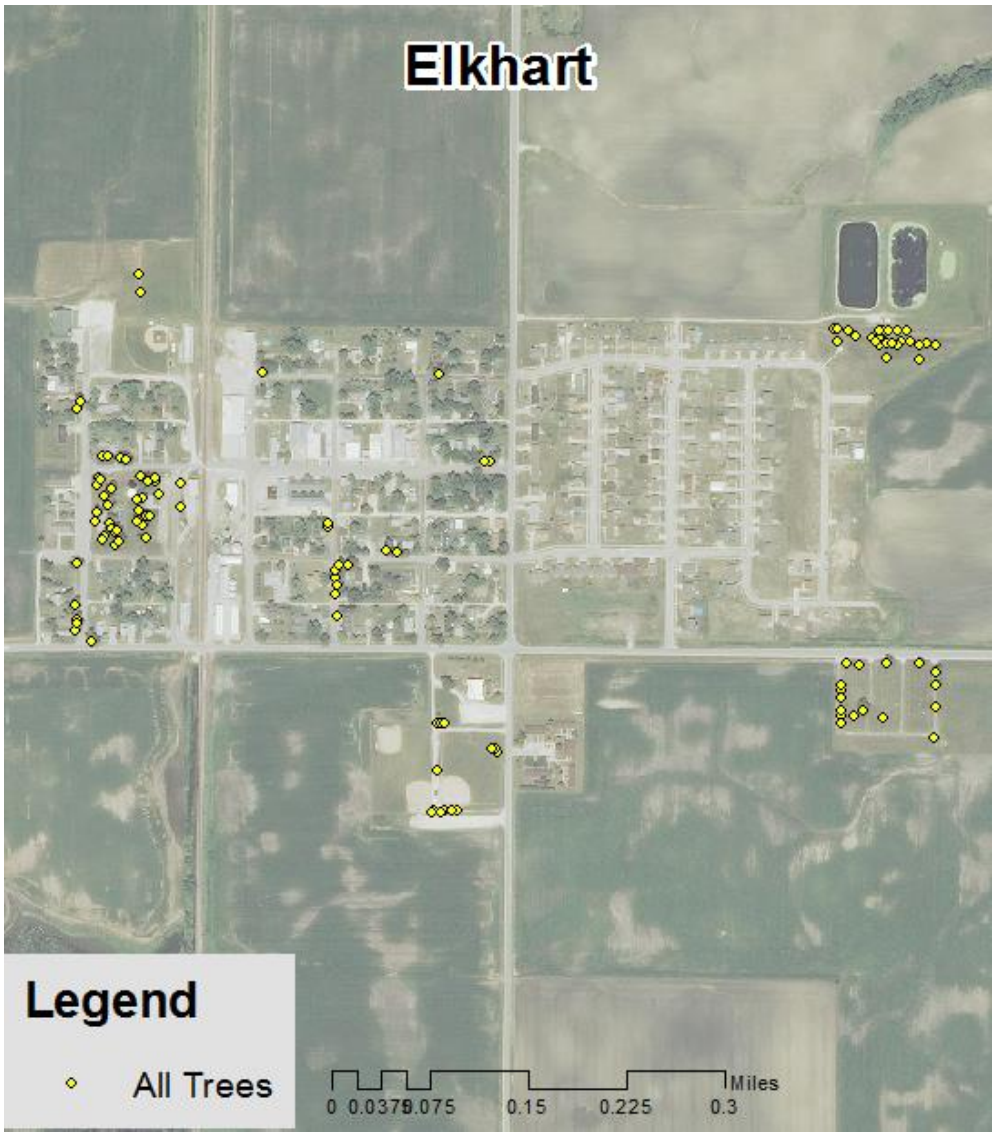
Elkhart, IA



2015 Urban Forest Management Plan
Prepared by Matt Brewer
Bureau of Forestry, Iowa DNR

Table of Contents

Executive Summary

Overview

This plan was developed to assist the City of Elkhart 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 15% of Elkhart's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2014, a tree inventory was conducted by Emma Hanigan, Iowa DNR, 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 115 trees inventoried.

- Elkhart's trees provide $18,129 of benefits annually, an average of $157 a tree
- There are over 15 species of trees
- The top three genera are: Maple 43%, Ash 15%, and Oak 15%
- 8% of trees are in need of some type of management
- 5 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 5 trees needing removal, 1 tree is over 24 inches in diameter at 4.5 ft and should be addressed *City ownership of the trees recommended for removal should be verified prior to any removal*
- 1 of the 17 ash trees should be carefully examined, as it has one or more symptoms that could be related to an EAB infestation
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With the current budget it could take 13 years to remove ash – Suggestion: request a budget increase to at least $1,400 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2014, a tree inventory was conducted by Emma Hanigan, Iowa DNR, 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 associated with EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

The data collected for the 115 city trees was entered into the USDA Forest Service program i-Tree Streets, part of the i-Tree suite. The following are results from the i-Tree Streets analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Elkhart's trees reduce energy related costs by approximately $4,473 annually (Appendix A, Table 1). These savings are both in Electricity (21.7 MWh) and in Natural Gas (2,887.3 Therms).

Annual Stormwater Benefits

Elkhart's trees intercept about 248,265 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $6,728 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 Elkhart, it is estimated that trees remove 276.5 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 $777 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Elkhart, trees sequester about 61,589 lbs of carbon a year with an associated value of $462 (Appendix A, Table 4). In addition, the trees store 890,279 lbs of carbon, with a yearly benefit of $6,677 (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. Elkhart receives $5,451 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree Streets analysis, Elkhart's trees provide $18,129 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 115 trees in Elkhart provide approximately $157 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

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

Maple	49	43%
Ash	17	15%
Oak	17	15%
Apple/Crabapple	12	10%
Spruce	8	7%
Pine	6	5%
Hackberry	3	3%
Linden/Basswood	2	2%
Willow	1	1%

Age Class

Most of Elkhart's trees (63%) are between 0 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2), with another 27% between 24 and 36 inches in diameter. For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Elkhart's size curve includes a significant amount of trees that are on the smaller side, and also a good number of trees that are fairly large.

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 Elkhart indicate that 83% of the trees are in good health, with only 4% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Additionally, 21% of Elkhart'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 12% of the population. This 12% 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).

Tree Removal	5	4%
Crown Cleaning	3	3%
Crown Reduction	1	1%

Canopy Cover

The total canopy with both private and public trees is 5%, 46 acres. The canopy cover included in the Elkhart inventory includes approximately 3 acres (Appendix A, Figure 4).

Land Use and Location

The majority of Elkhart's city and park trees are in front yards (no sidewalk) in Park/vacant/other settings (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use	
Park/vacant/other	75%
Single family residential	23%
Industrial/Large commercial	2%

Location	
Front yard	90%
Planting strip	10%

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

Elkhart has 5 trees that are recommended for removal and 4 trees that are in need of trimming. 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 trees first. After the removals are completed, the trimming can be done. Please refer to the six year maintenance plan at the end of this section.

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 5 removals, none are ash trees. There are a total of 17 ash trees, and 1 of those has signs and symptoms that have been associated with EAB. In addition, there are 2 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

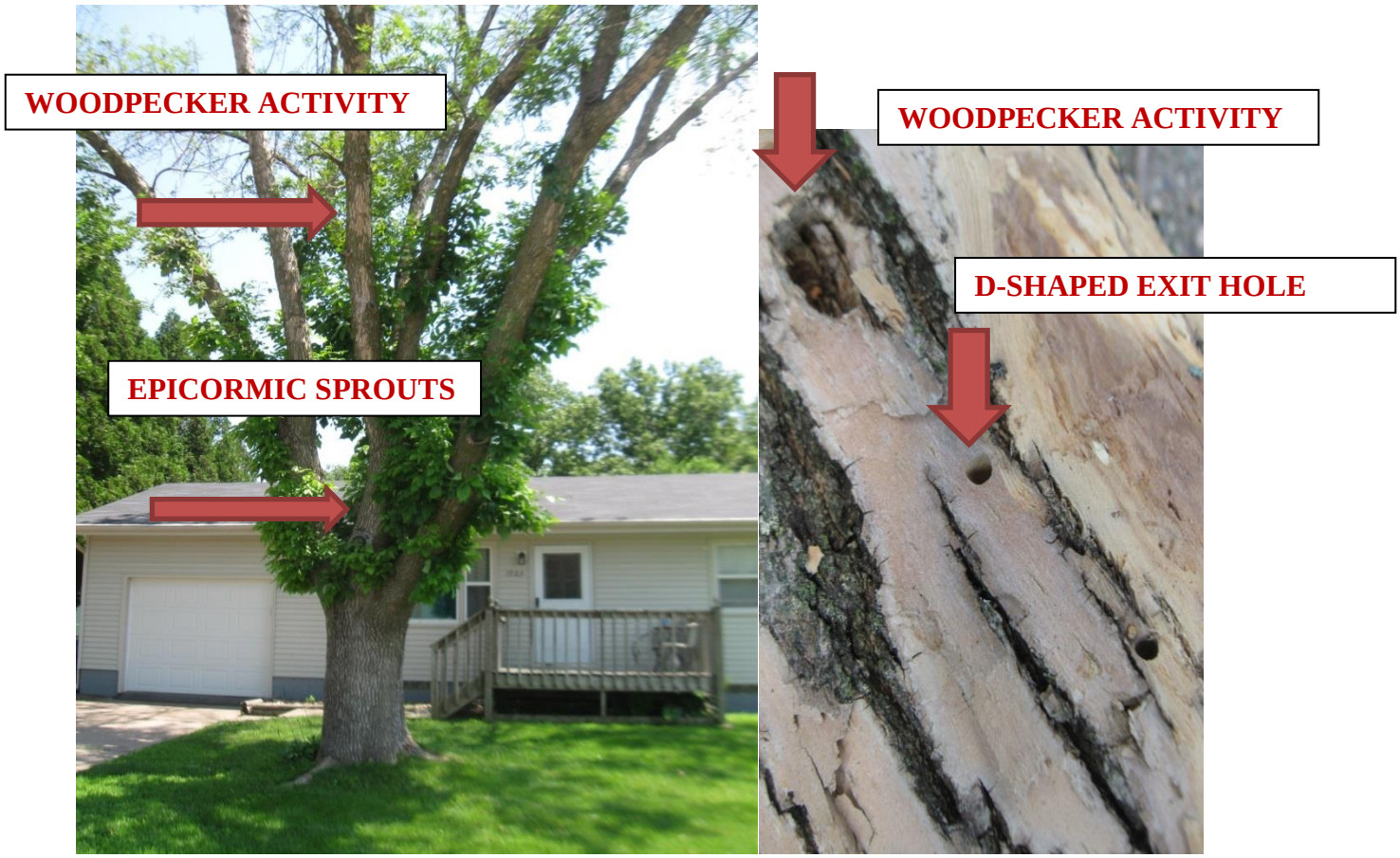
Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant at least 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees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

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 (43%) (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: any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut, as outlined in section 150.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 150.02 (Appendix C).

Continual Monitoring For EAB

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended that ash trees be checked with a visual survey every year for tree decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage (See examples below). Once EAB arrives in Elkhart, it could potentially kill all ash within 4 to 10 years of its arrival.

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



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

Six Year Maintenance Plan

Year 1

Removal: 5 trees marked for removal (if budget allows), otherwise as needed
Planting and Replacement: 6 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 2 ash trees with poor health, otherwise as needed
*Or saving for EAB, ash tree treatment
Planting and Replacement: 13 trees in open locations (can include replacements 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: Removal of any new critical concern trees and ash in poor health
*Or saving for EAB, ash tree treatment
Planting and Replacement: 13 trees to be planted in open locations and locations from previous removals
Visual Survey for signs and symptoms of EAB

Year 4

Removal: Removal of any new critical concern trees and ash in poor health
*Or saving for EAB, ash tree treatment
Planting and Replacement: 13 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: Removal of any new critical concern trees and ash in poor health
*Or saving for EAB, ash tree treatment
Planting and Replacement: 13 trees to be planted in open locations and locations from previous removals
Visual Survey for signs and symptoms of EAB

Year 6

Removal: Removal of any new critical concern trees and ash in poor health
*Or saving for EAB, ash tree treatment
Planting and Replacement: 13 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 in poor health will reduce exposure to Emerald Ash Borer over time. EAB could potentially kill all ash within 4 years of its arrival.
**Assuming a cost of $900 per tree for removal, the budget would need to be increased to $2,550 a year to remove all ash trees within 6 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*

Treatment of Ash Trees

Chemical treatment can be an effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit http://extension.entm.purdue.edu/treecomputer/

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:
- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

In addition, any other article, product or means of conveyance not listed above may be designated as a regulated article if a USDA inspector determines that it presents a risk of spreading EAB once a quarantine is in effect.

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 state of Iowa is under quarantine, so regulated articles may not be moved into non-quarantined states. For more information, please visit http://www.emeraldashborer.info/.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance 150.02 (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, any fruit-bearing tree or any tree of the kinds commonly known as 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 genera other than ash will be prioritized by hazardous or emergency situations only.

Monitoring

It is recommended that ash trees be checked with a visual survey every year for tree death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB. City Code 150.06 states "If it is determined with reasonable certainty that any such condition exists on private property and that 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 - Suggested budget based on a minimum of $2 per capita (population 683), which would cover about half of what would be needed to remove EAB infested trees over a six year period. Suggest setting aside additional funds to prepare for the expected arrival of EAB. Planting would be dependent on receiving grant funds annually.

Total $11,100 over 6 years ($1,400/year after first two years)

FY 2016 Budget
Removal: (3 trees) $2,700
*Or saving for EAB, ash tree treatment
Planting: $450
Watering & Maintenance: $50

FY 2017 Budget
Removal: (2 trees) $1,800
*Or saving for EAB, ash tree treatment
Planting: $450
Watering & Maintenance: $50

FY 2018 Budget
Removal: $1,200
*Or saving for EAB, ash tree treatment (for instance, 4 trees, if desired)
Planting: $150
Watering & Maintenance: $50

FY 2019 Budget
Removal: $1,200
*Or saving for EAB, ash tree treatment
Planting: $150
Watering & Maintenance: $50

FY 2020 Budget
Removal: $1,200
*Or saving for EAB, ash tree treatment
Planting: $150
Watering & Maintenance: $50

FY 2021 Budget
Removal: $1,200
*Or saving for EAB, ash tree treatment
Planting: $150
Watering & Maintenance: $50

*Reduction of ash over 6 years: approximately 8 ash trees removed. **It will take approximately 13 years to remove all ash with the current proposed budget.**

Proposed Budget Increase

EAB could potentially kill all ash trees in Elkhart within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $2,550 a year. If the budget were increased to $1,400 a year all ash could be removed within 13 years. Additionally, it is recommended that Elkhart 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.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For instance, in this treatment scenario, the average ash diameter is 20 inches and at $15 per inch, about 4 trees could be treated per year (every other year treatment). This would be 8 trees selected for treatment, and Elkhart would still need to find $8,000 for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $2,250 a year for treatment and leave $1,800 for removal. These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Elkhart. It is suggested to consider increasing the budget to plan for this.

Works Cited

Census Bureau. 2010. http://censtats.census.gov/data/IA/1601964290.pdf (April, 2013)

USDA Forest Service, et al. 2006. i-Tree Software Suite v1.0 User's Manual. Pp. 27-40.

McPherson EG, Simpson JR, Peper PJ, Gardner SL, Vargas KE, Ho J, Maco S, Xiao Q. 2005b. City of Charleston, South Carolina, municipal forest resource analysis. Internal Tech Rep. Davis, CA: U.S. Department of Agriculture, Center for Urban Forest Research. p. 57

Nowak, D.J. and J.F. Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

Peper, Paula J.; McPherson, E. Gregory; Simpson, James R.; Vargas, Kelaine E.; Xiao, Qingfu 2009. Lower Midwest community tree guide: benefits, costs, and strategic planting. Gen. Tech. Rep. PSW-GTR-219. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. p.115

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees

2/5/2015

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	9.7	733	1,248.3	1,223	1,956	(N/A)	24.3	43.7	69.87
Green ash	4.9	371	652.5	639	1,010	(N/A)	14.8	22.6	59.43
Bur oak	0.0	3	7.5	7	10	(N/A)	13.9	0.2	0.66
Apple	1.1	87	165.9	163	249	(N/A)	10.4	5.6	20.77
Maple	0.6	46	90.7	89	135	(N/A)	8.7	3.0	13.48
Sugar maple	2.1	157	267.5	262	420	(N/A)	6.1	9.4	59.94
Spruce	0.2	15	27.5	27	42	(N/A)	6.1	0.9	6.05
Norway maple	0.4	34	64.0	63	97	(N/A)	3.5	2.2	24.21
Northern hackberry	0.9	69	135.0	132	201	(N/A)	2.6	4.5	67.04
Scotch pine	0.4	29	43.9	43	72	(N/A)	2.6	1.6	24.14
Eastern white pine	0.2	18	33.6	33	51	(N/A)	2.6	1.1	17.10
American basswood	0.6	43	77.5	76	119	(N/A)	1.7	2.7	59.55
Willow	0.3	24	47.4	46	71	(N/A)	0.9	1.6	70.84
Blue spruce	0.1	5	10.2	10	15	(N/A)	0.9	0.3	14.80
Pin oak	0.1	8	15.8	15	24	(N/A)	0.9	0.5	23.64
Total	21.7	1,644	2,887.3	2,830	4,473	(N/A)	100.0	100.0	38.90

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

2/5/2015

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	134,570	3,647	(N/A)	24.3	54.2	130.24
Green ash	52,517	1,423	(N/A)	14.8	21.2	83.72
Bur oak	286	8	(N/A)	13.9	0.1	0.48
Apple	4,517	122	(N/A)	10.4	1.8	10.20
Maple	3,310	90	(N/A)	8.7	1.3	8.97
Sugar maple	22,558	611	(N/A)	6.1	9.1	87.33
Spruce	2,378	64	(N/A)	6.1	1.0	9.21
Norway maple	2,593	70	(N/A)	3.5	1.0	17.57
Northern hackberry	7,295	198	(N/A)	2.6	2.9	65.89
Scotch pine	4,616	125	(N/A)	2.6	1.9	41.70
Eastern white pine	2,730	74	(N/A)	2.6	1.1	24.66
American basswood	5,798	157	(N/A)	1.7	2.3	78.56
Willow	3,764	102	(N/A)	0.9	1.5	102.01
Blue spruce	755	20	(N/A)	0.9	0.3	20.47
Pin oak	579	16	(N/A)	0.9	0.2	15.69
Citywide total	248,265	6,728	(N/A)	100.0	100.0	58.50

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

2/5/2015

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2								
Silver maple	22.8	3.9	11.2	1.0	123	45.3	6.6	6.4	43.7	284	-11.7	-44	129.2	363	(N/A)	24.3	12.98
Green ash	6.4	1.0	3.1	0.3	34	23.2	3.4	3.2	22.1	145	0.0	0	62.8	179	(N/A)	14.8	10.53
Bur oak	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1	(N/A)	13.9	0.08
Apple	1.3	0.2	0.6	0.1	7	5.5	0.8	0.8	5.2	34	0.0	0	14.5	41	(N/A)	10.4	3.45
Maple	0.4	0.1	0.2	0.0	2	3.0	0.4	0.4	2.7	18	-0.2	-1	7.1	20	(N/A)	8.7	1.98
Sugar maple	3.0	0.5	1.5	0.1	16	9.7	1.4	1.4	9.4	61	-2.4	-9	24.7	69	(N/A)	6.1	9.80
Spruce	0.2	0.0	0.2	0.0	2	1.0	0.1	0.1	0.9	6	-0.8	-3	1.9	5	(N/A)	6.1	0.65
Norway maple	0.3	0.1	0.2	0.0	2	2.2	0.3	0.3	2.0	13	-0.1	0	5.3	15	(N/A)	3.5	3.75
Northern hackberry	0.9	0.2	0.5	0.0	5	4.4	0.6	0.6	4.1	27	0.0	0	11.4	33	(N/A)	2.6	10.85
Scotch pine	0.5	0.1	0.4	0.1	3	1.8	0.3	0.3	1.8	11	-1.6	-6	3.5	8	(N/A)	2.6	2.82
Eastern white pine	0.3	0.1	0.3	0.0	2	1.2	0.2	0.2	1.1	7	-0.9	-3	2.3	6	(N/A)	2.6	1.92
American basswood	0.8	0.1	0.4	0.0	4	2.7	0.4	0.4	2.6	17	-0.7	-2	6.7	19	(N/A)	1.7	9.32
Willow	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14	(N/A)	0.9	13.58
Blue spruce	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2	(N/A)	0.9	1.53
Pin oak	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	-0.1	0	1.1	3	(N/A)	0.9	3.05
Citywide total	38.0	6.4	19.2	1.8	207	102.6	15.0	14.3	98.1	641	-18.8	-71	276.5	777	(N/A)	100.0	6.75

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

2/5/2015

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	497,166	3,729	(N/A)	24.3	55.8	133.17
Green ash	209,990	1,575	(N/A)	14.8	23.6	92.64
Bur oak	195	1	(N/A)	13.9	0.0	0.09
Apple	20,866	156	(N/A)	10.4	2.3	13.04
Maple	5,789	43	(N/A)	8.7	0.7	4.34
Sugar maple	87,235	654	(N/A)	6.1	9.8	93.47
Spruce	1,439	11	(N/A)	6.1	0.2	1.54
Norway maple	5,842	44	(N/A)	3.5	0.7	10.95
Northern hackberry	12,426	93	(N/A)	2.6	1.4	31.07
Scotch pine	3,511	26	(N/A)	2.6	0.4	8.78
Eastern white pine	1,684	13	(N/A)	2.6	0.2	4.21
American basswood	28,547	214	(N/A)	1.7	3.2	107.05
Willow	14,280	107	(N/A)	0.9	1.6	107.10
Blue spruce	284	2	(N/A)	0.9	0.0	2.13
Pin oak	1,025	8	(N/A)	0.9	0.1	7.68
Citywide total	890,279	6,677	(N/A)	100.0	100.0	58.06

Table 5: Annual Carbon Sequestered

Annual CO Benefits of Public Trees

2/5/2015

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	38,096	286	-2,386	-103	-19	16,197	121	51,803	389 (N/A)	24.3	55.5	13.88
Green ash	11,316	85	-1,008	-50	-8	8,194	61	18,453	138 (N/A)	14.8	19.8	8.14
Bur oak	41	0	-2	-3	0	70	1	107	1 (N/A)	13.9	0.1	0.05
Apple	1,891	14	-100	-15	-1	1,916	14	3,691	28 (N/A)	10.4	4.0	2.31
Maple	876	7	-28	-7	0	1,015	8	1,856	14 (N/A)	8.7	2.0	1.39
Sugar maple	4,461	33	-419	-21	-3	3,480	26	7,501	56 (N/A)	6.1	8.0	8.04
Spruce	186	1	-7	-4	0	341	3	516	4 (N/A)	6.1	0.6	0.55
Norway maple	839	6	-28	-4	0	754	6	1,561	12 (N/A)	3.5	1.7	2.93
Northern hackberry	1,063	8	-60	-8	-1	1,520	11	2,515	19 (N/A)	2.6	2.7	6.29
Scotch pine	347	3	-17	-6	0	649	5	973	7 (N/A)	2.6	1.0	2.43
Eastern white pine	221	2	-8	-4	0	405	3	614	5 (N/A)	2.6	0.7	1.53
American basswood	1,681	13	-137	-6	-1	955	7	2,492	19 (N/A)	1.7	2.7	9.35
Willow	370	3	-69	-4	-1	539	4	837	6 (N/A)	0.9	0.9	6.27
Blue spruce	39	0	-1	-1	0	106	1	142	1 (N/A)	0.9	0.2	1.07
Pin oak	163	1	-5	-1	0	180	1	337	3 (N/A)	0.9	0.4	2.53
Citywide total	61,589	462	-4,274	-238	-34	36,323	272	93,399	700 (N/A)	100.0	100.0	6.09

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

2/5/2015

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	3,008	(N/A)	24.3	55.2	107.42
Green ash	939	(N/A)	14.8	17.2	55.21
Bur oak	84	(N/A)	13.9	1.5	5.26
Apple	109	(N/A)	10.4	2.0	9.12
Maple	157	(N/A)	8.7	2.9	15.66
Sugar maple	468	(N/A)	6.1	8.6	66.90
Spruce	77	(N/A)	6.1	1.4	10.93
Norway maple	94	(N/A)	3.5	1.7	23.58
Northern hackberry	157	(N/A)	2.6	2.9	52.26
Scotch pine	97	(N/A)	2.6	1.8	32.32
Eastern white pine	63	(N/A)	2.6	1.2	21.05
American basswood	123	(N/A)	1.7	2.3	61.41
Willow	31	(N/A)	0.9	0.6	31.46
Blue spruce	21	(N/A)	0.9	0.4	21.08
Pin oak	23	(N/A)	0.9	0.4	23.14
Citywide total	5,451	(N/A)	100.0	100.0	47.40

Table 7: Summary of Benefits in Dollars

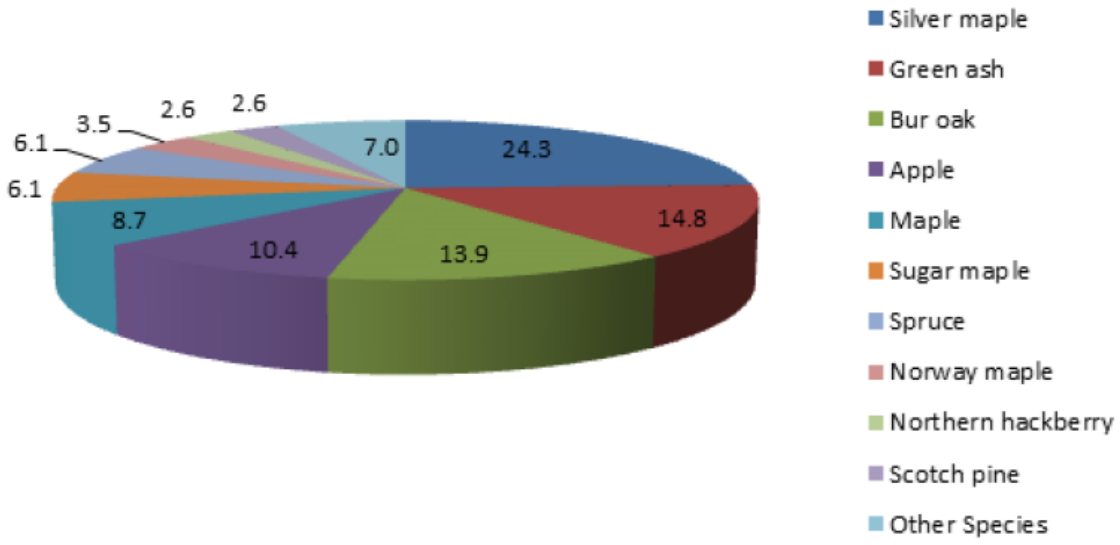
Total Annual Benefits of Public Trees by Species ($)

2/5/2015

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	1,956	389	363	3,647	3,008	9,363	(N/A)	51.6
Green ash	1,010	138	179	1,423	939	3,689	(N/A)	20.4
Bur oak	10	1	1	8	84	105	(N/A)	0.6
Apple	249	28	41	122	109	550	(N/A)	3.0
Maple	135	14	20	90	157	415	(N/A)	2.3
Sugar maple	420	56	69	611	468	1,624	(N/A)	9.0
Spruce	42	4	5	64	77	192	(N/A)	1.1
Norway maple	97	12	15	70	94	288	(N/A)	1.6
Northern hackberry	201	19	33	198	157	607	(N/A)	3.3
Scotch pine	72	7	8	125	97	310	(N/A)	1.7
Eastern white pine	51	5	6	74	63	199	(N/A)	1.1
American basswood	119	19	19	157	123	436	(N/A)	2.4
Willow	71	6	14	102	31	224	(N/A)	1.2
Blue spruce	15	1	2	20	21	59	(N/A)	0.3
Pin oak	24	3	3	16	23	68	(N/A)	0.4
Citywide Total	4,473	700	777	6,728	5,451	18,129	(N/A)	100.0

Species Distribution of Public Trees

2/5/2015

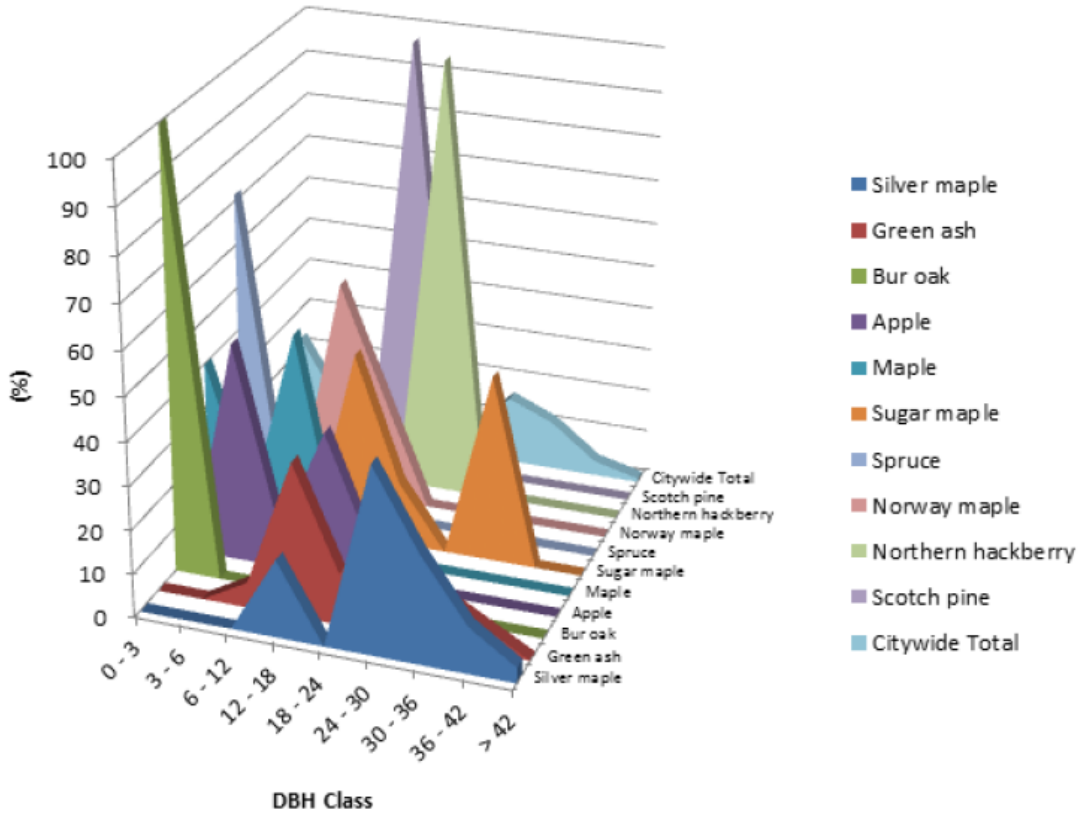


Species	Percent
Silver maple	24.3
Green ash	14.8
Bur oak	13.9
Apple	10.4
Maple	8.7
Sugar maple	6.1
Spruce	6.1
Norway maple	3.5
Northern hackberry	2.6
Scotch pine	2.6
Other Species	7.0
Total	100.0

Figure 1: Species Distribution

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

2/5/2015



	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	0.00	0.00	17.86	0.00	42.86	25.00	10.71	3.57
Green ash	0.00	0.00	5.88	35.29	11.76	29.41	11.76	5.88	0.00
Bur oak	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apple	0.00	50.00	8.33	33.33	8.33	0.00	0.00	0.00	0.00
Maple	40.00	10.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00
Sugar maple	0.00	0.00	0.00	42.86	14.29	0.00	42.86	0.00	0.00
Spruce	71.43	0.00	14.29	14.29	0.00	0.00	0.00	0.00	0.00
Norway maple	25.00	0.00	50.00	25.00	0.00	0.00	0.00	0.00	0.00
Northern hackberry	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Scotch pine	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
Citywide Total	22.61	6.09	12.17	21.74	6.09	15.65	11.30	3.48	0.87

Figure 2: Relative Age Class

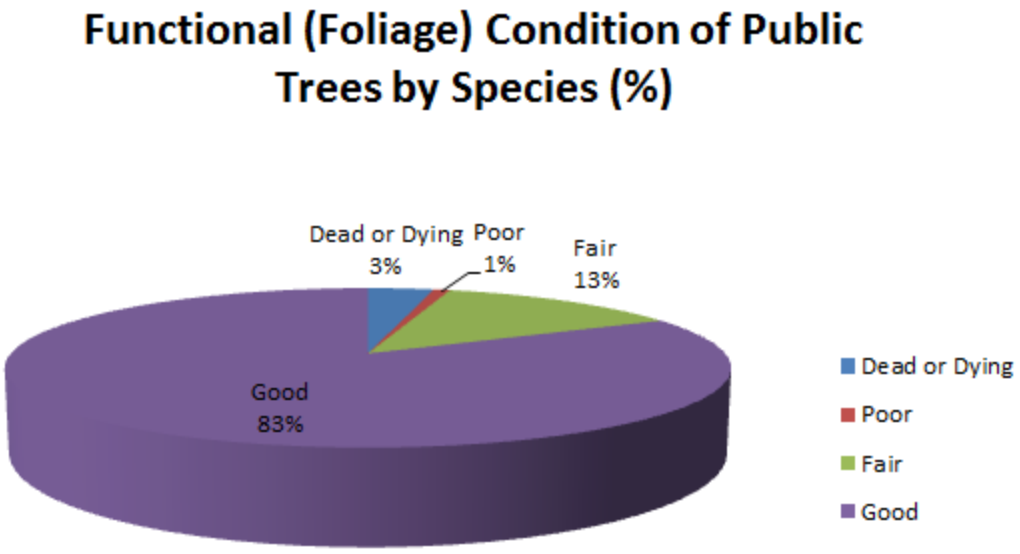


Figure 3: Foliage Condition

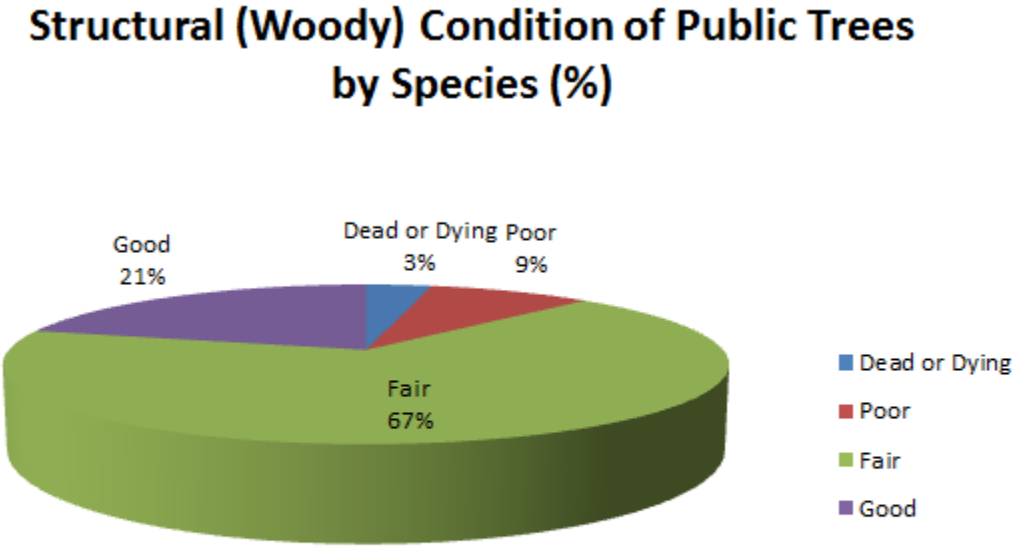
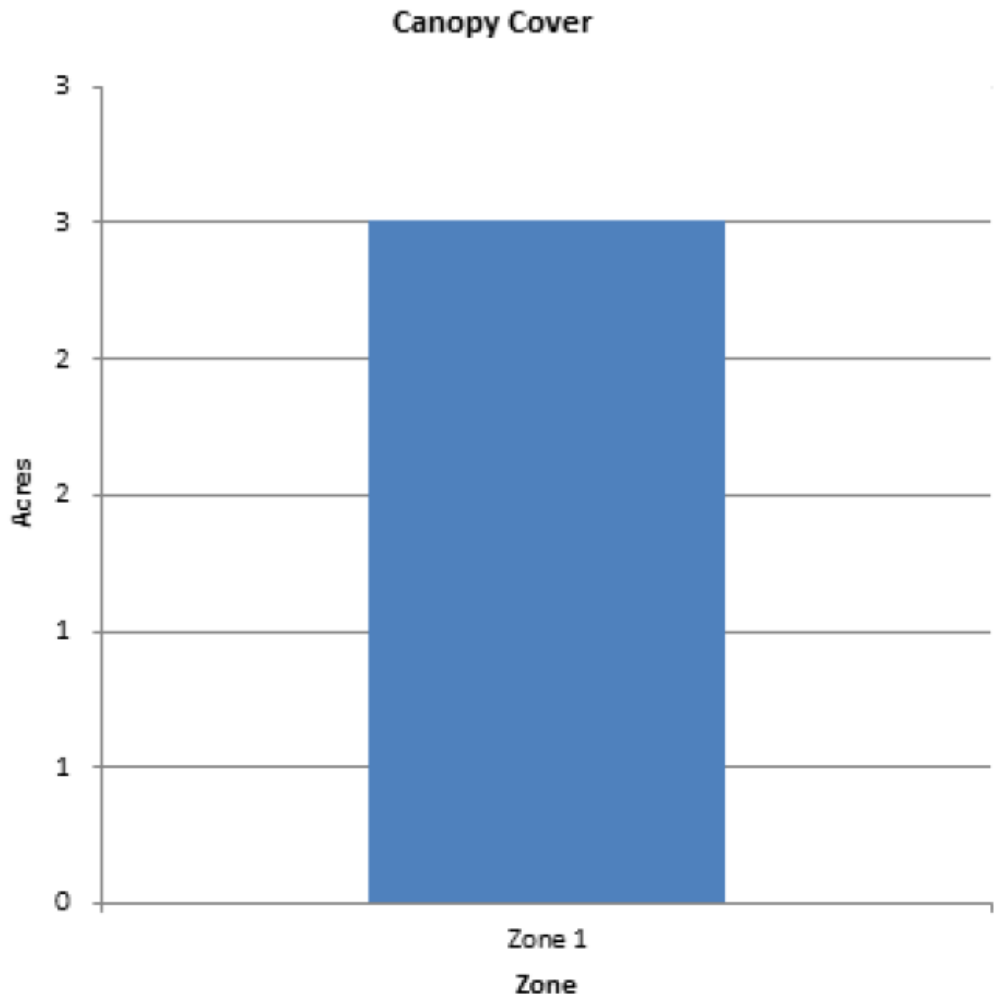


Figure 4: Wood Condition

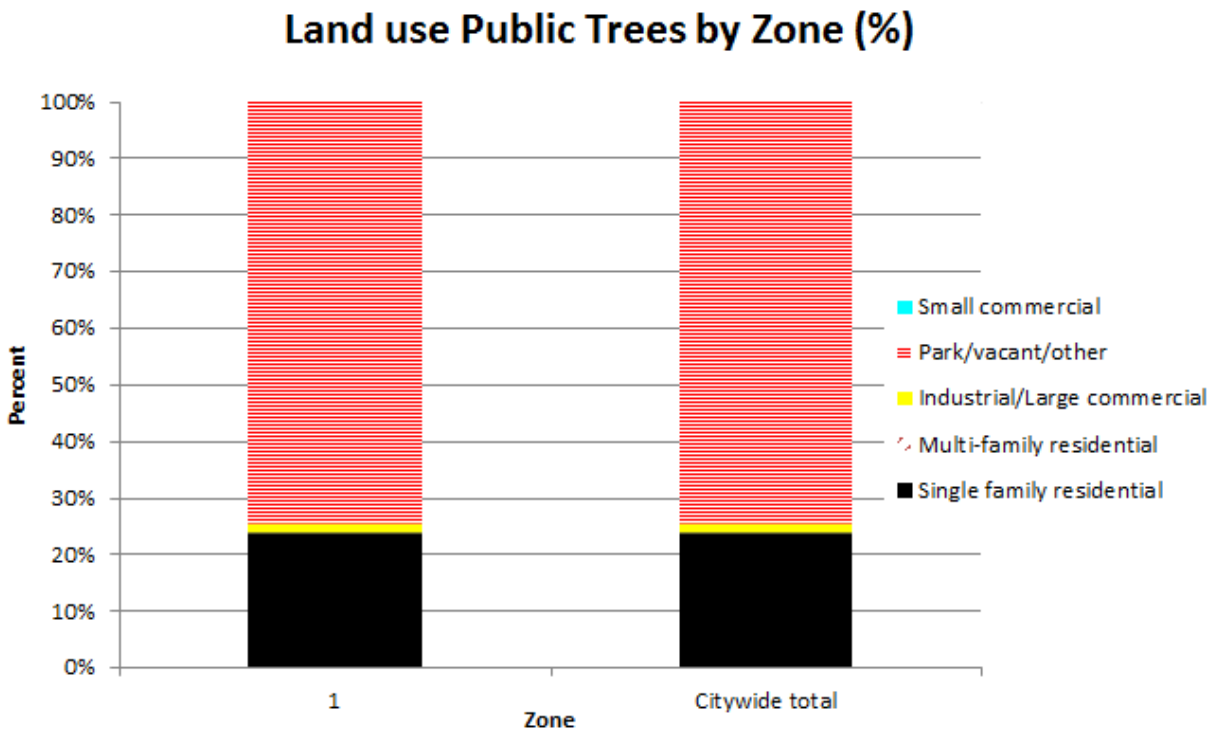
Canopy Cover of Public Trees (Acres)

2/5/2015



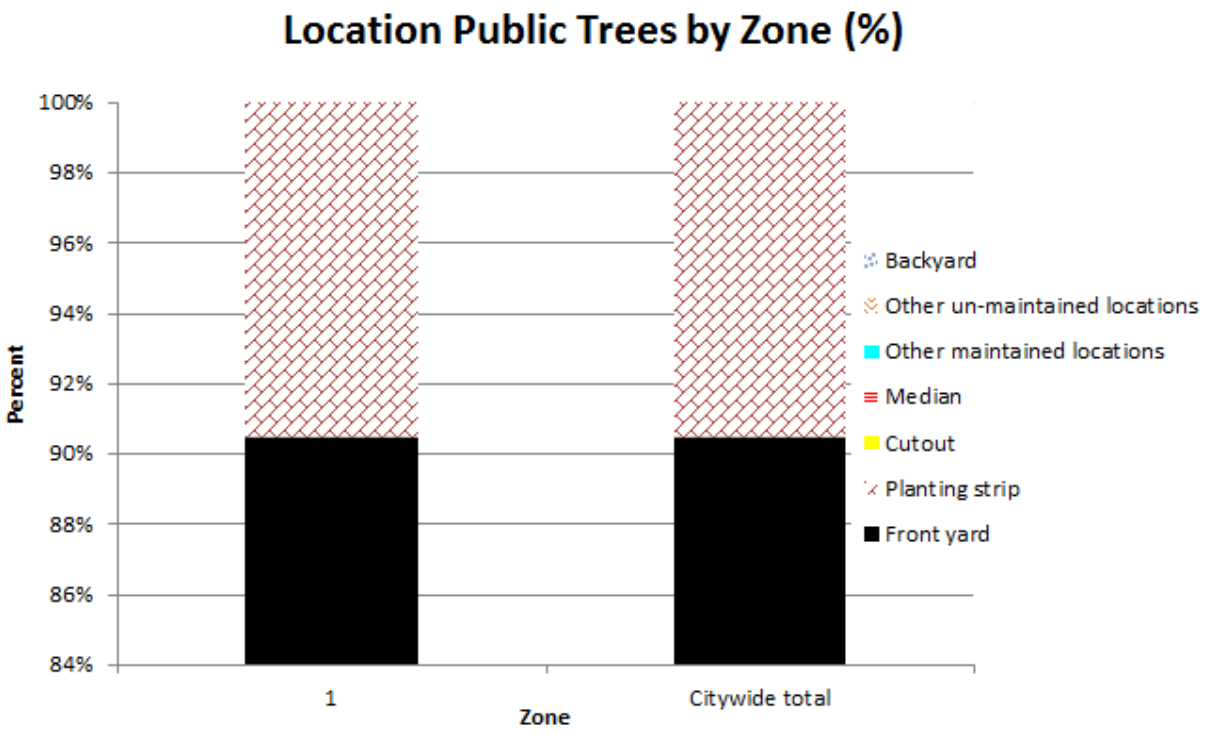
Zone	Acres	% of Total Canopy Cover
Zone 1	3	100.0
Citywide total	3	100.0

Figure 5: Canopy Cover in Acres



Zone	Single family residential	Multi-family residential	Industrial/Large commercial	Park/vacant /other	Small commercial
1	23.48	0.00	1.74	74.78	0.00
Citywide total	23.48	0.00	1.74	74.78	0.00

Figure 6: Land Use of city/park trees



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	90.43	9.57	0.00	0.00	0.00	0.00	0.00
Citywide total	90.43	9.57	0.00	0.00	0.00	0.00	0.00

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

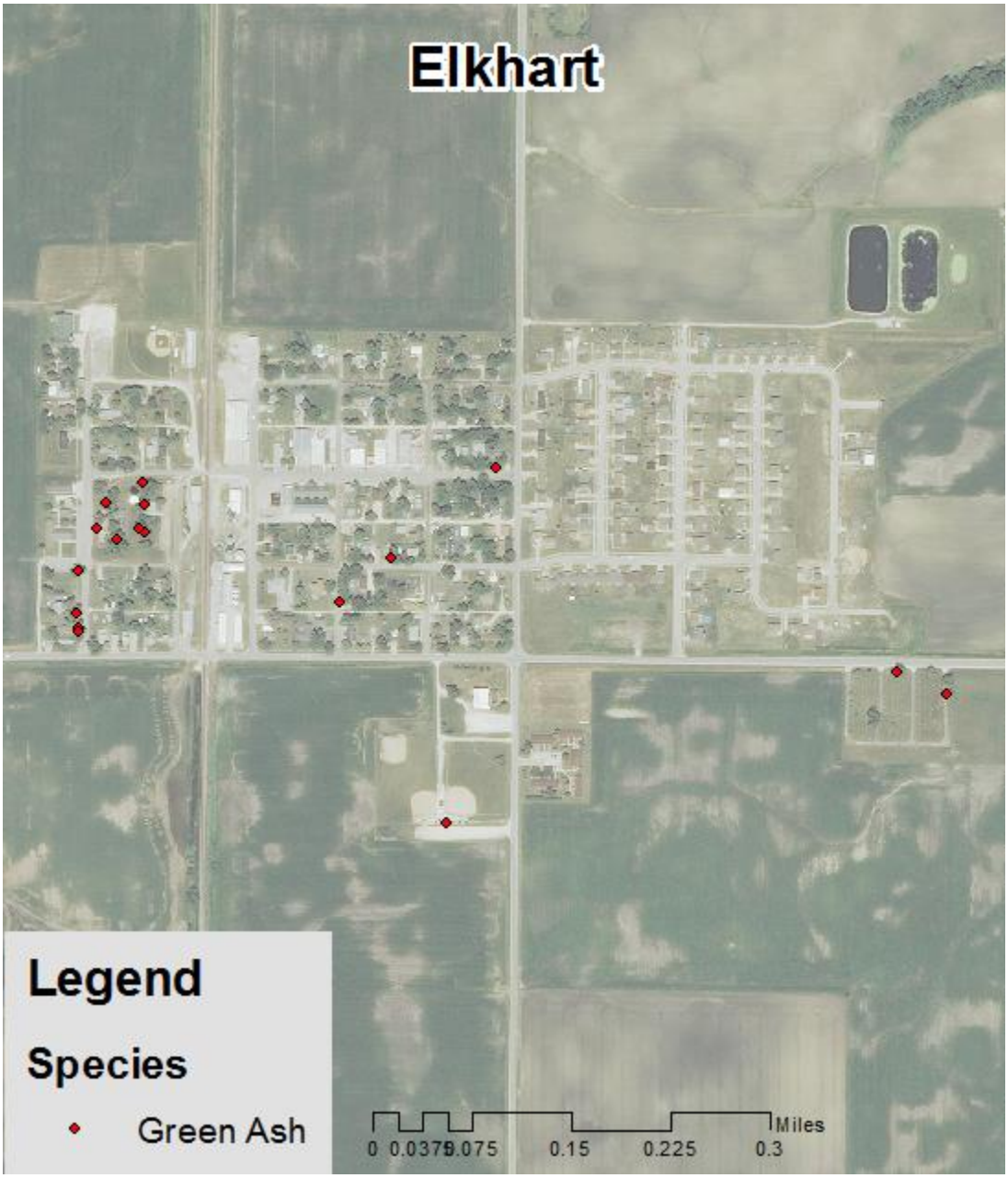


Figure 1: Location of Ash Trees

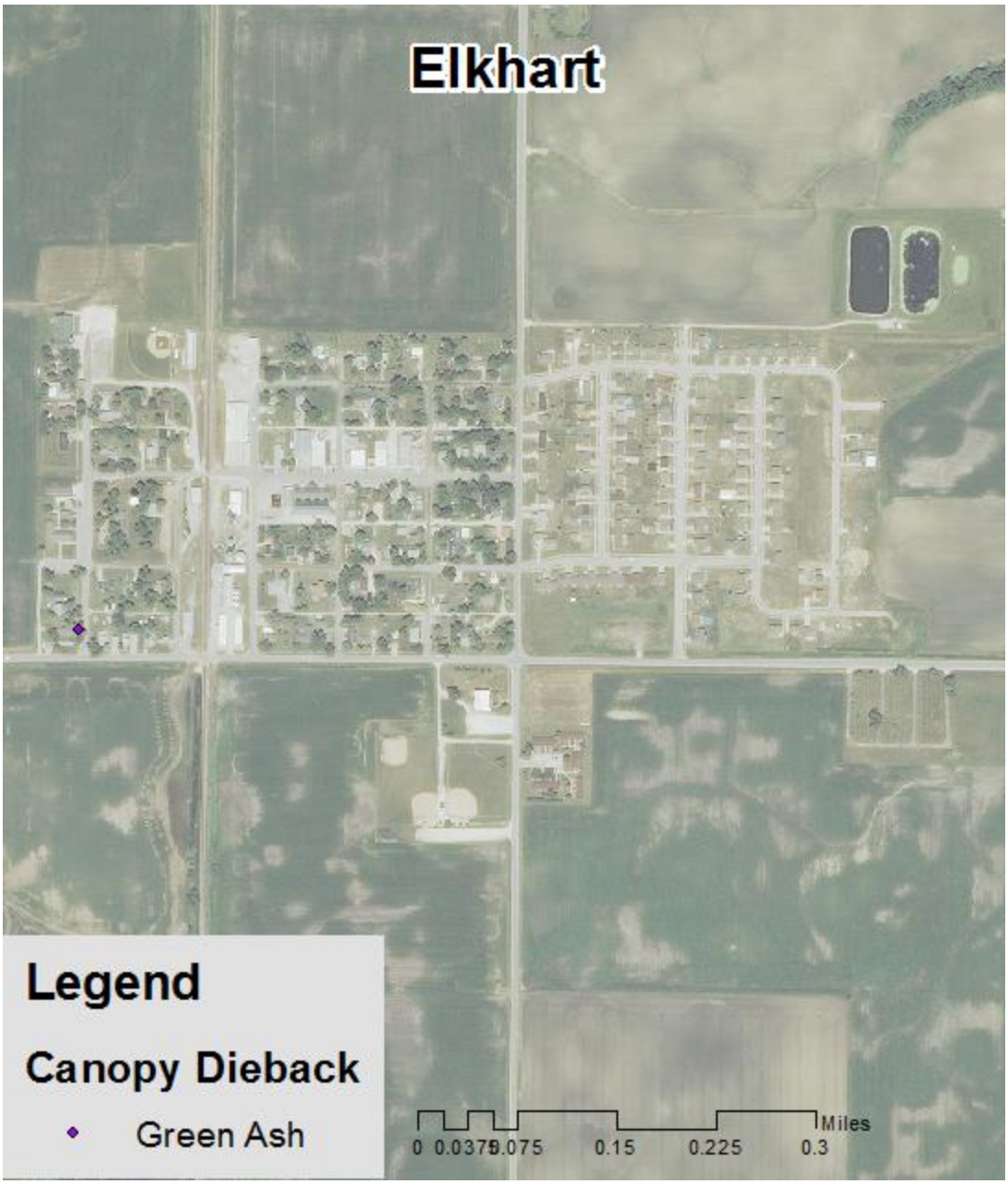


Figure 2: Location of EAB symptoms

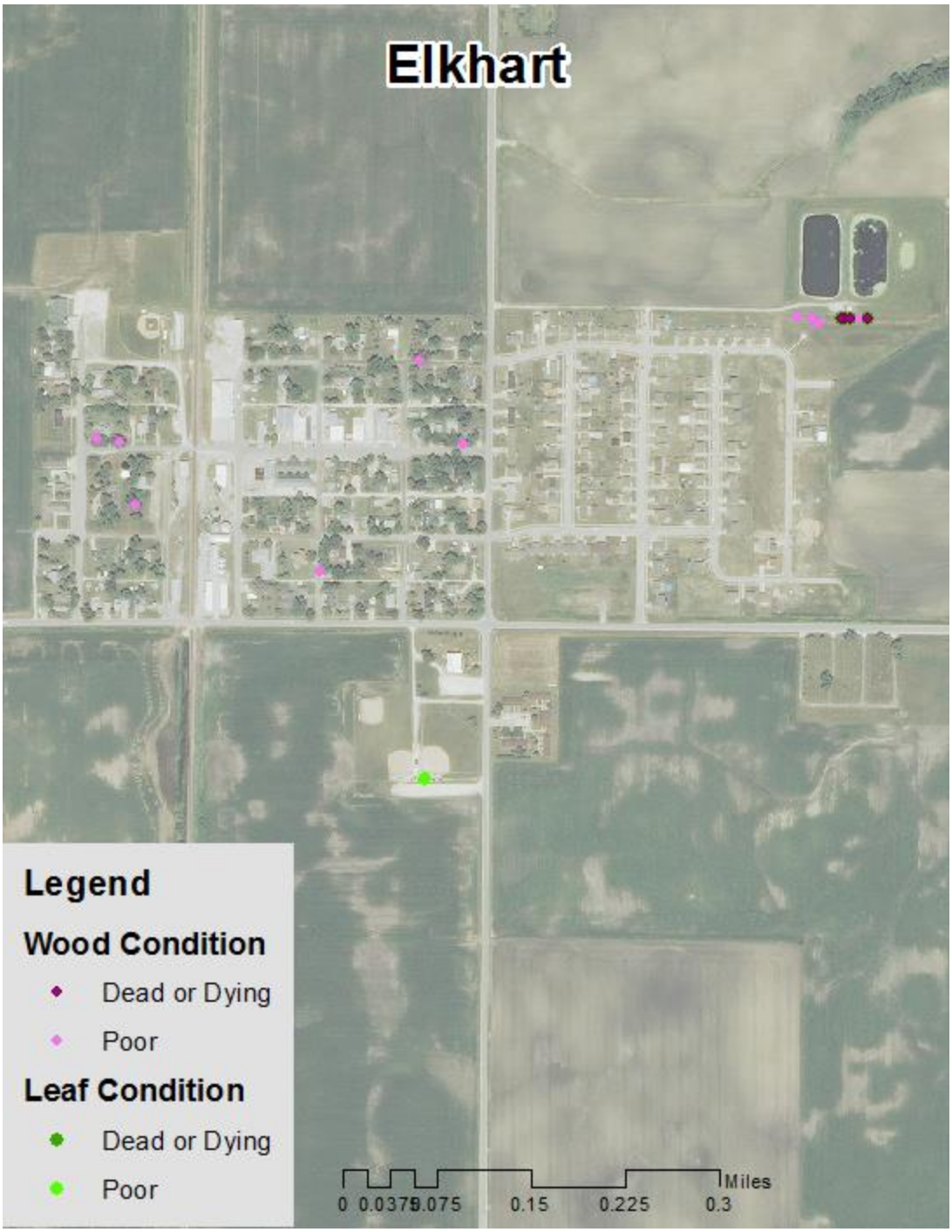


Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

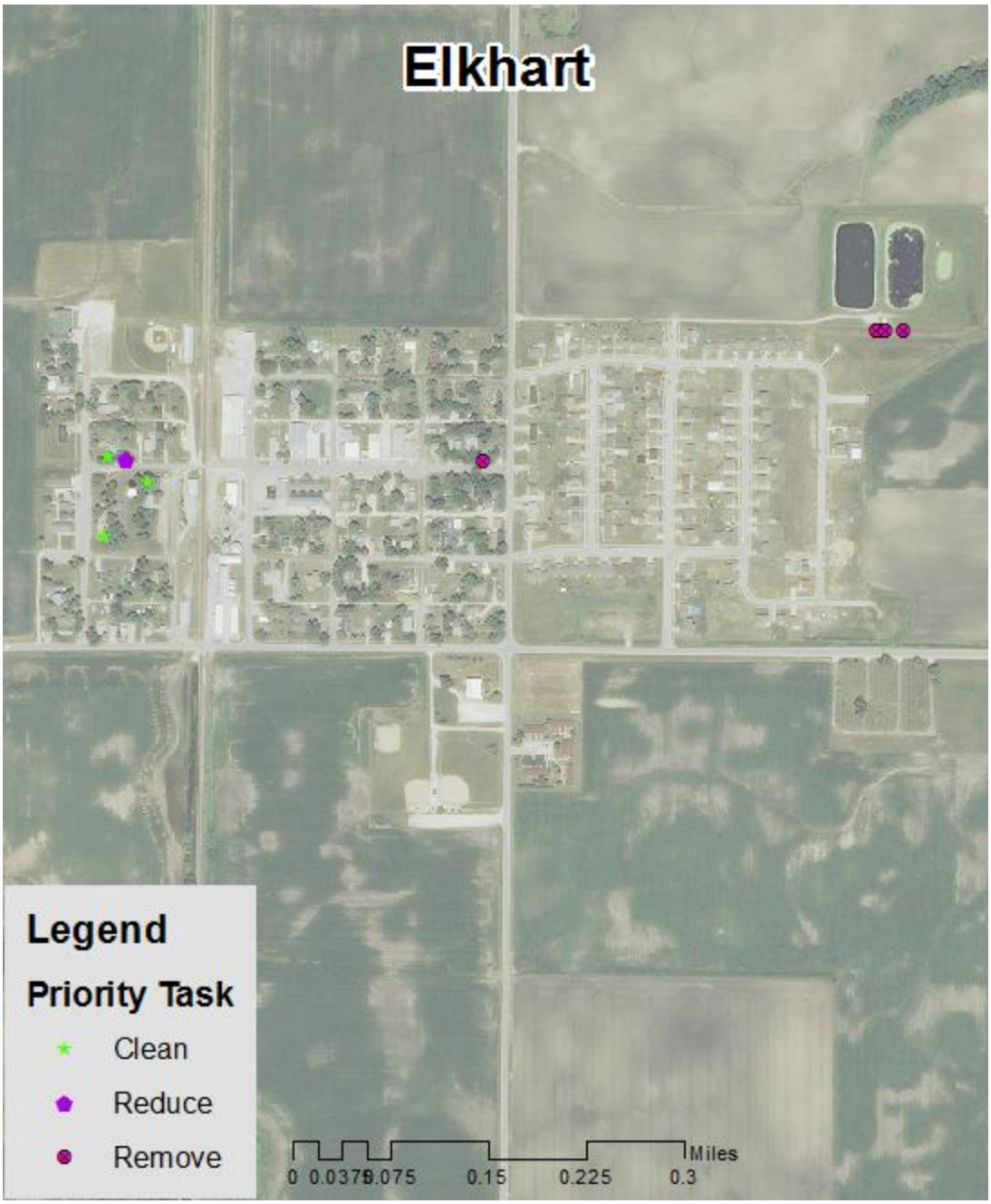


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Elkhart Tree Ordinances

CHAPTER 150

TREES

150.01 DEFINITION. For use in this chapter, "parking" 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.

150.02 PLANTING RESTRICTIONS. No tree shall be planted in any parking or street except in accordance with the following:

1. Alignment. All trees planted in any street shall be planted in the parking midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted in accordance with the directions of the City.

2. Spacing. Trees shall not be planted on any parking 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.

150.03 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 fifteen (15) feet above the surface of the street 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])

150.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 150.03, 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.

150.05 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.

150.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased or damaged, and such trees and shrubs shall be subject to the following:

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 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])