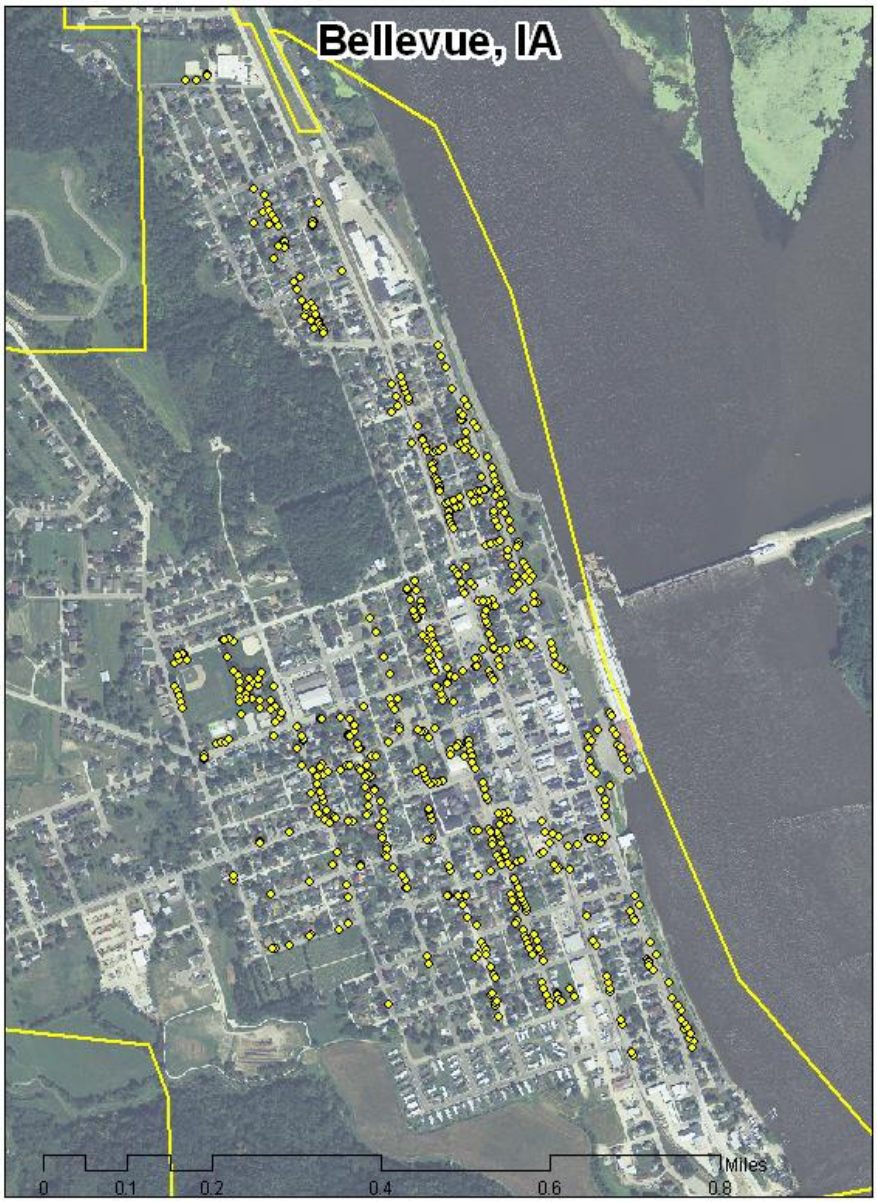
BELLEVUE, IA



2011 Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Bellevue 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 23% of Bellevue's city owned trees (ash) will die once EAB becomes established in the community. 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 2011, 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 605 trees inventoried.

- Bellevue's trees provide $92,842 of benefits annually, an average of $153 a tree
- There are over 41 species of trees
- The top three genus are: Maple 48%, Ash 23%, and Oak 5%
- 8% of trees are in need of some type of management
- 15 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.

- 15 trees need removal *City ownership of the trees recommended for removal should be verified prior to any removal*
- 17 of the 140 ash trees are in need of follow up because they are displaying signs and symptoms associated with EAB
- All trees should be pruned on a routine schedule- one quart of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Siberian elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly

Introduction

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

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

Inventory

In 2011, 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 of 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 605 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. Bellevue's trees reduce energy related costs by approximately $26,388 annually (Appendix A, Table 1). These savings are both in Electricity (125.4 MWh) and in Natural Gas (17,550 Therms).

Annual Stormwater Benefits

Bellevue's trees intercept about 1,123,220 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $30,441 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 Bellevue, it is estimated that trees remove 1,569 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 $4,402 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Bellevue, trees sequester about 464,761 lbs of carbon a year with an associated value of $3,486 (Appendix A, Table 4). In addition, the trees store 3,604,654 lbs of carbon, with a yearly benefit of $27,035 (Appendix A, Table 5).

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. Bellevue receives $28,125 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, Bellevue's trees provide $92,842 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 605 trees in Bellevue provide approximately $153 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Bellevue has over 31 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Maple(Sugar, Norway, Red, Amur, Silver, Black)	290	48%
Ash	140	23%
Oak(red, swamp, pin, bur)	30	5%
Honeylocust	19	3%
Apple(Crab, Apple)	19	3%
Linden(American, Little Leaf)	14	2%
Birch(River, Paper)	12	2%
Hackberry	11	2%
Walnut	11	2%
Pear	8	1%
Red Bud	7	1%
Ginkgo	6	1%
Sycamore	6	1%
Other*	32	5%

*other trees include the following: pecan, catalpa, concolor fir, coffee tree, red bud, tulip tree, magnolia, white pine, poplar, plum, black cherry, elm, Norway & blue spruce.

Size Class

Most of Bellevue's trees (56%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For size, a Bell Curve is preferred and shows the highest amount of trees around 14 inches in diameter at 4.5 ft. Bellevue's size curve is on the average side, indicating an average stand. Generally with trees size does not indicate age.

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 Bellevue indicate that 96% of the trees are in good health, with 1% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 76% of Bellevue'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 2% of the population. There is 8% 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).

Cleaning	25	4%
Raise	2	<1%
Reduce	6	1%
Removal	15	2%

Canopy Cover

The canopy cover of Bellevue is 13 acre (Appendix A, Figure 4). According to the 2000 census, Bellevue occupies 596 acres. Thus the canopy cover on city land is about 2%.

Land Use and Location

The majority of Bellevue's city and park trees are growing on the city parkings. (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	80%
Park/vacant/other	20%

Location	
Planting strip	100%

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

Bellevue are 15 critical concern trees. Of these critical concern trees 6 trees need to be removed, 3 need to be cleaned and 1 tree that needs to have its crown reduced. In addition there are 9 immediate tree that needs to be removed, 4 immediate trees need to be cleaned and 4 that needs crown reduction. There are also 22 trees that are routine trees that need maintenance. 1 of these need to be removed, 18 need to be cleaned, 3 need their crowns raised or reduced. Please refer to the six year maintenance plan at the end of this section.

Poor tree species

There are a total of 140 ash trees, and 17 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 Bellevue.

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 (48%) (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, Siberian elm, evergreen, willow or black walnut. All trees planted must meet the restrictions in city ordinance.

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 death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Six Year Maintenance Plan with No Additional Funding

Year 1

Removal: 5 Critical trees
Clean, Reduce & Raise: 4 critical trees
Visual Survey for signs and symptoms of EAB
Plant 5 Trees

Year 2

Removal: 5 immediate trees
Reduce & Clean: 8 immediate trees
Routine trimming: Contract to trim 1/4 of the city trees
Visual Survey for signs and symptoms of EAB
Plant 5 trees

Year 3

Removal: 4 immediate trees
Removal: 3 routine removals
Clean, Raise & Reduce: 9 trees
Plant 7 trees
Visual Survey for signs and symptoms of EAB

Year 4

Removal: 1 routine tree
Clean, Raise & Reduce: 21 trees
Routine trimming: Contract to trim 1/4 of the city trees
Visual Survey for signs and symptoms of EAB
Plant 1 tree

Year 5

Visual Survey for signs and symptoms of EAB

Year 6

Routine trimming: Contract to trim 1/4 of the city trees
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: EAB could potentially start killing ash within 6 years of its arrival. This should leave adequate time for a strategy, the tree removals will increase once it arrives, but if they are kept up, the EAB population will be reduced decreasing their impact.

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*

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of over 25 million 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 ash trees will be replaced. All trees will meet the restrictions in city ordinance. 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 genus 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.

Budget

Current Budget
Total $24,000 over 6 years ($4,000/year)

FY 2012 Budget
Removals: $2,500
Clean, Reduce & Raise: $400
Tree Planting: $500
FY 2013 Budget
Removals: $2,500
Routine trimming: $3,000
Clean, Reduce & Raise: $800
Tree Planting: $500
FY 2014 Budget
Removal: $3,500
Clean, Reduce & Raise: $900
Tree Planting: $700
FY 2015 Budget
Removals: $500
Routine trimming: $3,000
Clean, Reduce & Raise: $2,100
Tree Planting: $100
FY 2016 Budget
FY 2017 Budget
Routine trimming: $3,000

*Reduction of ash over 6 years: EAB could potentially start killing ash within 6 years of its arrival. This should leave adequate time for a strategy, the tree removals will increase once it arrives, but if they are keep up the EAB population will be reduced decreasing there impact.

Purposed Budget Increase

EAB could potentially kill all ash trees in Bellevue within 10-12 years of its arrival. To remove all ash trees within 10-12 years after the discovery of EAB the budget would need to be increased to $11,000 a year. If the budget were increased to $70,000 a year all ash could be removed within 1 year. Additionally, it is recommended that Bellevue 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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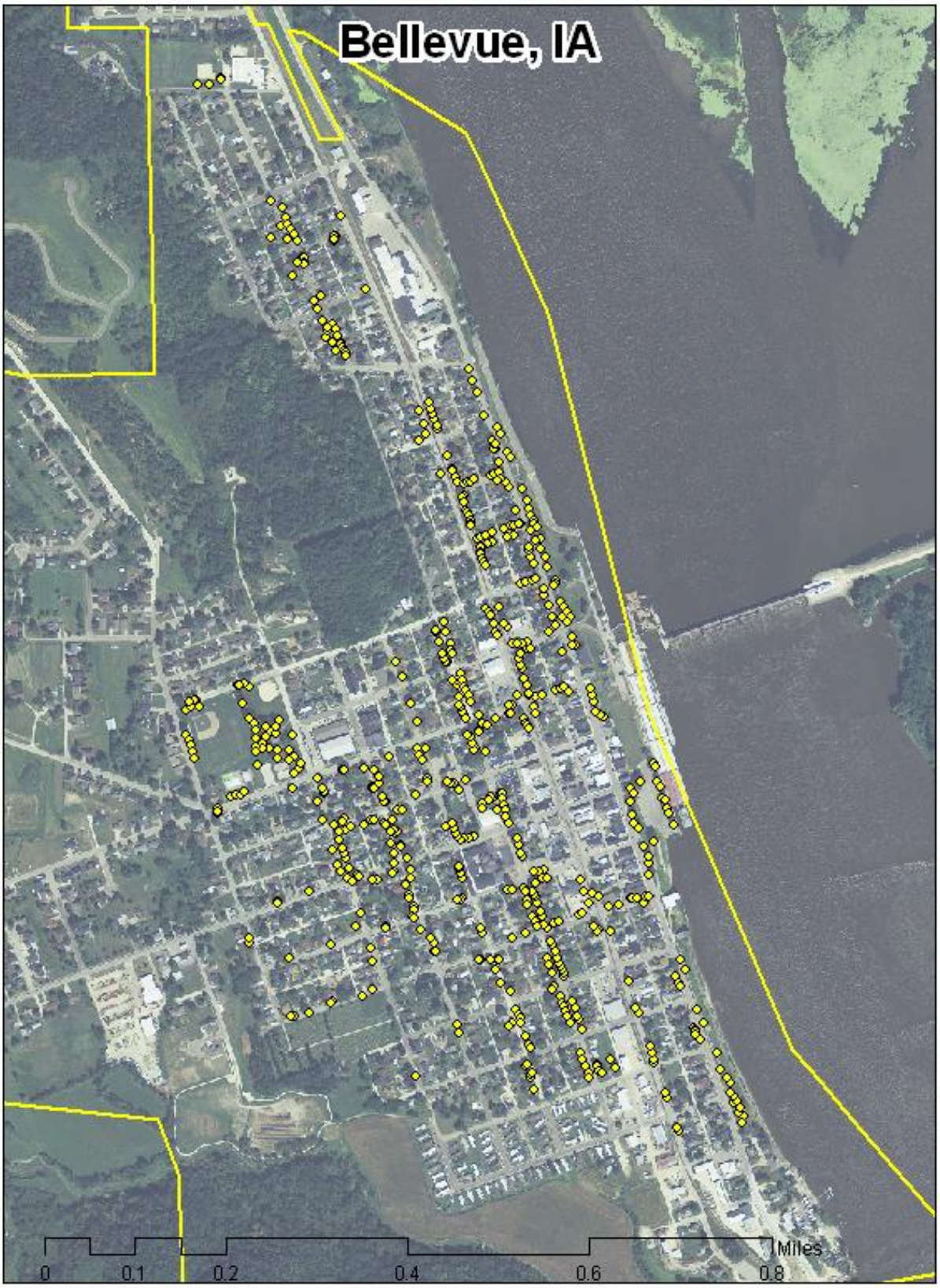
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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Stormwater Benefits of Public Trees by Species

10/15/2011

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	273,596	7,415	(N/A)	23.3	24.4	52.96
Norway maple	136,390	3,696	(N/A)	16.6	12.1	36.96
Silver maple	326,723	8,855	(N/A)	15.5	29.1	95.21
Sugar maple	89,509	2,426	(N/A)	11.0	8.0	36.76
Honeylocust	61,396	1,664	(N/A)	3.2	5.5	87.58
Apple	6,437	174	(N/A)	3.2	0.6	9.18
Red maple	9,421	255	(N/A)	3.0	0.8	14.19
Northern red oak	30,158	817	(N/A)	2.8	2.7	48.08
Birch	17,864	484	(N/A)	2.0	1.6	40.35
Northern hackberry	23,155	628	(N/A)	1.8	2.1	57.05
Black walnut	18,260	495	(N/A)	1.8	1.6	44.99
Black maple	17,188	466	(N/A)	1.3	1.5	58.23
Pear	2,734	74	(N/A)	1.3	0.2	9.26
Eastern redbud	2,057	56	(N/A)	1.2	0.2	7.97
American basswood	6,485	176	(N/A)	1.2	0.6	25.11
Littleleaf linden	7,219	196	(N/A)	1.2	0.6	27.95
Other street trees	94,627	2,565	(N/A)	9.8	8.4	43.47
Citywide total	1,123,220	30,441	(N/A)	100.0	100.0	50.57

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species

10/15/2011

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	273,596	7,415	(N/A)	23.3	24.4	52.96
Norway maple	136,390	3,696	(N/A)	16.6	12.1	36.96
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Northern hackberry	23,155	628	(N/A)	1.8	2.1	57.05
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Black maple	17,188	466	(N/A)	1.3	1.5	58.23
Pear	2,734	74	(N/A)	1.3	0.2	9.26
Eastern redbud	2,057	56	(N/A)	1.2	0.2	7.97
American basswood	6,485	176	(N/A)	1.2	0.6	25.11
Littleleaf linden	7,219	196	(N/A)	1.2	0.6	27.95
Other street trees	94,627	2,565	(N/A)	9.8	8.4	43.47
Citywide total	1,123,220	30,441	(N/A)	100.0	100.0	50.57

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species

10/15/2011

Species	Deposition (lb) O_3	NO_2	PM_{10}	SO_2	Total Depos. ($)	Avoided (lb) NO_2	PM_{10}	VOC	SO_2	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
Ash	52.4	9.0	26.2	2.3	285	158.8	23.0	22.0	149.8	987	-12.6	-47	431.0	1,224	(N/A)	23.3	8.74
Norway maple	23.0	4.0	11.9	1.0	126	93.6	13.6	13.0	89.0	584	-5.8	-22	243.3	688	(N/A)	16.6	6.88
Silver maple	50.7	8.6	25.7	2.2	276	126.8	18.5	17.7	121.4	793	-28.7	-108	343.0	961	(N/A)	15.4	10.33
Sugar maple	9.9	1.7	5.5	0.4	56	54.8	8.0	7.7	52.7	343	-8.3	-31	132.5	368	(N/A)	11.0	5.57
Honeylocust	11.8	1.9	5.4	0.5	62	28.8	4.2	4.0	27.5	180	-8.7	-33	75.5	209	(N/A)	3.2	11.03
Apple	1.5	0.2	0.8	0.1	8	8.9	1.3	1.2	8.1	55	0.0	0	22.0	63	(N/A)	3.2	3.29
Red maple	1.5	0.3	0.8	0.1	8	7.9	1.2	1.1	7.5	49	-0.6	-2	19.7	55	(N/A)	3.0	3.07
Northern red oak	6.2	1.1	3.0	0.3	34	15.3	2.2	2.1	14.5	95	-8.8	-33	35.9	95	(N/A)	2.8	5.62
Birch	3.1	0.5	1.6	0.1	17	12.1	1.8	1.7	11.6	76	-0.8	-3	31.7	90	(N/A)	2.0	7.46
Northern hackberry	3.8	0.7	2.0	0.2	21	13.3	1.9	1.8	12.6	83	0.0	0	36.4	104	(N/A)	1.8	9.44
Black walnut	1.7	0.3	0.9	0.1	9	10.8	1.6	1.5	10.5	68	0.0	0	27.4	77	(N/A)	1.8	7.04
Black maple	4.2	0.7	2.0	0.2	22	9.1	1.3	1.3	8.6	57	-1.4	-5	26.0	74	(N/A)	1.3	9.22
Pear	0.7	0.1	0.4	0.0	4	3.7	0.5	0.5	3.5	23	0.0	0	9.5	27	(N/A)	1.3	3.36
Eastern redbud	0.4	0.1	0.2	0.0	2	2.9	0.4	0.4	2.6	18	0.0	0	7.0	20	(N/A)	1.2	2.86
American basswood	0.6	0.1	0.4	0.0	3	4.4	0.6	0.6	4.1	27	-0.6	-2	10.2	28	(N/A)	1.2	4.03
Littleleaf linden	0.9	0.1	0.5	0.0	5	5.4	0.8	0.8	5.3	34	-0.5	-2	13.3	37	(N/A)	1.2	5.32
Other street trees	12.5	2.2	7.4	0.8	72	44.9	6.5	6.2	42.6	280	-18.3	-69	104.9	283	(N/A)	9.8	4.79
Citywide total	184.9	31.6	94.8	8.5	1,010	601.4	87.6	83.6	571.9	3,749	-95.1	-357	1,569.2	4,402	(N/A)	100.0	7.31

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees by Species

10/15/2011

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	865,805	6,494	(N/A)	23.3	24.0	46.38
Norway maple	380,415	2,853	(N/A)	16.6	10.6	28.53
Silver maple	1,174,332	8,807	(N/A)	15.5	32.6	94.70
Sugar maple	291,943	2,190	(N/A)	11.0	8.1	33.18
Honeylocust	148,211	1,112	(N/A)	3.2	4.1	58.50
Apple	25,037	188	(N/A)	3.2	0.7	9.88
Red maple	18,838	141	(N/A)	3.0	0.5	7.85
Northern red oak	131,158	984	(N/A)	2.8	3.6	57.86
Birch	50,897	382	(N/A)	2.0	1.4	31.81
Northern	61,651	462	(N/A)	1.8	1.7	42.03
Black walnut	55,090	413	(N/A)	1.8	1.5	37.56
Black maple	45,552	342	(N/A)	1.3	1.3	42.70
Pear	11,461	86	(N/A)	1.3	0.3	10.74
Eastern redbud	7,754	58	(N/A)	1.2	0.2	8.31
American	23,119	173	(N/A)	1.2	0.6	24.77
Littleleaf linden	20,024	150	(N/A)	1.2	0.6	21.45
Other street trees	133,069	2,200	(N/A)	9.8	8.1	37.29
Citywide total	3,604,654	27,035	(N/A)	100.0	100.0	44.91

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees by Species

10/15/2011

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	48,938	367	-4,156	-27	-31	55,376	415	100,131	751	(N/A)	23.3	21.5	5.36
Norway maple	33,534	252	-1,826	-20	-14	32,890	247	64,578	484	(N/A)	16.6	13.9	4.84
Silver maple	98,579	739	-5,637	-18	-42	45,000	337	137,924	1,034	(N/A)	15.5	29.7	11.12
Sugar maple	20,308	152	-1,401	-13	-11	19,512	146	38,406	288	(N/A)	11.0	8.3	4.36
Honeylocust	18,129	136	-711	-4	-5	10,188	76	27,602	207	(N/A)	3.2	5.9	10.90
Apple	2,703	20	-120	-4	-1	3,009	23	5,588	42	(N/A)	3.2	1.2	2.21
Red maple	2,682	20	-90	-4	-1	2,789	21	5,377	40	(N/A)	3.0	1.2	2.24
Northern red oak	3,004	23	-630	-3	-5	5,362	40	7,734	58	(N/A)	2.8	1.7	3.41
Birch	4,213	32	-244	-2	-2	4,271	32	8,238	62	(N/A)	2.0	1.8	5.15
Northern hackberry	2,867	22	-296	-2	-2	4,670	35	7,239	54	(N/A)	1.8	1.6	4.94
Black walnut	4,997	37	-264	-2	-2	3,890	29	8,620	65	(N/A)	1.8	1.9	5.88
Black maple	4,507	34	-219	-2	-2	3,187	24	7,474	56	(N/A)	1.3	1.6	7.01
Pear	1,144	9	-55	-2	0	1,285	10	2,373	18	(N/A)	1.3	0.5	2.22
Eastern redbud	875	7	-37	-1	0	966	7	1,803	14	(N/A)	1.2	0.4	1.93
American basswood	1,754	13	-111	-1	-1	1,507	11	3,149	24	(N/A)	1.2	0.7	3.37
Littleleaf linden	3,018	23	-96	-1	-1	1,951	15	4,872	37	(N/A)	1.2	1.1	5.22
Other street trees	19,301	145	-1,408	-12	-11	15,774	118	33,656	252	(N/A)	9.8	7.2	4.28
Citywide total	270,553	2,029	-17,302	-117	-131	211,628	1,587	464,761	3,486	(N/A)	100.0	100.0	5.79

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

10/15/2011

Species	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	4,797	(N/A)	23.3	17.1	34.27
Norway maple	3,394	(N/A)	16.6	12.1	33.94
Silver maple	8,147	(N/A)	15.5	29.0	87.60
Sugar maple	2,381	(N/A)	11.0	8.5	36.08
Honeylocust	4,096	(N/A)	3.2	14.6	215.59
Apple	154	(N/A)	3.2	0.6	8.09
Red maple	420	(N/A)	3.0	1.5	23.36
Northern red oak	251	(N/A)	2.8	0.9	14.75
Birch	427	(N/A)	2.0	1.5	35.61
Northern hackberry	454	(N/A)	1.8	1.6	41.27
Black walnut	486	(N/A)	1.8	1.7	44.14
Black maple	562	(N/A)	1.3	2.0	70.23
Pear	65	(N/A)	1.3	0.2	8.18
Eastern redbud	50	(N/A)	1.2	0.2	7.08
American basswood	155	(N/A)	1.2	0.6	22.15
Littleleaf linden	338	(N/A)	1.2	1.2	48.27
Other street trees	1,948	(N/A)	9.8	6.9	33.01
Citywide total	28,125	(N/A)	100.0	100.0	46.72

Table 7: Summary of Benefits in Dollars

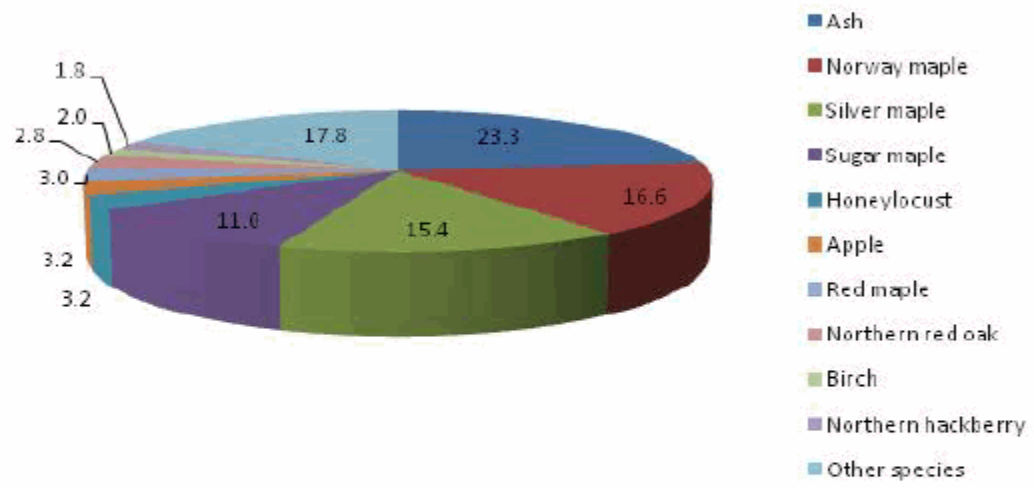
Total Annual Benefits of Public Trees by Species ($)

10/15/20

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Ash	7,027	751	1,224	7,415	4,797	21,214	(±0)	22.8
Norway maple	4,098	484	688	3,696	3,394	12,360	(±0)	13.3
Silver maple	5,519	1,034	961	8,855	8,147	24,516	(±0)	26.4
Sugar maple	2,375	288	368	2,426	2,381	7,838	(±0)	8.4
Honeylocust	1,256	207	209	1,664	4,096	7,433	(±0)	8.0
Apple	413	42	63	174	154	845	(±0)	0.9
Red maple	345	40	55	255	420	1,116	(±0)	1.2
Northern red oak	676	58	95	817	251	1,898	(±0)	2.0
Birch	530	62	90	484	427	1,593	(±0)	1.7
Northern hackberry	582	54	104	628	454	1,822	(±0)	2.0
Black walnut	463	65	77	495	486	1,585	(±0)	1.7
Black maple	402	56	74	466	562	1,559	(±0)	1.7
Pear	167	18	27	74	65	351	(±0)	0.4
Eastern redbud	134	14	20	56	50	273	(±0)	0.3
American basswood	196	24	28	176	155	579	(±0)	0.6
Littleleaf linden	230	37	37	196	338	837	(±0)	0.9
Other street trees	1,975	252	283	2,565	1,948	7,023	(±0)	7.6
Citywide Total	26,388	3,486	4,402	30,441	28,125	92,842	(±0)	100.0

Species Distribution of Public Trees (%)

10/15/2011

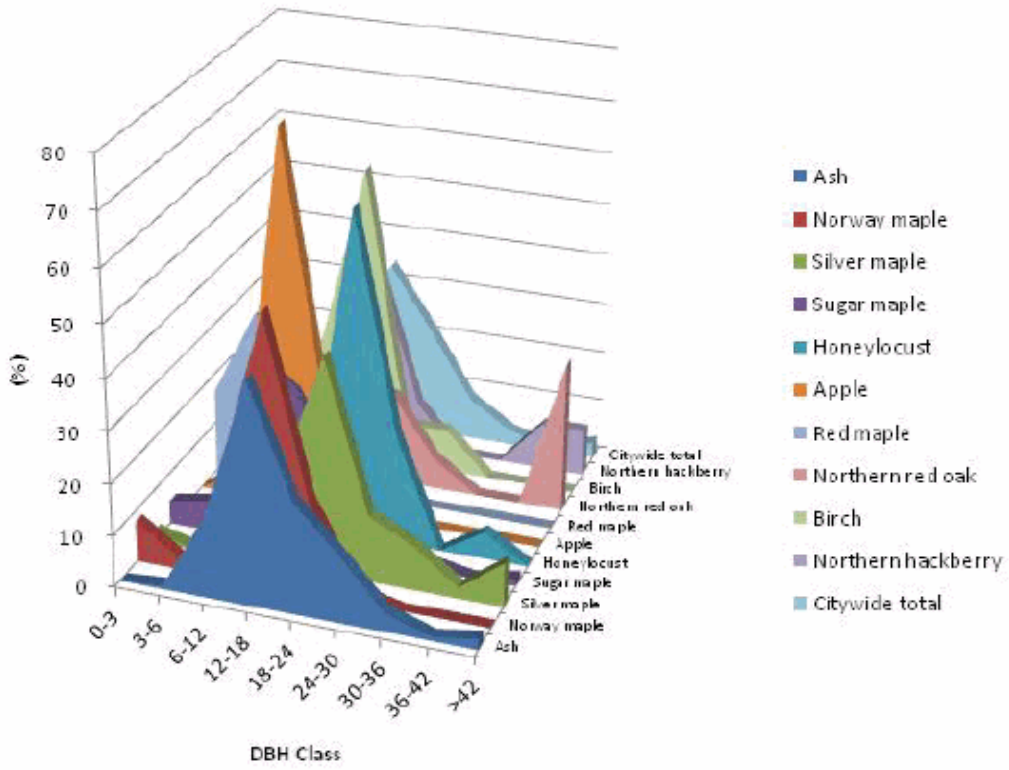


Species	Percent
Ash	23.3
Norway maple	16.6
Silver maple	15.4
Sugar maple	11.0
Honeylocust	3.2
Apple	3.2
Red maple	3.0
Northern red oak	2.8
Birch	2.0
Northern hackberry	1.8
Other species	17.8
Total	100.0

Figure 1: Species Distribution

Relative Age Distribution of Top 10 Public Tree Species (%)

10/15/2011



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Ash	0.0	0.7	15.7	42.9	21.4	12.9	3.6	0.7	2.1
Norway maple	8.0	2.0	18.0	52.0	18.0	2.0	0.0	0.0	0.0
Silver maple	2.2	0.0	5.4	18.3	41.9	12.9	8.6	2.2	8.6
Sugar maple	4.5	6.1	36.4	30.3	15.2	4.5	1.5	0.0	1.5
Honeylocust	0.0	0.0	0.0	10.5	63.2	21.1	0.0	5.3	0.0
Apple	0.0	5.3	73.7	21.1	0.0	0.0	0.0	0.0	0.0
Red maple	16.7	33.3	33.3	16.7	0.0	0.0	0.0	0.0	0.0
Northern red oak	0.0	5.9	23.5	17.6	17.6	5.9	0.0	0.0	29.4
Birch	0.0	0.0	25.0	58.3	8.3	8.3	0.0	0.0	0.0
Northern hackberry	0.0	9.1	27.3	36.4	9.1	0.0	0.0	9.1	9.1
Citywide total	2.7	5.0	22.4	33.6	21.4	8.1	2.8	0.8	3.2

Figure 2: Relative Age Class

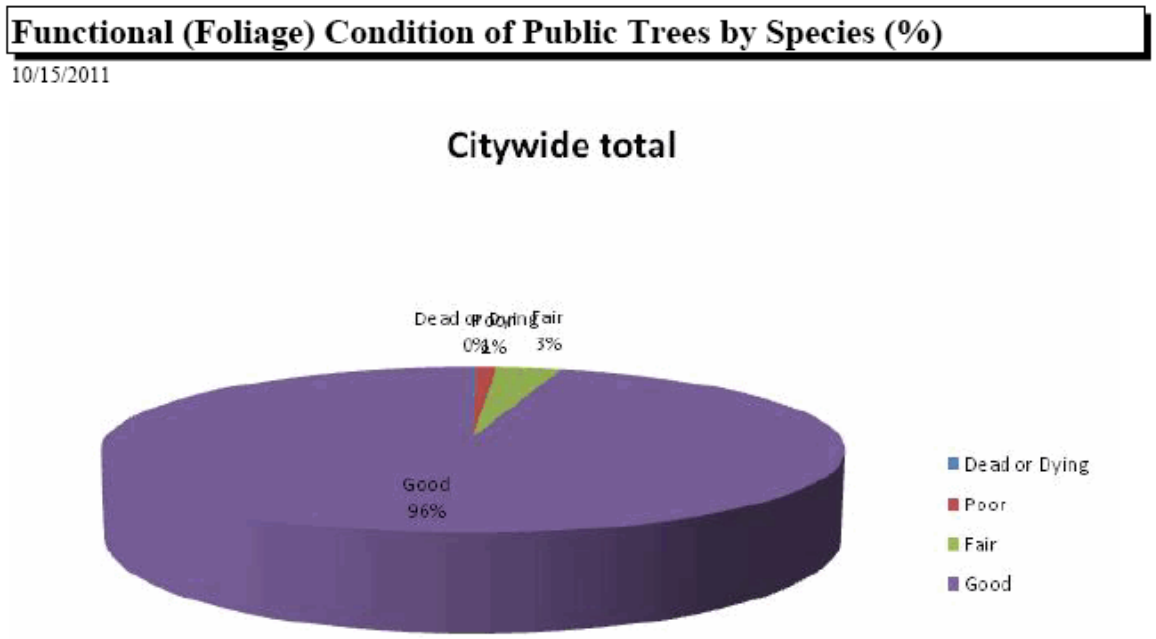


Figure 3: Foliage Condition

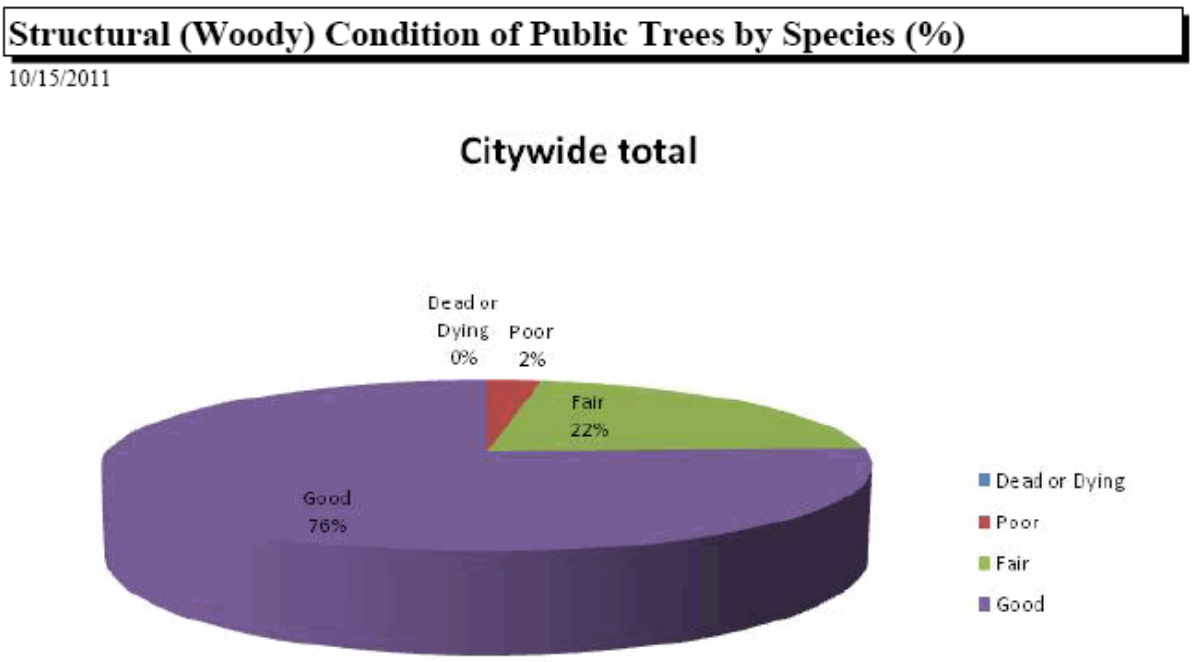
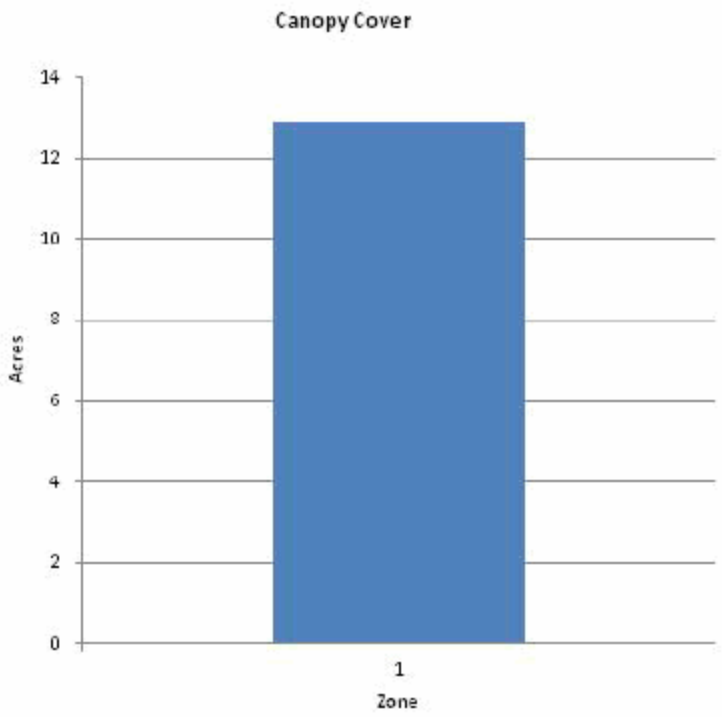


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

10/15/2011



Zone	Acres	% of Total Canopy Cover
1	13	100.0
Citywide total	13	100.0

	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide	0	0	13		

Figure 5: Canopy Cover in Acres

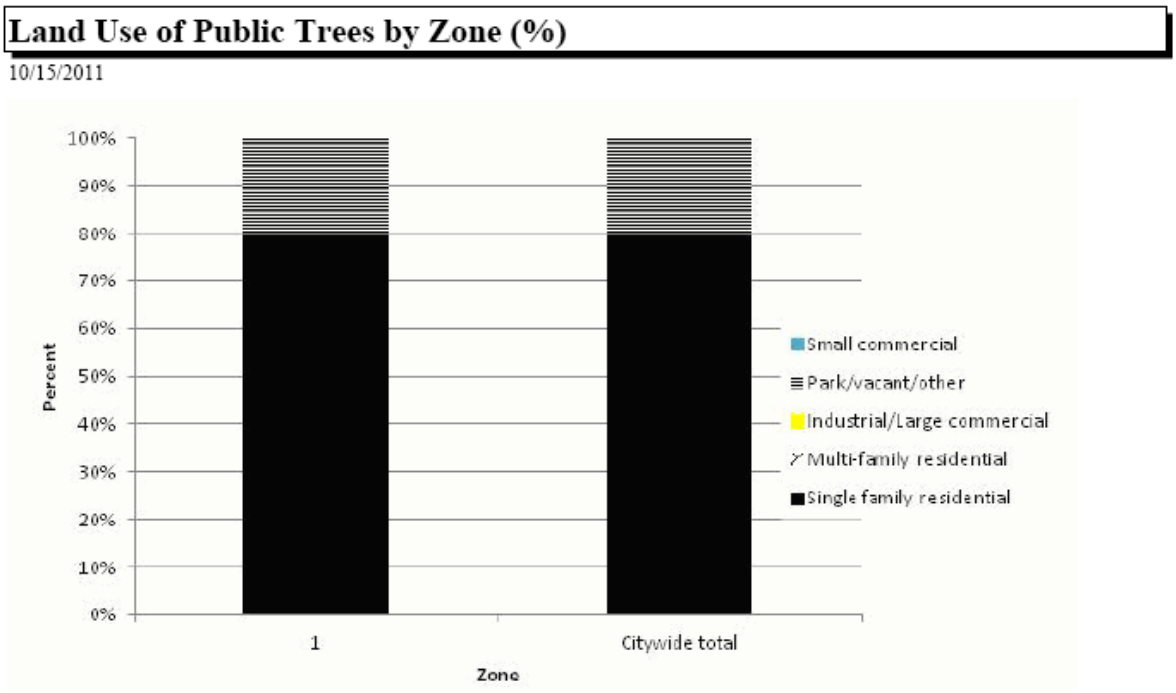
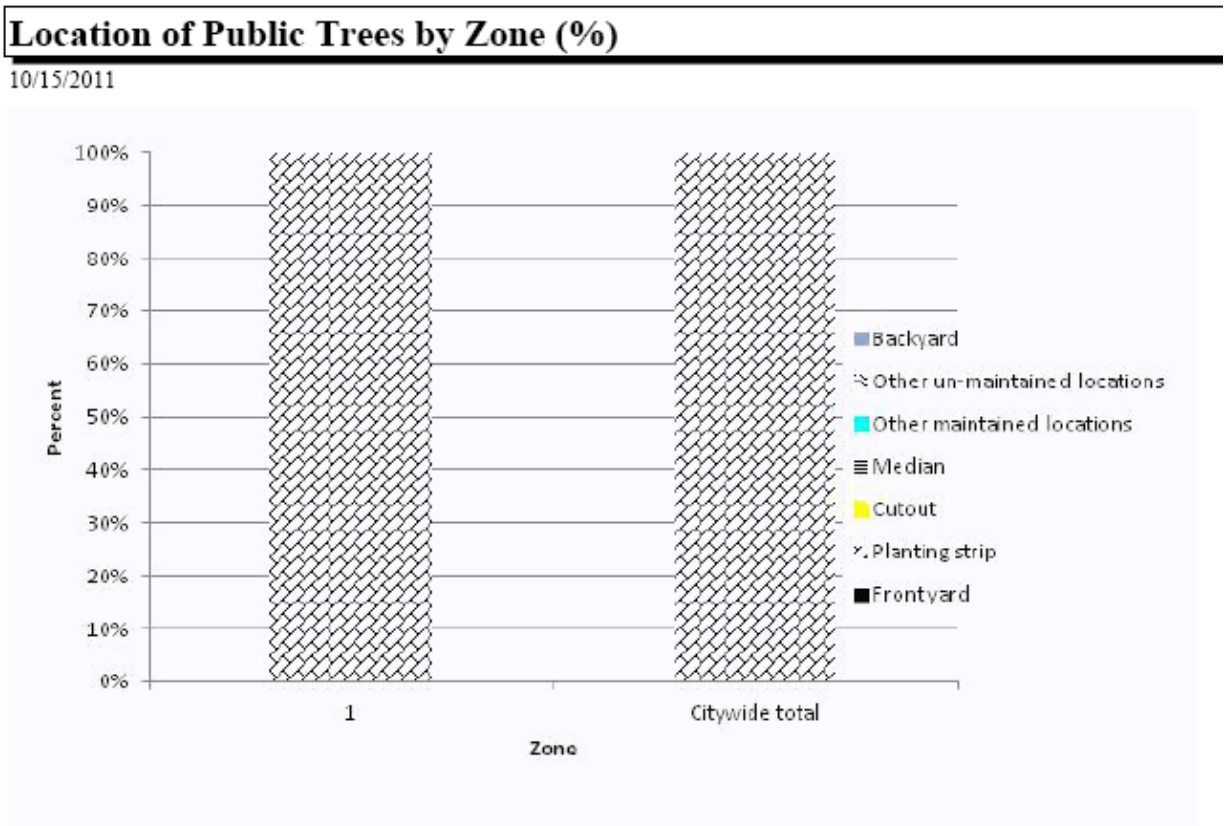


Figure 6: Land Use of city/park trees



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Citywide total	0.0	100.0	0.0	0.0	0.0	0.0	0.0

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

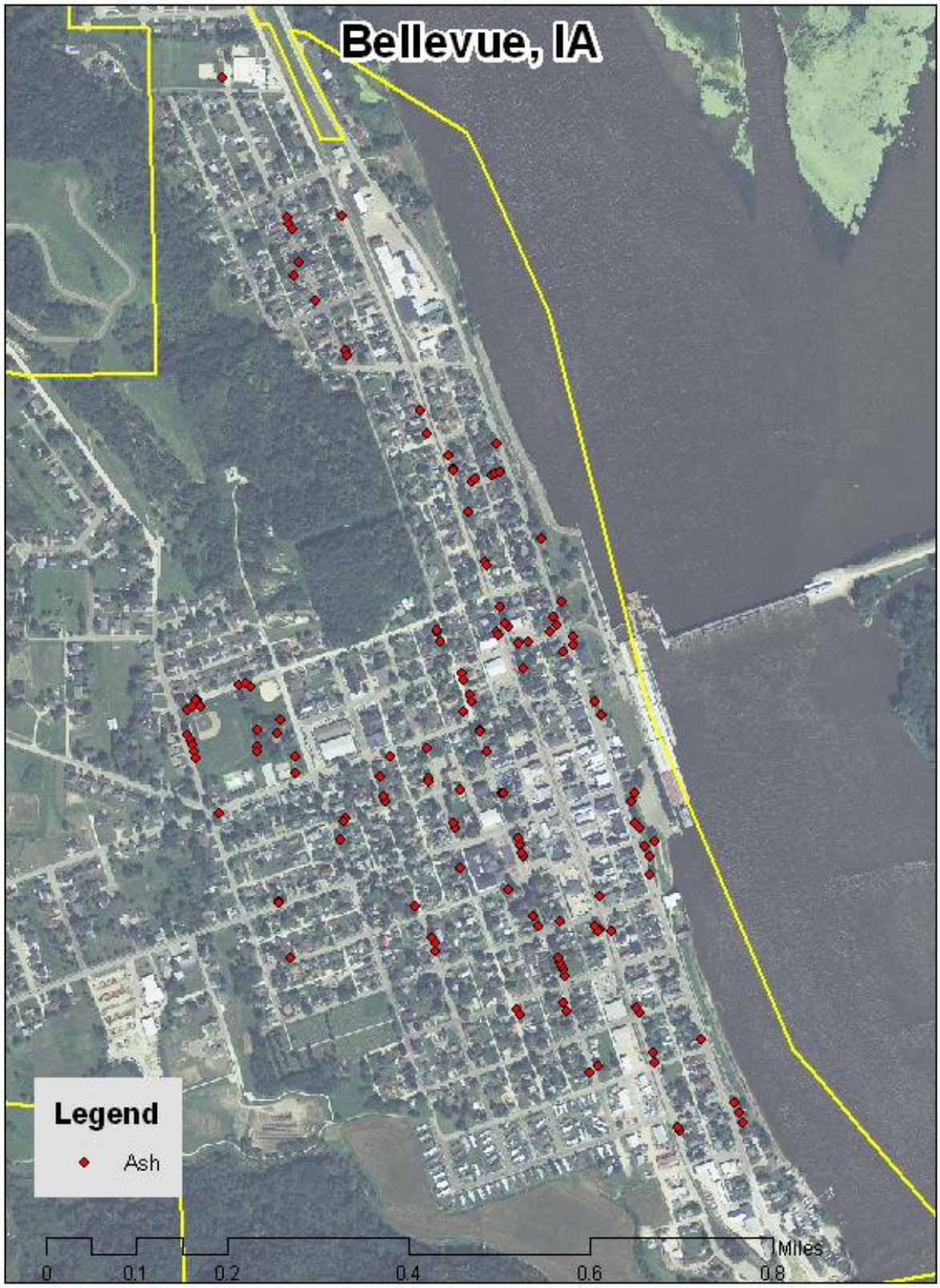


Figure 1: Location of Ash Trees

Figure 2: Location of EAB symptoms

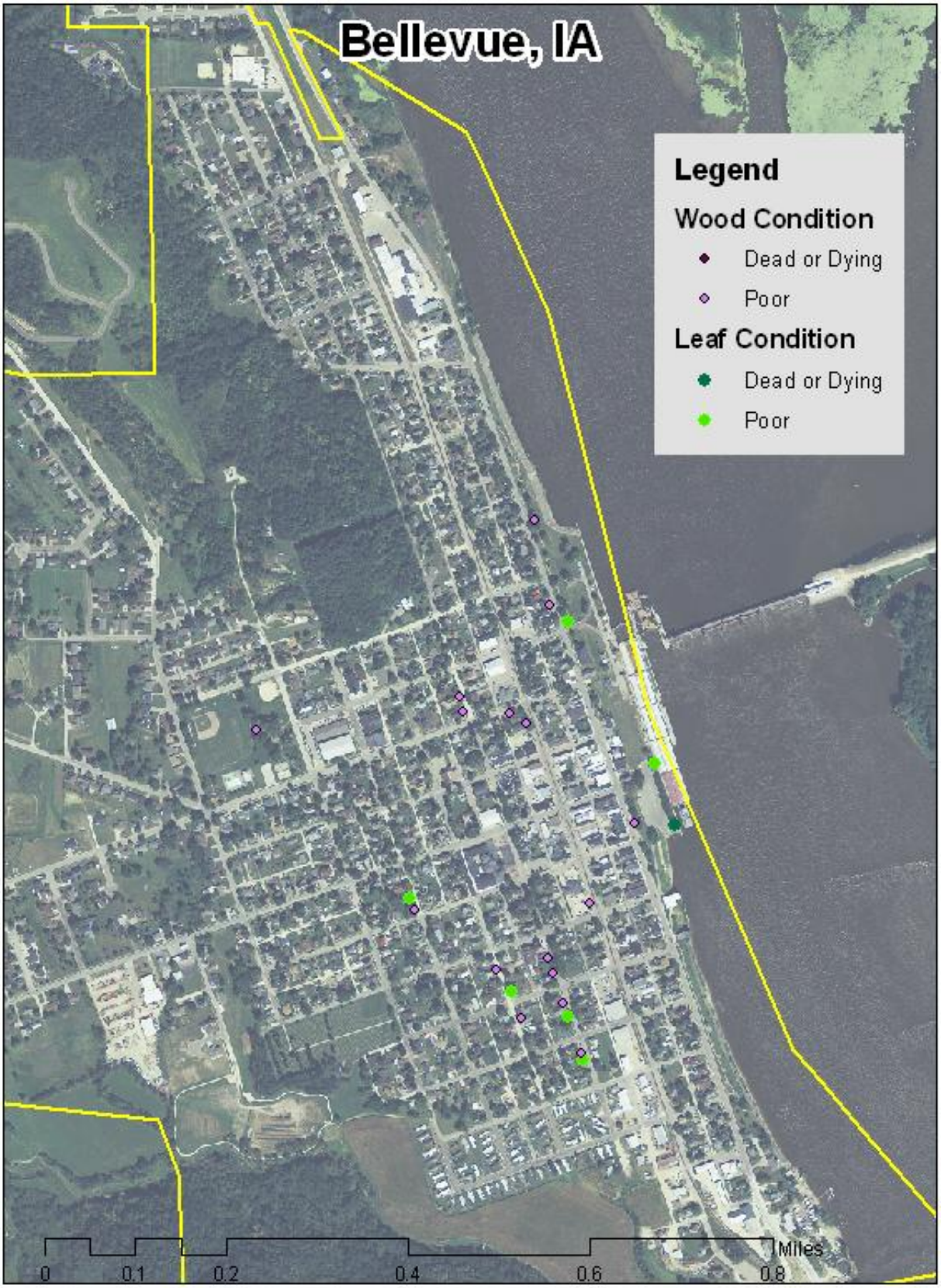


Figure 3: Location of Poor Condition Trees

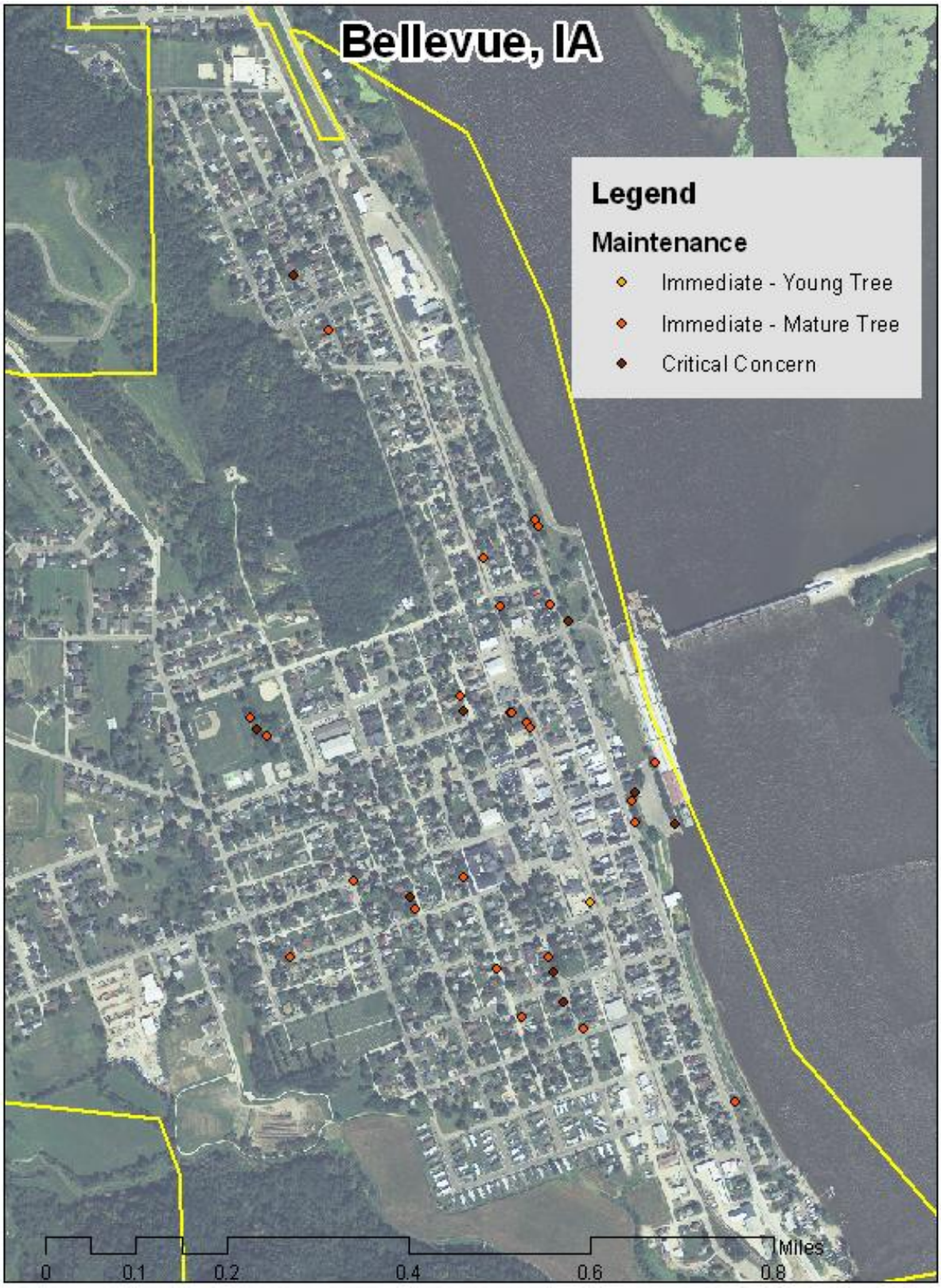


Figure 4: Location of Trees with Recommended Maintenance

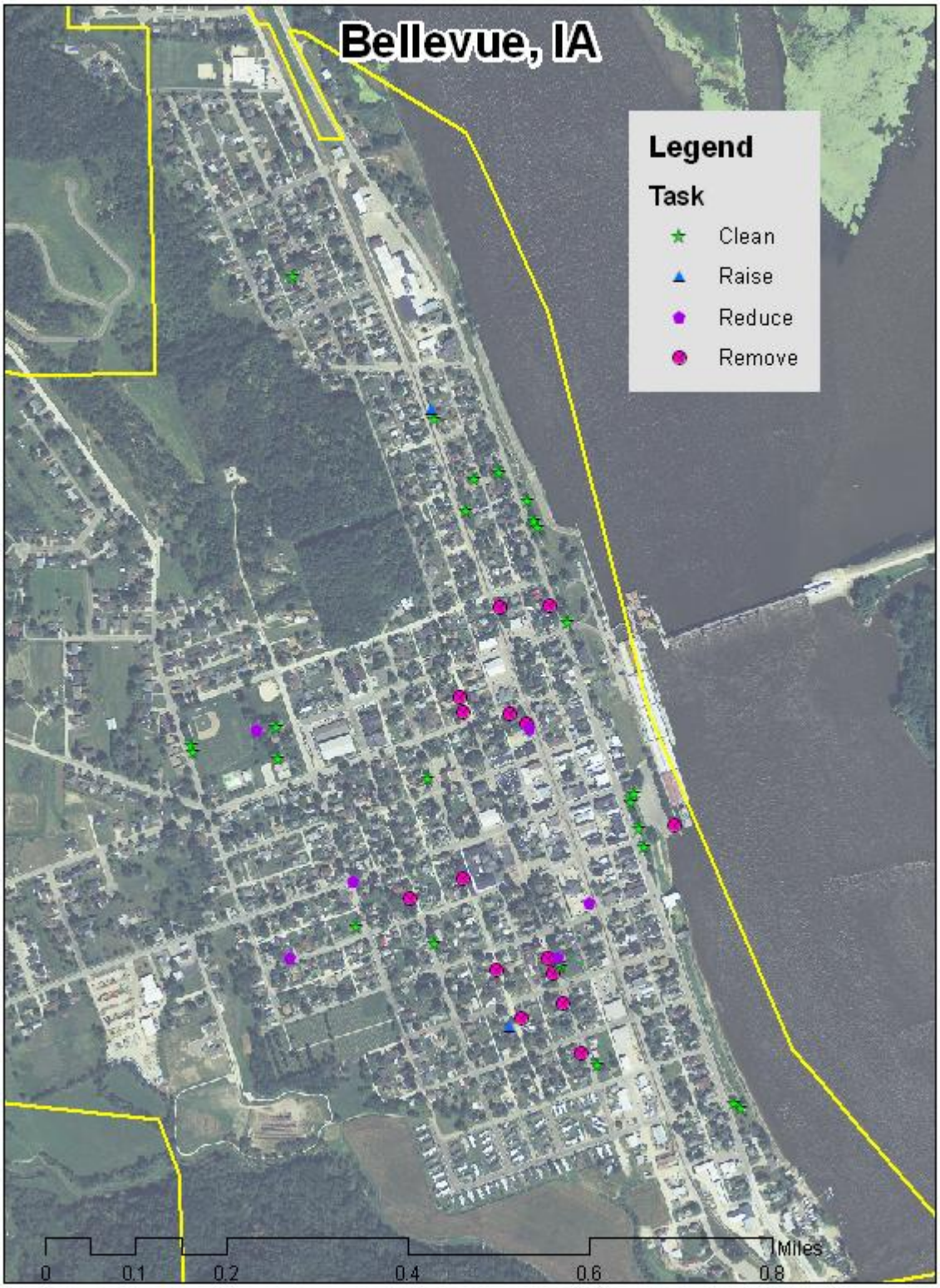


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

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