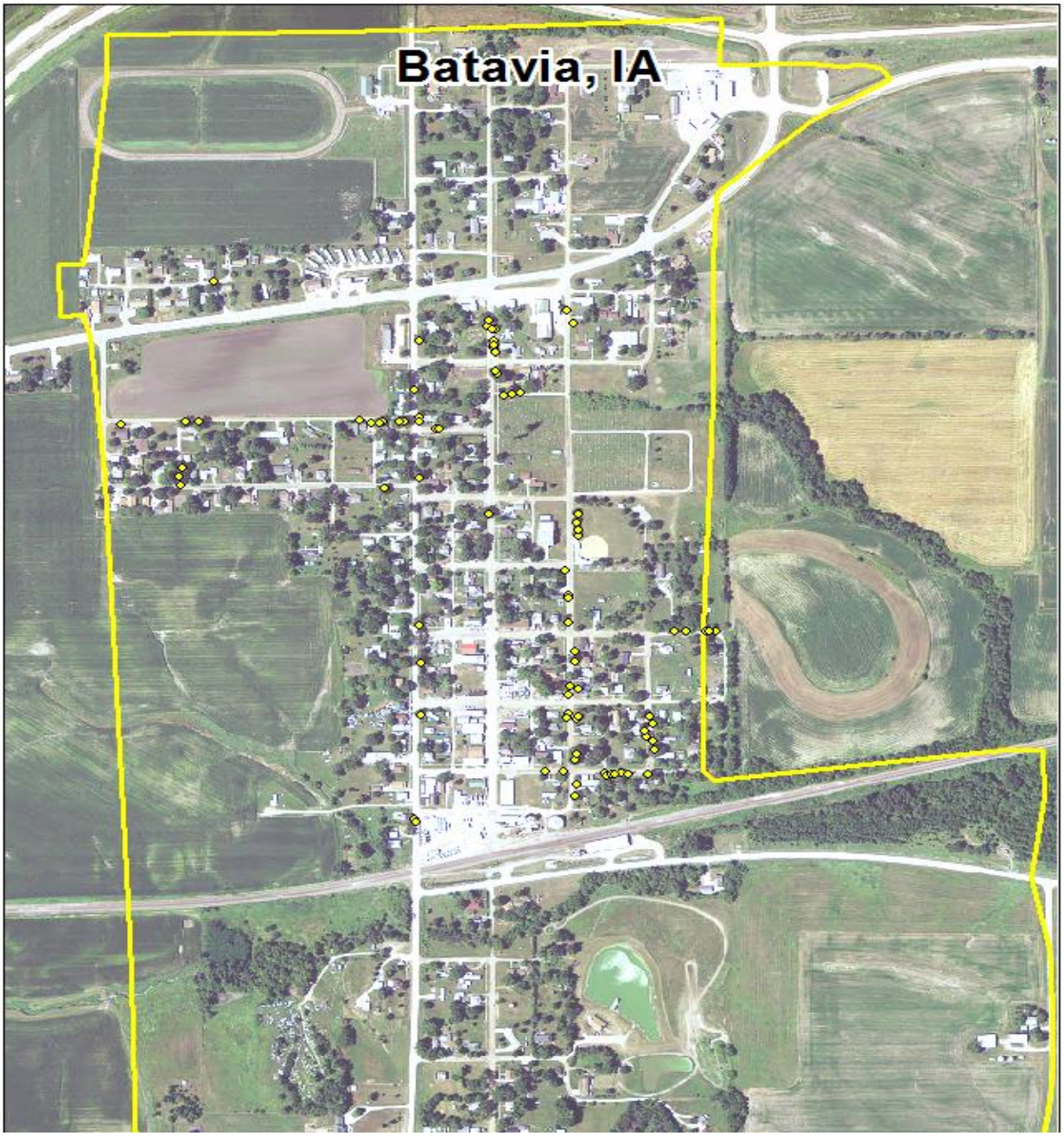
Batavia, IA



2014 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Batavia with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 13% of Batavia'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 85 trees inventoried.

- Batavia's trees provide $12,894 of benefits annually, an average of $152 a tree
- There are over 23 species of trees
- The top three genera are: Maple 28%, Ash 13%, Pine 9.4%, and Apple 9.4%
- 10% of trees are in need of some type of management
- 3 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 3 trees needing removal, 2 trees are over 36 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*
- 3 of the 11 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
- It would take an annual budget of approximately $2,200 to remove all ash and critical/immediate concern trees, maintain existing trees, and plant replacement trees.

Introduction

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

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

Inventory

In 2014, a tree inventory was conducted that included 100% of the city owned trees on streets. 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 85 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. Batavia's trees reduce energy related costs by approximately $3,437 annually (Appendix A, Table 1). These savings are both in Electricity (16.6 MWh) and in Natural Gas (2,221.4 Therms).

Annual Stormwater Benefits

Batavia's trees intercept about 181,277 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $4,913 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 mater (ozone). In Batavia, it is estimated that trees remove 210.9 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 $592 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Batavia, trees sequester about 37,564 lbs of carbon a year with an associated value of $282 (Appendix A, Table 5). In addition, the trees store 688,561 lbs of carbon, with a yearly benefit of $5,164 (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. Batavia receives $3,671 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, Batavia's trees provide $12,894 of benefits annually. Benefits of individual trees vary based on size, species, health and

location, but on average each of the 85 trees in Batavia provide approximately $152 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Batavia has over 23 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	24	28.2%
Ash	11	12.9%
Pine	8	9.4%
Apple (Crab)	8	9.4%
Spruce	6	7.1%
Siberian elm	5	5.9%
Oak	5	5.9%
Walnut	4	4.7%
Honey Locust	4	4.7%
All others	10	11.8%

Age Class

Most of Batavia's trees (52%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). Only 14% are under 6 inches, while 34% are over 18 inches in diameter. 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. Batavia's size curve is on the larger side, indicating an older than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Batavia indicate that 92% of the trees are in good health, with only 1% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 82% of Batavia'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.

Management Needs

The following outlines the specific management needs of the street trees by number of trees and percent of canopy (Appendix B, Figure 3).

Crown Cleaning	2	2.4%
Tree Removal	3	3.5%
Crown Reduction	3	3.5%

Canopy Cover

The total canopy with both private and public trees is 19%, which equals about 70 acres of Batavia's 380 acres. The canopy cover included in the Batavia inventory includes approximately 1.9 acres (Appendix A, Figure 5).

Land Use and Location

The majority of Batavia's city trees are in front yards 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	92%
Park/vacant/other	6%
Small commercial	2%

Location	
Planting strip	27%
Front yard	73%

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

Batavia has 3 immediate concern trees that need 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 immediate concern trees first. There are 2 trees over 36 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 8 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 3 removals, none are ash trees. There are a total of 11 ash trees, and 3 of those have signs and symptoms that have been associated with EAB. *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 Batavia.

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 (28%) (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. City ordinances should be adopted for planting requirements (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 Recommendation

Year 1

Removal: 3 largest critical/immediate concern trees
Planting and Replacement: 4 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 2 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment
Planting and Replacement: 4 trees in open locations
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 3

Removal: 3 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment
Planting and Replacement: 4 trees to be planted in open locations and locations from previous removals
Visual Survey for signs and symptoms of EAB

Year 4

Removal: 2 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment
Planting and Replacement: 4 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 5

Removal: 3 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment
Planting and Replacement: 4 trees to be planted in open locations and locations from previous removals
Visual Survey for signs and symptoms of EAB

Year 6

Removal: 2 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment
Planting and Replacement: 4 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: All ash needing removal should have been removed. EAB could potentially kill all ash within 4 years of its arrival.

**To remove all ash trees and critical/immediate concern trees within 6 years, maintain existing trees, and plant replacement trees, the budget would need to be approximately $2,200 per year.

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 should not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut. Appendix C has recommended planting list.

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. City Ordinances should be adopted to address dangerous, diseased, or nuisance trees on private property (Appendix C).

Budget

Esimated Budget Needs
Total $13,200 over 6 years ($2,200/year)

FY 01 Budget
Removal: $1,500
Planting: $400
Watering & Maintenance: $300

FY 02 Budget
Removal: $1,000
*Or saving for ash tree treatment
Planting: $400
Routine trimming: $500
Watering & Maintenance: $300

FY 03 Budget
Removal: $1,500
*Or saving for ash tree treatment
Planting: $400
Watering & Maintenance: $300

FY 04 Budget
Removal: $1,000
*Or saving for ash tree treatment
Planting: $400
Routine trimming: $500
Watering & Maintenance: $300

FY 05 Budget
Removal: $1,500
*Or saving for ash tree treatment
Planting: $400
Watering & Maintenance: $300

FY 06 Budget
Removal: $1,000
*Or saving for ash tree treatment
Planting: $400
Routine trimming: $500
Watering & Maintenance: $300

Purposed Budget Increase

EAB could potentially kill all ash trees in Batavia within 4 years of its arrival. To remove all ash trees and critical/immediate concern trees within 6 years, maintain existing trees, and plant replacement trees, the budget would need to be approximately $2,200 per year. Additionally, it is recommended that Keosauqua 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.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Batavia

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
Silver maple	4.9	369	634.4	622	990	(N/A)	16.5	28.8	70.74
Green ash	2.7	208	356.2	349	557	(N/A)	12.9	16.2	50.61
Apple	0.5	37	84.6	83	120	(N/A)	9.4	3.5	15.00
Eastern white pine	0.6	44	76.4	75	119	(N/A)	8.2	3.5	16.96
Sugar maple	1.0	78	125.7	123	201	(N/A)	5.9	5.8	40.17
Siberian elm	1.6	121	205.1	201	322	(N/A)	5.9	9.4	64.34
Blue spruce	0.3	21	40.4	40	61	(N/A)	4.7	1.8	15.26
Black walnut	1.2	90	169.9	167	256	(N/A)	4.7	7.5	64.12
Honeylocust	0.5	40	81.0	79	120	(N/A)	4.7	3.5	29.94
Northern white cedar	0.1	5	11.9	12	17	(N/A)	3.5	0.5	5.61
Norway maple	0.6	44	75.8	74	118	(N/A)	3.5	3.4	39.34
White oak	0.2	14	27.5	27	41	(N/A)	2.4	1.2	20.64
Catalpa	0.7	55	90.1	88	143	(N/A)	2.4	4.2	71.43
Northern pin oak	0.6	42	76.9	75	118	(N/A)	2.4	3.4	58.81
Broadleaf Deciduous Small	0.0	2	4.4	4	6	(N/A)	2.4	0.2	3.13
Norway spruce	0.3	21	34.3	34	55	(N/A)	2.4	1.6	27.30
Boxelder	0.2	15	23.9	23	39	(N/A)	1.2	1.1	38.63
Mulberry	0.2	15	31.6	31	46	(N/A)	1.2	1.3	46.14
River birch	0.2	18	29.5	29	47	(N/A)	1.2	1.4	46.78
Callery pear	0.0	0	0.8	1	1	(N/A)	1.2	0.0	1.10
Scotch pine	0.1	4	9.5	9	14	(N/A)	1.2	0.4	13.58
Northern red oak	0.2	16	30.6	30	46	(N/A)	1.2	1.3	46.28
Red maple	0.0	0	0.7	1	1	(N/A)	1.2	0.0	1.03
Total	16.6	1,260	2,221.4	2,177	3,437	(N/A)	100.0	100.0	40.43

Table 2: Annual Stormwater Benefits

Batavia

Annual Stormwater Benefits of Public Trees

12/29/2014

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	71,664	1,942	(N/A)	16.5	39.5	138.72
Green ash	28,697	778	(N/A)	12.9	15.8	70.70
Apple	1,724	47	(N/A)	9.4	1.0	5.84
Eastern white pine	6,615	179	(N/A)	8.2	3.6	25.61
Sugar maple	7,908	214	(N/A)	5.9	4.4	42.86
Siberian elm	15,363	416	(N/A)	5.9	8.5	83.27
Blue spruce	3,312	90	(N/A)	4.7	1.8	22.44
Black walnut	13,067	354	(N/A)	4.7	7.2	88.53
Honeylocust	2,509	68	(N/A)	4.7	1.4	17.00
Northern white cedar	638	17	(N/A)	3.5	0.4	5.77
Norway maple	3,404	92	(N/A)	3.5	1.9	30.75
White oak	1,216	33	(N/A)	2.4	0.7	16.47
Catalpa	8,704	236	(N/A)	2.4	4.8	117.95
Northern pin oak	5,173	140	(N/A)	2.4	2.9	70.10
Broadleaf Deciduous Small	76	2	(N/A)	2.4	0.0	1.03
Norway spruce	4,508	122	(N/A)	2.4	2.5	61.08
Boxelder	1,456	39	(N/A)	1.2	0.8	39.46
Mulberry	1,174	32	(N/A)	1.2	0.6	31.82
River birch	1,409	38	(N/A)	1.2	0.8	38.19
Callery pear	12	0	(N/A)	1.2	0.0	0.33
Scotch pine	596	16	(N/A)	1.2	0.3	16.14
Northern red oak	2,039	55	(N/A)	1.2	1.1	55.25
Red maple	12	0	(N/A)	1.2	0.0	0.32
Citywide total	181,277	4,913	(N/A)	100.0	100.0	57.80

Table 3: Annual Air Quality Benefits

Batavia

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								
Silver maple	12.4	2.1	6.1	0.6	67	22.9	3.3	3.2	22.0	143	-6.5	-24	66.1	186	(N/A)	16.5	13.27
Green ash	4.0	0.6	1.9	0.2	21	12.9	1.9	1.8	12.4	81	0.0	0	35.7	102	(N/A)	12.9	9.28
Apple	0.3	0.0	0.2	0.0	2	2.5	0.4	0.3	2.2	15	0.0	0	5.9	17	(N/A)	9.4	2.09
Eastern white pine	0.7	0.1	0.6	0.1	5	2.7	0.4	0.4	2.6	17	-2.2	-8	5.4	13	(N/A)	8.2	1.92
Sugar maple	0.9	0.2	0.5	0.0	5	4.8	0.7	0.7	4.6	30	-0.7	-3	11.6	32	(N/A)	5.9	6.42
Siberian elm	2.4	0.4	1.2	0.1	13	7.5	1.1	1.0	7.2	47	0.0	0	21.0	60	(N/A)	5.9	12.02
Blue spruce	0.3	0.1	0.3	0.0	2	1.4	0.2	0.2	1.3	8	-1.1	-4	2.7	7	(N/A)	4.7	1.68
Black walnut	1.5	0.2	0.7	0.1	8	5.7	0.8	0.8	5.4	35	0.0	0	15.3	44	(N/A)	4.7	10.91
Honeylocust	0.3	0.0	0.2	0.0	2	2.6	0.4	0.4	2.4	16	-0.2	-1	6.1	17	(N/A)	4.7	4.28
Northern white cedar	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2	(N/A)	3.5	0.56
Norway maple	0.5	0.1	0.3	0.0	3	2.7	0.4	0.4	2.6	17	-0.1	-1	6.9	19	(N/A)	3.5	6.43
White oak	0.0	0.0	0.0	0.0	0	0.9	0.1	0.1	0.9	6	0.0	0	2.1	6	(N/A)	2.4	2.99
Catalpa	1.7	0.3	0.8	0.1	9	3.4	0.5	0.5	3.3	21	0.0	0	10.4	30	(N/A)	2.4	14.99
Northern pin oak	1.1	0.2	0.5	0.0	6	2.7	0.4	0.4	2.5	17	-0.3	-1	7.5	21	(N/A)	2.4	10.75
Broadleaf Deciduous Small	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1	(N/A)	2.4	0.41
Norway spruce	0.5	0.1	0.4	0.1	3	1.3	0.2	0.2	1.2	8	-1.9	-7	2.1	4	(N/A)	2.4	2.13
Boxelder	0.1	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	-0.1	0	2.3	6	(N/A)	1.2	6.37
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)	1.2	8.35
River birch	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8	(N/A)	1.2	7.92
Callery pear	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)	1.2	0.14
Scotch pine	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	1	(N/A)	1.2	1.48
Northern red oak	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	1.0	6	-0.6	-2	2.4	7	(N/A)	1.2	6.50
Red maple	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)	1.2	0.13
Citywide total	28.0	4.7	14.4	1.4	153	78.7	11.5	11.0	75.2	491	-14.0	-53	210.9	592	(N/A)	100.0	6.97

Table 4: Annual Carbon Stored

Batavia

Stored CO2 Benefits of Public Trees

12/29/2014

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	286,973	2,152	(N/A)	16.5	41.7	153.74
Green ash	137,262	1,029	(N/A)	12.9	19.9	93.59
Apple	5,803	44	(N/A)	9.4	0.8	5.44
Eastern white pine	4,319	32	(N/A)	8.2	0.6	4.63
Sugar maple	25,169	189	(N/A)	5.9	3.7	37.75
Siberian elm	59,917	449	(N/A)	5.9	8.7	89.88
Blue spruce	1,729	13	(N/A)	4.7	0.3	3.24
Black walnut	48,461	363	(N/A)	4.7	7.0	90.86
Honeylocust	3,632	27	(N/A)	4.7	0.5	6.81
Northern white cedar	115	1	(N/A)	3.5	0.0	0.29
Norway maple	8,349	63	(N/A)	3.5	1.2	20.87
White oak	2,069	16	(N/A)	2.4	0.3	7.76
Catalpa	59,654	447	(N/A)	2.4	8.7	223.70
Northern pin oak	17,904	134	(N/A)	2.4	2.6	67.14
Broadleaf Deciduous	192	1	(N/A)	2.4	0.0	0.72
Norway spruce	4,513	34	(N/A)	2.4	0.7	16.92
Boxelder	3,624	27	(N/A)	1.2	0.5	27.18
Mulberry	6,743	51	(N/A)	1.2	1.0	50.57
River birch	3,624	27	(N/A)	1.2	0.5	27.18
Callery pear	17	0	(N/A)	1.2	0.0	0.13
Scotch pine	257	2	(N/A)	1.2	0.0	1.93
Northern red oak	8,218	62	(N/A)	1.2	1.2	61.63
Red maple	17	0	(N/A)	1.2	0.0	0.13
Citywide total	688,561	5,164	(N/A)	100.0	100.0	60.76

Table 5: Annual Carbon Sequestered

Batavia

Annual CO Benefits of Public Trees

12/29/2014

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	20,667	155	-1,377	-54	0	0	0	19,235	144 (N/A)	16.5	51.2	10.30
Green ash	5,315	40	-659	-28	0	0	0	4,628	35 (N/A)	12.9	12.3	3.16
Apple	759	6	-28	-8	0	0	0	723	5 (N/A)	9.4	1.9	0.68
Eastern white pine	523	4	-21	-10	0	0	0	492	4 (N/A)	8.2	1.3	0.53
Sugar maple	1,732	13	-121	-10	0	0	0	1,602	12 (N/A)	5.9	4.3	2.40
Siberian elm	2,819	21	-288	-16	0	0	0	2,515	19 (N/A)	5.9	6.7	3.77
Blue spruce	180	1	-8	-5	0	0	0	167	1 (N/A)	4.7	0.4	0.31
Black walnut	3,033	23	-233	-12	0	0	0	2,788	21 (N/A)	4.7	7.4	5.23
Honeylocust	805	6	-17	-5	0	0	0	783	6 (N/A)	4.7	2.1	1.47
Northern white cedar	54	0	-1	-2	0	0	0	52	0 (N/A)	3.5	0.1	0.13
Norway maple	996	7	-40	-5	0	0	0	951	7 (N/A)	3.5	2.5	2.38
White oak	418	3	-10	-2	0	0	0	405	3 (N/A)	2.4	1.1	1.52
Catalpa	924	7	-286	-8	0	0	0	630	5 (N/A)	2.4	1.7	2.36
Northern pin oak	756	6	-86	-5	0	0	0	665	5 (N/A)	2.4	1.8	2.49
Broadleaf Deciduous Smal	47	0	-1	-1	0	0	0	45	0 (N/A)	2.4	0.1	0.17
Norway spruce	303	2	-22	-5	0	0	0	277	2 (N/A)	2.4	0.7	1.04
Boxelder	418	3	-17	-2	0	0	0	399	3 (N/A)	1.2	1.1	2.99
Mulberry	478	4	-32	-3	0	0	0	443	3 (N/A)	1.2	1.2	3.33
River birch	386	3	-17	-2	0	0	0	367	3 (N/A)	1.2	1.0	2.75
Callery pear	5	0	0	0	0	0	0	5	0 (N/A)	1.2	0.0	0.04
Scotch pine	53	0	-1	-1	0	0	0	50	0 (N/A)	1.2	0.1	0.38
Northern red oak	382	3	-39	-3	0	0	0	340	3 (N/A)	1.2	0.9	2.55
Red maple	3	0	0	0	0	0	0	2	0 (N/A)	1.2	0.0	0.02
Citywide total	41,056	308	-3,305	-187	-1	0	0	37,564	282 (N/A)	100.0	100.0	3.31

Table 6: Annual Social and Aesthetic Benefits

Batavia

Annual Aesthetic/Other Benefits of Public Trees

12/29/2014

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	1,580	(N/A)	16.5	43.0	112.87
Green ash	479	(N/A)	12.9	13.1	43.57
Apple	43	(N/A)	9.4	1.2	5.32
Eastern white pine	150	(N/A)	8.2	4.1	21.44
Sugar maple	196	(N/A)	5.9	5.3	39.11
Siberian elm	210	(N/A)	5.9	5.7	41.90
Blue spruce	80	(N/A)	4.7	2.2	19.93
Black walnut	247	(N/A)	4.7	6.7	61.64
Honeylocust	126	(N/A)	4.7	3.4	31.49
Northern white cedar	21	(N/A)	3.5	0.6	6.83
Norway maple	105	(N/A)	3.5	2.8	34.85
White oak	57	(N/A)	2.4	1.6	28.56
Catalpa	74	(N/A)	2.4	2.0	37.21
Northern pin oak	71	(N/A)	2.4	1.9	35.31
Broadleaf Deciduous Small	2	(N/A)	2.4	0.1	1.05
Norway spruce	79	(N/A)	2.4	2.2	39.70
Boxelder	39	(N/A)	1.2	1.1	39.36
Mulberry	29	(N/A)	1.2	0.8	28.80
River birch	39	(N/A)	1.2	1.1	39.16
Callery pear	3	(N/A)	1.2	0.1	2.74
Scotch pine	15	(N/A)	1.2	0.4	15.42
Northern red oak	27	(N/A)	1.2	0.7	27.47
Red maple	0	(N/A)	1.2	0.0	0.04
Citywide total	3,671	(N/A)	100.0	100.0	43.19

Table 7: Summary of Benefits in Dollars

Batavia

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 $
Silver maple	990	144	186	1,942	1,580	4,843	(N/A)	37.6
Green ash	557	35	102	778	479	1,950	(N/A)	15.1
Apple	120	5	17	47	43	231	(N/A)	1.8
Eastern white pine	119	4	13	179	150	465	(N/A)	3.6
Sugar maple	201	12	32	214	196	655	(N/A)	5.1
Siberian elm	322	19	60	416	210	1,026	(N/A)	8.0
Blue spruce	61	1	7	90	80	238	(N/A)	1.8
Black walnut	256	21	44	354	247	922	(N/A)	7.1
Honeylocust	120	6	17	68	126	337	(N/A)	2.6
Northern white cedar	17	0	2	17	21	57	(N/A)	0.4
Norway maple	118	7	19	92	105	341	(N/A)	2.6
White oak	41	3	6	33	57	140	(N/A)	1.1
Catalpa	143	5	30	236	74	488	(N/A)	3.8
Northern pin oak	118	5	21	140	71	355	(N/A)	2.8
Broadleaf Deciduous Sn	6	0	1	2	2	12	(N/A)	0.1
Norway spruce	55	2	4	122	79	263	(N/A)	2.0
Boxelder	39	3	6	39	39	127	(N/A)	1.0
Mulberry	46	3	8	32	29	118	(N/A)	0.9
River birch	47	3	8	38	39	135	(N/A)	1.0
Callery pear	1	0	0	0	3	4	(N/A)	0.0
Scotch pine	14	0	1	16	15	47	(N/A)	0.4
Northern red oak	46	3	7	55	27	138	(N/A)	1.1
Red maple	1	0	0	0	0	2	(N/A)	0.0
Citywide Total	3,437	282	592	4,913	3,671	12,894	(N/A)	100.0

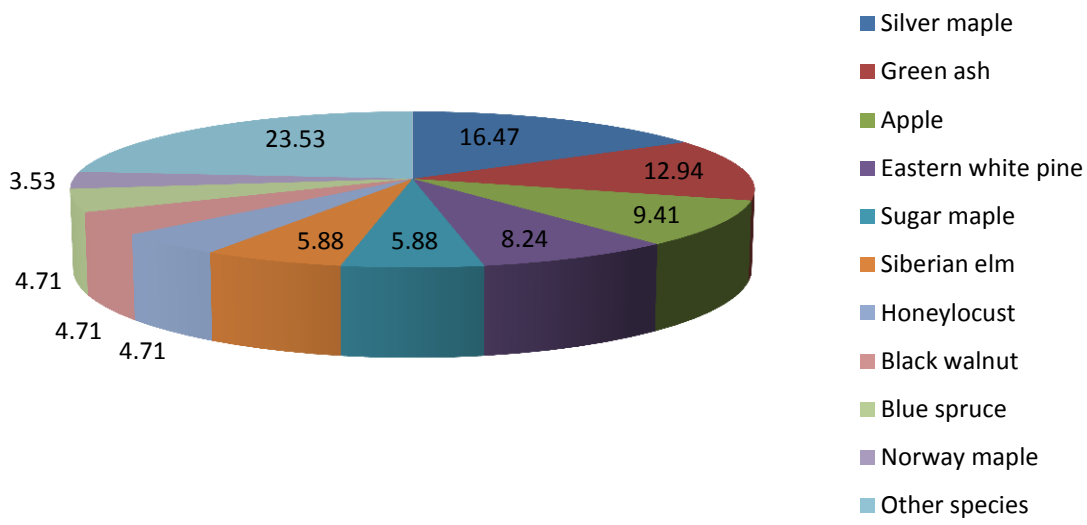

Figure 1: Species Distribution

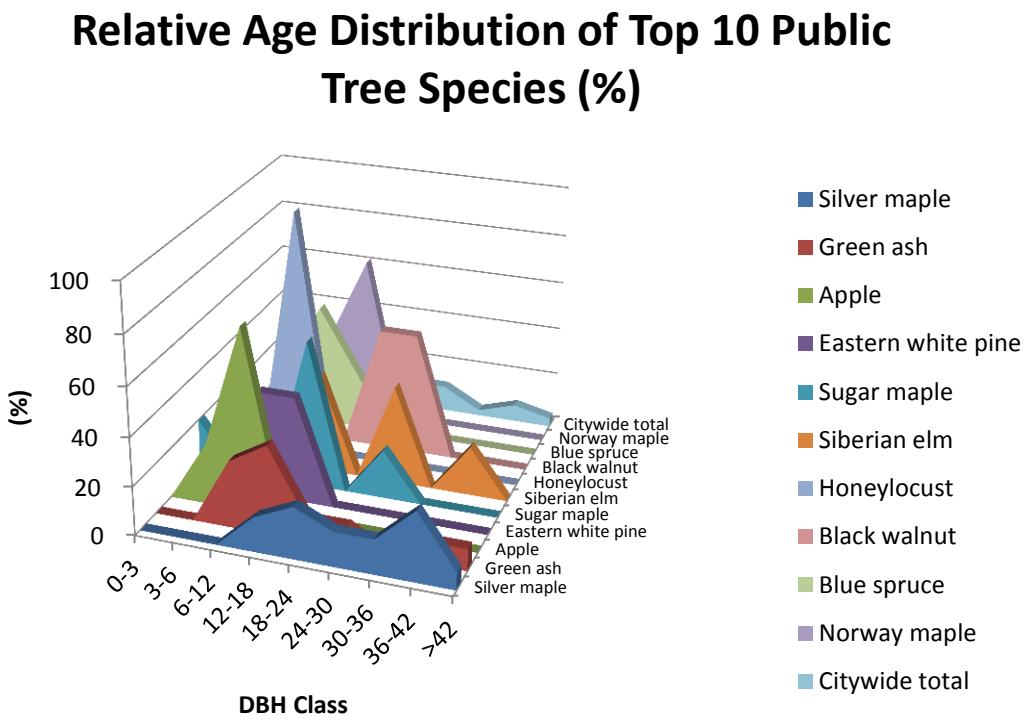

Figure 2: Relative Age Class

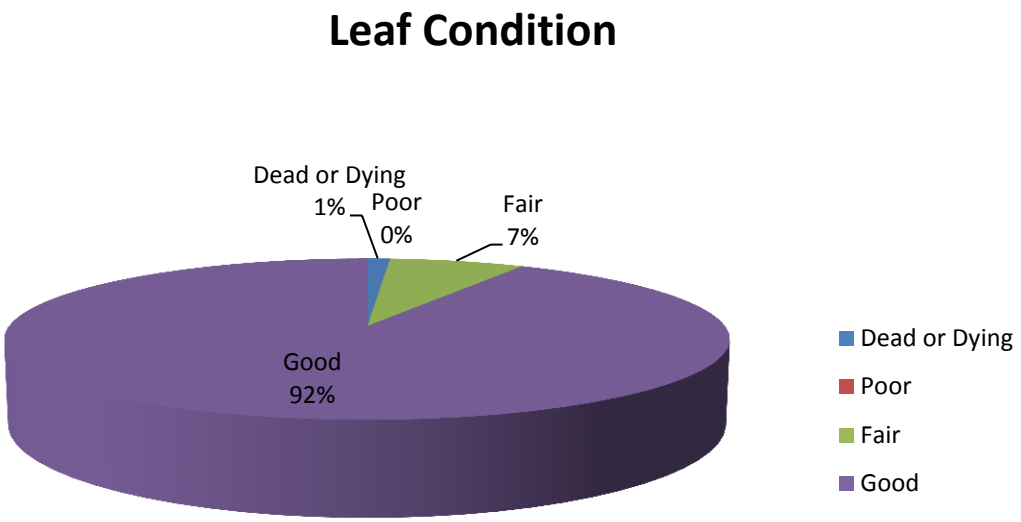

Figure 3: Foliage Condition

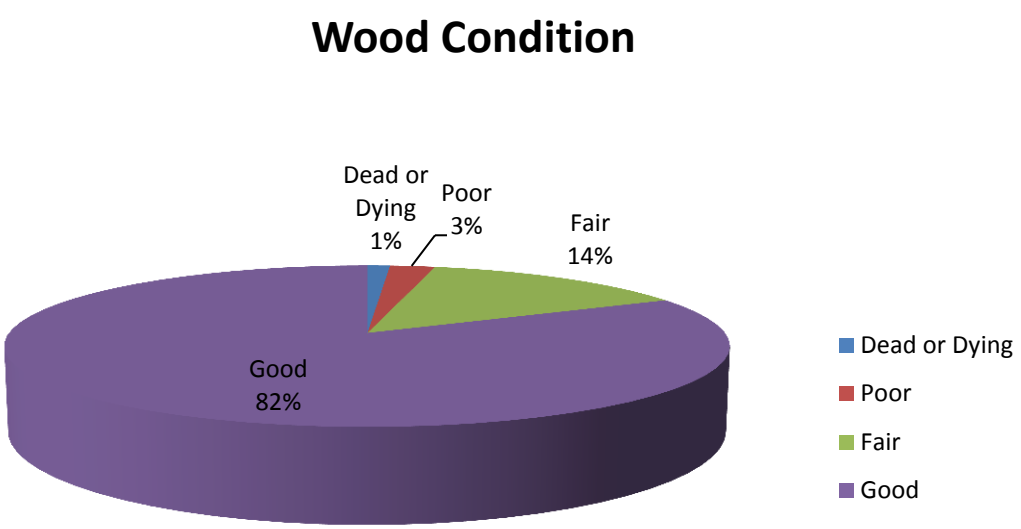

Figure 4: Wood Condition

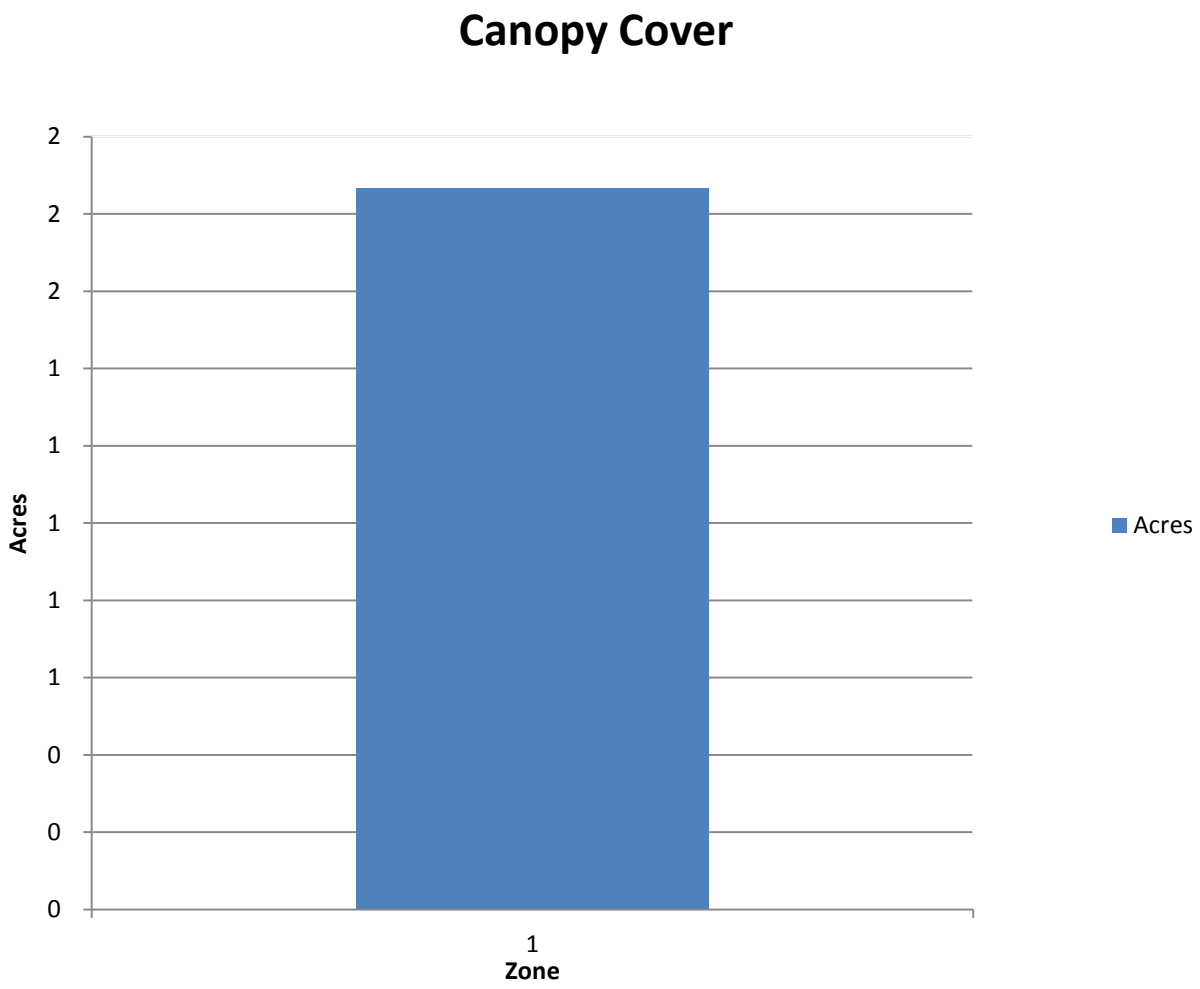

Figure 5: Canopy Cover in Acres

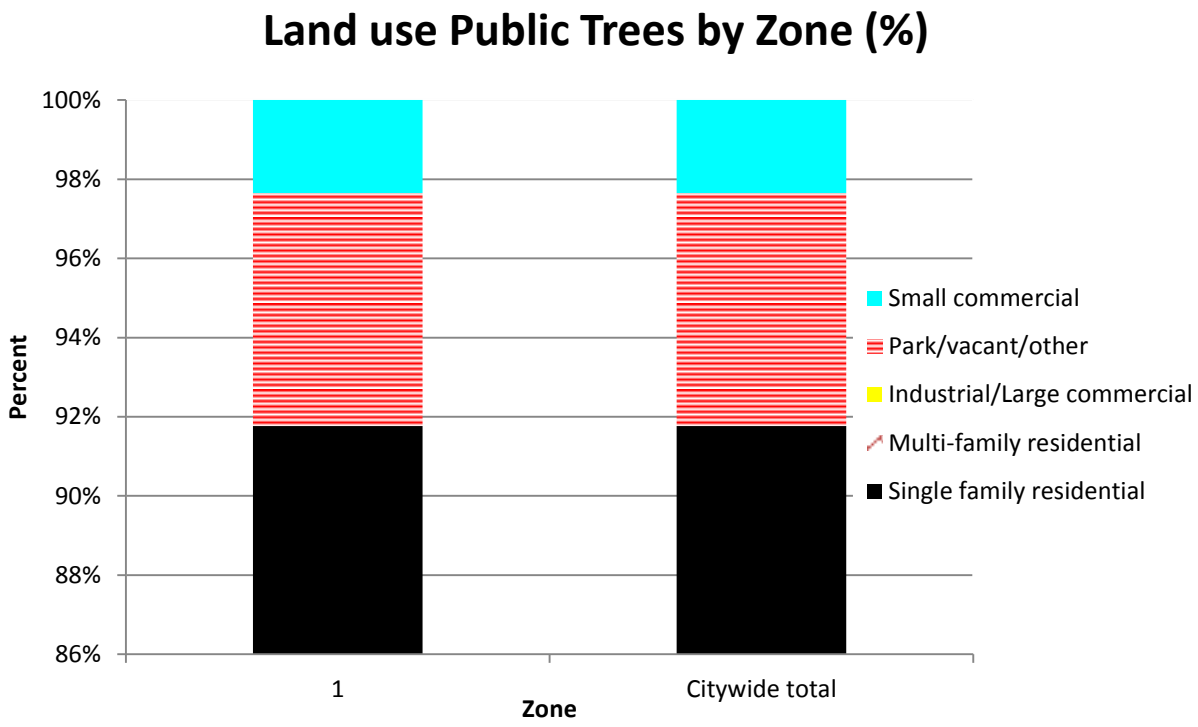

Figure 6: Land Use of city/park trees

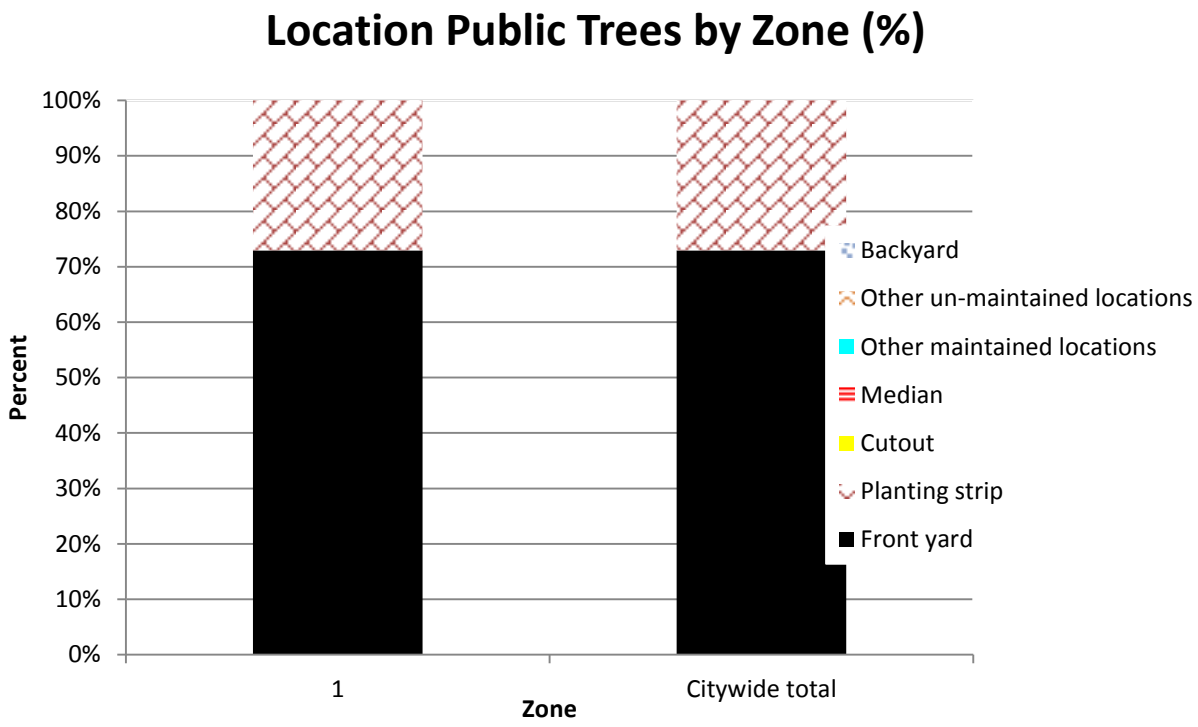

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

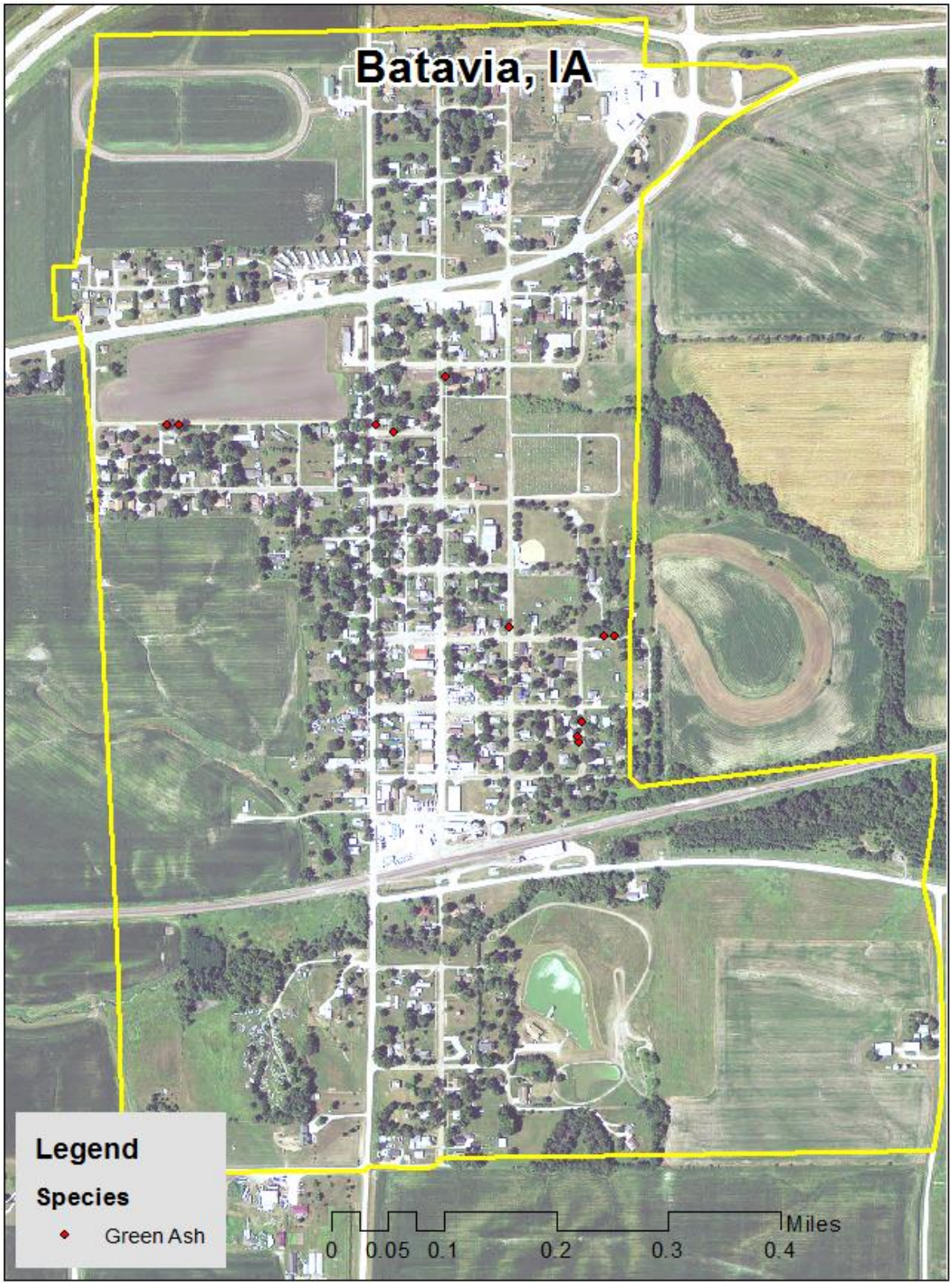

Figure 1: Location of Ash Trees

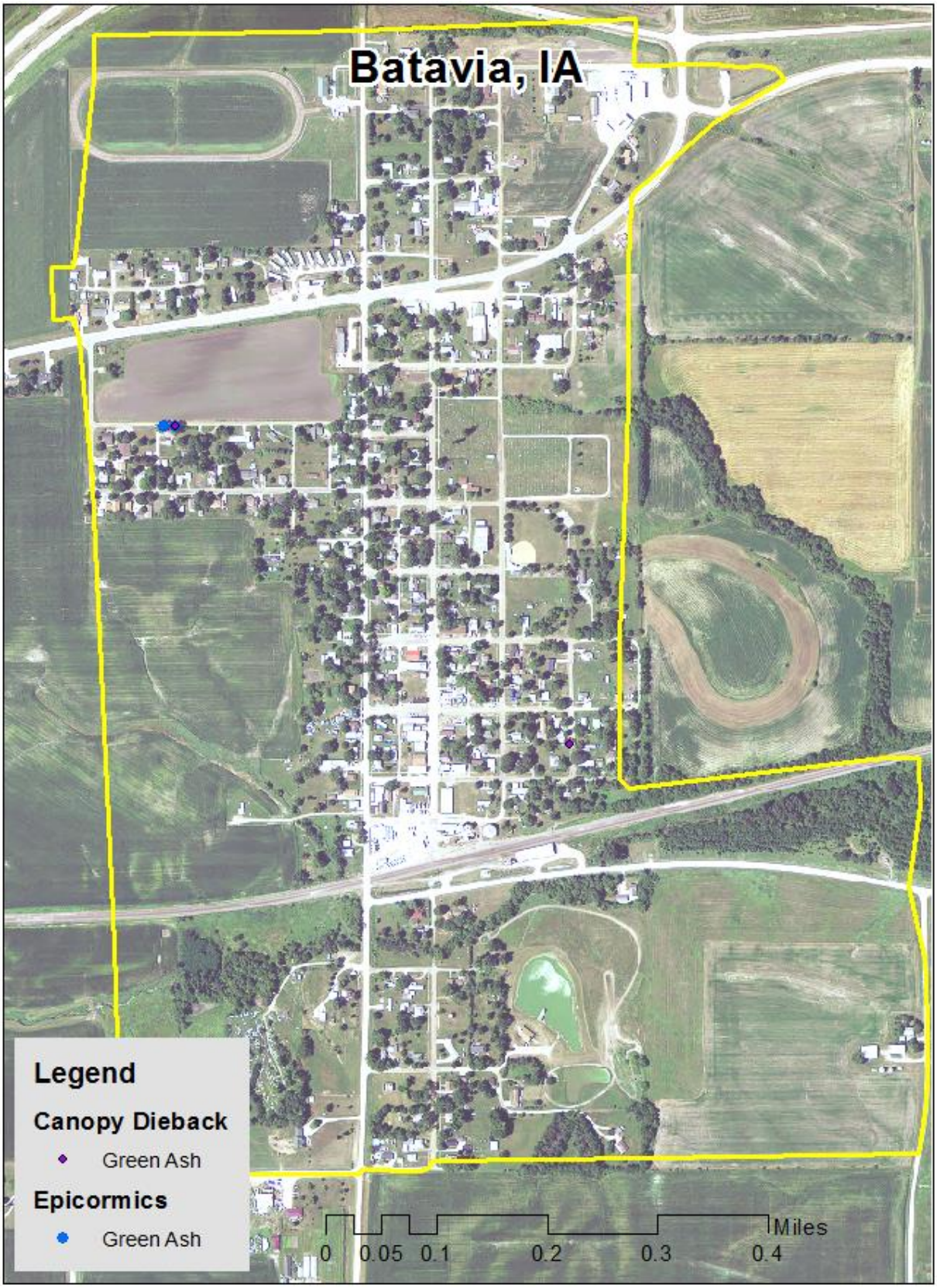

Figure 2: Location of EAB symptoms

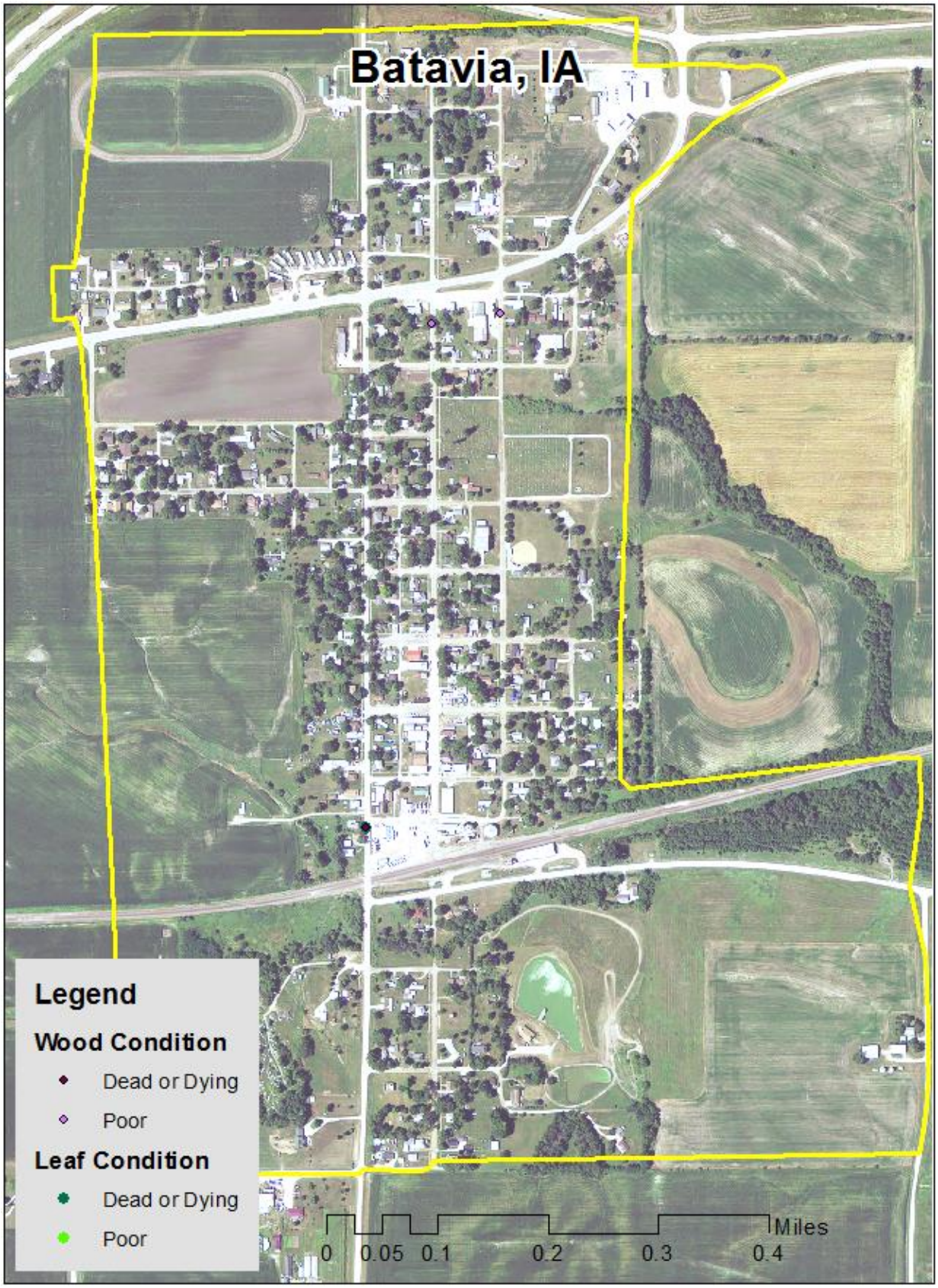

Figure 3: Location of Poor Condition Trees

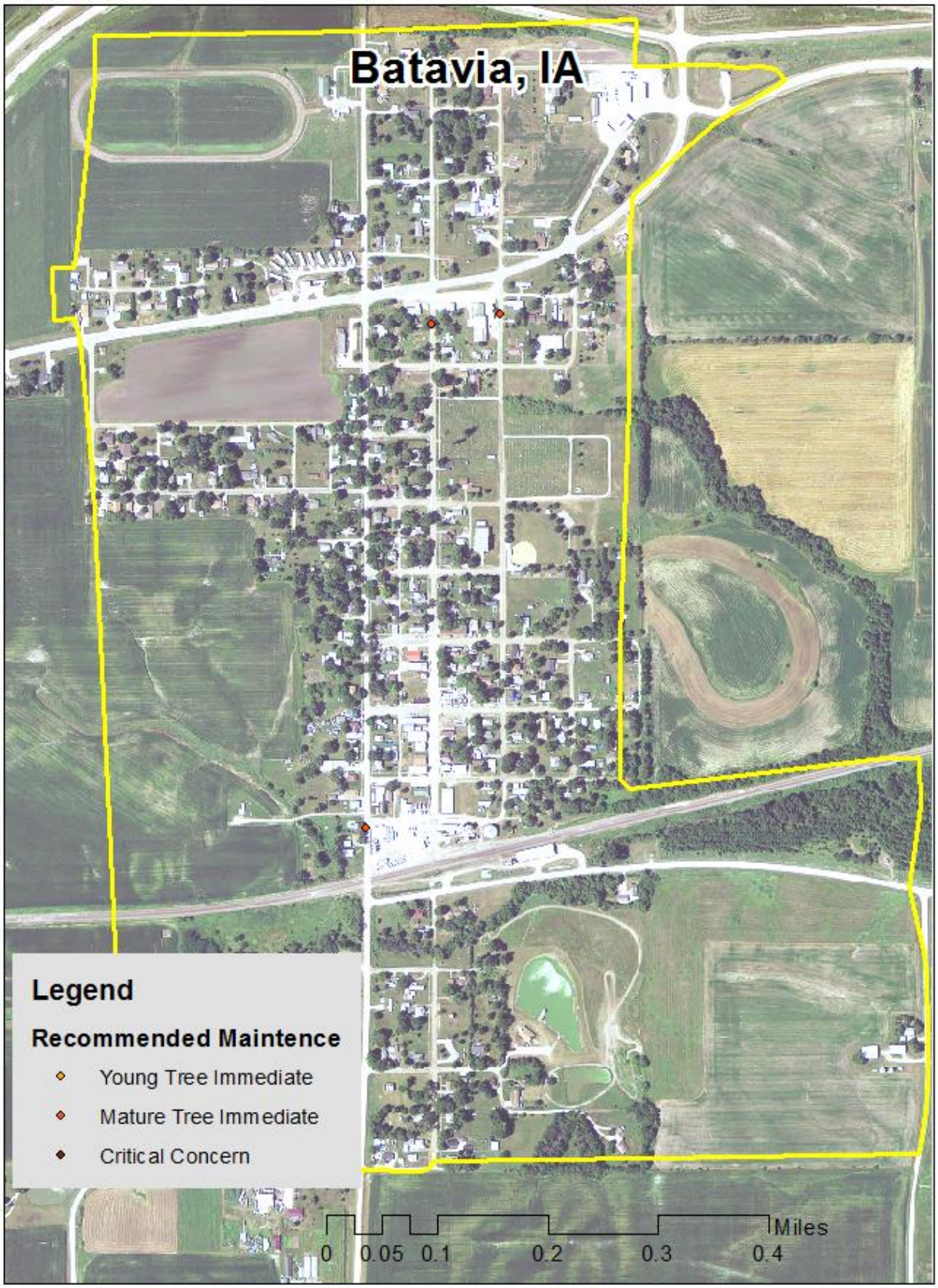

Figure 4: Location of Trees with Recommended Maintenance

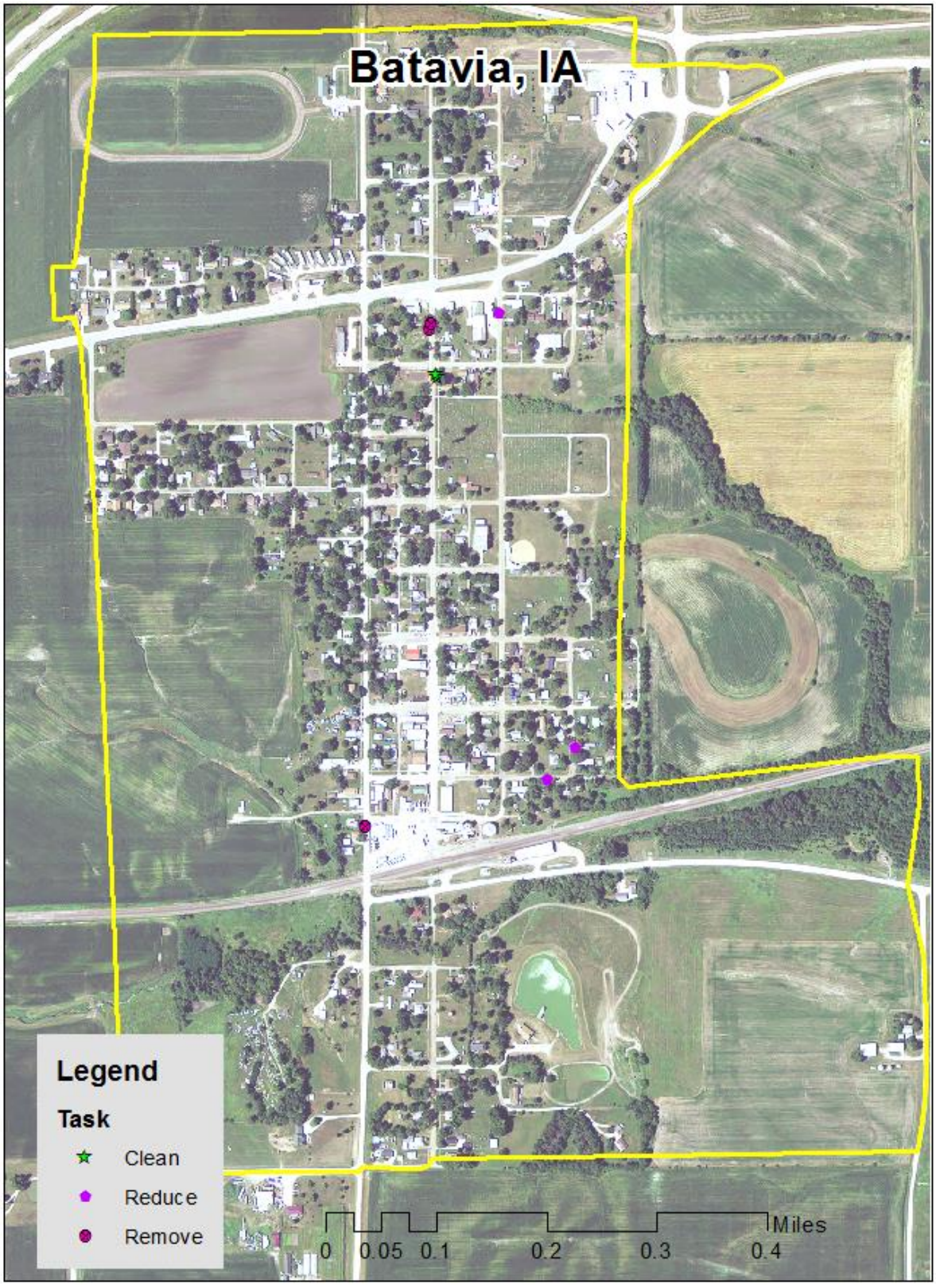

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: "Sample" Tree Ordinances

CHAPTER 151
TREES AND GRASS

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

151.02 PLANTING RESTRICTIONS. No tree shall be planted in any boulevard or street except in accordance with the following:
1. Alignment. All tress planted in any street shall be planted in the boulevard 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 ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any boulevard which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

151.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least eighteen (18) feet above the surface of a street, twenty (20) feet above the surface of a primary highway, and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the
City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.
(Code of Iowa, Sec. 364.12[2c, d, & e])

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

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

151.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be 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. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that 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 fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.
(Code of Iowa, Sec. 364.12[3b & h])

151.07 CUTTING OR MOWING OF GRASS.
1. Duty to Cut and Mow Lawns and Lots. The owner of any property shall cut and mow all lawns and lots so that such growth shall be less than four (4) inches at all times.
2. Cutting and Mowing by City. If a property owner refuses or fails to cut and mow lawns and lots within forty-eight (48) hours after being delivered a notice from the City to perform such action, the Council may require said work to be done and the cost and expenses thereof shall be assessed to the property owner after due notice is given. The amount of such assessment shall be certified to the County Auditor as provided by law and the same shall be collected with and in the same manner as general property taxes.

‘Sample’ Recommended Planting List:

Common Name	Scientific Name	Cultivars/ Selections
Shade Trees		
Black Maple	*Acer nigrum*	
Red Maple	*Acer rubrum*	Burgundy Belle, Red Sunset, Scarlet Jewel, Redpoint, Somerset
Sugar Maple	*Acer saccharum*	Commemoration, Crescendo, Endowment, Fall Fiesta, Legacy, Green Mountain
Hackberry	*Celtis occidentalis*	Chicagoland, Prairie Pride, Windy City
Yellowwood	*Cladrastis kentuckea*	
Ginkgo (male only)	*Ginkgo biloba*	Autumn Gold, Golden Colonnade, Halka, Magyar, Presidential Gold, Princeton Sentry
Thornless Honeylocust	*Gleditisia triacanthos*	Northern Acclaim, Skyline, Shademaster
Kentucky Coffeetree	*Gymnocladus dioicus*	
Larch	*Larix decidua*	
American Hophornbeam	*Ostrya virginiana*	
London Planetree	*Platanus x acerfolia*	Bloodgood
Corktree (male only)	*Phellodendron spp.*	Macho, Longenecker, Eye Stopper and His Majesty
White Oak	*Quercus alba*	
Swamp White Oak	*Quercus bicolor*	
Shingle Oak	*Quercus imbricaria*	
Bur Oak	*Quercus macrocarpa*	
Chinkapin Oak	*Quercus muehlenbergii*	
English Oak	*Quercus robur*	
Northern Red Oak	*Quercus rubra*	
Bald Cypress	*Taxodium distichum*	
American Linden	*Tilia americana*	Boulevard, Front Yard, Legend
Silver Linden	*Tillia tomemtosa*	
Low Growing Trees		
Serviceberry	*Amelanchier spp.*	Autumn Brilliance, Cole's Select, Cumulus, Princess Diana, Strata
American Hornbeam	*Carpinus caroliniana*	
Eastern Redbud	*Cercis canadensis*	
Pagoda Dogwood	*Cornus alternifolia*	
Flowering Crabapple	*Malus spp.*	Adirondack, Cardinal, David, Donald Wyman, Doublooms, Florbunda, Golden Raindrops, Harvest Gold, Indian Magic, Louisa, Mary Potter, Purple Prince, Red Jewel, Royal Fountain, Royal Raindrops, Sugar Tyme
Japanese Tree Lilac	*Syringa reticulata*	Ivory Silk, Summer Snow

Parks only Conifers		
White Fir	*Abies concolor*	
Norway Spruce	*Picea abies*	
White Spruce	*Picea glauca*	
Black Hills Spruce	*Picea glauca var. densata*	
Serbian Spruce	*Picea omorika*	
White Pine	*Pinus strobus*	
Arborvitae	*Thuja occidentalis*	
Eastern Hemlock	*Tsuga canadensis*	