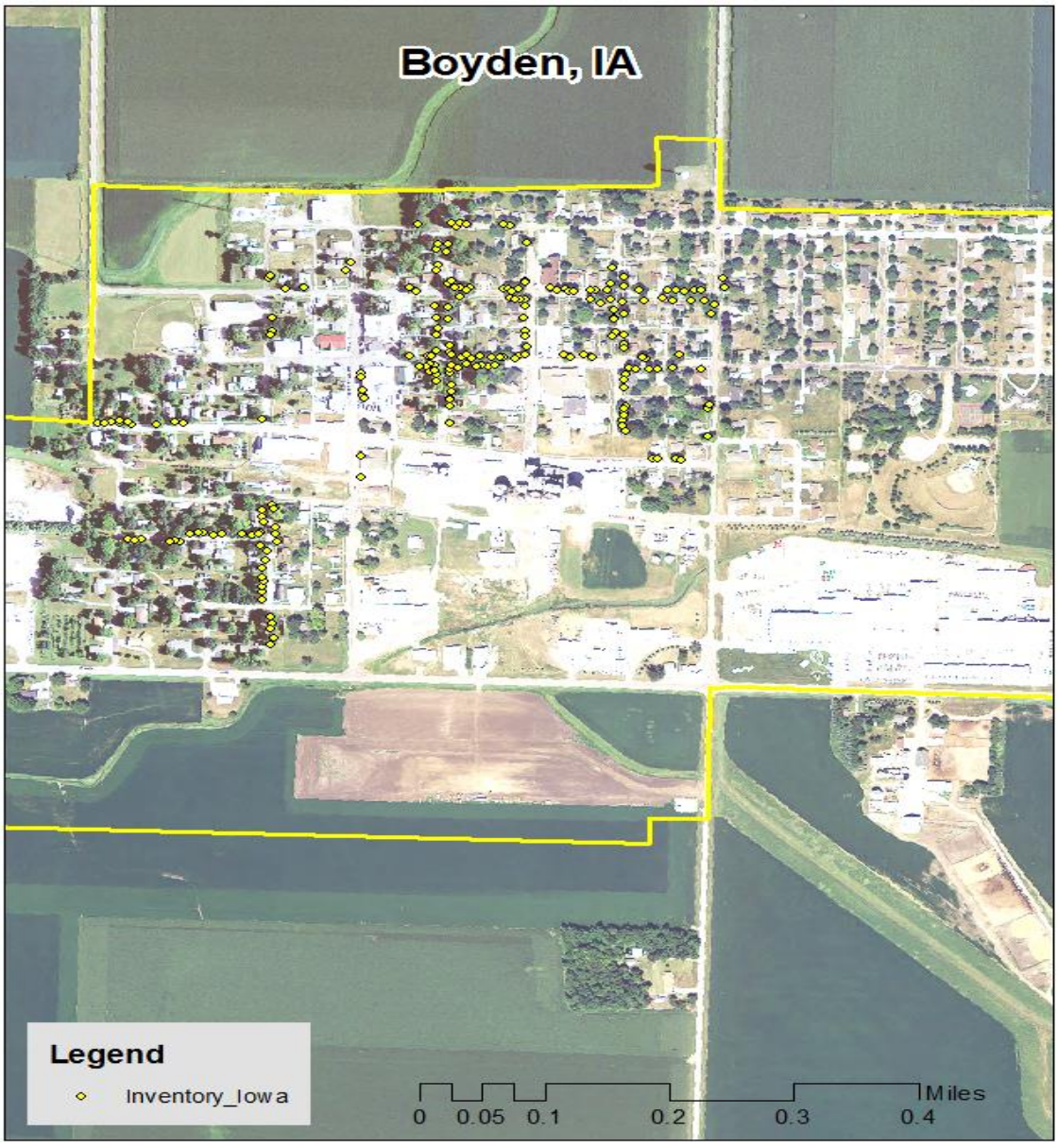
BOYDEN, IA



2014 Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Boyden with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community; and sound tree management allows a community to take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 20% of Boyden's city-owned trees (Green and White 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 2013 a street 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 218 trees inventoried.

- Boyden's trees provide $46,670 of benefits annually, an average of $214 a tree.
- 15 species of trees were found in the inventory.
- The top three Genera are: Maple 61%, Ash 18%, and Linden 8%.
- 35% of trees are in need of some type of management.
- 11 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 11 trees needing removal, 8 trees are over 24 inches in diameter at 4.5 ft. and must be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*.
- 18 of the 41 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, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.
- Check ash trees with a visual survey yearly.
- The current budget does not include tree removal or maintenance to remove ash or any other dead, dying, or damaged tree. So, no estimate can be made for the number of years needed to remove dead, dying, or damaged trees. Suggestion: request a budget increase or line item of $3,000 annually; and apply for grants to plant replacement trees.
- Review a later section on pages 9 and 10 entitled "Other Hazardous Ash Trees with Decay."

Introduction

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

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

Inventory

In 2013, a tree inventory was conducted that included 100% of the city-owned trees along 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 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 218 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. Boyden's trees reduce energy related costs by approximately $11,792 annually (Appendix A, Table 1). These savings are both in Electricity (56.1 MWh) and in Natural Gas (7,687.5 Therms).

Annual Stormwater Benefits

Boyden's trees intercept about 671,449 gallons of rainfall or snowmelt a year (Appendix A, Table 2). This interception provides $18,198 of benefits to the city.

Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. Your urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption. Potentially lessening the power demand from power plants, and emitting less volatile organic matter (ozone). In Boyden, it is estimated that trees remove 751 lbs. of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $1,668 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Boyden, trees sequester a net total about 236,479 lbs. of carbon a year with an associated value of $1,774 (Appendix A, Table 5). In addition, the trees store 2,634,546 lbs. of carbon, with a yearly benefit of $19,759 (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. Boyden receives $12,782 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, Boyden's trees provide $46,670 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 206 trees in Boyden provide approximately $214 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Boyden has 15 different tree species along city streets (Appendix A, Figure 1).
The distribution of trees by genera is as follows:

Maple	124	61%
Ash	45	18%
Linden/Basswood	15	8%
Apple's	6	3%
Black walnut	4	2%
Birch	3	2%
Northern Hackberry	2	1%
Other species	7	4%

Of the 206 street trees, the following list is a breakdown of the 5 most abundant tree species:

Silver maple	30.1%
Norway maple	24.8%
Green ash	19.9%
Sugar maple	6.8%
American Basswood	4.9%

Your street trees breakdown as follows:

Silver maple	30.1%
Norway maple	24.8%
Green ash	19.9%
Sugar maple	6.8%
American Linden Or Basswood	4.9%
Honeylocust	3.9%
Juniper	3.4%
Littleleaf Linden	3.4%
Apple-Malus species	2.4%
Birch	1.9%
Northern Hackberry	1.5%
Bur oak	.9%
Mulberry	.5%
White ash	.5%
American elm	.5%

Age Class

Most of Boyden's trees (72%) are between 12 and 36 inches in diameter at 4.5 ft (Appendix A, Figure 2 and Appendix A, Table 8). And, 87% of your trees are between 6 and 42 inches in diameter when measured at 4.5 feet above the ground (Appendix A, Figure 2 and Appendix A, Table 8). With regard to age/size, it is preferred that the highest number of trees be in the smaller diameters, so younger and smaller trees will replace natural mortality and to maintain tree canopy cover. Boyden's size curve is on the middle to larger trunk diameters, indicating a more mature 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 Boyden indicate that 48% of the trees are in good health, with only 16% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 53% of Boyden's trees are in good health for **wood** condition (appendix A, Figure 4 & Appendix B, Figure 3). **Wood** condition falling into the poor, dead or dying is about 15% of the population. This 15% is an estimate of trees that need management follow up.

Management Needs

The following outlines the specific management needs of the street and park trees by number of trees and percent of canopy (Appendix B, Figure 5).

Crown Cleaning	59	28%
Crown Raising	3	2%
Tree Staking	0	0%
Tree Removal	11	5%
Crown Reduction	10	5%

Definitions:
Crown cleaning-removing dead, diseased, damaged, poorly attached, or crossing branches.
Crown raising-removing lower branches from the trunk to eliminate obstructions or clearance problems.
Tree staking-encourage straight truck, strong scaffold branching, eliminate multiple leaders, crossing branches, and girdling ties and replacing stakes.
Tree Removal-tree is dangerous, dead or dying, and no amount of care will increase longevity or safety.
Crown Reduction-pruning to reduce tree height, spread, overcrowding, wind resistance, or an increase of light penetration.

Canopy Cover

The canopy cover of Boyden is approximately 6.75 acres (Appendix A, Figure 5). According to the 2010 census, Boyden occupies 479 acres. Thus the canopy cover on city land is about 1.4%.

Land Use and Location

The majority of Boyden's street 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	99+%
Park/vacant/other	<1%
Industrial/Large commercial	0%
Small commercial	<1%
Multifamily residential	0%

Location	
Planting strip	98%
Other maintained locations	00%
Cutout (surrounded by pavement)	1%
Front yard	1%

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 defects such as trunk cracks longer than 24 inches should be removed. A few trees have main trunks which are forked between 2 feet and 8 feet above the ground. Any of these forked trees, with open splits exposing interior wood, should be removed. Broken branches and branches that interfere with motorist's vision of pedestrians, vehicles, traffic signs and signals should be removed.

Hazardous trees

Boyden has 11 'removal' trees that need removal without regard to the species (Appendix A, Table 8, page 21) AND 3 'critical concern' trees (Appendix A, Table 9, page 21). These trees can be seen as red circles with a black X on the map titled Location of Trees with Recommended Maintenance map (Appendix B, Figure 5). See also Appendix B, Figure 4 titled Recommend Maintenance looking for the purple diamonds. By comparing Figures 4 & 5, you will notice that some of the 'critical concern' trees on figure 4 are also 'removal' trees on Figure 5. It is recommended to start with the large diameter 'critical concern' trees first. All 3 trees are 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 3 'critical concern' trees are

addressed, move on to the remaining 'removal' trees and then those marked as needing 'immediate' maintenance that may include trimming.

Definition: Critical Concern-for public safety, tree should be inspected without delay (by city and homeowner).

Poor and Dead/Dying Trees

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 11 removals, 4 are ash trees. There are a total of 37 public ash trees, 18 have signs and symptoms that have been associated with EAB. In addition, there are 8 ash trees that are in poor health based on the condition of the wood. *City ownership of the trees recommended for removal should be verified prior to any removal*.

Other Hazardous Green Ash trees with Decay

Ash trees are listed by their addresses, or house color if no address was found, or position on the city block. In some cases, the entire tree is recommended for removal by the district forester; or the homeowner should remove the ash tree since the main trunk or the main forks are decaying. These trees are brought to your attention because decay caused by a fungus dissolves the cellulose portion of the wood fibers, resulting in weakened branches, limbs, or main trunks. Once weakened, the decayed portion simply breaks off without the benefit of winds, ice or snow, and fall onto anything below.

Tree number:

1. 911 E. Webb Street, gray-blue corner house, northeast corner, driveway tree hanging over sidewalk and driveway.
2. 1004 E. Pleasant Street, tree on N. Blaine Street, at corner, branch over N. Blaine Street. Also the next large ash to the south with a branch over N. Blaine Street. Also the next large ash tree on E. Pleasant Street, branch over street parking.
3. 706 S. Sherman Street, light gray house on corner of W. Taft Street, south tree in front yard.

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety problems. 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 Boyden.

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, Boyden is heavily planted with Maple (61%) and ash (18%). (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. Recommended and nuisance trees are normally listed in the tree section or the city code, as outlined in Section 151.02 of the city ordinance (Appendix C). All planted trees must meet the restrictions in your city code.

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: all 3 of your 'critical concern' trees.
- Planting and Replacement: 9 trees to be planted in open locations using annual utility grant.
- Visual Survey for signs and symptoms of EAB

Year 2

- Removal: remainder of 'removal' trees and 6 ash trees of the 42 trees needing immediate work.
- Planting and Replacement: 6 trees in open locations using annual utility grant.
- Routine trimming: Contract to trim 1/3 of the city trees.
- Visual Survey for signs and symptoms of EAB.

Year 3

Removal: another 8 trees of the 42 trees needing immediate work.
Planting and Replacement: 9 trees to be planted in open locations using annual utility grant.
Visual Survey for signs and symptoms of EAB.

Year 4

Removal: another 8 trees needing immediate work.
Planting and Replacement: 7 trees in open locations using annual utility grant.
Routine trimming: Contract to trim 1/3 of the city trees.
Visual Survey for signs and symptoms of EAB.

Year 5

Removal: another 8 trees needing immediate work.
Planting and Replacement: 9 trees in open locations using annual utility grant.
Visual Survey for signs and symptoms of EAB.

Year 6

Removal: another 8 trees needing immediate work.
Planting and Replacement: 7 trees in open locations using annual utility grant.
Routine trimming: Contract to trim 1/3 of the city trees.
Visual Survey for signs and symptoms of EAB.

Year 7

Continue working on the remaining 6 ash trees needing immediate work.

*Reduction of ash over 6 to 7 years: Approximately 42 to 45 ash trees removed (representing 100% of public ash). EAB could potentially kill all public and private ash trees within 4 years of its arrival.
** To remove all ash trees within 6 years, the budget would need to be increased by $4,000 a year (based on a cost of $550 per tree and 7 ash trees per year).

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal can be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figures 3, 4 and 5). 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, spreading removal costs out over several years while allowing trees to continue to provide benefits. Boyden has the benefit of not finding any actual infestations of EAB, so the yearly removal of the worst ash trees now can lower future removal costs. Chemical 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 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 it is necessary. At present, the entire State of Iowa is under quarantine for all of the items listed above.

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? The entire of State of Iowa is now under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website for more information: http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. .

Canopy Replacement

As budget permits, all removed ash trees will be replaced. An updated, sample city tree code can be found in Appendix C covering public and private trees, and sampling of trees for insects or diseases. All new trees will meet the restrictions in city ordinance 151.02, part 3 (Appendix C) if Boyden amends this section. 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. Chapter 151.06 of your current code states "If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within 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."

Budget

Current Budget

Boyden does not have a line item or budget for tree care, replacement, or removals. However, Boyden has spent the following amounts for trimming after ice and wind storms:

August 2012 to January 2013	**$835 for trimming**
November 2012	**$1,400 for trimming by Schwabach.**
May to June 2013	**$1,750 for trimming by Schwabach.**

The next section suggests budget amounts or line items for the next six years in the event EAB enters Boyden.

Future Budget Taking Insect and Disease Problems into Account

FY 2014 Budget
- Removal: $1,650
- Planting: $900
- Watering & Maintenance: $500

FY 2015 Budget
- Removal: $3,200
- Planting: $600
- Routine trimming: $1,700
- Watering & Maintenance: $500

FY 2016 Budget
- Removal: $4,400
- Planting: $800
- Watering & Maintenance: $500

FY 2017 Budget
- Removal: $4,400
- Planting: $600
- Routine trimming: $1,700
- Watering & Maintenance: $500

FY 2018 Budget
- Removal: $4,400
- Planting: $900
- Watering & Maintenance: $500

FY 2019 Budget
- Removal: $4,400
- Planting: $600
- Routine trimming: $1,700
- Watering & Maintenance: $500

*Reduction of ash trees along city streets over 6 years: 14 of the worst ash trees will be removed. The District Forester is estimating the number of privately-owned ash trees in Boyden to be 2 to 3 times more than the number of street trees or 150. The state-wide estimate for urban tree removal is $500 to $1000 each.

Purposed Budget Increase

EAB could potentially kill all ash trees in Boyden within 4 years of its arrival. To remove all ash trees within 6 to 7 years the budget would need to be increased by $4,000 a year. If the budget were increased by $10,000 a year, all ash could be removed within 3 years. Additionally, it is recommended that Boyden 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

Boyden

Annual Energy Benefits of Public Trees by Species

3/21/2014

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	20.7	1,574	2,733.6	2,679	4,252	(N/A)	29.1	36.1	70.87
Norway maple	13.5	1,021	1,938.5	1,900	2,921	(N/A)	24.8	24.8	57.27
Green ash	9.9	751	1,357.9	1,331	2,082	(N/A)	18.0	17.7	56.26
Sugar maple	3.3	251	455.3	446	697	(N/A)	6.8	5.9	49.82
American basswood	1.9	147	272.7	267	414	(N/A)	4.9	3.5	41.41
Apple	0.2	14	32.4	32	46	(N/A)	3.4	0.4	6.58
Littleleaf linden	0.7	54	89.0	87	141	(N/A)	3.4	1.2	20.19
Black walnut	1.5	114	214.9	211	325	(N/A)	2.4	2.8	64.98
Birch	0.8	59	104.7	103	161	(N/A)	1.9	1.4	40.31
Northern hackberry	1.0	74	144.0	141	215	(N/A)	1.5	1.8	71.73
Honeylocust	1.0	79	137.1	134	213	(N/A)	1.5	1.8	71.11
Other street trees	1.6	120	207.5	203	323	(N/A)	2.4	2.7	64.65
Citywide total	56.1	4,258	7,687.5	7,534	11,792	(N/A)	100.0	100.0	57.24

Table 2: Annual Stormwater Benefits

Boyden

Annual Stormwater Benefits of Public Trees by Species

3/21/2014

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	309,887	8,399	(N/A)	29.1	46.2	139.98
Norway maple	132,650	3,595	(N/A)	24.8	19.8	70.49
Green ash	113,648	3,080	(N/A)	18.0	16.9	83.25
Sugar maple	35,057	950	(N/A)	6.8	5.2	67.86
American basswood	15,465	419	(N/A)	4.9	2.3	41.91
Apple	615	17	(N/A)	3.4	0.1	2.38
Littleleaf linden	4,346	118	(N/A)	3.4	0.7	16.83
Black walnut	17,204	466	(N/A)	2.4	2.6	93.25
Birch	5,460	148	(N/A)	1.9	0.8	36.99
Northern hackberry	8,482	230	(N/A)	1.5	1.3	76.63
Honeylocust	12,274	333	(N/A)	1.5	1.8	110.88
Other street trees	16,361	443	(N/A)	2.4	2.4	88.68
Citywide total	671,449	18,198	(N/A)	100.0	100.0	88.34

Table 3: Annual Air Quality Benefits

Boyden

Annual Air Quality Benefits of Public Trees by Species

3/21/2014

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
Silver maple	55.0	9.3	26.8	2.4	296	97.8	14.3	13.7	93.8	612	-28.5	-107	284.6	801	(N/A)	29.1	13.34
Norway maple	28.1	4.8	13.7	1.2	151	65.2	9.4	9.0	61.0	404	-6.5	-24	186.0	531	(N/A)	24.8	10.41
Green ash	14.4	2.3	6.8	0.6	76	47.3	6.9	6.6	44.8	294	0.0	0	129.7	371	(N/A)	18.0	10.02
Sugar maple	4.5	0.8	2.3	0.2	24	15.8	2.3	2.2	15.0	98	-3.5	-13	39.4	109	(N/A)	6.8	7.82
American basswood	1.7	0.3	0.9	0.1	9	9.3	1.4	1.3	8.8	58	-1.6	-6	22.1	61	(N/A)	4.9	6.13
Apple	0.1	0.0	0.0	0.0	0	1.0	0.1	0.1	0.9	6	0.0	0	2.2	6	(N/A)	3.4	0.89
Littleleaf linden	0.5	0.1	0.3	0.0	3	3.3	0.5	0.5	3.2	21	-0.3	-1	8.2	23	(N/A)	3.4	3.25
Black walnut	2.1	0.3	1.0	0.1	11	7.3	1.1	1.0	6.8	45	0.0	0	19.7	56	(N/A)	2.4	11.24
Birch	0.9	0.2	0.5	0.0	5	3.7	0.5	0.5	3.5	23	-0.2	-1	9.6	27	(N/A)	1.9	6.80
Northern hackberry	1.2	0.2	0.6	0.1	6	4.8	0.7	0.7	4.4	29	0.0	0	12.6	36	(N/A)	1.5	11.97
Honeylocust	2.4	0.4	1.1	0.1	13	4.9	0.7	0.7	4.7	31	-1.9	-7	13.2	36	(N/A)	1.5	12.12
Other street trees	4.0	0.7	1.8	0.2	21	7.5	1.1	1.0	7.2	47	0.0	0	23.4	68	(N/A)	2.4	13.57
Citywide total	114.8	19.4	55.9	5.1	617	267.8	39.0	37.2	254.1	1,668	-42.6	-160	750.6	2,126	(N/A)	100.0	10.32

Table 4: Annual Carbon Stored

Boyden

Stored CO2 Benefits of Public Trees by Species

3/21/2014

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	1,271,918	9,539	(N/A)	29.1	48.3	158.99
Norway maple	463,443	3,476	(N/A)	24.8	17.6	68.15
Green ash	471,591	3,537	(N/A)	18.0	17.9	95.59
Sugar maple	127,378	955	(N/A)	6.8	4.8	68.24
American	59,935	450	(N/A)	4.9	2.3	44.95
Apple	1,811	14	(N/A)	3.4	0.1	1.94
Littleleaf linden	12,021	90	(N/A)	3.4	0.5	12.88
Black walnut	67,089	503	(N/A)	2.4	2.6	100.63
Birch	15,412	116	(N/A)	1.9	0.6	28.90
Northern	16,331	122	(N/A)	1.5	0.6	40.83
Honeylocust	31,232	234	(N/A)	1.5	1.2	78.08
Other street trees	43,714	723	(N/A)	2.4	3.7	144.56
Citywide total	2,634,536	19,759	(N/A)	100.0	100.0	95.92

Table 5: Annual Carbon Sequestered

Boyden

Annual CO_2 Benefits of Public Trees by Species

3/21/2014

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	90,722	680	-6,105	-12	-46	34,775	261	119,380	895	(N/A)	29.1	50.5	14.92
Norway maple	17,107	128	-2,225	-10	-17	22,570	169	37,443	281	(N/A)	24.8	15.8	5.51
Green ash	23,365	175	-2,264	-7	-17	16,593	124	37,687	283	(N/A)	18.0	15.9	7.64
Sugar maple	7,175	54	-611	-3	-5	5,553	42	12,114	91	(N/A)	6.8	5.1	6.49
American basswood	4,265	32	-288	-2	-2	3,247	24	7,223	54	(N/A)	4.9	3.1	5.42
Apple	312	2	-9	-1	0	316	2	618	5	(N/A)	3.4	0.3	0.66
Littleleaf linden	1,862	14	-58	-1	0	1,195	9	2,998	22	(N/A)	3.4	1.3	3.21
Black walnut	3,796	28	-322	-1	-2	2,526	19	5,999	45	(N/A)	2.4	2.5	9.00
Birch	1,337	10	-74	-1	-1	1,295	10	2,557	19	(N/A)	1.9	1.1	4.79
Northern hackberry	1,208	9	-78	-1	-1	1,637	12	2,766	21	(N/A)	1.5	1.2	6.92
Honeylocust	936	7	-150	-1	-1	1,745	13	2,531	19	(N/A)	1.5	1.1	6.33
Other street trees	2,977	22	-463	-1	-3	2,651	20	5,164	39	(N/A)	2.4	2.2	7.75
Citywide total	155,062	1,163	-12,646	-40	-95	94,103	706	236,479	1,774	(N/A)	100.0	100.0	8.61

Table 6: Annual Social and Aesthetic Benefits

Boyden

Annual Aesthetic/Other Benefits of Public Trees by Species

3/21/2014

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	6,859	(N/A)	29.1	53.7	114.31
Norway maple	1,599	(N/A)	24.8	12.5	31.36
Green ash	1,925	(N/A)	18.0	15.1	52.03
Sugar maple	768	(N/A)	6.8	6.0	54.89
American basswood	351	(N/A)	4.9	2.8	35.11
Apple	17	(N/A)	3.4	0.1	2.39
Littleleaf linden	212	(N/A)	3.4	1.7	30.35
Black walnut	305	(N/A)	2.4	2.4	61.05
Birch	134	(N/A)	1.9	1.1	33.56
Northern hackberry	168	(N/A)	1.5	1.3	56.03
Honeylocust	195	(N/A)	1.5	1.5	64.87
Other street trees	248	(N/A)	2.4	1.9	49.63
Citywide total	12,782	(N/A)	100.0	100.0	62.05

Table 7: Summary of Benefits in Dollars

Average Annual Benefits of Public Trees by Species

Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	$4,252	$895	$801	$8,399	$6,859	$21,205.72	(±0)	45.44
Norway maple	$2,921	$281	$531	$3,595	$1,599	$8,926.92	(±0)	19.13
Green ash	$2,082	$283	$371	$3,080	$1,925	$7,740.30	(±0)	16.58
Sugar maple	$697	$91	$109	$950	$768	$2,616.35	(±0)	5.61
American basswood	$414	$54	$61	$419	$351	$1,299.79	(±0)	2.79
Apple	$46	$5	$6	$17	$17	$90.31	(±0)	0.19
Littleleaf linden	$141	$22	$23	$118	$212	$516.83	(±0)	1.11
Black walnut	$325	$45	$56	$466	$305	$1,197.62	(±0)	2.57
Birch	$161	$19	$27	$148	$134	$489.84	(±0)	1.05
Northern hackberry	$215	$21	$36	$230	$168	$669.79	(±0)	1.44
Honeylocust	$213	$19	$36	$333	$195	$795.93	(±0)	1.71
Other street trees	$323	$39	$68	$443	$248	$1,121.39	(±0)	2.40
Citywide total	$11,792	$1,774	$2,126	$18,198	$12,782	$46,670.80	(±0)	100.00

Table 8. Priority Task Summary for All Trees

Priority Task Summary for All Trees
206 Public and Private Trees
DBH Classes in inches (Diameter at Breast Height)

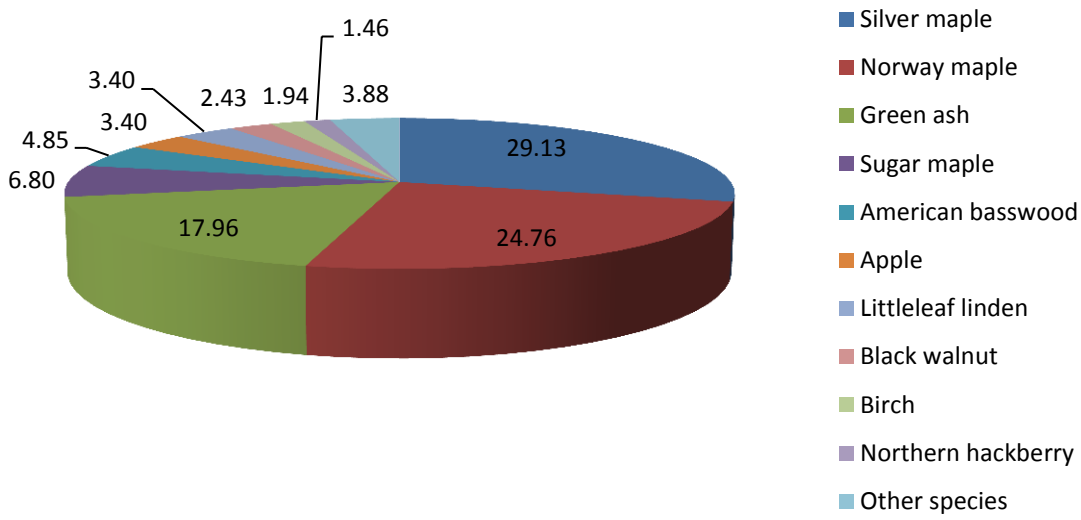
Maintenance Type	0 to 3 inches	3 to 6 inches	6 to 12 inches	12 to 18 inches	18 to 24 inches	24 to 30 inches	30 to 36 inches	36 to 42 inches	> 42 inches	Total	% of Total
none	4	10	16	22	31	22	10	5	3	123	59.71
Stake/Train	0	0	0	0	0	0	0	0	0	0	0
Clean crown	0	4	1	7	8	13	15	7	4	59	28.64
Raise crown	0	0	0	0	3	0	0	0	0	3	1.46
Reduce crown	0	0	0	1	0	4	2	2	1	10	4.85
Remove Tree	0	0	0	2	1	3	4	1	0	11	5.34
Treat problem	0	0	0	0	0	0	0	0	0	0	0
City wide total	4	14	17	32	43	42	31	15	8	206	100

Table 9. Recommended Maintenance for All Trees

Recommended Maintenance for All Trees
206 Public and Private Trees
DBH Classes in inches(Diameter at Breast Height)

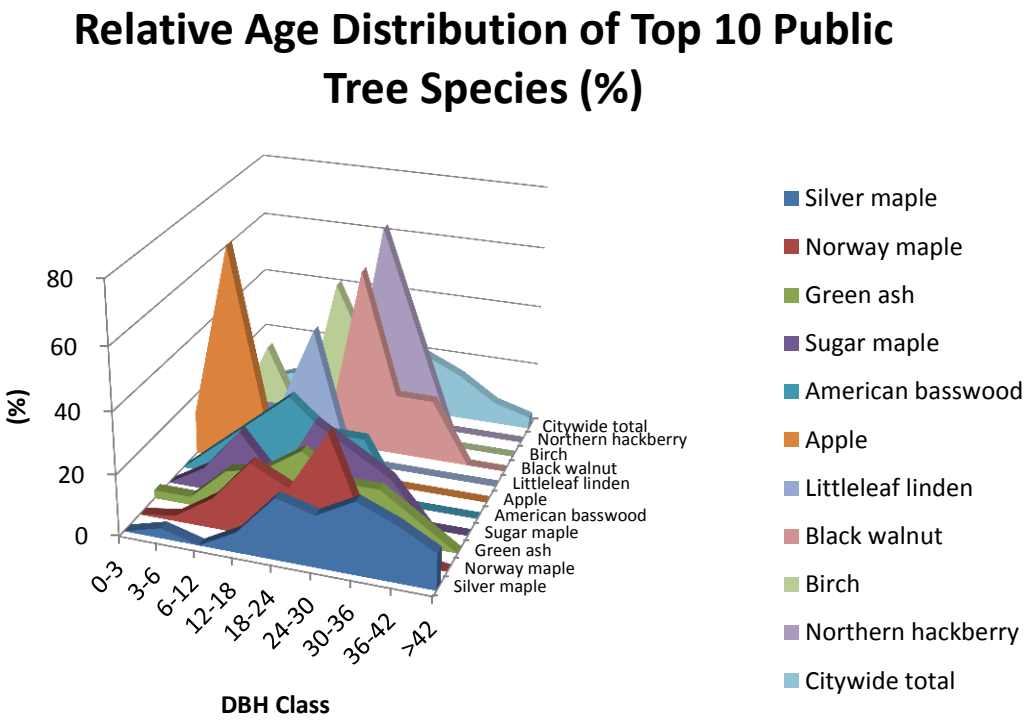
Maintenance Type	0 to 3 inches	3 to 6 inches	6 to 12 inches	12 to 18 inches	18 to 24 inches	24 to 30 inches	30 to 36 inches	36 to 42 inches	> 42 inches	Total	% of Total
Young tree (routine)	2	7	12	4	3	0	0	0	0	28	13.6
Young tree (immediate)	0	0	0	0	0	0	0	0	0	0	0
Mature tree (routine)	2	7	5	24	36	32	16	8	3	133	64.6
Mature tree (immediate)	0	0	0	4	4	9	14	6	5	42	20.4
Critical concern (public safety)	0	0	0	0	0	1	1	1	0	3	1.46
City wide total	4	14	17	32	43	42	31	15	8	206	100

Appendix A
Figure 1: Species Distribution



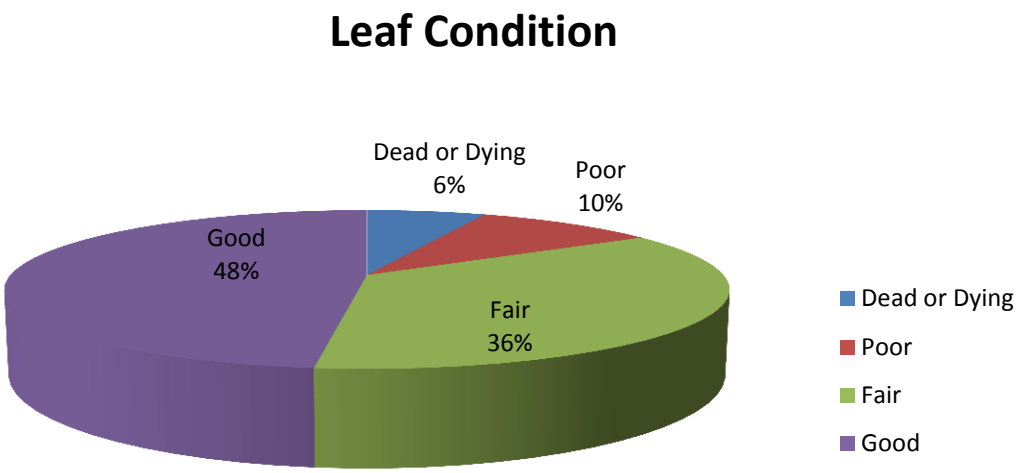
Species	Percent
Silver maple	29.13
Norway maple	24.76
Green ash	17.96
Sugar maple	6.80
American basswood	4.85
Apple	3.40
Littleleaf linden	3.40
Black walnut	2.43
Birch	1.94
Northern hackberry	1.46
Other species	3.88
Total	100.00

Figure 2: Relative Age Class



Relative Age Distribution of Top 10 Public Tree Species (%)									
3/21/2014									
	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Silver maple	0.00	3.33	0.00	6.67	20.00	16.67	23.33	18.33	11.67
Norway maple	0.00	1.96	9.80	23.53	17.65	37.25	7.84	1.96	0.00
Green ash	2.70	2.70	13.51	16.22	24.32	16.22	16.22	8.11	0.00
Sugar maple	0.00	7.14	21.43	7.14	28.57	21.43	14.29	0.00	0.00
American basswood	0.00	10.00	20.00	30.00	20.00	20.00	0.00	0.00	0.00
Apple	14.29	71.43	14.29	0.00	0.00	0.00	0.00	0.00	0.00
Littleleaf linden	28.57	14.29	14.29	42.86	0.00	0.00	0.00	0.00	0.00
Black walnut	0.00	0.00	0.00	0.00	60.00	20.00	20.00	0.00	0.00
Birch	0.00	25.00	0.00	50.00	25.00	0.00	0.00	0.00	0.00
Northern hackberry	0.00	0.00	0.00	0.00	66.67	33.33	0.00	0.00	0.00
Citywide total	1.94	6.80	8.25	15.53	20.87	20.39	15.05	7.28	3.88

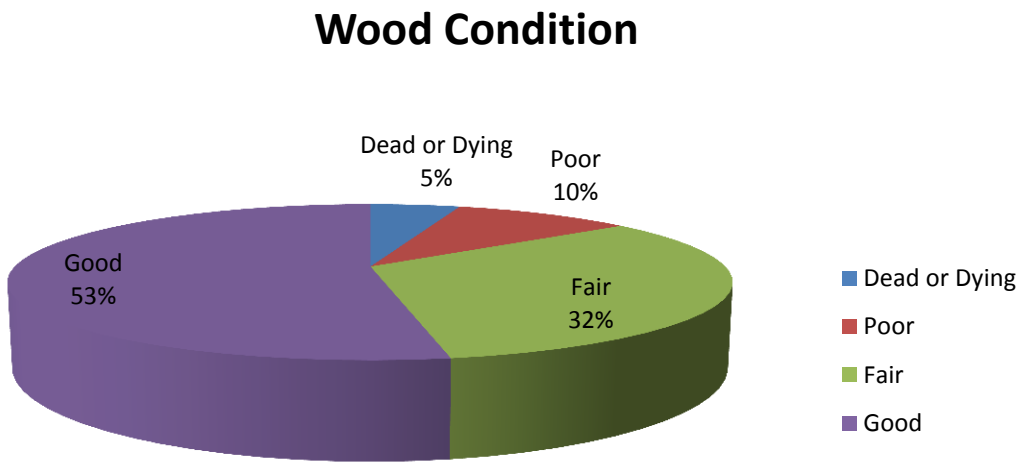
Figure 3: Foliage Condition



Condition (Foliage) of Public Trees by Species (%)
3/21/2014

Species Name	Dead or Dying	Poor	Fair	Good
Silver maple	6.67	15.00	40.00	38.33
Norway maple	1.96	5.88	37.25	54.90
Green ash	21.62	18.92	35.14	24.32
Sugar maple	0.00	0.00	21.43	78.57
American basswood	0.00	0.00	10.00	90.00
Apple	0.00	0.00	14.29	85.71
Littleleaf linden	0.00	0.00	14.29	85.71
Black walnut	0.00	0.00	80.00	20.00
Birch	0.00	0.00	75.00	25.00
Northern hackberry	0.00	0.00	33.33	66.67
Honeylocust	0.00	33.33	66.67	0.00
Citywide total	6.31	9.71	35.92	48.06

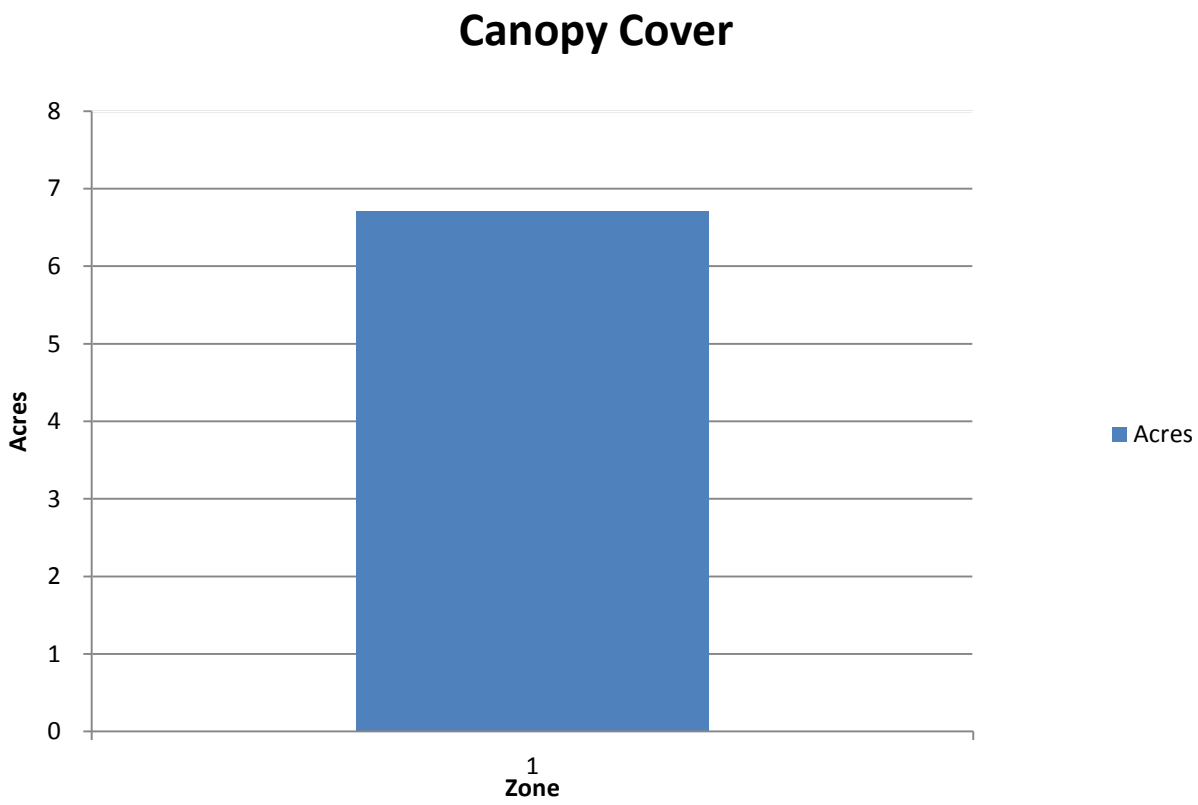
Figure 4: Wood Condition



Condition (Woody) of Public Trees by Species (%)
3/21/2014

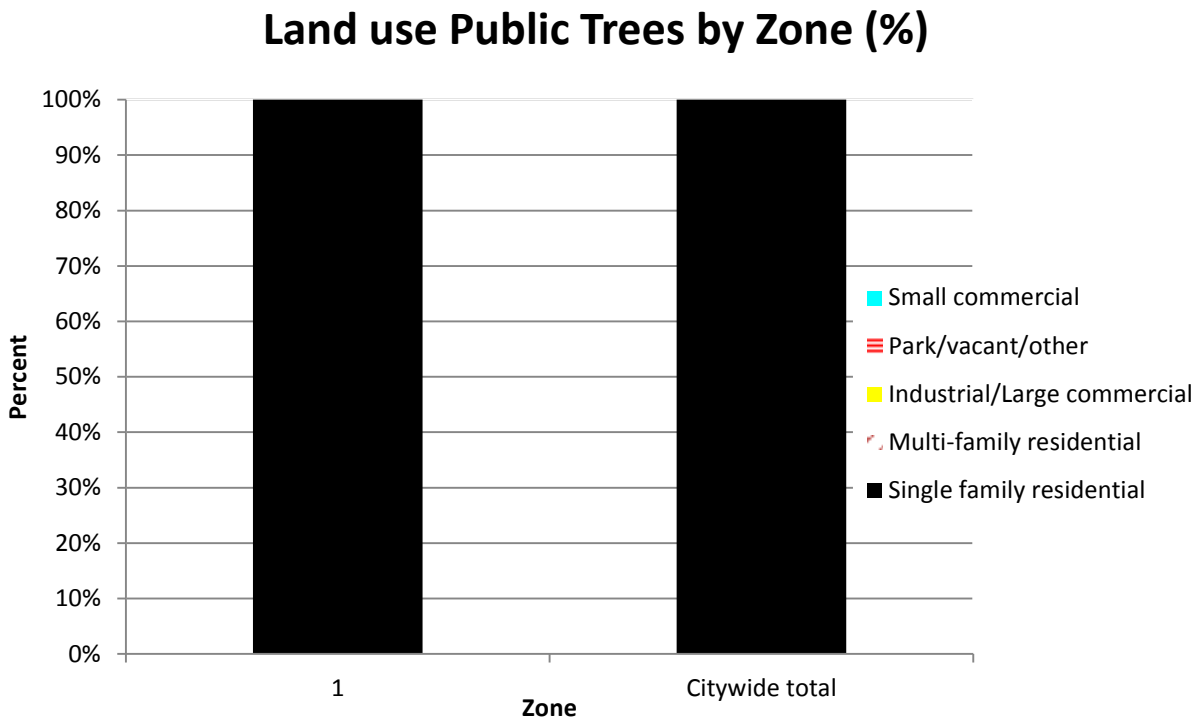
Species Name	Dead or Dying	Poor	Fair	Good
Silver maple	8.33	13.33	28.33	50.00
Norway maple	3.92	3.92	47.06	45.10
Green ash	5.41	18.92	21.62	54.05
Sugar maple	0.00	0.00	35.71	64.29
American basswood	0.00	10.00	10.00	80.00
Apple	0.00	0.00	42.86	57.14
Littleleaf linden	0.00	14.29	28.57	57.14
Black walnut	0.00	0.00	20.00	80.00
Birch	0.00	0.00	75.00	25.00
Northern hackberry	33.33	0.00	0.00	66.67
Honeylocust	0.00	0.00	33.33	66.67
Citywide total	4.85	9.71	32.52	52.91

Figure 5: Canopy Cover in Acres



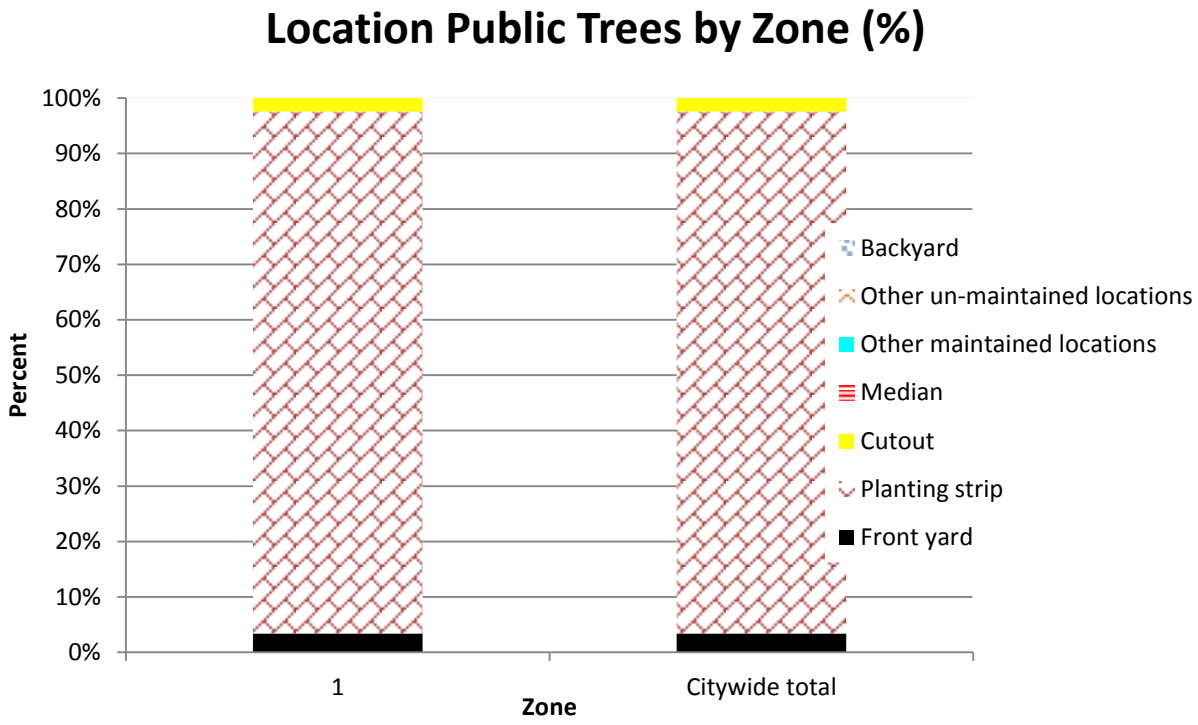
	Total Land Area	Total Canopy Cover	Canopy Cover as % of Total Land Area
Citywide total		6.71	1.4

Figure 6: Land Use of city/park trees



Zone	Single family residential	Multi-family residential	Industrial/Large commercial	Park/vacant/other	Small commercial
1	100.00	0.00	0.00	0.00	0.00
Citywide total	100.00	0.00	0.00	0.00	0.00

Figure 7: Location of city trees



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	3.40	94.17	2.43	0.00	0.00	0.00	0.00
Citywide total	3.40	94.17	2.43	0.00	0.00	0.00	0.00

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

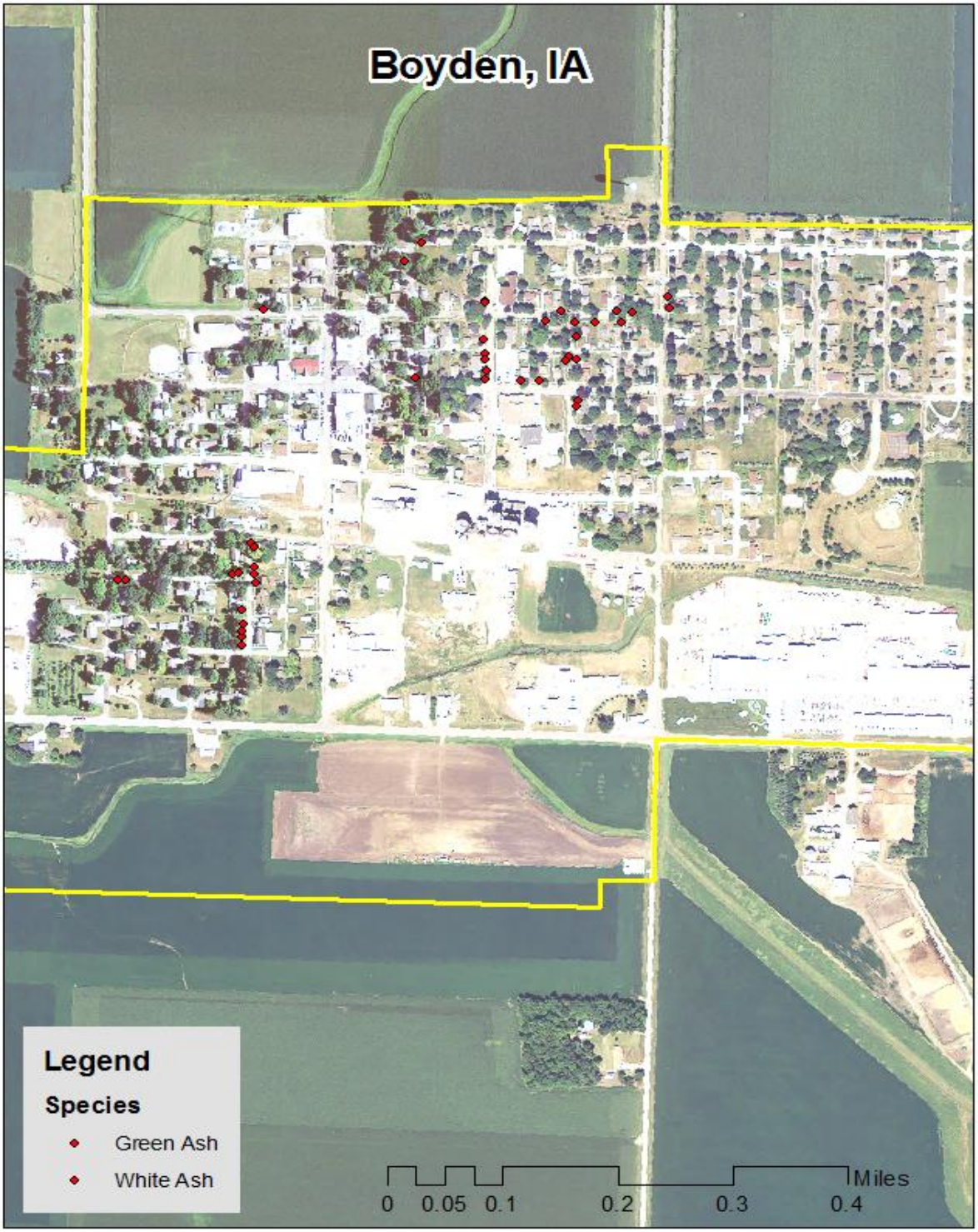


Figure 2: Location of EAB symptoms

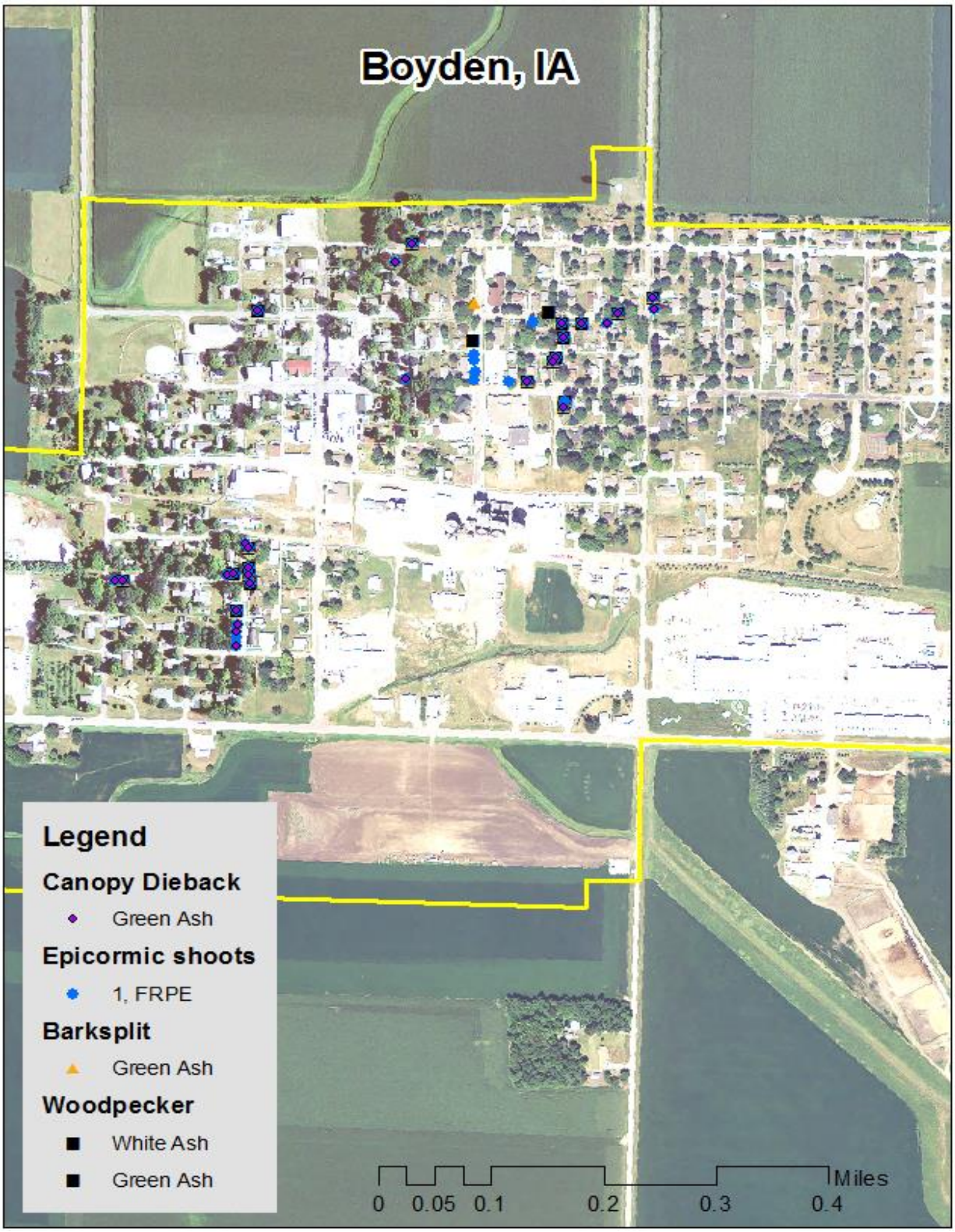


Figure 3: Location of Poor Condition Trees

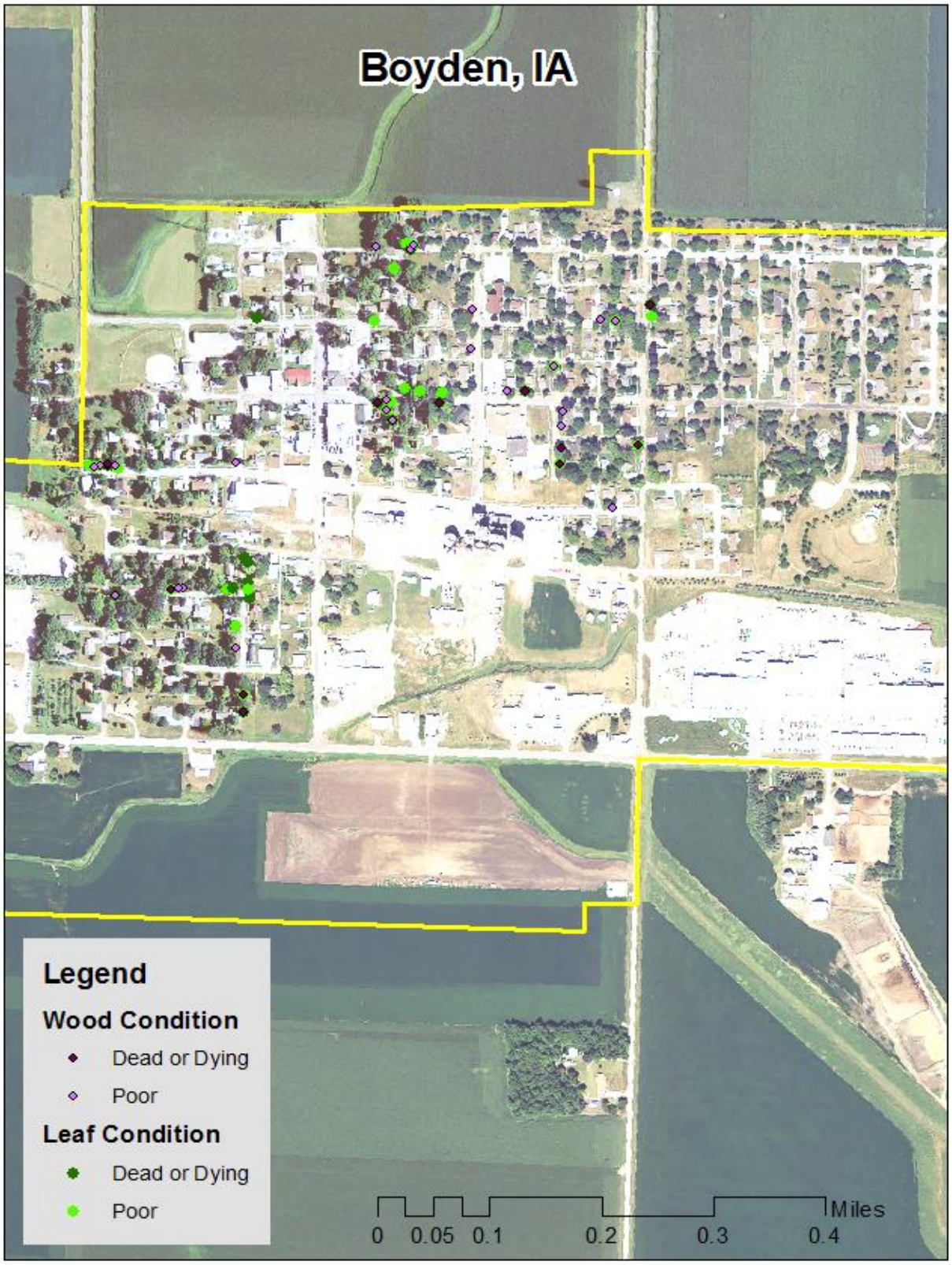


Figure 4: Location of Trees with Recommended Maintenance

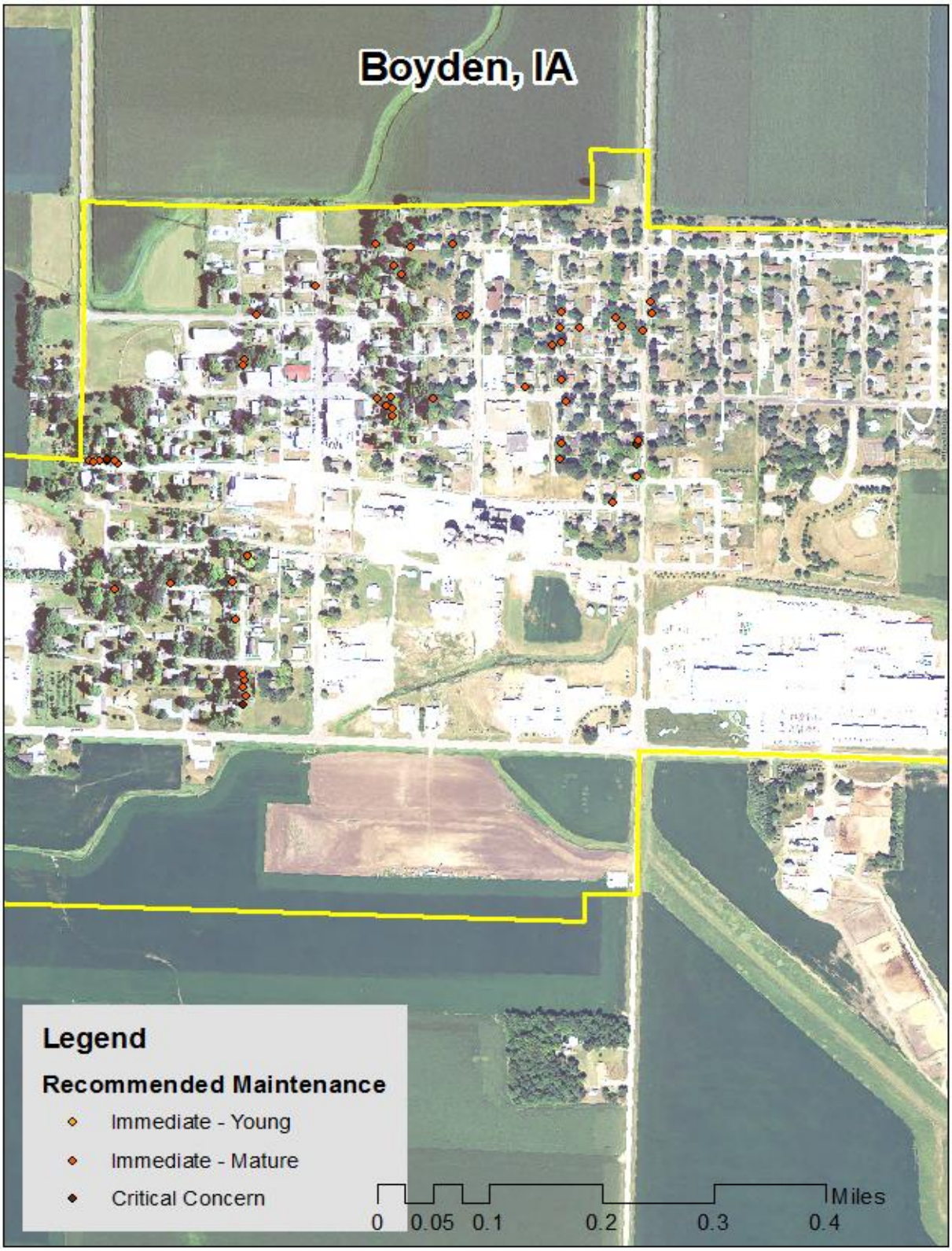
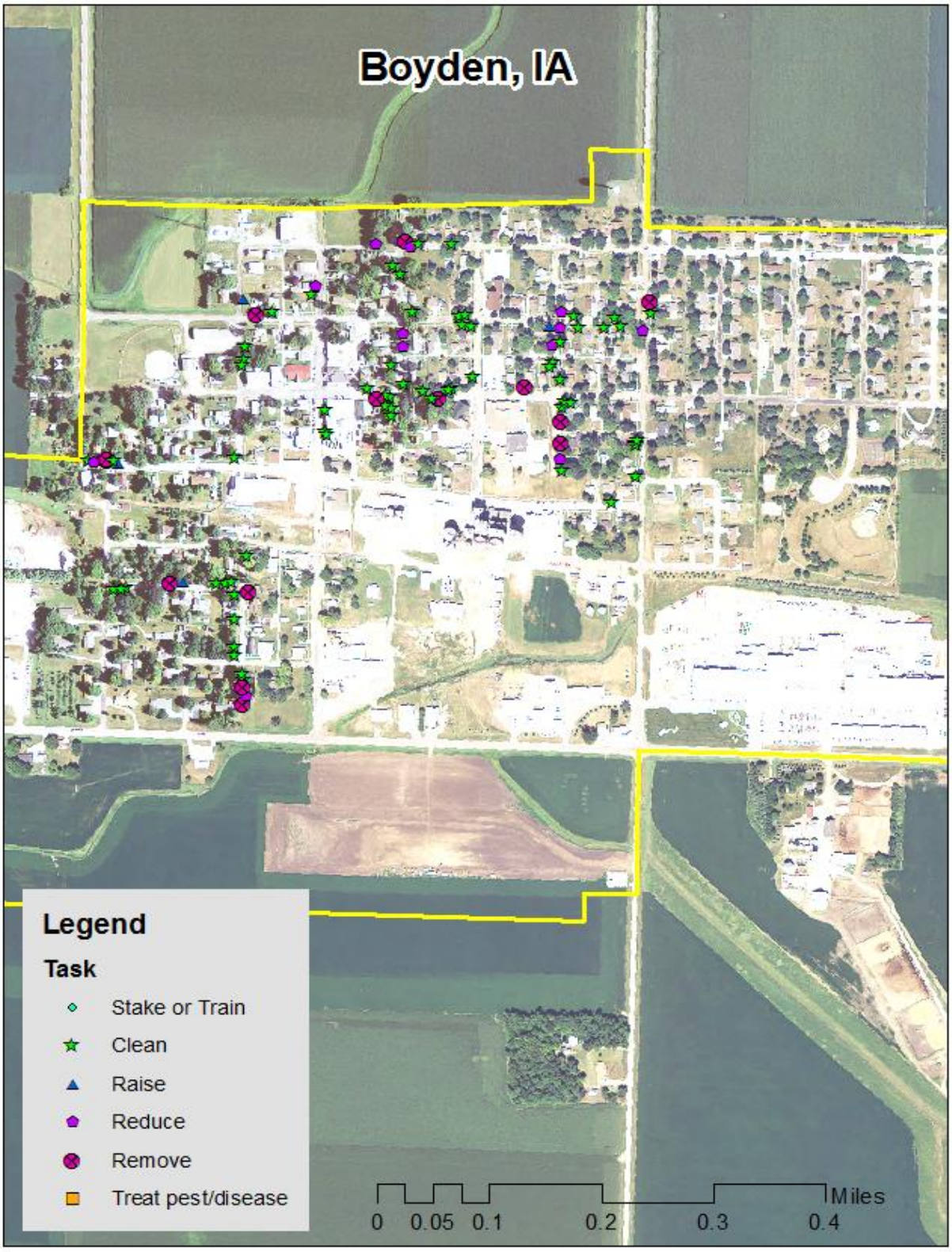


Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***



Appendix C: Boyden Tree Ordinances

Minor changes to your current city tree code are noted in blue below.

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. See page 13 for adding ash and maple to this restricted tree list.

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]). Wording and numbers in this section are additions or changes to your current code.

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])

The State of Iowa is an Equal Opportunity Employer and provider of ADA services.

Federal law prohibits employment discrimination on the basis of race, color, age, religion, national origin, sex or disability. State law prohibits employment discrimination on the basis of race, color, creed, age, sex, sexual orientation, gender identity, national origin, religion, pregnancy, or disability. State law also prohibits public accommodation (such as access to services or physical facilities) discrimination on the basis of race, color, creed, religion, sex, sexual orientation, gender identity, religion, national origin, or disability. If you believe you have been discriminated against in any program, activity or facility as described above, or if you desire further information, please contact the Iowa Civil Rights Commission, 1-800-457-4416, or write to the Iowa Department of Natural Resources, Wallace State Office Bldg., 502 E. 9th St., Des Moines, IA 50319.

If you need accommodations because of disability to access the services of this Agency, please contact Director Charles Gipp at 515-281-5918.