Belle Plaine, IA

Belle Plaine, IA

Legend
◇ All Trees

Miles
0   0.125 0.25   0.5   0.75   1

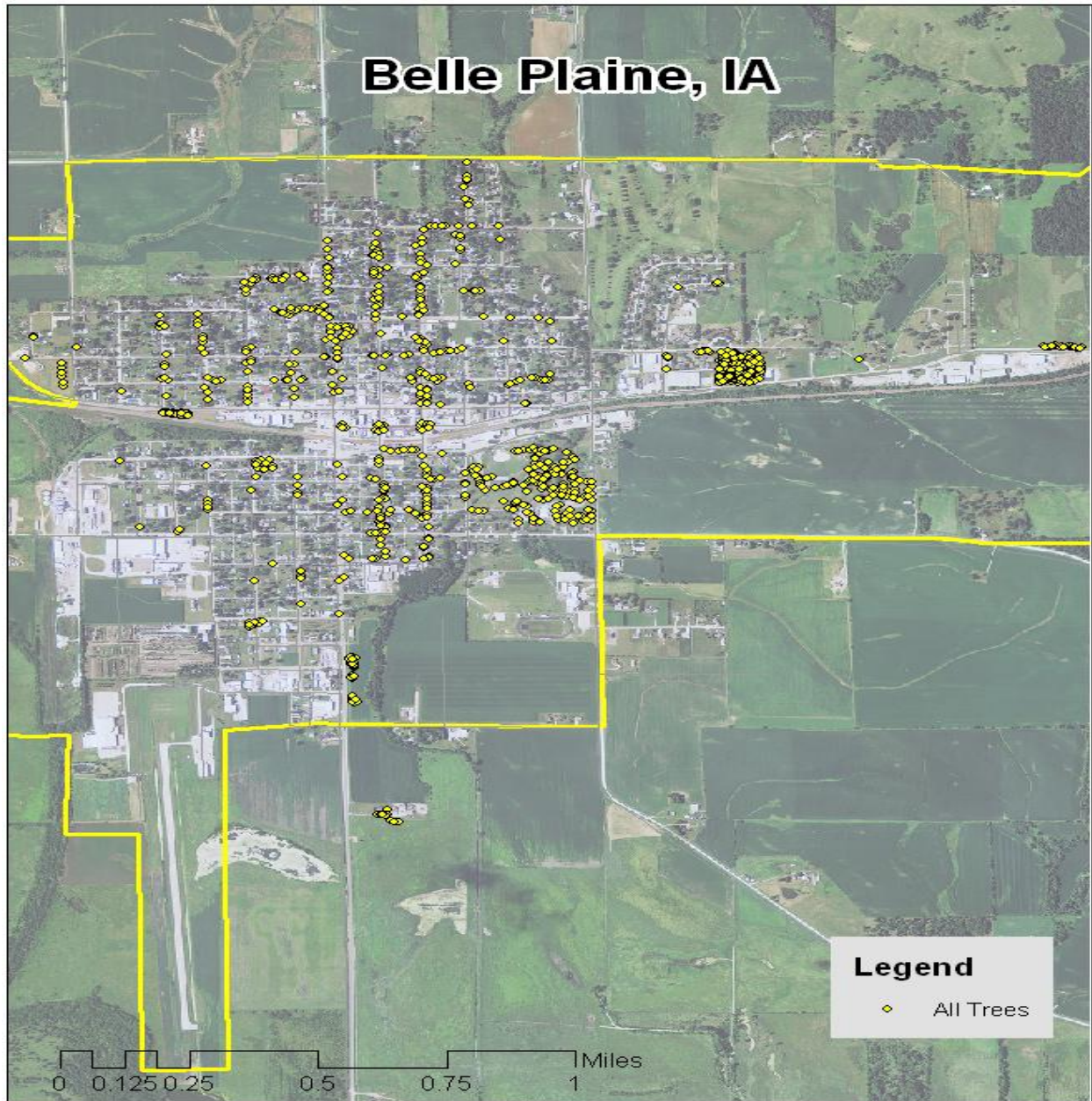## 2012 Management Plan
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In Partnership with the Bureau of Forestry, Iowa DNR

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Executive Summary_____

Overview

This plan was developed to assist the City of Belle Plaine 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 12% of Belle Plaine'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 2012, 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 894 trees inventoried.

- Belle Plaine trees provide $132,617 of benefits annually, an average of $148. a tree
- There are over 11 species of trees
- The top three genus are: Maple 24%, Ash 12%, and Crabapple 9%
- 58% of trees are in need of some type of management
- 32 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 32 trees needing removal, 12 trees are over 18 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*
- 60 of the 108 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 third of the city every other year
- Plant a diverse mix of trees that do not include: ash and maple
- Check ash trees with a visual survey yearly
- With the current budget it could take 24 years to remove ash – Suggestion: request a budget increase to $10,000 annually and apply for grants to plant replacement trees

Introduction _____

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

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

Inventory _____

In 2012, 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 894 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. Findings

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Belle Plaine's trees reduce energy related costs by approximately $36,456 annually (Appendix A, Table 1). These savings are both in Electricity (172.9 MWh) and in Natural Gas (23,811 Therms).

Annual Stormwater Benefits

Belle Plain's trees intercept about 1,878.834 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $50,920 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 Belle Plaine, it is estimated that trees remove 2,175 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 $6,079 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Belle Plaine*, trees sequester about 6,318.652 lbs of carbon a year with an associated value of $47,390 (Appendix A, Table 4). In addition, the trees store 597,964 lbs of carbon, with a yearly benefit of $4,485. (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. Belle Plaine receives $34,678 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, Belle Plaine's trees provide $132,617 of benefits annually. Benefits of individual trees vary based on size, species, health

and location, but on average each of the 894 trees in Belle Plaine provide approximately $148 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Belle Plaine has over 11 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genus is as follows:

Ash	104	12%
Maple Sugar	84	9.5%
Apple (Crab)	80	8.9%
Conifer Evergreen	78	8.7%
Silver Maple	50	5.6%
Northern Hackberry	45	5.0%
Norway Maple	45	4.9%
Northern Pin Oak	43	4.8%
Red Maple	39	4.4%
River Birch	31	3.5%
Other species	295	32.9%

Age Class

Most of Belle Plaine's trees (46%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, a Bell Curve is preferred and shows the highest amount of trees around 18 inches in diameter at 4.5 ft. Belle Plaine's size curve is on the smaller side, indicating a younger than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Belle Plaine indicate that 6% 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, 41% of Belle Plaine'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 7% of the population. This 7% is an estimate of trees that need management follow up.

Management Needs

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

Crown Cleaning	519	58%
Crown Raising	25	3%

6

Tree Staking	65	7%
Tree Removal	32	3.5%
Crown Reduction	69	8%

Canopy Cover

The canopy cover of Belle Plaine is approximately 19 acres (Appendix A, Figure 4).   According to the 2010 census, Belle Plaine occupies 2067.2 acres. Thus the canopy cover on city land is about 0.9%.

Land Use and Location

The majority of Belle Plaine's city and park trees are in planting strips in single family residential neighborhoods (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use

Single family residential	47%
Park/vacant/other	52%
Industrial/Large commercial	<1%
Small commercial	0%
Multifamily residential	0%

Location

Planting strip	100%
Other maintained locations	0%
Cutout (surrounded by pavement)	0%
Front yard	0%

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

Belle Plaine has 6 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 4 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are

addressed, there should be follow up on the trees marked as needing maintenance that do not include trimming. There are a total of 275 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 6 removals, 4 are ash trees. There are a total of 104 ash trees, and 40 of those have signs and symptoms that have been associated with EAB. In addition, there are 46 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Belle Plaine.

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 (45%) (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.

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 <u>No Additional Funding</u>

Year 1

 Removal: 4 largest critical concern trees,14 additional ash trees in poor health
 Planting and Replacement: 21 trees to be planted in open locations
 Visual Survey for signs and symptoms of EAB

Year 2

 Removal: 2 critical concern trees and 14 additional ash trees with poor health
 Planting and Replacement: 21 trees in open locations from year one removals
 Routine trimming: Contract to trim 1/3 of the city trees
 Visual Survey for signs and symptoms of EAB

Year 3

 Removal: 20 trees - removal of any new critical concern trees and ash in poor health
 Planting and Replacement: 19 trees to be planted in open locations and locations from previous removals
 Visual Survey for signs and symptoms of EAB

Year 4

 Removal: 14 trees - removal of any new critical concern trees and ash in poor health
 Planting and Replacement: 24 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: 20 trees - removal of any new critical concern trees and ash in poor health
 Planting and Replacement: 17 trees to be planted in open locations and locations from previous removals
 Visual Survey for signs and symptoms of EAB

Year 6

 Removal: 20 trees - removal of any new critical concern trees and ash in poor health
 Planting and Replacement: 24 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: Approximately 30 to 38 ash trees removed (approximately 25% of ash). It will take approximately 24 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 years of its arrival.
** To remove all ash trees within 6 years, the budget would need to be increased to $19,500 a year. If the budget were increased to $10,000 a year all ash could be removed in 13 years.

Emerald Ash Borer Plan_____

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms

of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). *City ownership of the tree recommended for removal should be verified prior to any removal*

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 31 (Appendix C). The new plantings will be a diverse mix and will not include ash and maple.

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 treat or start removing ash trees on their property upon arrival of EAB.

Budget _____

Current Budget
Total $30,408.00 over 6 years ($5068/year)

FY 2012 Budget
 Removal: $9000.00 (Additional $3,932. 00 needed)
 Planting: ($2,100.00 Additional funds needed)
 Watering & Maintenance: ($500 Additional funds needed)
FY 2013 Budget
 Removal: $8,000.00 (Additional $2,932.00 needed)
 Planting: ($2,100.00 Additional funds needed)
 Routine trimming: ($1,124.50 Additional funds needed)
 Watering & Maintenance: ($500 Additional funds needed)
FY 2014 Budget
 Removal: 10,000.00 (Additional $4,932.00 needed)
 Planting: ($1,900.00 Additional funds needed)
 Watering & Maintenance: ($500 additional funds needed)
FY 2015 Budget
 Removal: $7,000.00 (Additional $1,932.00 needed)
 Planting: ($2,400.00 Additional funds needed)
 Routine trimming: ($1,124.50 Additional funds needed)
 Watering & Maintenance: ($500 Additional funds needed)
FY 2016 Budget
 Removal: $10,000.00 (Additional $4,932.00 needed)
 Planting: ($1,700.00 Additional funds needed)
 Watering & Maintenance: ($500 Additional funds needed)
FY 2017 Budget
 Removal: $10,000.00 (Additional $4,932.00 needed)
 Planting: ($2,400.00 Additional funds needed)
 Routine trimming: ($1,124.50 Additional funds needed)
 Watering & Maintenance: ($500 Additional funds needed)

*Reduction of ash over 6 years: approximately 30 to 38 ash trees removed (approximately 25% of ash). **It will take approximately 24 years to remove all ash with the current budget.**

Purposed Budget Increase
EAB could potentially kill all ash trees in Belle Plaine within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $9000.00 a year. If the budget were increased to $10,000 a year all ash could be removed within 13 years. Additionally, it is recommended that Belle Plaine 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

Belle Plaine

Annual Energy Benefits of Public Trees by Species

12/19/2012

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	29.4	2,228	3,981.5	3,902	6,130	(N/A)	11.7	16.8	58.38
Sugar maple	24.4	1,853	3,318.7	3,252	5,105	(N/A)	9.5	14.0	60.06
Apple	3.3	250	543.3	532	782	(N/A)	9.0	2.2	9.78
Conifer Evergreen	6.2	472	845.8	829	1,301	(N/A)	8.7	3.6	16.68
Silver maple	15.6	1,187	2,045.8	2,005	3,192	(N/A)	5.6	8.8	63.84
Northern hackberry	15.1	1,146	2,143.0	2,100	3,247	(N/A)	5.0	8.9	72.14
Norway maple	10.0	762	1,435.2	1,406	2,169	(N/A)	4.9	6.0	49.29
Northern pin oak	11.2	849	1,625.3	1,593	2,442	(N/A)	4.8	6.7	56.80
Red maple	5.9	446	776.2	761	1,207	(N/A)	4.4	3.3	30.94
River birch	7.3	553	1,057.8	1,037	1,590	(N/A)	3.5	4.4	51.29
Maple	1.2	95	170.2	167	261	(N/A)	2.2	0.7	13.07
Northern red oak	3.4	261	466.4	457	718	(N/A)	2.1	2.0	37.81
Ash	4.6	350	638.1	625	976	(N/A)	2.0	2.7	54.21
Conifer Evergreen Small	0.2	18	37.1	36	54	(N/A)	1.7	0.2	3.62
Conifer Evergreen Large	2.0	148	260.1	255	403	(N/A)	1.6	1.1	28.80
Spruce	1.2	93	170.7	167	260	(N/A)	1.6	0.7	18.59
Littleleaf linden	1.9	144	253.3	248	392	(N/A)	1.6	1.1	27.99
Blue spruce	1.6	122	208.7	205	327	(N/A)	1.5	0.9	25.14
Ginkgo	1.8	137	243.9	239	376	(N/A)	1.3	1.0	31.36
Black walnut	2.9	222	389.0	381	603	(N/A)	1.2	1.7	54.84
Oak	0.2	15	28.1	27	43	(N/A)	1.2	0.1	3.88
Bur oak	0.6	43	81.3	80	123	(N/A)	1.2	0.3	11.14
Hickory	1.6	124	223.7	219	344	(N/A)	1.1	0.9	34.36
American sycamore	3.7	283	501.9	492	775	(N/A)	1.1	2.1	77.50
White ash	1.9	141	221.3	217	358	(N/A)	1.0	1.0	39.79
Swamp white oak	0.5	35	69.9	69	103	(N/A)	1.0	0.3	11.48
Other street trees	15.0	1,141	2,074.7	2,033	3,174	(N/A)	9.4	8.7	37.78
Citywide total	172.9	13,121	23,811.0	23,335	36,456	(N/A)	100.0	100.0	40.78

Table 2: Annual Stormwater Benefits

Belle Plaine

Annual Stormwater Benefits of Public Trees by Species

12/19/2012

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	322,134	8,730	(N/A)	11.7	17.2	83.15
Sugar maple	280,864	7,612	(N/A)	9.5	15.0	89.55
Apple	13,958	378	(N/A)	9.0	0.7	4.73
Conifer Evergreen	76,723	2,079	(N/A)	8.7	4.1	26.66
Silver maple	213,115	5,776	(N/A)	5.6	11.3	115.52
Northern hackberry	152,568	4,135	(N/A)	5.0	8.1	91.89
Norway maple	87,175	2,363	(N/A)	4.9	4.6	53.70
Northern pin oak	116,412	3,155	(N/A)	4.8	6.2	73.37
Red maple	43,126	1,169	(N/A)	4.4	2.3	29.97
River birch	68,945	1,869	(N/A)	3.5	3.7	60.28
Maple	6,988	189	(N/A)	2.2	0.4	9.47
Northern red oak	32,526	882	(N/A)	2.1	1.7	46.40
Ash	39,525	1,071	(N/A)	2.0	2.1	59.51
Conifer Evergreen Small	2,751	75	(N/A)	1.7	0.2	4.97
Conifer Evergreen Large	38,864	1,053	(N/A)	1.6	2.1	75.23
Spruce	23,907	648	(N/A)	1.6	1.3	46.28
Littleleaf linden	14,325	388	(N/A)	1.6	0.8	27.73
Blue spruce	22,627	613	(N/A)	1.5	1.2	47.17
Ginkgo	12,854	348	(N/A)	1.3	0.7	29.03
Black walnut	30,080	815	(N/A)	1.2	1.6	74.11
Oak	1,248	34	(N/A)	1.2	0.1	3.07
Bur oak	5,455	148	(N/A)	1.2	0.3	13.44
Hickory	13,152	356	(N/A)	1.1	0.7	35.64
American sycamore	56,484	1,531	(N/A)	1.1	3.0	153.08
White ash	14,403	390	(N/A)	1.0	0.8	43.37
Swamp white oak	4,313	117	(N/A)	1.0	0.2	12.99
Other street trees	184,311	4,995	(N/A)	9.4	9.8	59.47
Citywide total	1,878,834	50,920	(N/A)	100.0	100.0	56.96

Table 3: Annual Air Quality Benefits

Belle Plaine

12/19/2012

Species	Deposition (lb) O₃	NO₂	PM₁₀	SO₂	Total Depos. ($)	Avoided (lb) NO₂	PM₁₀	VOC	SO₂	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
Green ash	39.7	6.3	19.0	1.8	211	139.9	20.4	19.4	133.1	872	0.0	0	379.6	1,083	(N/A)	11.7	10.32
Sugar maple	37.9	6.5	18.8	1.7	205	116.2	16.9	16.2	110.6	725	-29.6	-111	295.0	818	(N/A)	9.5	9.63
Apple	3.5	0.6	1.8	0.2	19	16.5	2.3	2.2	14.9	101	0.0	0	41.9	120	(N/A)	8.9	1.50
Conifer Evergreen	8.9	1.8	7.9	1.1	60	29.6	4.3	4.1	28.2	184	-26.5	-99	59.3	145	(N/A)	8.7	1.86
Silver maple	35.4	6.0	17.5	1.6	191	73.6	10.8	10.3	70.8	461	-18.5	-69	207.4	583	(N/A)	5.6	11.65
Northern hackberry	24.5	4.2	12.4	1.1	133	72.9	10.6	10.1	68.5	452	0.0	0	204.2	586	(N/A)	5.0	13.02
Norway maple	17.0	2.9	8.4	0.8	92	48.6	7.0	6.7	45.6	301	-4.1	-15	133.0	378	(N/A)	4.9	8.59
Northern pin oak	25.3	4.4	12.3	1.1	136	54.4	7.9	7.5	50.8	336	-5.8	-22	157.7	451	(N/A)	4.8	10.49
Red maple	9.3	1.6	4.5	0.4	50	27.8	4.1	3.9	26.6	174	-3.3	-12	74.8	211	(N/A)	4.4	5.42
River birch	14.1	2.4	6.9	0.6	76	35.4	5.1	4.9	33.1	219	-3.3	-12	99.3	283	(N/A)	3.5	9.13
Maple	1.1	0.2	0.6	0.0	6	5.9	0.9	0.8	5.7	37	-0.4	-2	14.7	41	(N/A)	2.2	2.07
Northern red oak	6.8	1.2	3.3	0.3	37	16.4	2.4	2.3	15.6	102	-9.6	-36	38.6	103	(N/A)	2.1	5.40
Ash	7.8	1.3	3.9	0.3	42	22.1	3.2	3.1	20.9	138	-1.9	-7	60.9	173	(N/A)	2.0	9.62
Conifer Evergreen Small	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.1	7	-1.3	-5	1.5	3	(N/A)	1.7	0.20
Conifer Evergreen Large	4.6	0.9	3.7	0.6	30	9.2	1.4	1.3	8.9	58	-19.7	-74	10.8	14	(N/A)	1.6	1.00
Spruce	2.7	0.5	2.2	0.3	18	5.9	0.9	0.8	5.5	36	-11.5	-43	7.3	11	(N/A)	1.6	0.79
Littleleaf linden	2.0	0.3	1.1	0.1	11	9.0	1.3	1.3	8.6	56	-1.0	-4	22.6	63	(N/A)	1.6	4.53
Blue spruce	3.1	0.6	2.6	0.4	21	7.6	1.1	1.1	7.3	47	-8.4	-31	15.3	36	(N/A)	1.5	2.80
Ginkgo	3.5	0.6	1.7	0.2	19	8.6	1.3	1.2	8.2	54	-1.1	-4	24.1	68	(N/A)	1.3	5.69
Black walnut	3.5	0.6	1.7	0.2	19	13.9	2.0	1.9	13.3	87	0.0	0	37.1	106	(N/A)	1.2	9.60
Oak	0.0	0.0	0.0	0.0	0	1.0	0.1	0.1	0.9	6	0.0	0	2.2	6	(N/A)	1.2	0.56
Bur oak	0.5	0.1	0.3	0.0	3	2.7	0.4	0.4	2.6	17	0.0	0	7.0	20	(N/A)	1.2	1.81
Hickory	1.1	0.2	0.6	0.0	6	7.8	1.1	1.1	7.4	49	0.0	0	19.4	55	(N/A)	1.1	5.49
American sycamore	8.7	1.4	3.9	0.4	45	17.7	2.6	2.5	16.9	111	0.0	0	54.0	156	(N/A)	1.1	15.61
White ash	1.4	0.2	0.8	0.1	8	8.6	1.3	1.2	8.4	54	0.0	0	22.0	62	(N/A)	1.0	6.90
Swamp white oak	0.9	0.2	0.4	0.0	5	2.3	0.3	0.3	2.1	14	-0.2	-1	6.3	18	(N/A)	1.0	1.99
Other street trees	29.6	5.1	16.4	1.9	166	71.9	10.5	10.0	68.1	447	-34.3	-129	179.1	485	(N/A)	9.4	5.77
Citywide total	293.0	50.2	152.6	15.1	1,611	826.4	120.2	114.6	783.4	5,145	-180.5	-677	2,175.1	6,079	(N/A)	100.0	6.80

Table 4: Annual Carbon Stored

Belle Plaine

12/19/2012

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	1,299,608	9,747	(N/A)	11.7	20.6	92.83
Sugar maple	1,087,738	8,158	(N/A)	9.5	17.2	95.98
Apple	62,043	465	(N/A)	9.0	1.0	5.82
Conifer Evergreen	51,893	389	(N/A)	8.7	0.8	4.99
Silver maple	779,942	5,850	(N/A)	5.6	12.3	116.99
Northern	374,862	2,811	(N/A)	5.0	5.9	62.48
Norway maple	279,275	2,095	(N/A)	4.9	4.4	47.60
Northern pin oak	418,809	3,141	(N/A)	4.8	6.6	73.05
Red maple	104,075	781	(N/A)	4.4	1.7	20.01
River birch	232,794	1,746	(N/A)	3.5	3.7	56.32
Maple	13,777	103	(N/A)	2.2	0.2	5.17
Northern red oak	142,505	1,069	(N/A)	2.1	2.3	56.25
Ash	128,955	967	(N/A)	2.0	2.0	53.73
Conifer Evergreen	645	5	(N/A)	1.7	0.0	0.32
Conifer Evergreen	48,724	365	(N/A)	1.6	0.8	26.10
Spruce	27,814	209	(N/A)	1.6	0.4	14.90
Littleleaf linden	44,587	334	(N/A)	1.6	0.7	23.89
Blue spruce	21,177	159	(N/A)	1.5	0.3	12.22
Ginkgo	50,093	376	(N/A)	1.3	0.8	31.31
Black walnut	115,220	864	(N/A)	1.2	1.8	78.56
Oak	1,676	13	(N/A)	1.2	0.0	1.14
Bur oak	18,112	136	(N/A)	1.2	0.3	12.35
Hickory	36,867	277	(N/A)	1.1	0.6	27.65
American	292,144	2,191	(N/A)	1.1	4.6	219.11
White ash	34,598	259	(N/A)	1.0	0.6	28.83
Swamp white oak	15,020	113	(N/A)	1.0	0.2	12.52
Other street trees	288,350	4,768	(N/A)	9.4	10.1	56.76
Citywide total	6,318,652	47,390	(N/A)	100.0	100.0	53.01

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Table 5: Annual Carbon Sequestered

Belle Plaine

Annual CO$_2$ Benefits of Public Trees by Species

12/19/2012

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
Green ash	68,351	513	-6,238	-20	-47	49,248	369	111,340	835 (N/A)	11.7	18.6	7.95
Sugar maple	56,255	422	-5,221	-17	-39	40,948	307	91,966	690 (N/A)	9.5	15.4	8.11
Apple	6,304	47	-298	-16	-2	5,515	41	11,506	86 (N/A)	9.0	1.9	1.08
Conifer Evergreen	4,377	33	-249	-15	-2	10,439	78	14,552	109 (N/A)	8.7	2.4	1.40
Silver maple	60,971	457	-3,744	-10	-28	26,235	197	83,453	626 (N/A)	5.6	14.0	12.52
Northern hackberry	19,472	146	-1,799	-9	-14	25,333	190	42,997	322 (N/A)	5.0	7.2	7.17
Norway maple	16,314	122	-1,341	-9	-10	16,850	126	31,815	239 (N/A)	4.9	5.3	5.42
Northern pin oak	7,804	59	-2,010	-8	-15	18,772	141	24,557	184 (N/A)	4.8	4.1	4.28
Red maple	13,161	99	-500	-8	-4	9,852	74	22,507	169 (N/A)	4.4	3.8	4.33
River birch	9,695	73	-1,117	-6	-8	12,227	92	20,799	156 (N/A)	3.5	3.5	5.03
Maple	1,973	15	-66	-4	-1	2,092	16	3,995	30 (N/A)	2.2	0.7	1.50
Northern red oak	3,374	25	-684	-4	-5	5,773	43	8,459	63 (N/A)	2.1	1.4	3.34
Ash	6,217	47	-619	-4	-5	7,744	58	13,339	100 (N/A)	2.0	2.2	5.56
Conifer Evergreen	200	2	-3	-3	0	395	3	590	4 (N/A)	1.7	0.1	0.29
Conifer Evergreen	2,416	18	-234	-3	-2	3,279	25	5,459	41 (N/A)	1.6	0.9	2.92
Spruce	1,506	11	-134	-3	-1	2,054	15	3,424	26 (N/A)	1.6	0.6	1.83
Littleleaf linden	5,460	41	-214	-3	-2	3,175	24	8,419	63 (N/A)	1.6	1.4	4.51
Blue spruce	1,382	10	-102	-3	-1	2,701	20	3,979	30 (N/A)	1.5	0.7	2.30
Ginkgo	1,602	12	-240	-2	-2	3,035	23	4,394	33 (N/A)	1.3	0.7	2.75
Black walnut	6,808	51	-553	-2	-4	4,907	37	11,160	84 (N/A)	1.2	1.9	7.61
Oak	449	3	-8	-2	0	335	3	775	6 (N/A)	1.2	0.1	0.53
Bur oak	1,367	10	-87	-2	-1	949	7	2,227	17 (N/A)	1.2	0.4	1.52
Hickory	3,708	28	-177	-2	-1	2,749	21	6,278	47 (N/A)	1.1	1.1	4.71
American sycamore	8,046	60	-1,402	-2	-11	6,258	47	12,899	97 (N/A)	1.1	2.2	9.67
White ash	4,018	30	-166	-2	-1	3,122	23	6,972	52 (N/A)	1.0	1.2	5.81
Swamp white oak	314	2	-72	-2	-1	768	6	1,008	8 (N/A)	1.0	0.2	0.84
Other street trees	26,955	202	-3,051	-16	-23	25,208	189	49,096	368 (N/A)	9.4	8.2	4.38
Citywide total	338,502	2,539	-30,330	-174	-229	289,966	2,175	597,964	4,485 (N/A)	100.0	100.0	5.02

Table 6: Annual Social and Aesthetic Benefits

Belle Plaine

Annual Aesthetic/Other Benefits of Public Trees by Species

12/19/2012

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	5,695	(N/A)	11.7	16.4	54.23
Sugar maple	5,790	(N/A)	9.5	16.7	68.12
Apple	356	(N/A)	9.0	1.0	4.45
Conifer Evergreen	1,526	(N/A)	8.7	4.4	19.56
Silver maple	4,904	(N/A)	5.6	14.1	98.08
Northern hackberry	2,547	(N/A)	5.0	7.4	56.61
Norway maple	1,564	(N/A)	4.9	4.5	35.55
Northern pin oak	758	(N/A)	4.8	2.2	17.64
Red maple	1,757	(N/A)	4.4	5.1	45.06
River birch	927	(N/A)	3.5	2.7	29.90
Maple	310	(N/A)	2.2	0.9	15.52
Northern red oak	266	(N/A)	2.1	0.8	14.00
Ash	602	(N/A)	2.0	1.7	33.46
Conifer Evergreen Small	201	(N/A)	1.7	0.6	13.37
Conifer Evergreen Large	504	(N/A)	1.6	1.5	35.99
Spruce	357	(N/A)	1.6	1.0	25.47
Littleleaf linden	604	(N/A)	1.6	1.7	43.12
Blue spruce	289	(N/A)	1.5	0.8	22.21
Ginkgo	127	(N/A)	1.3	0.4	10.61
Black walnut	578	(N/A)	1.2	1.7	52.54
Oak	110	(N/A)	1.2	0.3	9.96
Bur oak	174	(N/A)	1.2	0.5	15.84
Hickory	384	(N/A)	1.1	1.1	38.43
American sycamore	558	(N/A)	1.1	1.6	55.76
White ash	515	(N/A)	1.0	1.5	57.22
Swamp white oak	52	(N/A)	1.0	0.2	5.82
Other street trees	3,223	(N/A)	9.4	9.3	38.37
Citywide total	34,678	(N/A)	100.0	100.0	38.79

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Table 7: Summary of Benefits in Dollars

Belle Plaine

## Total Annual Benefits of Public Trees by Species ($)

12/19/20

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Green ash	6,130	835	1,083	8,730	5,695	22,474	(±0)	16.9
Sugar maple	5,105	690	818	7,612	5,790	20,015	(±0)	15.1
Apple	782	86	120	378	356	1,722	(±0)	1.3
Conifer Evergreen	1,301	109	145	2,079	1,526	5,161	(±0)	3.9
Silver maple	3,192	626	583	5,776	4,904	15,081	(±0)	11.4
Northern hackberry	3,246	322	586	4,135	2,547	10,837	(±0)	8.2
Norway maple	2,169	239	378	2,363	1,564	6,713	(±0)	5.1
Northern pin oak	2,442	184	451	3,155	758	6,991	(±0)	5.3
Red maple	1,207	169	211	1,169	1,757	4,513	(±0)	3.4
River birch	1,590	156	283	1,869	927	4,824	(±0)	3.6
Maple	261	30	41	189	310	833	(±0)	0.6
Northern red oak	718	63	103	882	266	2,032	(±0)	1.5
Ash	976	100	173	1,071	602	2,922	(±0)	2.2
Conifer Evergreen	54	4	3	75	201	337	(±0)	0.3
Conifer Evergreen	403	41	14	1,053	504	2,015	(±0)	1.5
Spruce	260	26	11	648	357	1,301	(±0)	1.0
Littleleaf linden	392	63	63	388	604	1,510	(±0)	1.1
Blue spruce	327	30	36	613	289	1,295	(±0)	1.0
Ginkgo	376	33	68	348	127	953	(±0)	0.7
Black walnut	603	84	106	815	578	2,186	(±0)	1.6
Oak	43	6	6	34	110	198	(±0)	0.1
Bur oak	123	17	20	148	174	481	(±0)	0.4
Hickory	344	47	55	356	384	1,186	(±0)	0.9
American sycamore	775	97	156	1,531	558	3,116	(±0)	2.3
White ash	358	52	62	390	515	1,378	(±0)	1.0
Swamp white oak	103	8	18	117	52	298	(±0)	0.2
Other street trees	3,174	368	485	4,995	3,223	12,245	(±0)	9.2
Citywide Total	36,456	4,485	6,079	50,920	34,678	132,617	(±0)	100.0

Belle Plaine

Species Distribution of Public Trees (%)

12/19/2012
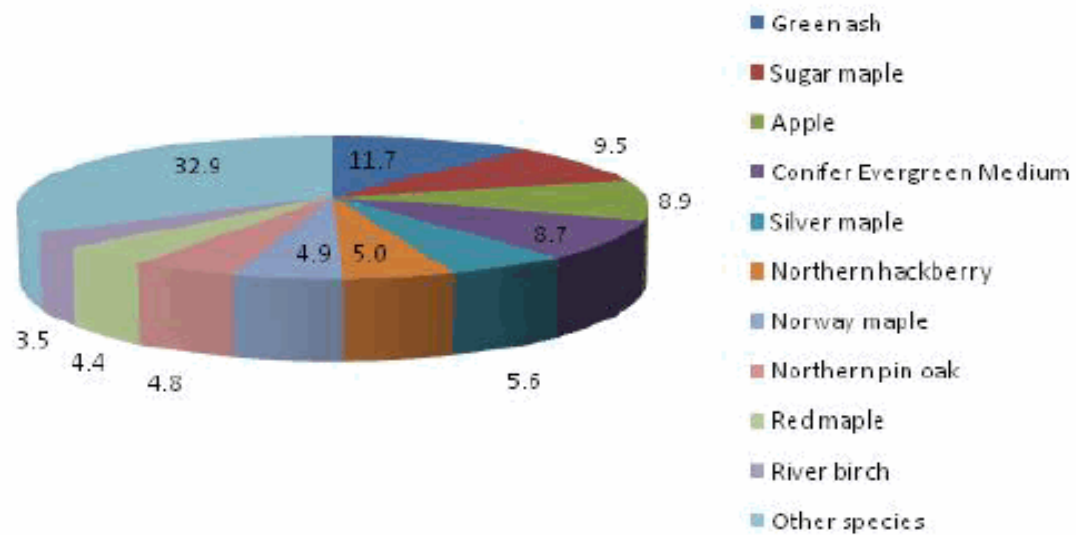
Species	Percent
Green ash	11.7
Sugar maple	9.5
Apple	8.9
Conifer Evergreen	8.7
Silver maple	5.6
Northern hackberry	5.0
Norway maple	4.9
Northern pin oak	4.8
Red maple	4.4
River birch	3.5
Other species	32.9
Total	100.0

Figure 1: Species Distribution

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Belle Plaine

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

12/19/2012
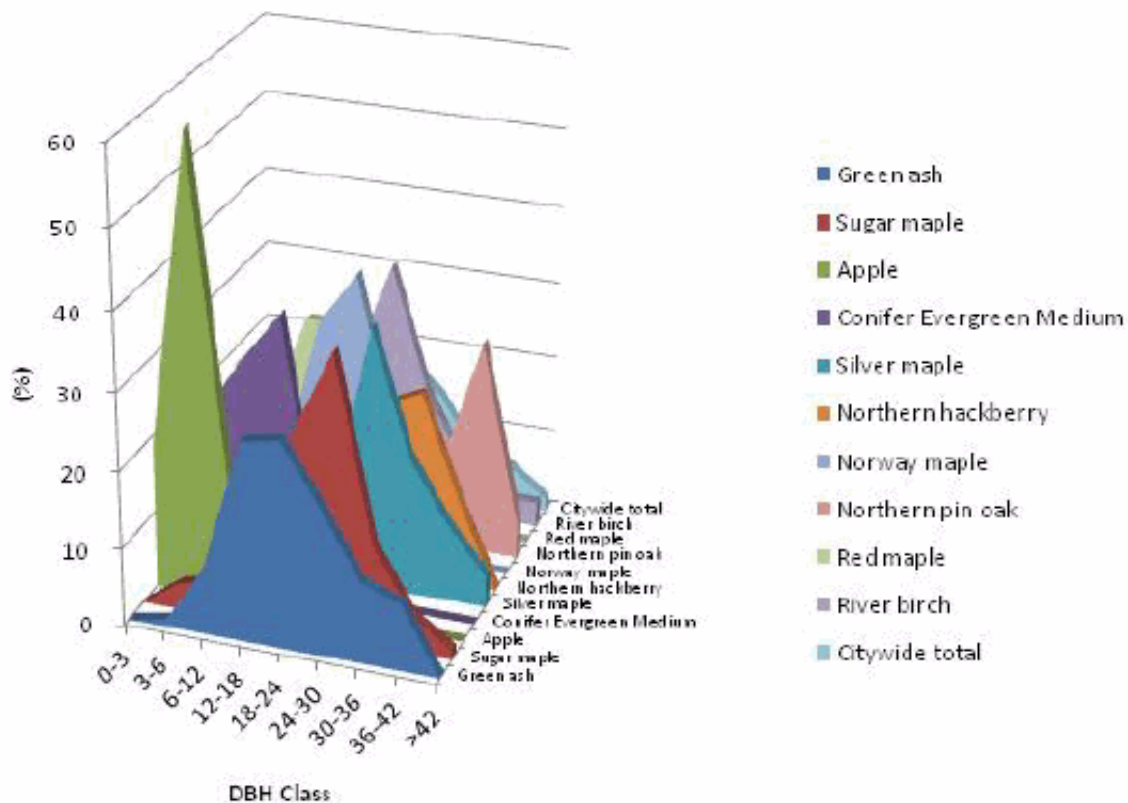
Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Green ash	0.0	1.0	8.6	25.7	26.7	19.0	10.5	8.6	0.0
Sugar maple	0.0	3.5	4.7	10.6	25.9	36.5	12.9	4.7	1.2
Apple	18.8	58.8	13.8	1.3	7.5	0.0	0.0	0.0	0.0
Conifer Evergreen	6.4	21.8	29.5	35.9	6.4	0.0	0.0	0.0	0.0
Silver maple	2.0	0.0	8.0	14.0	10.0	34.0	18.0	10.0	4.0
Northern hackberry	4.4	0.0	8.9	11.1	17.8	22.2	24.4	11.1	0.0
Norway maple	2.3	6.8	9.1	29.5	36.4	15.9	0.0	0.0	0.0
Northern pin oak	4.7	2.3	9.3	16.3	9.3	14.0	11.6	27.9	4.7
Red maple	17.9	12.8	25.6	25.6	17.9	0.0	0.0	0.0	0.0
River birch	0.0	12.9	6.5	19.4	32.3	16.1	6.5	3.2	3.2
Citywide total	8.2	15.0	12.5	18.7	17.9	14.2	6.6	5.4	1.6

Figure 2: Relative Age Class

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Belle Plaine

Functional (Foliage) Condition of Public Trees by Species (%)

12/19/2012

Citywide total

Good
6%

Dead or Dying
3%

Poor
1%

Fair
90%

Legend:
- Dead or Dying
- Poor
- Fair
- Good
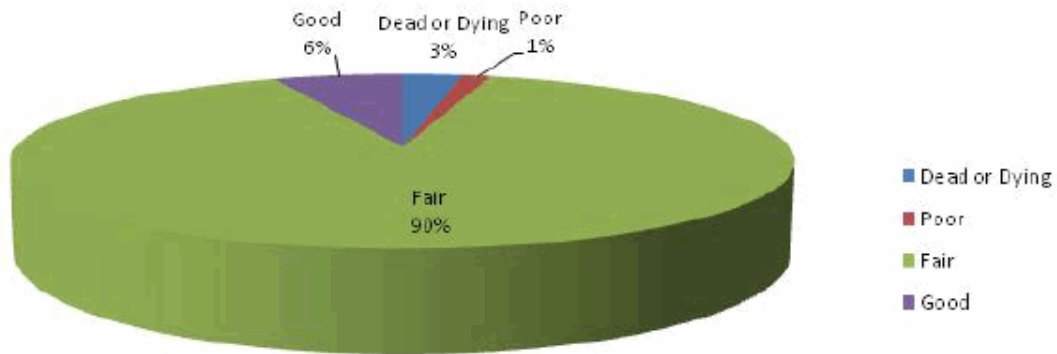
Figure 3: Foliage Condition

Belle Plaine

Structural (Woody) Condition of Public Trees by Species (%)

12/19/2012

Citywide total

Dead or Dying
3%

Poor
7%

Good
41%

Fair
49%

Legend:
- Dead or Dying
- Poor
- Fair
- Good
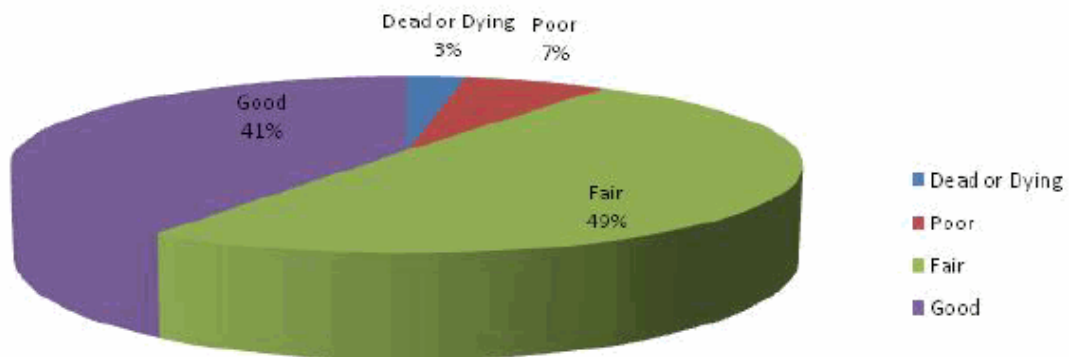
Figure 4: Wood Condition

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Belle Plaine

Canopy Cover of Public Trees (Acres)

12/19/2012
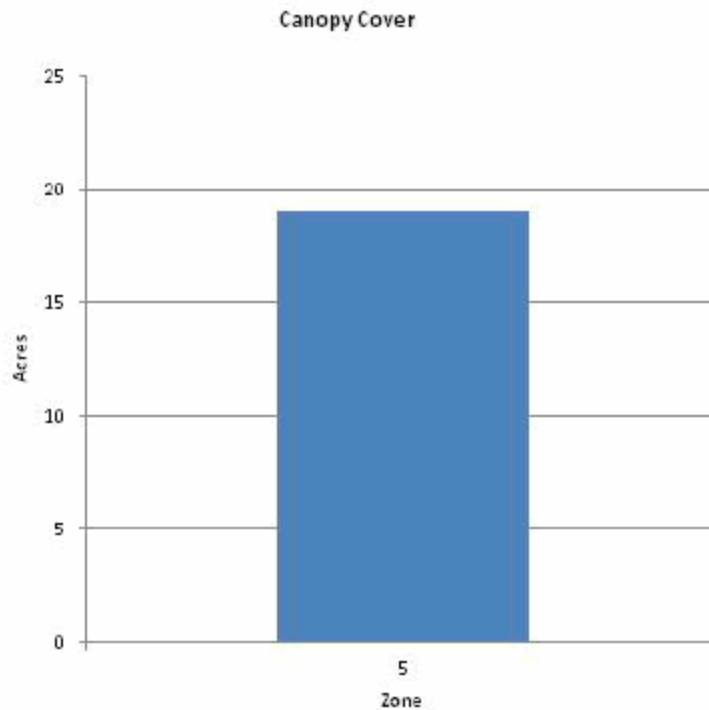
Canopy Cover

Zone	Acres	% of Total Canopy Cover
5	19	100.0
Citywide total	19	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	19		

Figure 5: Canopy Cover in Acres

Belle Plaine

Land Use of Public Trees by Zone (%)

12/19/2012
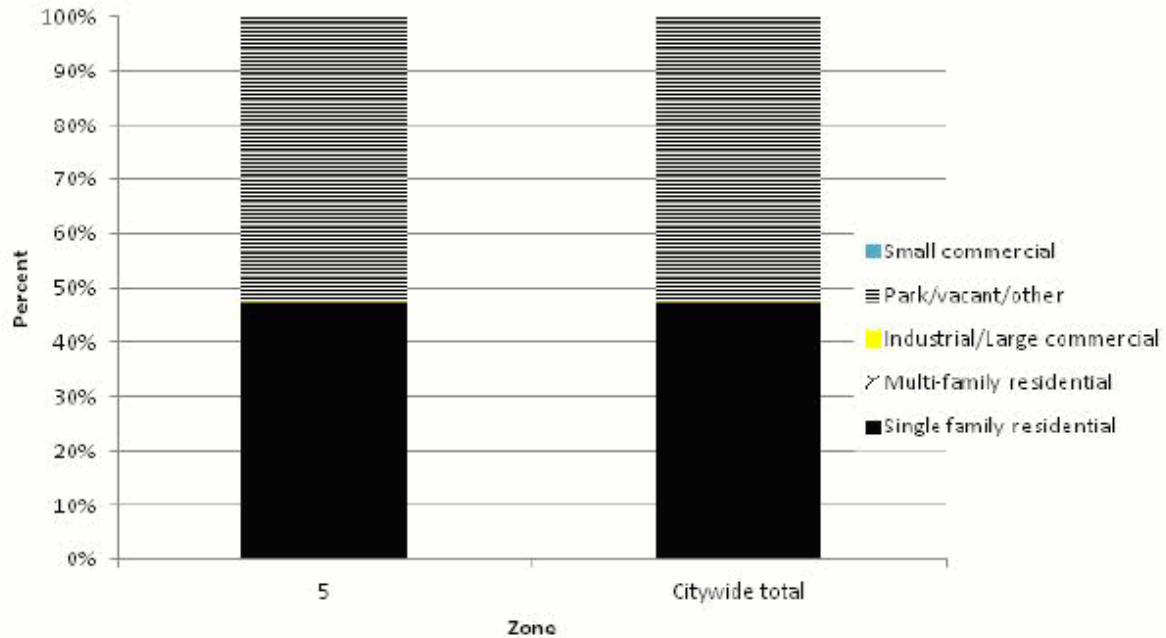
Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
5	47.2	0.0	0.2	52.6	0.0
Citywide total	47.2	0.0	0.2	52.6	0.0

Figure 6: Land Use of city/park trees

Belle Plaine

Location of Public Trees by Zone (%)

12/19/2012
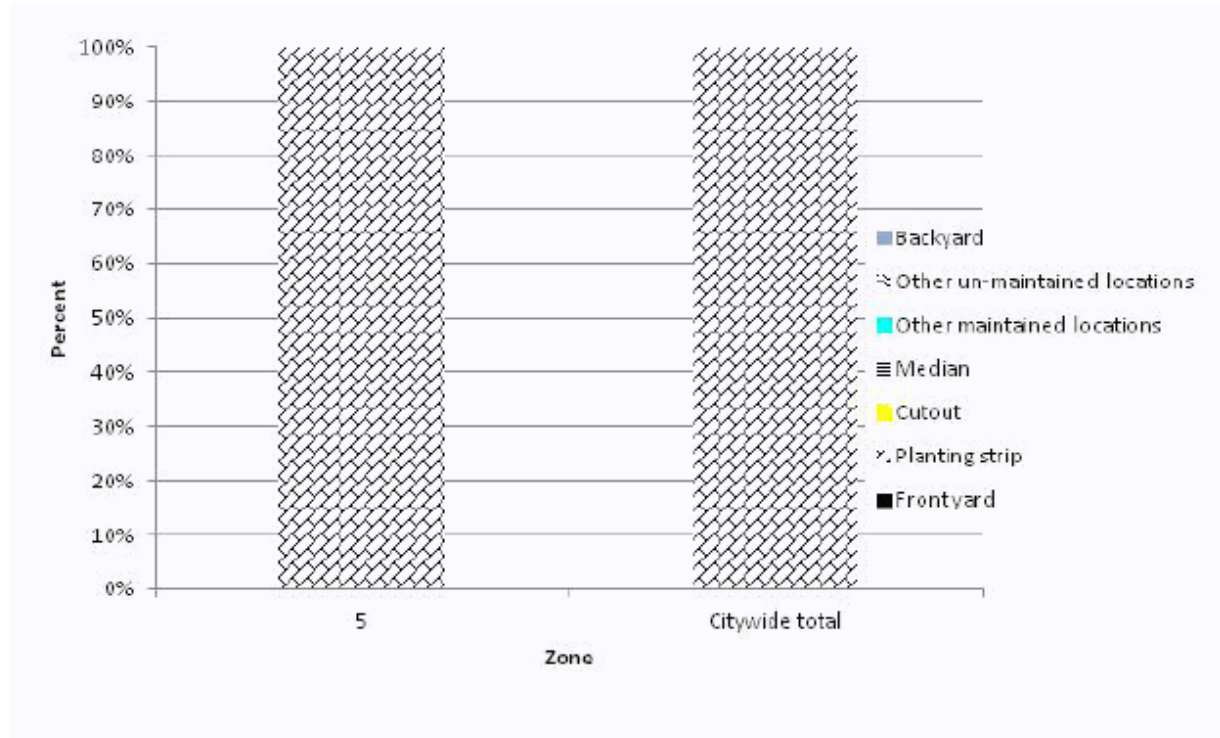
Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard	
5	0.0	100.0	0.0	0.0	0.0	0.0	0.0	
Citywide total	0.0	100.0	0.0	0.0	0.0	0.0	0.0	

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping
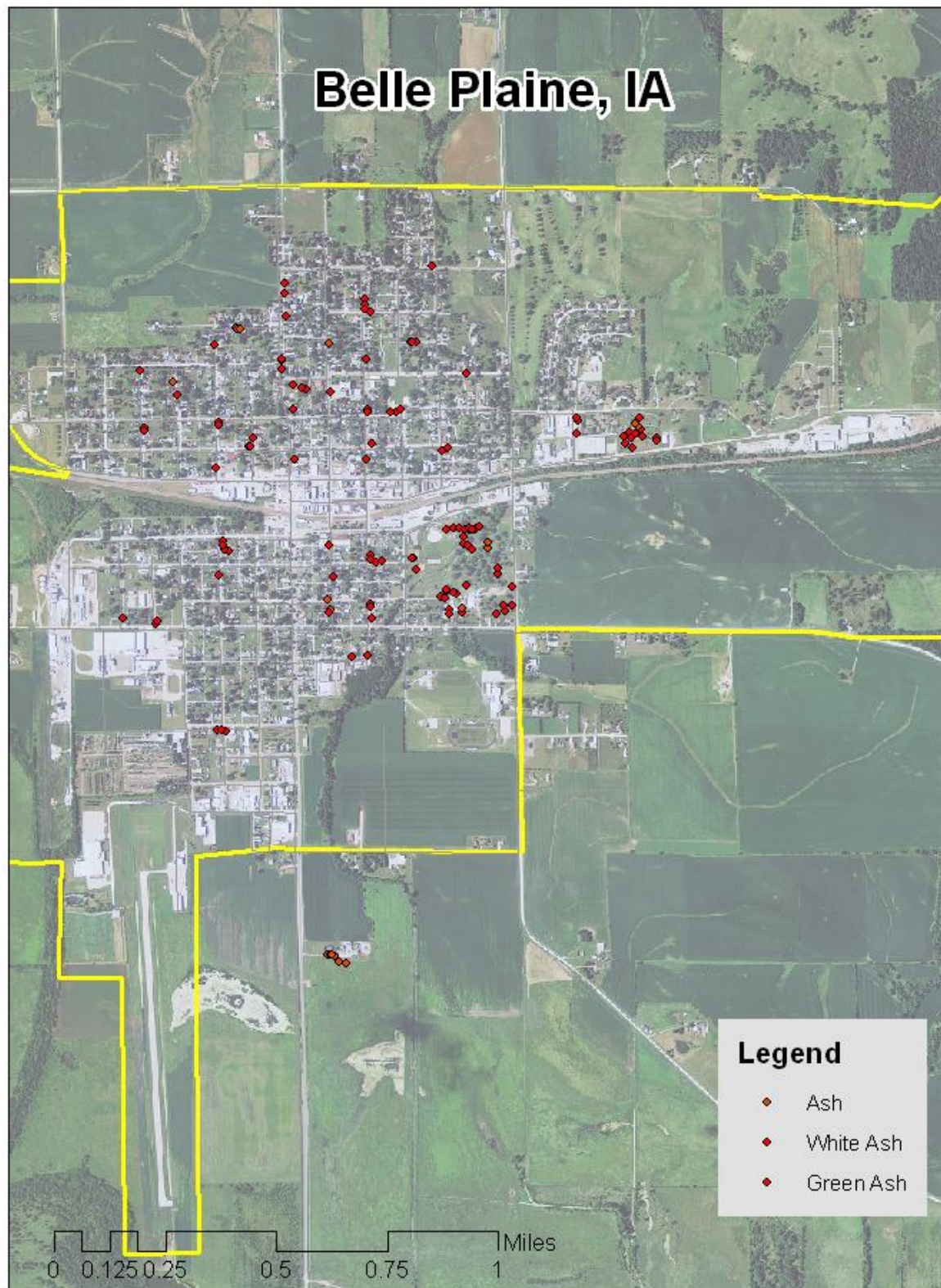
Figure 1: Location of Ash Trees

Figure 2: Location of EAB symptoms

Belle Plaine, IA

Legend

Wood Condition
- Dead or Dying
- Poor

Leaf Condition
- Dead or Dying
- Poor

Miles
0   0.125 0.25   0.5   0.75   1

Belle Plaine, IA

Legend

Recommended Mnt

◆ Immediate- Young Tree

◆ Immediate- Mature Tree

◆ Critical Concern

Miles
0   0.125 0.25   0.5   0.75   1
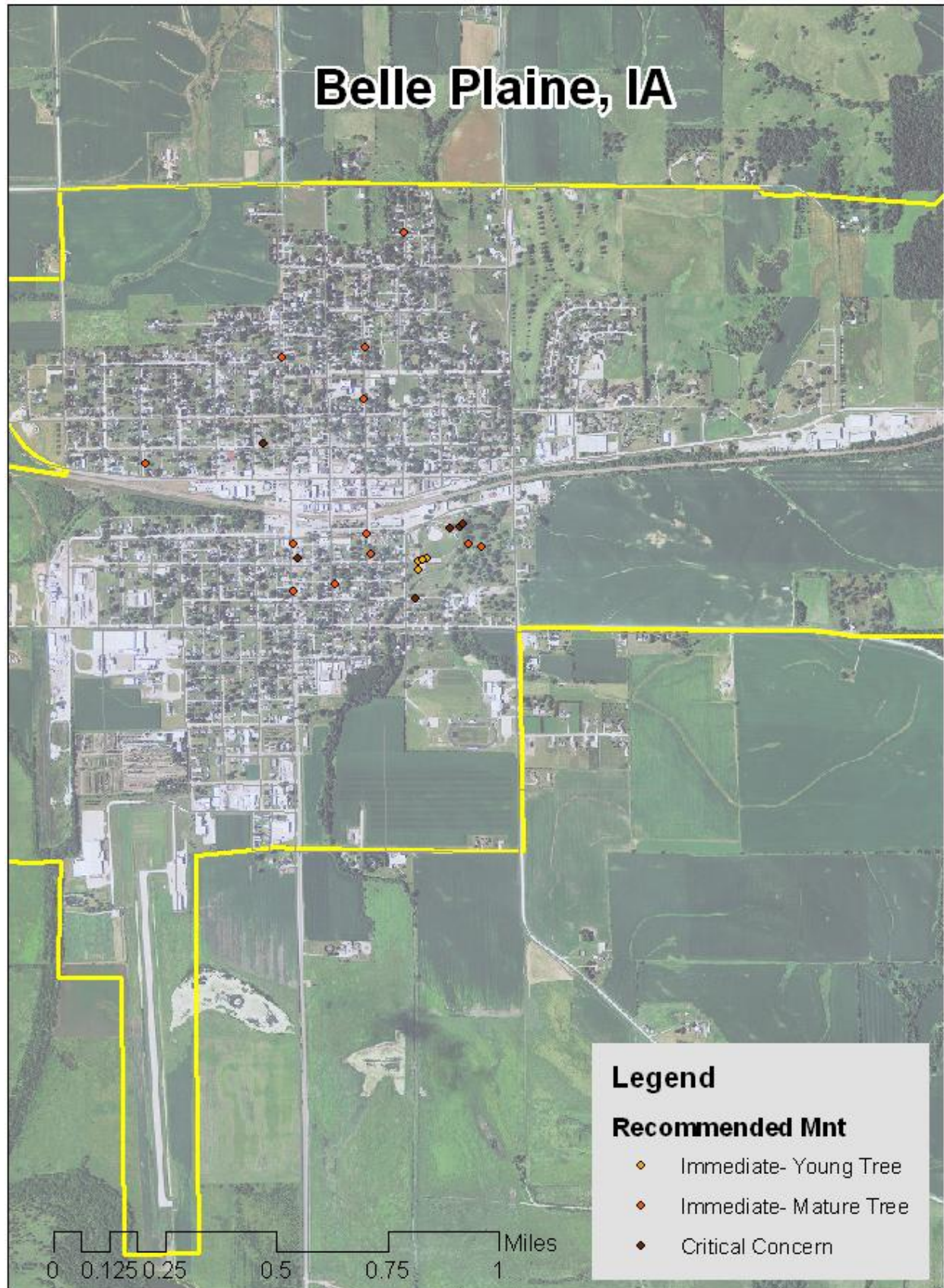
Figure 4: Location of Trees with Recommended Maintenance

Belle Plaine, IA

Legend

Task
- ◆ Stake/train
- ★ Clean
- ▲ Raise
- ⬟ Reduce
- ⬤ Remove
- ▢ Pest

Miles
0 0.125 0.25   0.5   0.75   1
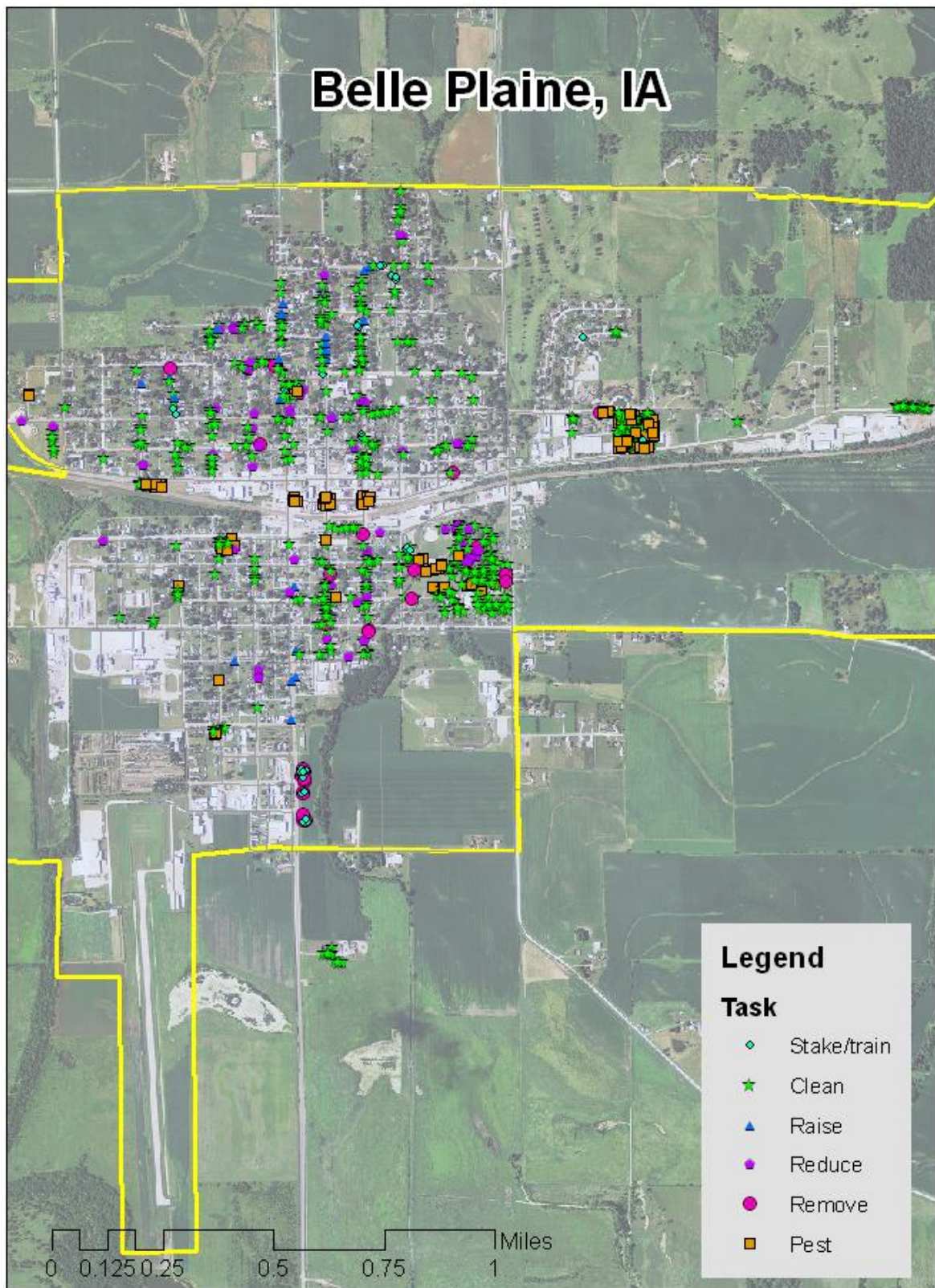
Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal

Appendix C: <u>Belle Plaine</u> <u>Tree Ordinances</u>

TITLE III COMMUNITY PROTECTION

CHAPTER 31

REGULATING THE PLANTING, CARE AND TRIMMING OF TREES

SECTION 3-31-1   PURPOSE. The purpose of this ordinance is to beautify and preserve the appearance of the City by requiring street trees to be uniformly located and maintained. The primary responsibility for maintaining street trees is placed upon the abutting property owner or his agent; but the Public Works Director shall personally supervise any cutting or trimming of said trees.

SECTION 3-31-2   DEFINITIONS. For use in this ordinance, the following terms are defined:

(1)   The term "person" shall mean individual, firm, corporation, trust, association or any other organized group.

(2)   The "street" shall mean the entire width between property lines of avenues or highways.

(3)   The term "parking" shall mean that part of the street, avenue or highway in the city not covered by sidewalk and laying between the lot lines and curb line; or, on unpaved street, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

(4)   The term "property owner" shall mean a person owning private property in the city as shown by the county auditor's plats of the city.

(5)   The term "public property" shall mean any and all property located within the confines of the city and owned by the city or held in the name of the city by any of the departments, commissions or agencies within the city government.

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SECTION 3-31-3 ARBORICULTURAL SPECIFICATIONS AND STANDARDS OF PRACTICE.

(1) Planting: Trees shall not be planted on the parking if it is less than eight feet in width, or contains less than eighty-one (81) square feet of exposed soil surface, Trees shall not be planted closer than twenty-five (25) feet to street intersections (property lines extended) and five (5) feet to driveways. Only trees projected to have a height of twenty-one feet or less may be planted under utility lines, Trees must be planted with the center of the planting hole not closer than one (foot) from underground gas or electric utilities. All trees must be of the kind, type and size recommended by the Board and approved by the City Council. A list of acceptable trees shall be on file with the City Clerk, however, this list is not exclusive as to the type of tree which my fit the area as there are many trees which may not be on the list but would be acceptable to the area of planting.

(2) Grade: Unless otherwise allowed for substantial reasons, all standard sized trees shall have comparatively straight trunks, well-developed leaders, and top and root characteristics of the species or variety showing evidence of proper nursery pruning. All trees must be free of insect, disease, mechanical injuries and other objectionable features at the time of planting. All new planted trees shall have a height of no less than five feet above the ground.

(3). Support: Trees may be guyed or supported in an upright position according to accepted arboricultural practices. The guys or supports shall be fastened in such a way that they not griddle or cause serious injury to the trees or endanger public safety.

(4) Trimming or Pruning: All cuts are to be made sufficiently closer to the parent stem so that healing can readily start under normal conditions. If pruning of the top of existing trees is needed due to overhead utility lines the Director of Public Works should be contacted before pruning. The stag tops should be pruned to nearest crotch in a lateral branch or to nearest crotch of the central leader.

SECTION 3-31-4 REMOVAL OF TREES. The Public Works Director shall remove, on the order of the council, any trees on the streets of this municipality which interferes with the making of improvements or with travel thereon. He shall additionally remove any trees on the street, not on private property, which have become diseased, or which constitute a danger to the public, or which may otherwise be declared a nuisance. Any diseased tree cut down should be burned or removed to a designated disposal area immediately.

SECTION 3-31-5 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street and sidewalks trimmed so that all branches will be at least fifteen feet above the surface of the street and ten feet above the sidewalks.

SECTION 3-31-6   TRIMMING OF TREES UNDER THE SUPERVISION OF THE PUBLIC WORKS DIRECTOR. Except as allowed in Section 3, no person may trim or cut any tree in a street or public place unless the work is done under personal supervision of the Public Works Director.

SECTION 3-31-7   NUISANCE AND CONDEMNATION OR PROTECTION. No person shall intentionally damage, cut carve, attach any rope, wire, nail advertising posters or other contrivance to any tree (except to protect, brace or straighten) or set fire or permit fire to burn which such fire will injure any portion of the tree.

SECTION 3-31-8   RIDERS TO PERMITS. The City Council shall authorize a member of the Tree Board to attend a seminar for the purpose of training him or her in the care of trees in all respects and shall pay for expense of the seminar.