 20%. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Currently the only City Code related to tree planting is the nuisance rule that does not allow the planting or presence of cotton-bearing cottonwood trees and all other cotton bearing poplar trees. If the community is going to allow planting of trees between the street and the sidewalk there should be an ordinance that controls species and location of new trees. Any new plantings within the parks or the streets should be a diverse mix of species and should not and include ash, maple, cottonwood, poplar, box elder, Siberian elm, or any potentially non-native invasive tree species. Organizations like the Iowa DNR Forestry Bureau, ISU Extension Horticulture, and Trees Forever can provide a variety of information on tree selection.

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. Once EAB arrives in Norway it could potentially kill all ash within 4 to 10 years of its arrival.

EAB infested tree in Muscatine with top thinning and many new green epicormic sprouts

EAB infested tree in Muscatine with sprouting, wood pecker activity, and D-shaped exit holes

Six Year Maintenance Plan with No Additional Funding

Year 1 – Year 6

According to information obtained from the community at this point there is no specific budget for forestry activities such as removal, tree planting, and pruning. Below are activities that the community should consider when developing annual budgets:
Removal: 1 tree has been identified to be evaluated for removal now. Cost of tree removal is between $600 to $1,000 per tree.
Planting and Replacement: Attempt to add new trees to public spaces such as parks and along streets where desirable when budget allows. The cost of new trees can be between $100 to $300 a tree.
Visual Survey for signs and symptoms of EAB on annual basis
Routine Pruning: Do routine pruning of park trees on 4 to 7 year rotation and evaluate newly planted trees annually for pruning

*EAB could potentially kill all ash within 4 to 10 years of its arrival to Norway. Once ash trees begin to actually die they can decline quickly which will require immediate removal. If all 20 ash need to be removed at some point it will cost an estimated $600 to $1,000 per tree to remove them which is a total of $12,000 to $20,000. *City ownership of any tree (s) recommended for removal should be verified prior to any removal*

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first. Next will be all ash in poor condition and displaying signs and symptoms of EAB. *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. *At this point the entire state of Iowa is under Federal Quarantine, which does not allow the movement of regulated items outside of the state.

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? Wood waste can be disposed of as you normally would if your county is not part of a separate quarantine which **Benton County** is not.

Canopy Replacement

Based on information supplied there is no city code that restricts tree planting between the street and the sidewalk. The city should consider developing an ordinance that controls any tree planting within the city right-of-way. Any new plantings within the parks or along the streets should be a diverse mix of species and should not and include ash, maple, cottonwood, poplar, box elder, Siberian elm, or any potentially non-native invasive tree species. Organizations like the Iowa DNR Forestry Bureau, ISU Extension Horticulture, and Trees Forever can provide a variety of information on tree selection.

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. **Once EAB arrives in Norway it could potentially kill all ash within 4 to 10 years of its arrival.**

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB and as ash trees decline in health and become a concern. Currently the only related information in the city code is the removal of trees infected with Dutch elm disease. To address all potential future tree insect and disease threats the city should consider adding something similar to the following to the city code: "If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within sixty (60) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 60 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property."

Budget

EAB could potentially kill all ash within 4 to 10 years of its arrival to Norway. Once ash trees begin to actually die they can decline quickly which will require immediate removal. If all 20 ash need to be removed at some point it will cost an estimated $600 to $1,000 per tree to remove them which is a total of $12,000 to $20,000. *City ownership of any tree (s) recommended for removal should be verified prior to any removal*

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Norway

Annual Energy Benefits of Public Trees

12/29/2014

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	5.1	389	703.5	689	1,078	(N/A)	35.2	38.8	56.74
Norway maple	1.3	102	185.3	182	283	(N/A)	13.0	10.2	40.47
Silver maple	2.2	167	293.4	287	455	(N/A)	11.1	16.4	75.76
Sugar maple	1.5	116	203.2	199	315	(N/A)	7.4	11.3	78.67
Red maple	0.5	39	60.8	60	99	(N/A)	5.6	3.6	32.98
Eastern red cedar	0.2	17	32.9	32	49	(N/A)	3.7	1.8	24.57
Swamp white oak	0.0	1	1.6	2	2	(N/A)	3.7	0.1	1.10
Honeylocust	0.7	51	89.7	88	139	(N/A)	3.7	5.0	69.53
Black walnut	0.6	45	85.0	83	128	(N/A)	3.7	4.6	64.12
Blue spruce	0.1	10	15.2	15	25	(N/A)	1.9	0.9	24.51
White ash	0.3	23	43.0	42	66	(N/A)	1.9	2.4	65.60
Mulberry	0.2	15	31.6	31	46	(N/A)	1.9	1.7	46.14
Maple	0.0	3	5.2	5	8	(N/A)	1.9	0.3	7.85
Northern hackberry	0.3	23	45.0	44	67	(N/A)	1.9	2.4	67.04
Eastern hophornbeam	0.0	0	0.6	1	1	(N/A)	1.9	0.0	0.87
Apple	0.1	6	12.8	13	18	(N/A)	1.9	0.7	18.19
Total	13.2	1,006	1,808.8	1,773	2,778	(N/A)	100.0	100.0	51.45

Table 2: Annual Stormwater Benefits

Norway

Annual Stormwater Benefits of Public Trees

12/29/2014

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	49,006	1,328	(N/A)	35.2	33.4	69.90
Norway maple	9,784	265	(N/A)	13.0	6.7	37.88
Silver maple	35,019	949	(N/A)	11.1	23.9	158.17
Sugar maple	23,291	631	(N/A)	7.4	15.9	157.80
Red maple	3,219	87	(N/A)	5.6	2.2	29.08
Eastern red cedar	3,269	89	(N/A)	3.7	2.2	44.30
Swamp white oak	24	1	(N/A)	3.7	0.0	0.33
Honeylocust	7,590	206	(N/A)	3.7	5.2	102.84
Black walnut	6,534	177	(N/A)	3.7	4.5	88.53
Blue spruce	1,544	42	(N/A)	1.9	1.1	41.85
White ash	3,225	87	(N/A)	1.9	2.2	87.40
Mulberry	1,174	32	(N/A)	1.9	0.8	31.82
Maple	137	4	(N/A)	1.9	0.1	3.72
Northern hackberry	2,432	66	(N/A)	1.9	1.7	65.89
Eastern hophornbeam	7	0	(N/A)	1.9	0.0	0.20
Apple	264	7	(N/A)	1.9	0.2	7.17
Citywide total	146,521	3,971	(N/A)	100.0	100.0	73.53

Table 3: Annual Air Quality Benefits

Norway

Annual Air Quality Benefits of Public Trees

12/29/2014

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								
Green ash	5.2	0.8	2.6	0.2	28	24.5	3.6	3.4	23.2	152	0.0	0	63.5	180	(N/A)	35.2	9.50
Norway maple	1.7	0.3	0.9	0.1	9	6.4	0.9	0.9	6.1	40	-0.4	-2	16.8	48	(N/A)	13.0	6.81
Silver maple	6.4	1.1	3.1	0.3	34	10.4	1.5	1.5	10.0	65	-3.3	-13	30.9	87	(N/A)	11.1	14.49
Sugar maple	3.5	0.6	1.7	0.2	19	7.2	1.1	1.0	6.9	45	-2.7	-10	19.4	54	(N/A)	7.4	13.43
Red maple	0.6	0.1	0.3	0.0	3	2.4	0.4	0.3	2.3	15	-0.2	-1	6.3	18	(N/A)	5.6	5.88
Eastern red cedar	0.7	0.1	0.5	0.1	4	1.1	0.2	0.1	1.0	7	-1.8	-7	2.0	4	(N/A)	3.7	2.19
Swamp white oak	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0	(N/A)	3.7	0.14
Honeylocust	1.5	0.2	0.7	0.1	8	3.2	0.5	0.4	3.0	20	-1.1	-4	8.5	23	(N/A)	3.7	11.74
Black walnut	0.8	0.1	0.4	0.0	4	2.9	0.4	0.4	2.7	18	0.0	0	7.6	22	(N/A)	3.7	10.91
Blue spruce	0.2	0.0	0.2	0.0	1	0.6	0.1	0.1	0.6	4	-0.6	-2	1.2	3	(N/A)	1.9	2.89
White ash	0.4	0.1	0.2	0.0	2	1.5	0.2	0.2	1.4	9	0.0	0	3.9	11	(N/A)	1.9	11.18
Mulberry	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8	(N/A)	1.9	8.35
Maple	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1	(N/A)	1.9	1.12
Northern hackberry	0.3	0.1	0.2	0.0	2	1.5	0.2	0.2	1.4	9	0.0	0	3.8	11	(N/A)	1.9	10.85
Eastern hophornbeam	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	(N/A)	1.9	0.11
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)	1.9	2.55
Citywide total	21.7	3.6	10.9	1.0	118	63.2	9.2	8.8	60.0	394	-10.2	-38	168.3	473	(N/A)	100.0	8.77

Table 4: Annual Carbon Stored

Norway

Stored CO2 Benefits of Public Trees

12/29/2014

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	166,027	1,245	(N/A)	35.2	31.6	65.54
Norway maple	27,881	209	(N/A)	13.0	5.3	29.87
Silver maple	153,065	1,148	(N/A)	11.1	29.1	191.33
Sugar maple	104,435	783	(N/A)	7.4	19.9	195.81
Red maple	7,265	54	(N/A)	5.6	1.4	18.16
Eastern red cedar	2,204	17	(N/A)	3.7	0.4	8.27
Swamp white oak	34	0	(N/A)	3.7	0.0	0.13
Honeylocust	18,988	142	(N/A)	3.7	3.6	71.20
Black walnut	24,230	182	(N/A)	3.7	4.6	90.86
Blue spruce	1,118	8	(N/A)	1.9	0.2	8.39
White ash	8,458	63	(N/A)	1.9	1.6	63.43
Mulberry	6,743	51	(N/A)	1.9	1.3	50.57
Maple	218	2	(N/A)	1.9	0.0	1.64
Northern hackberry	4,142	31	(N/A)	1.9	0.8	31.07
Eastern hophornbeam	14	0	(N/A)	1.9	0.0	0.10
Apple	908	7	(N/A)	1.9	0.2	6.81
Citywide total	525,729	3,943	(N/A)	100.0	100.0	73.02

Table 5: Annual Carbon Sequestered

Norway

Annual CO Benefits of Public Trees

12/29/2014

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($) Error	Standard	% of Total Trees	% of Total $	Avg. $/tree
Green ash	12,251	92	-797	-51	0	0	0	11,403	86	(N/A)	35.2	34.1	4.50
Norway maple	2,327	17	-134	-13	0	0	0	2,180	16	(N/A)	13.0	6.5	2.34
Silver maple	10,370	78	-735	-26	0	0	0	9,610	72	(N/A)	11.1	28.7	12.01
Sugar maple	4,319	32	-501	-18	0	0	0	3,800	28	(N/A)	7.4	11.4	7.12
Red maple	969	7	-35	-4	0	0	0	930	7	(N/A)	5.6	2.8	2.33
Eastern red cedar	0	0	-11	-4	0	0	0	-14	0	(N/A)	3.7	0.0	-0.05
Swamp white oak	11	0	0	0	0	0	0	10	0	(N/A)	3.7	0.0	0.04
Honeylocust	2,422	18	-91	-5	0	0	0	2,326	17	(N/A)	3.7	7.0	8.72
Black walnut	1,517	11	-116	-6	0	0	0	1,394	10	(N/A)	3.7	4.2	5.23
Blue spruce	91	1	-5	-2	0	0	0	83	1	(N/A)	1.9	0.2	0.63
White ash	845	6	-41	-3	0	0	0	802	6	(N/A)	1.9	2.4	6.01
Mulberry	478	4	-32	-3	0	0	0	443	3	(N/A)	1.9	1.3	3.33
Maple	39	0	-1	-1	0	0	0	37	0	(N/A)	1.9	0.1	0.28
Northern hackberry	354	3	-20	-3	0	0	0	332	2	(N/A)	1.9	1.0	2.49
Eastern hophornbeam	9	0	0	0	0	0	0	8	0	(N/A)	1.9	0.0	0.06
Apple	114	1	-4	-1	0	0	0	108	1	(N/A)	1.9	0.3	0.81
Citywide total	36,116	271	-2,524	-140	-1	0	0	33,452	251	(N/A)	100.0	100.0	4.65

Table 6: Annual Social and Aesthetic Benefits

Norway

Annual Aesthetic/Other Benefits of Public Trees

12/29/2014

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	1,069	(N/A)	35.2	30.3	56.24
Norway maple	233	(N/A)	13.0	6.6	33.22
Silver maple	758	(N/A)	11.1	21.5	126.31
Sugar maple	406	(N/A)	7.4	11.5	101.52
Red maple	132	(N/A)	5.6	3.7	43.94
Eastern red cedar	0	(N/A)	3.7	0.0	0.00
Swamp white oak	5	(N/A)	3.7	0.2	2.74
Honeylocust	584	(N/A)	3.7	16.5	291.75
Black walnut	123	(N/A)	3.7	3.5	61.64
Blue spruce	25	(N/A)	1.9	0.7	25.23
White ash	101	(N/A)	1.9	2.9	101.35
Mulberry	29	(N/A)	1.9	0.8	28.80
Maple	7	(N/A)	1.9	0.2	7.28
Northern hackberry	52	(N/A)	1.9	1.5	52.26
Eastern hophornbeam	0	(N/A)	1.9	0.0	0.03
Apple	6	(N/A)	1.9	0.2	6.40
Citywide total	3,530	(N/A)	100.0	100.0	65.38

Table 7: Summary of Benefits in Dollars

Norway

Total Annual Benefits of Public Trees by Species ($)

12/29/201

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Green ash	1,078	86	180	1,328	1,069	3,741	(N/A)	34.0
Norway maple	283	16	48	265	233	845	(N/A)	7.7
Silver maple	455	72	87	949	758	2,320	(N/A)	21.1
Sugar maple	315	28	54	631	406	1,434	(N/A)	13.0
Red maple	99	7	18	87	132	343	(N/A)	3.1
Eastern red cedar	49	0	4	89	0	142	(N/A)	1.3
Swamp white oak	2	0	0	1	5	9	(N/A)	0.1
Honeylocust	139	17	23	206	584	969	(N/A)	8.8
Black walnut	128	10	22	177	123	461	(N/A)	4.2
Blue spruce	25	1	3	42	25	95	(N/A)	0.9
White ash	66	6	11	87	101	272	(N/A)	2.5
Mulberry	46	3	8	32	29	118	(N/A)	1.1
Maple	8	0	1	4	7	20	(N/A)	0.2
Northern hackberry	67	2	11	66	52	199	(N/A)	1.8
Eastern hophornbeam	1	0	0	0	0	1	(N/A)	0.0
Apple	18	1	3	7	6	35	(N/A)	0.3
Citywide Total	2,778	251	473	3,971	3,530	11,004	(N/A)	100.0

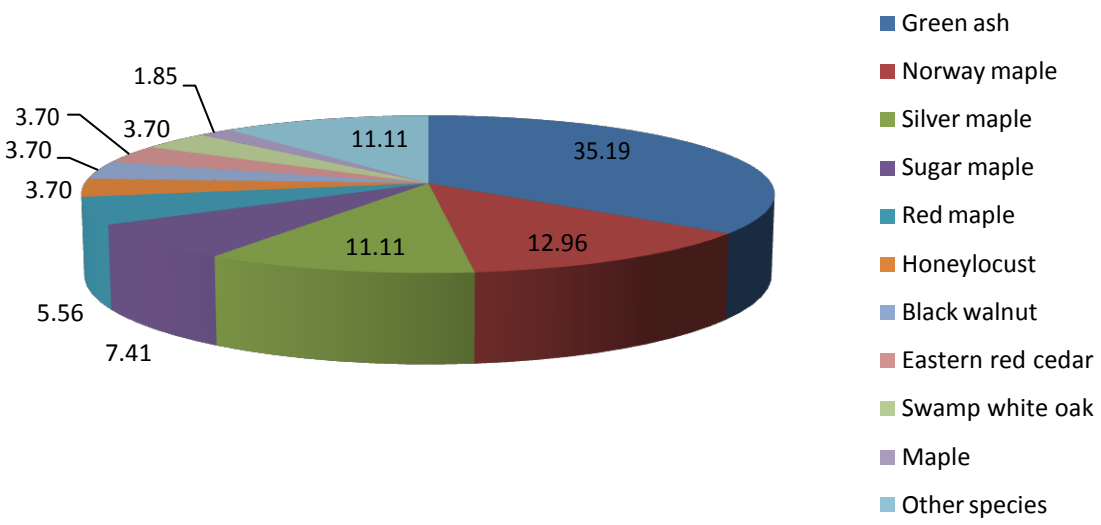


Figure 1: Species Distribution

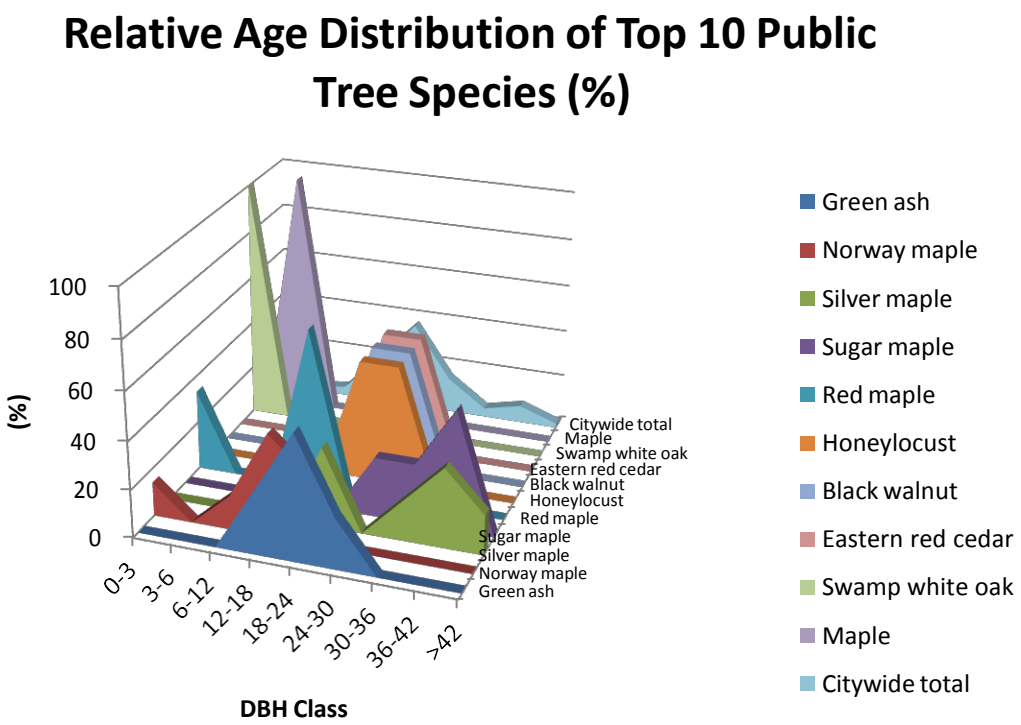


Figure 2: Relative Age Class

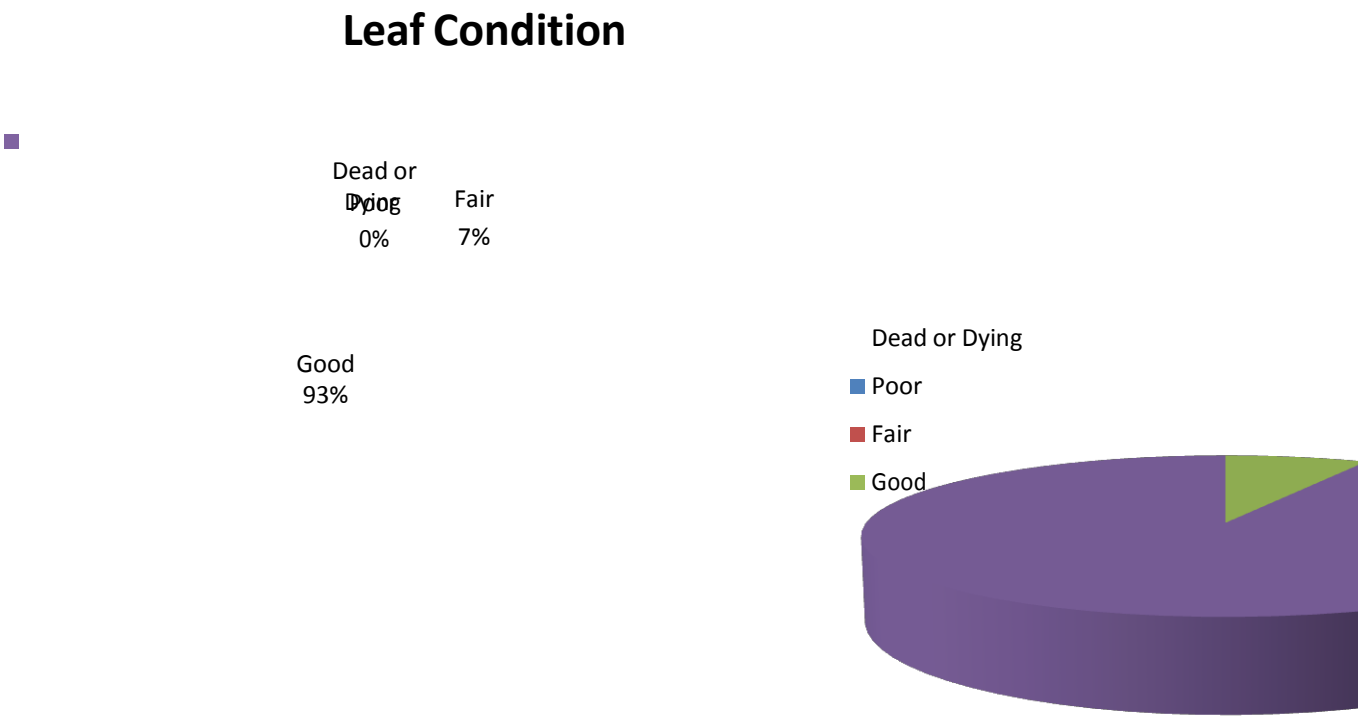


Figure 3: Foliage Condition

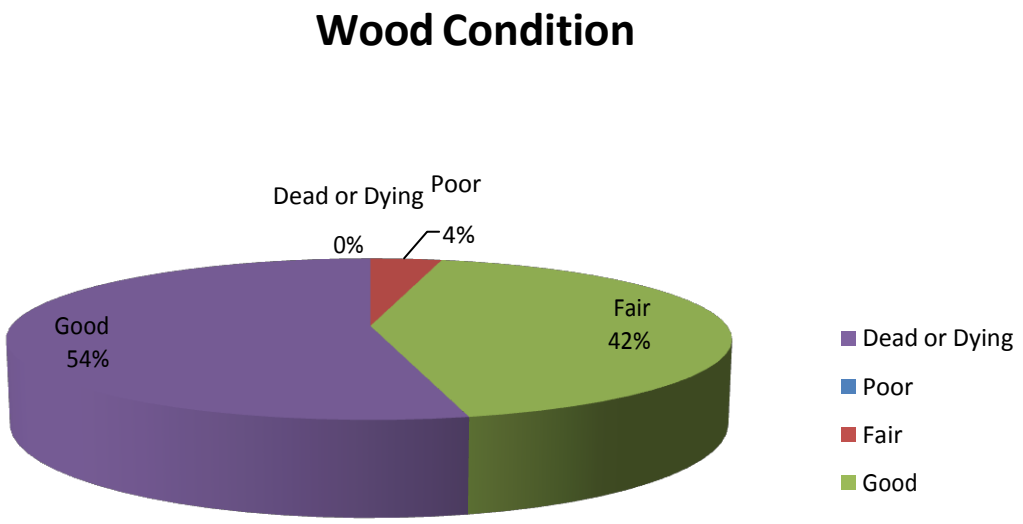


Figure 4: Wood Condition

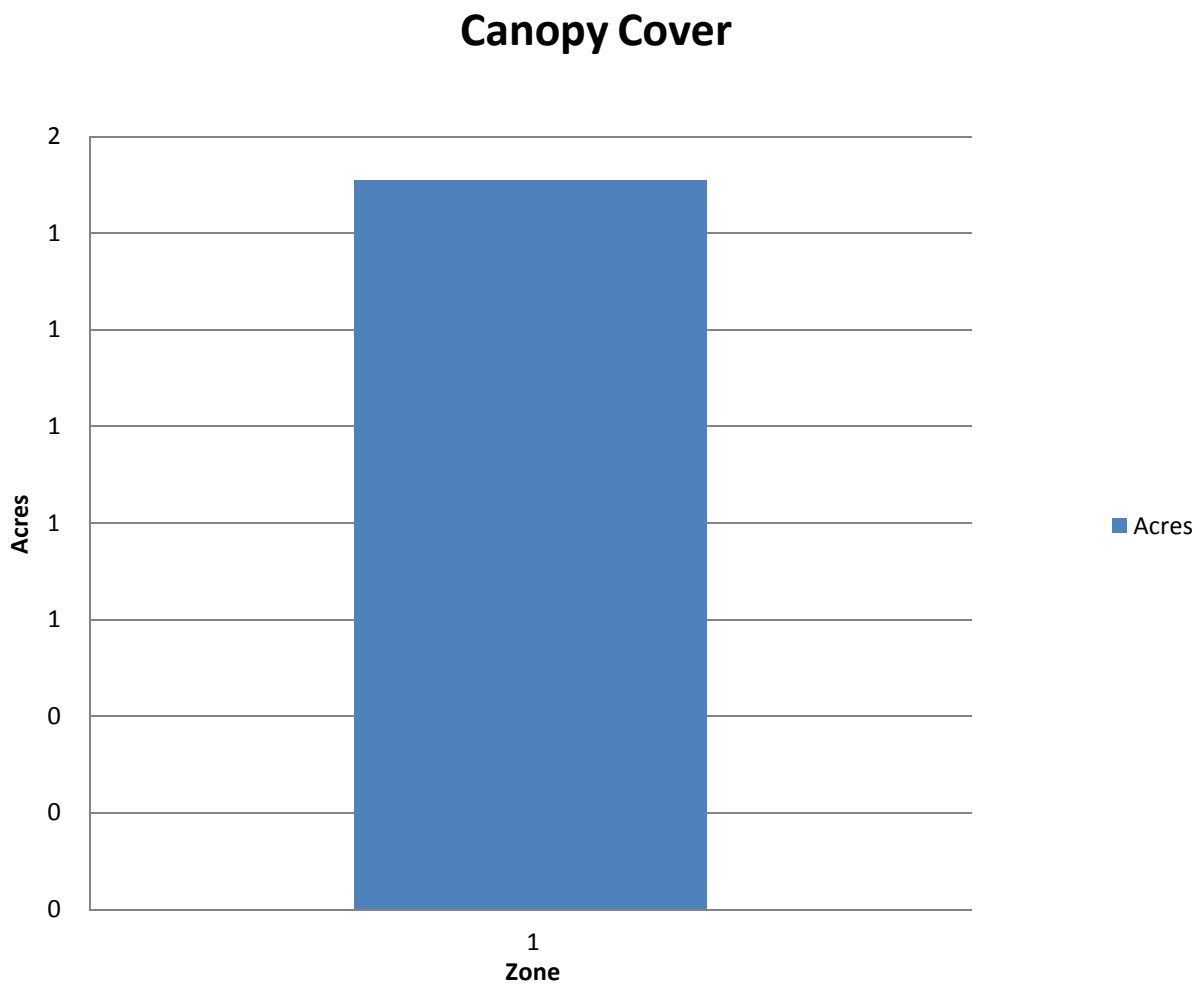


Figure 5: Canopy Cover in Acres

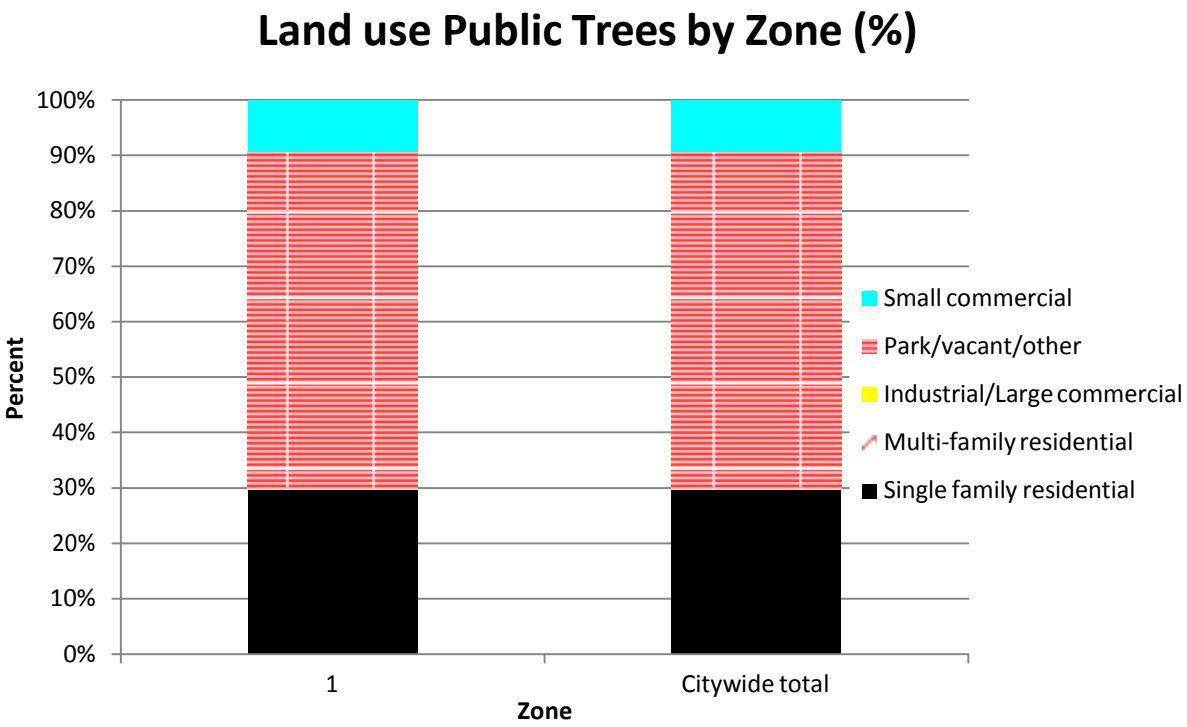


Figure 6: Land Use of city/park trees

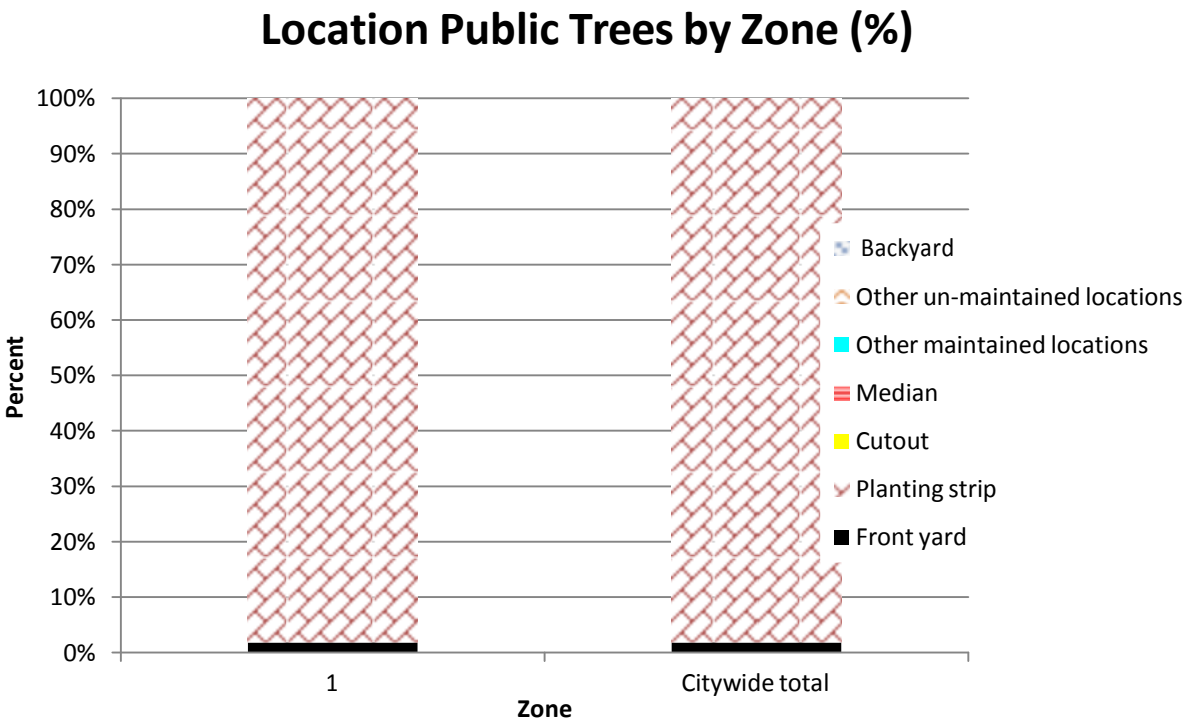
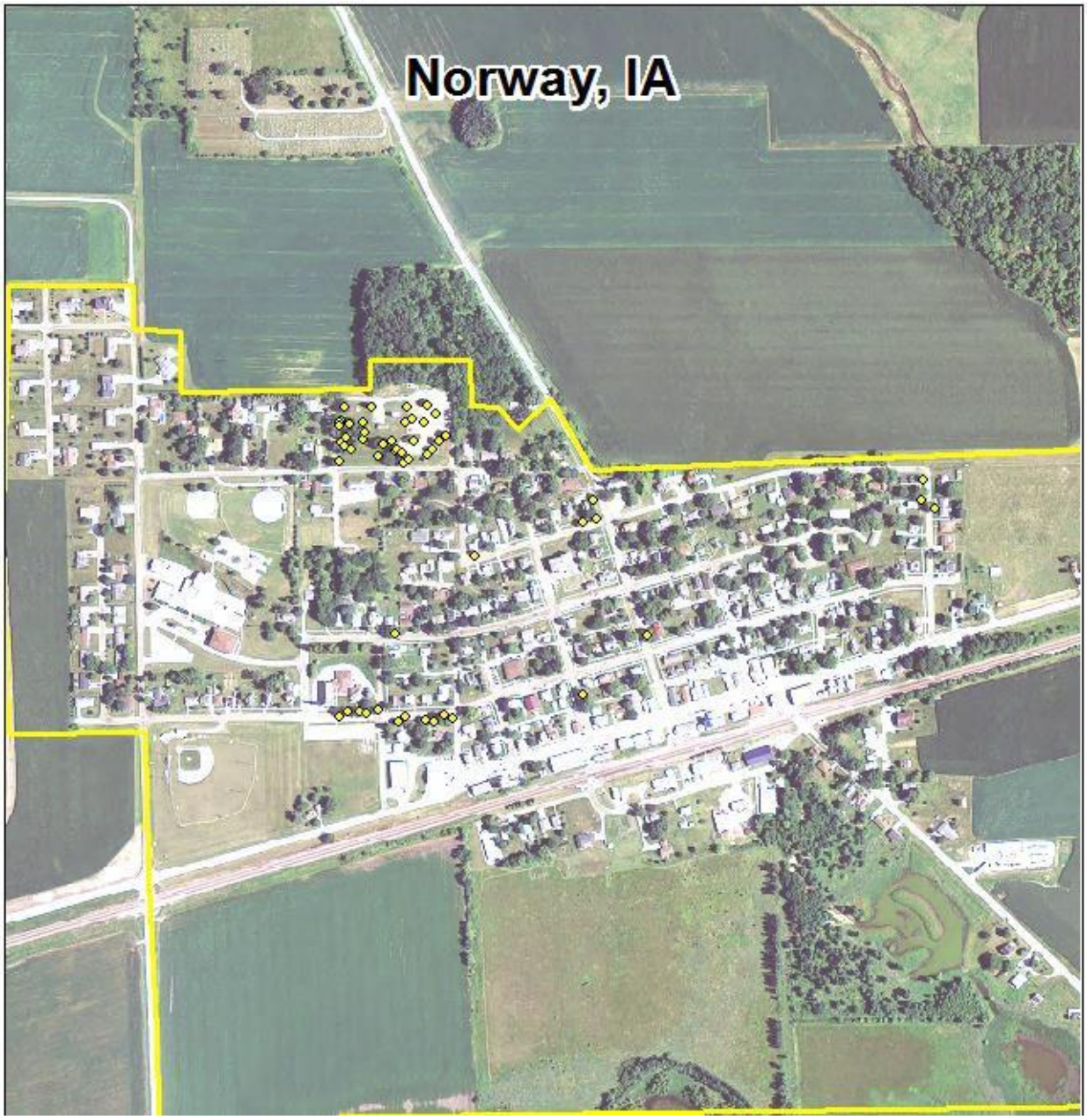


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping



All Norway Public Trees

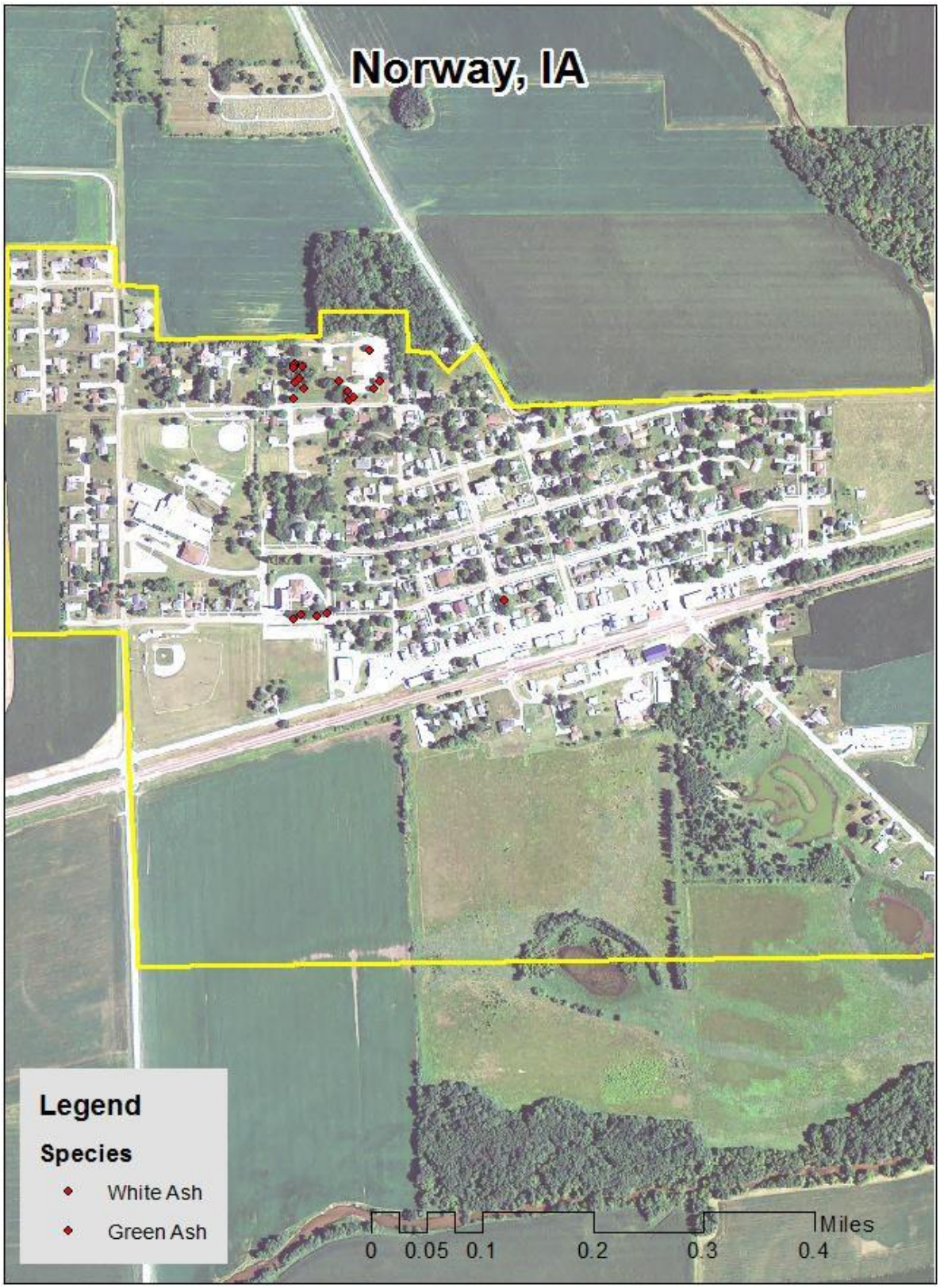


Figure 1: Location of Ash Trees

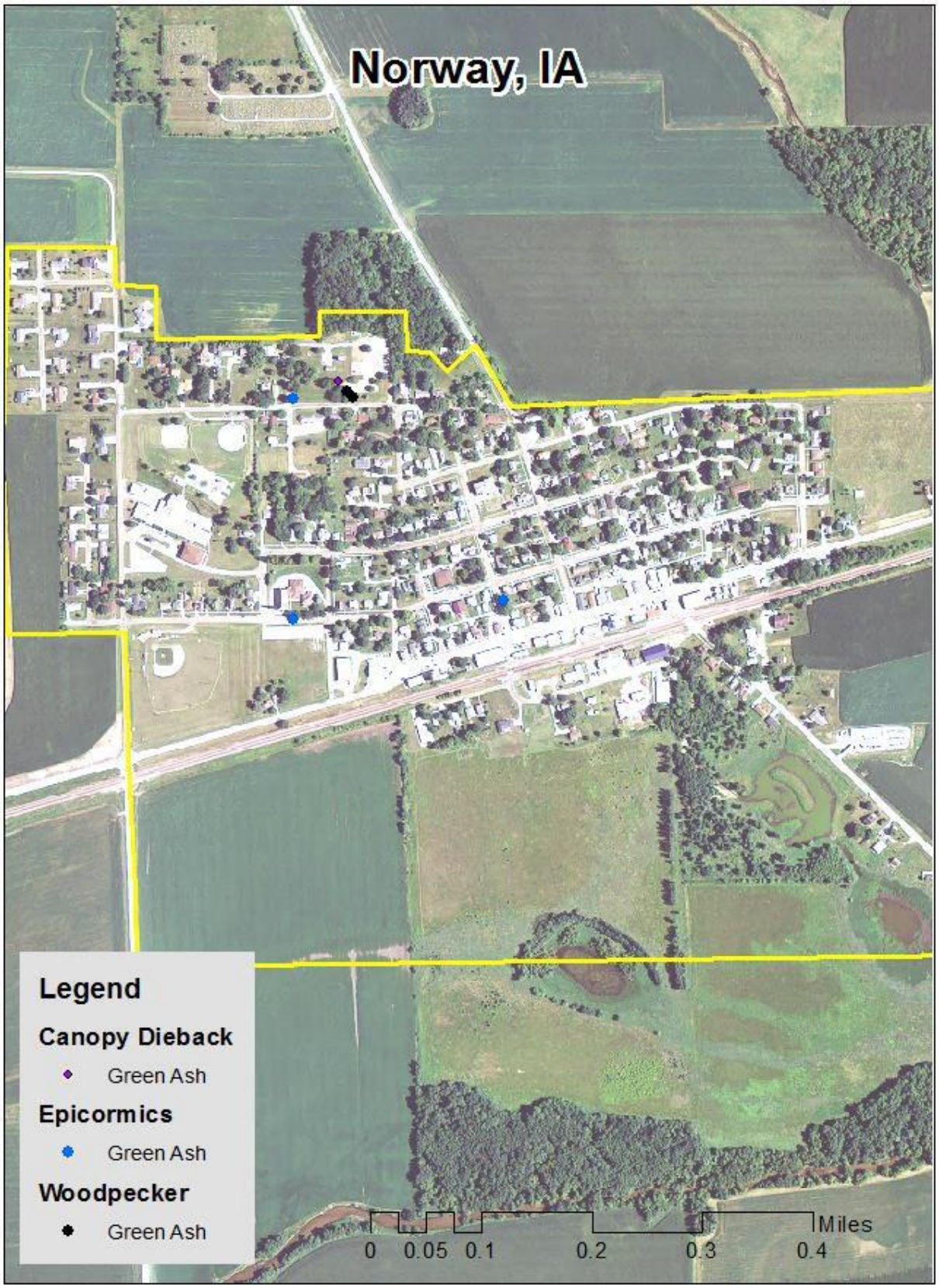


Figure 2: Location of EAB symptoms

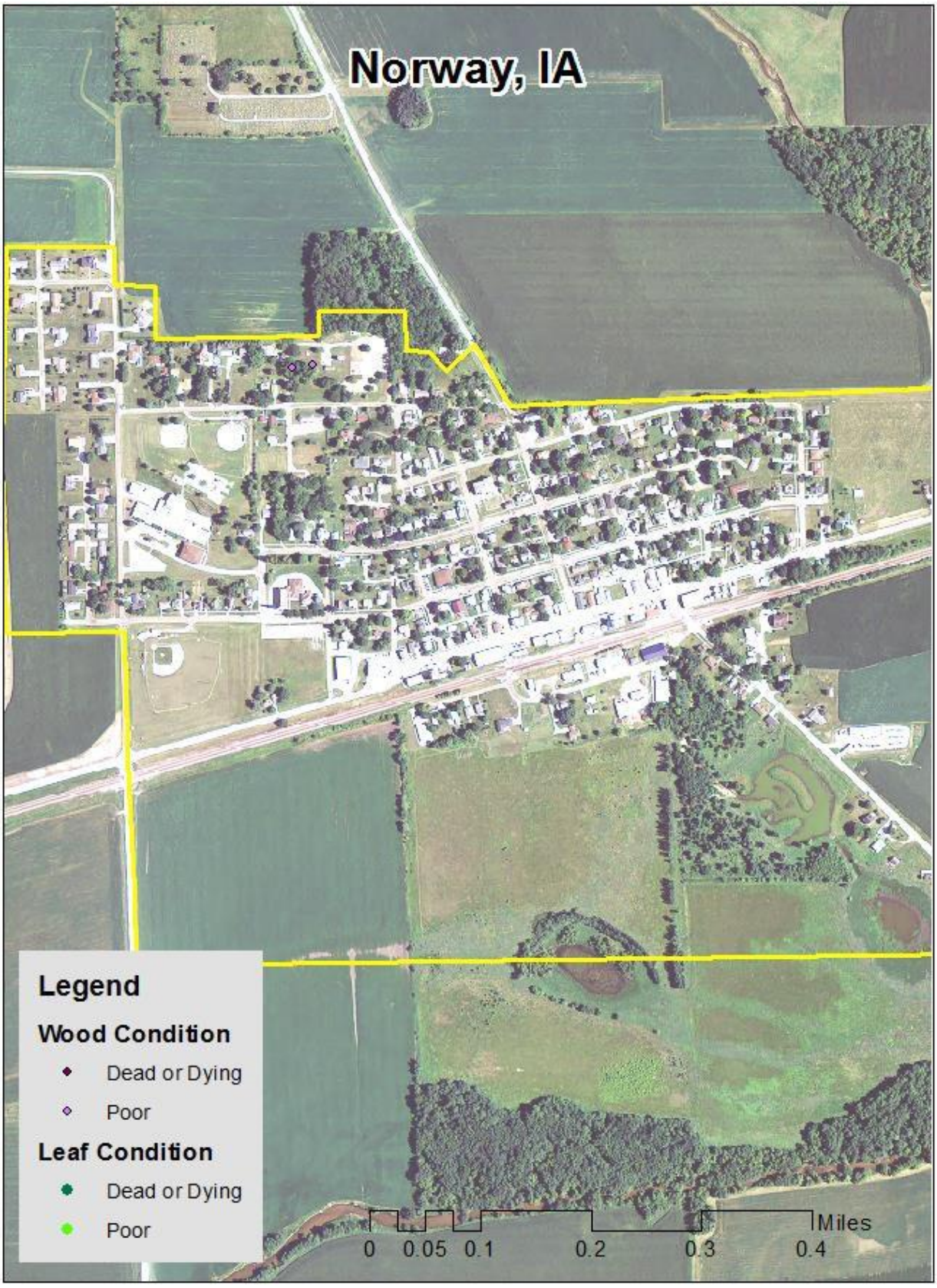


Figure 3: Location of Poor Condition Trees

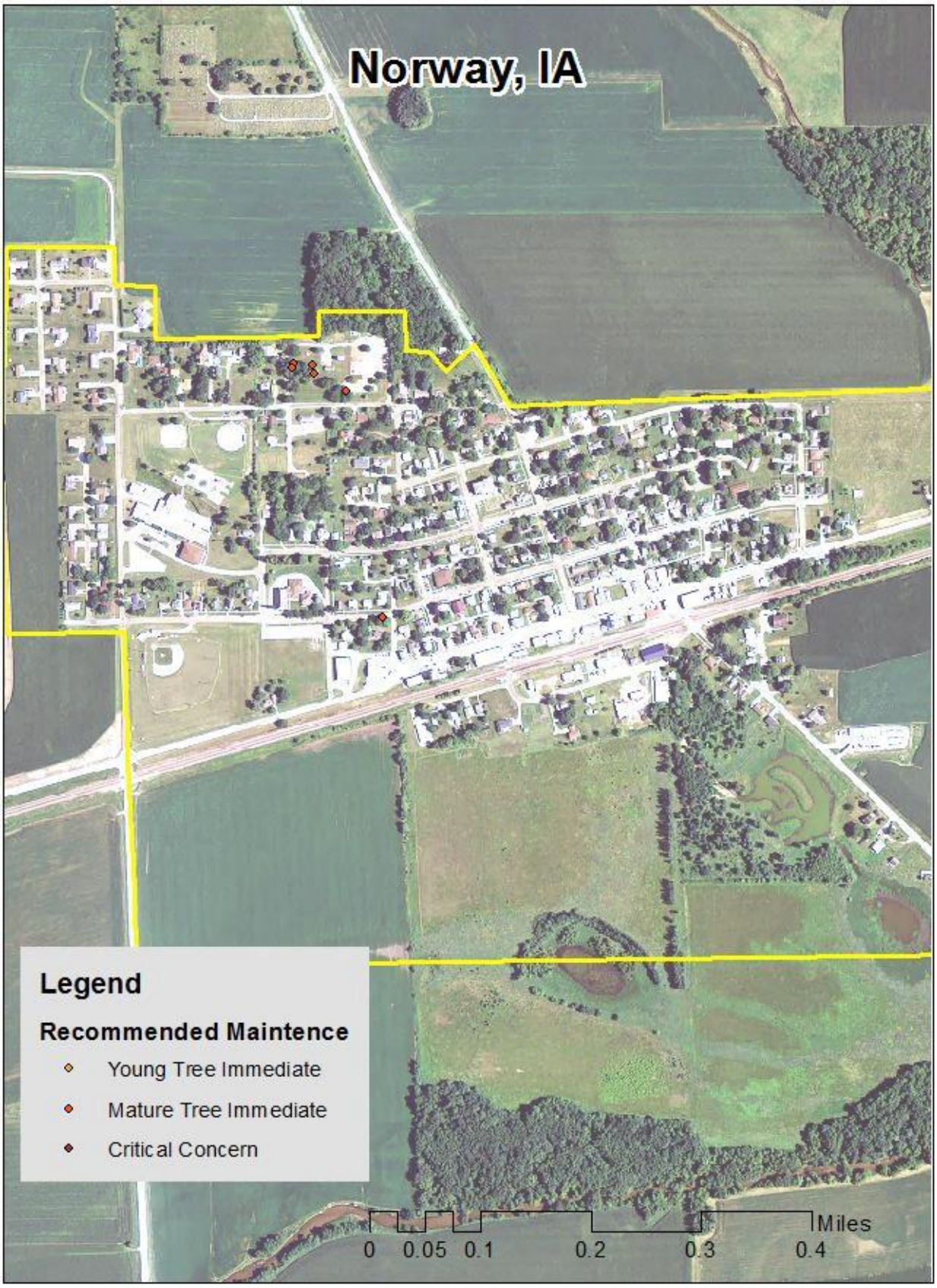


Figure 4: Location of Trees with Recommended Maintenance

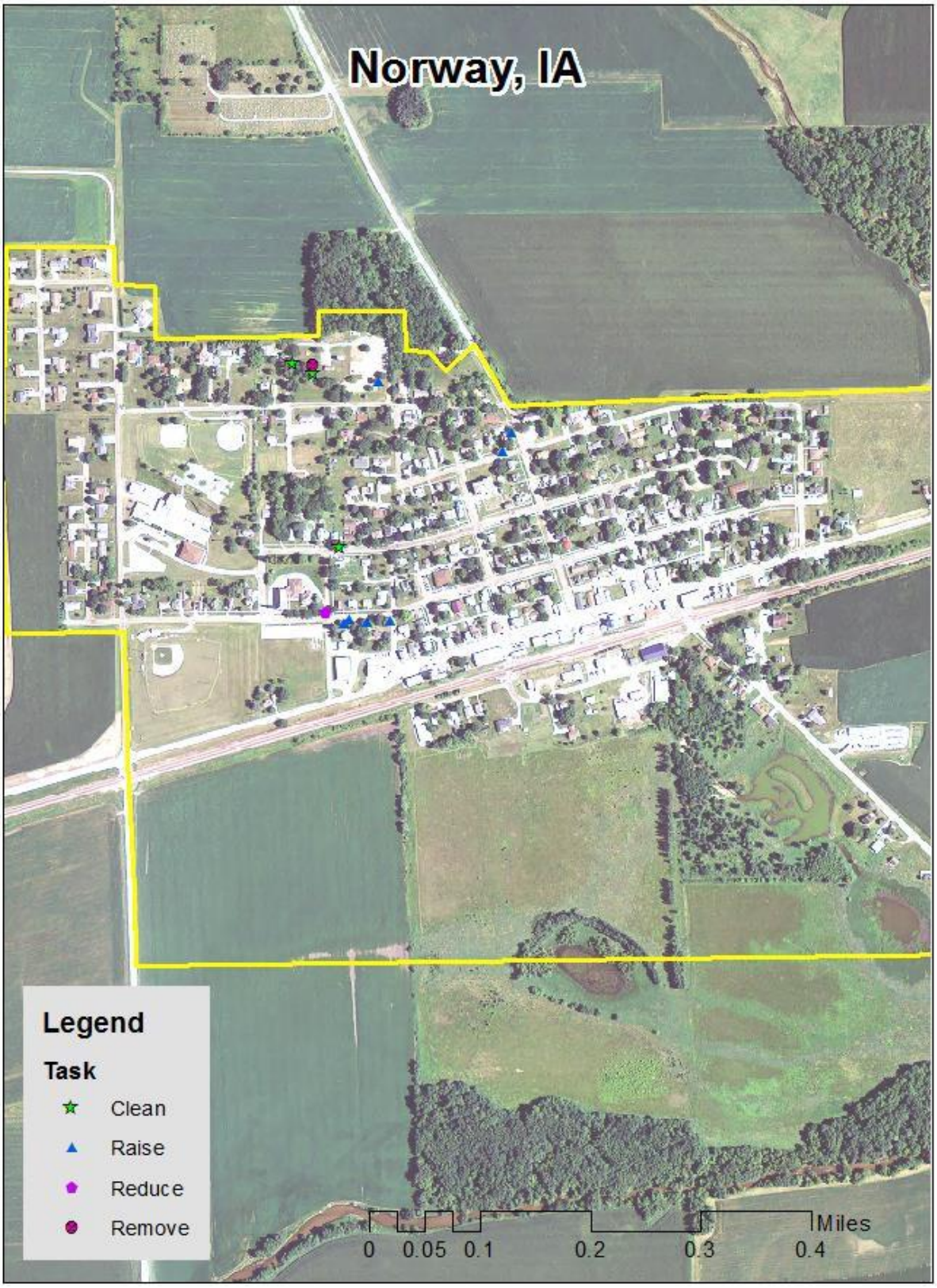


Figure 5: Maintenance Tasks

Appendix C: Norway Tree Ordinance

Currently the only ordinance is under nuisance ordinance that considers “Cotton-bearing cotton wood trees and all other cotton-bearing poplar trees in the city”.

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