Gilman, IA

2016 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Gilman 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 19% of Gilman'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 2015, a tree inventory was conducted by Matt Brewer, 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 162 trees inventoried.

- Gilman's trees provide $39,914 of benefits annually, an average of $246 a tree
- There are over 21 species of trees
- The top three genera are: Maple 56%, Ash 19%, and Oak 6%
- 15% 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, 3 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*
- 1 of the 30 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- Budget impacts from ash removal – Suggestion: request a budget increase to at least $2,100-$4,500 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2015, a tree inventory was conducted by Matt Brewer, 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 162 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. Gilman's trees reduce energy related costs by approximately $10,014 annually (Appendix A, Table 1). These savings are both in Electricity (47.6 MWh) and in Natural Gas (6,534.7 Therms).

Annual Stormwater Benefits

Gilman's trees intercept about 595,344 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $16,134 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 Gilman, it is estimated that trees remove 630.6 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 $1,782 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Gilman, trees sequester about 129,053 lbs of carbon a year with an associated value of $968 (Appendix A, Table 4). In addition, the trees store 2,439,242 lbs of carbon, with a yearly benefit of $18,294 (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. Gilman receives $10,510 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, Gilman's trees provide $39,914 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 162 trees in Gilman provides approximately $246 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Gilman has over 21 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	90	56%
Ash	30	19%
Oak	9	6%
Black Walnut	7	4%
Elm	4	2%
Mulberry	3	2%
Spruce	3	2%
Ginkgo	2	1%
Eastern Red Cedar	2	1%
Tuliptree	2	1%
American Sycamore	2	1%
Aspen/Cottonwood	2	1%
Hackberry	1	1%
Cherry/Plum	1	1%
Linden/Basswood	1	1%
Other Small Deciduous	3	2%

Age Class

Over half of Gilman's trees (64%) are between 18 and 36 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that a large number of trees are in the smallest size categories (a downward slope) to prepare for natural mortality and to maintain canopy cover. Gilman will have an aging tree population as this 64% matures, and should consider new plantings (currently only 4% are under 6 inches in diameter) to develop the next generation of trees.

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 Gilman indicate that 85% 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). Additionally, 55% of Gilman'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 10% of the population. This 10% 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	20	12%
Tree Removal	5	3%

Canopy Cover

The total canopy with both private and public trees is 11% (39 acres). The canopy cover included in the Gilman inventory includes approximately 6 acres (Appendix A, Figure 4).

Land Use and Location

The majority of Gilman'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	94%
Park/vacant/other	4%
Multifamily residential	1%
Small commercial	<1%

Location	
Planting strip	66%
Front yard	34%

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

Gilman has 0 critical concern trees, but 5 trees that need removal and 20 that need cleaning as soon as is practical. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). Please refer to the six year maintenance plan at the end of this section. There are a total of 25 trees marked as needing maintenance.

Poor tree species

Ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 5 removals, 1 is an ash tree. There are a total of 30 ash trees, and 1 of those has signs and symptoms that have been associated with EAB. In addition, there is 1 ash tree that is 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.

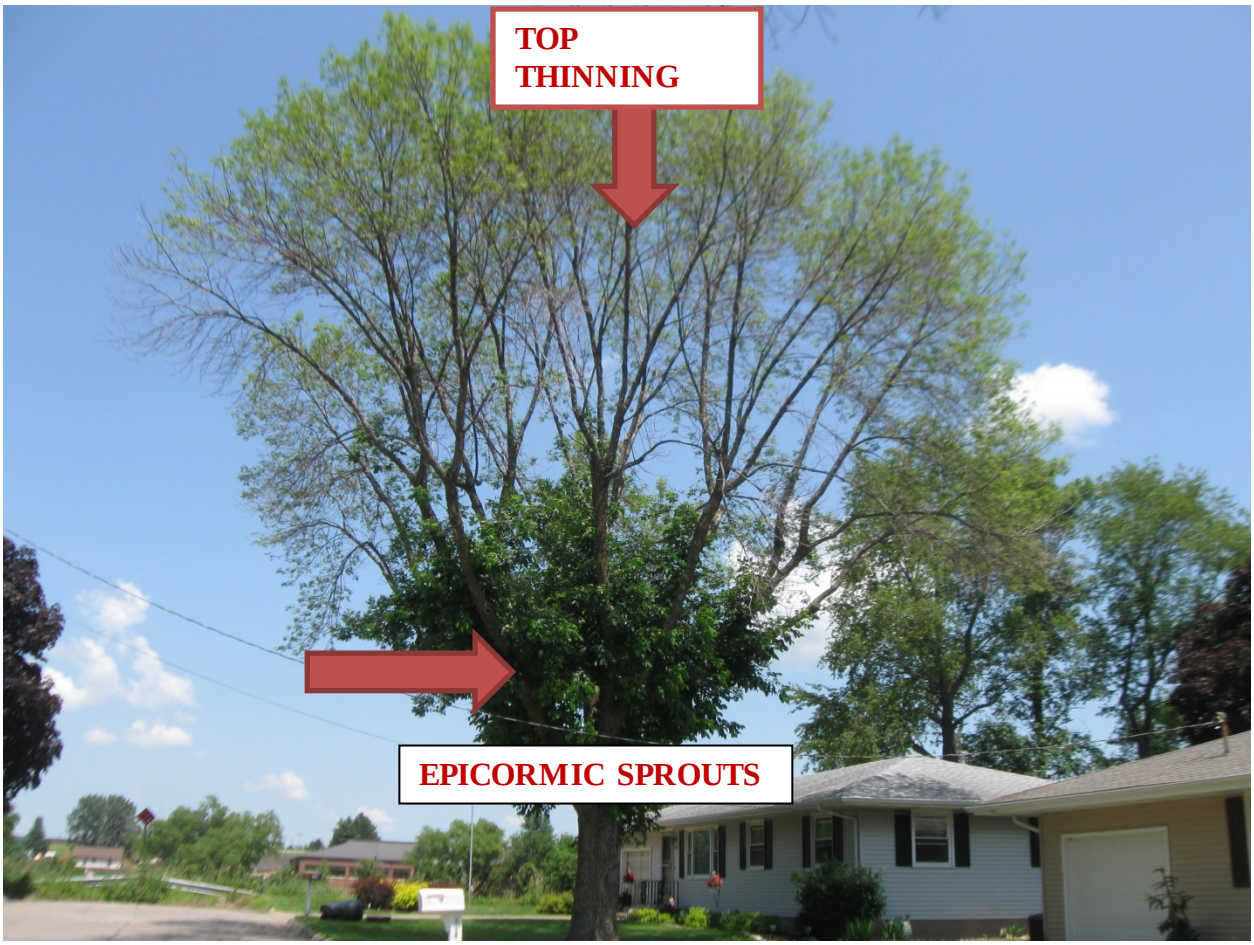
Planting

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 Gilman.

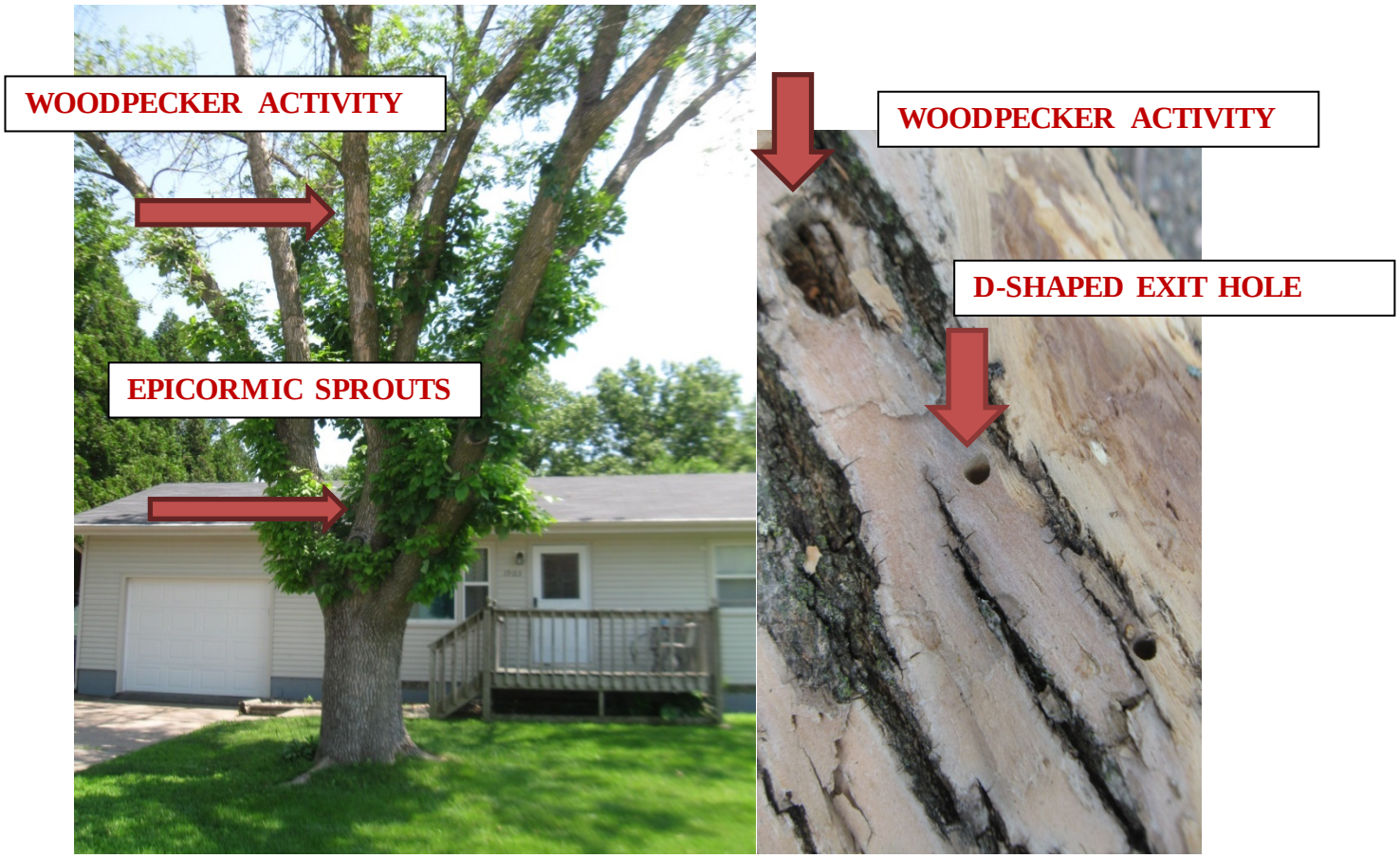
It is important to plant a diverse mix of species in the urban forest to maintain canopy health, since most insects and diseases target a genus (ash) or species (green ash) of trees. Current diversity recommendations advise that a genus (i.e. maple, oak) not make up more than 10% of the urban forest and a single species (i.e. silver maple, sugar maple, white oak, bur oak) not make up more than 5-10% of the total urban forest. Presently, the forest is heavily planted with maple (56%) (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.

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 Gilman, 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

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. 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 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.

Six Year Maintenance Plan and Cost Estimates

Year 1 (FY 2016)

Remove 3 trees (marked for removal)	$2,700
Plant and Maintain 10 trees in open locations (pursue grants)	$1,000
Ash tree treatment (if elected), 10 trees in good condition, average 24–30"	avg. $405/tree
-$15 per inch, treated every two years, see note	
*Or saving for future ash removal	
Visual Survey for signs and symptoms of EAB	

Year 2 (FY 2017)

Remove 2 trees (marked for removal)	$1,800
Plant and Maintain 10 trees in open locations (pursue grants)	$1,000
Ash tree treatment (if elected) or saving for future ash removal	
Routine trimming: Contract to trim 1/3 of the city trees (~$300 per tree)	
Visual Survey for signs and symptoms of EAB	

Year 3 (FY 2018)

Remove any new critical concern trees and ash in poor health	$900/tree
Plant and Maintain 20 trees in open locations (pursue grants)	$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Visual Survey for signs and symptoms of EAB	

Year 4 (FY 2019)

Remove any new critical concern trees and ash in poor health	$900/tree
Plant and Maintain 20 trees in open locations (pursue grants)	$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Routine trimming: Contract to trim 1/3 of the city trees (~$300 per tree)	
Visual Survey for signs and symptoms of EAB	

Year 5 (FY 2020)

Remove any new critical concern trees and ash in poor health	$900/tree
Plant and Maintain 20 trees in open locations (pursue grants)	$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Visual Survey for signs and symptoms of EAB	

Year 6 (FY 2021)

Remove any new critical concern trees and ash in poor health	$900/tree
Plant and Maintain 20 trees in open locations (pursue grants)	$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Routine trimming: Contract to trim 1/3 of the city trees (~$300 per tree)	
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 4-15 years of its arrival.
******Assuming a cost of $900 per tree for removal, the budget would need to be increased to $4,500 a year to remove all ash trees within 6 years.
*******Suggest a future (post ash removal and replacement) budget of at least $2 per capita (population 509). Currently, this amount would cover about 23% 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 at least partially dependent on receiving grant funds annually.

Proposed Budget Increase

EAB could potentially kill all ash trees in Gilman within 4-15 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $4,500 a year. If the budget were increased to $2,100 a year all ash could be removed within 13 years. Additionally, it is recommended that Gilman 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 an example, if the average ash diameter is 20 inches and treatment costs $15 per inch, then treating 10 trees would cost about $3,000 (every other year treatment). This would be 10 trees selected for treatment, and Gilman would still need to find $900 per tree for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $4,500 every two years for treatment and leave five less trees for removal (for at least two more years). 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 Gilman. It is suggested to consider increasing the budget to plan for this.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees

1/15/2016

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	12.7	964	1,674.9	1,641	2,606	(N/A)	22.2	26.0	72.38
Green ash	10.1	764	1,400.6	1,373	2,136	(N/A)	18.5	21.3	71.21
Norway maple	7.1	542	1,051.3	1,030	1,572	(N/A)	17.3	15.7	56.15
Sugar maple	7.1	538	951.2	932	1,470	(N/A)	14.2	14.7	63.91
Pin oak	2.6	196	348.7	342	538	(N/A)	4.9	5.4	67.20
Black walnut	2.0	153	278.4	273	426	(N/A)	4.3	4.3	60.85
Elm	1.6	124	222.6	218	343	(N/A)	2.5	3.4	85.65
Mulberry	0.6	44	87.9	86	130	(N/A)	1.9	1.3	43.47
Spruce	0.1	9	19.7	19	28	(N/A)	1.9	0.3	9.36
Broadleaf Deciduous Small	0.2	13	29.5	29	42	(N/A)	1.9	0.4	13.93
Tulip tree	0.2	14	27.5	27	41	(N/A)	1.2	0.4	20.64
Maple	0.0	3	6.0	6	9	(N/A)	1.2	0.1	4.44
Eastern red cedar	0.1	7	15.9	16	23	(N/A)	1.2	0.2	11.47
Cottonwood	0.9	66	118.0	116	182	(N/A)	1.2	1.8	91.02
American sycamore	0.8	63	112.7	110	173	(N/A)	1.2	1.7	86.52
Ginkgo	0.5	36	64.0	63	99	(N/A)	1.2	1.0	49.28
Plum	0.0	2	3.8	4	5	(N/A)	0.6	0.1	5.40
American basswood	0.4	30	56.8	56	86	(N/A)	0.6	0.9	86.12
Northern hackberry	0.3	20	33.4	33	53	(N/A)	0.6	0.5	53.09
Red maple	0.0	3	5.2	5	8	(N/A)	0.6	0.1	7.85
Bur oak	0.2	18	27.0	26	44	(N/A)	0.6	0.4	44.23
Total	47.6	3,610	6,534.7	6,404	10,014	(N/A)	100.0	100.0	61.82

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

1/15/2016

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	188,981	5,121	(N/A)	22.2	31.7	142.26
Green ash	127,809	3,464	(N/A)	18.5	21.5	115.45
Norway maple	72,840	1,974	(N/A)	17.3	12.2	70.50
Sugar maple	83,749	2,270	(N/A)	14.2	14.1	98.68
Pin oak	26,670	723	(N/A)	4.9	4.5	90.35
Black walnut	23,732	643	(N/A)	4.3	4.0	91.88
Elm	23,911	648	(N/A)	2.5	4.0	162.00
Mulberry	3,015	82	(N/A)	1.9	0.5	27.23
Spruce	1,240	34	(N/A)	1.9	0.2	11.20
Broadleaf Deciduous Small	598	16	(N/A)	1.9	0.1	5.40
Tulip tree	1,216	33	(N/A)	1.2	0.2	16.47
Maple	149	4	(N/A)	1.2	0.0	2.02
Eastern red cedar	1,318	36	(N/A)	1.2	0.2	17.86
Cottonwood	14,478	392	(N/A)	1.2	2.4	196.17
American sycamore	12,729	345	(N/A)	1.2	2.1	172.48
Ginkgo	3,715	101	(N/A)	1.2	0.6	50.33
Plum	69	2	(N/A)	0.6	0.0	1.86
American basswood	6,096	165	(N/A)	0.6	1.0	165.21
Northern hackberry	1,427	39	(N/A)	0.6	0.2	38.66
Red maple	137	4	(N/A)	0.6	0.0	3.72
Bur oak	1,466	40	(N/A)	0.6	0.2	39.72
Citywide total	595,344	16,134	(N/A)	100.0	100.0	99.59

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

1/15/2016

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	32.5	5.5	15.9	1.4	175	59.9	8.8	8.4	57.5	375	-16.6	-62	173.3	488	(N/A)	22.2	13.55
Green ash	17.2	2.7	7.9	0.8	91	48.3	7.0	6.7	45.6	300	0.0	0	136.2	391	(N/A)	18.5	13.02
Norway maple	15.5	2.7	7.6	0.7	84	34.8	5.0	4.8	32.4	215	-3.6	-13	99.9	285	(N/A)	17.3	10.20
Sugar maple	11.4	1.9	5.6	0.5	61	33.6	4.9	4.7	32.1	210	-8.9	-33	85.9	238	(N/A)	14.2	10.35
Pin oak	4.5	0.8	2.3	0.2	24	12.3	1.8	1.7	11.7	77	-8.3	-31	26.9	70	(N/A)	4.9	8.71
Black walnut	3.0	0.5	1.4	0.1	16	9.7	1.4	1.3	9.1	60	0.0	0	26.6	76	(N/A)	4.3	10.89
Elm	4.0	0.6	1.8	0.2	21	7.8	1.1	1.1	7.4	49	0.0	0	24.1	70	(N/A)	2.5	17.44
Mulberry	1.1	0.2	0.5	0.0	6	2.9	0.4	0.4	2.6	18	0.0	0	8.1	23	(N/A)	1.9	7.75
Spruce	0.1	0.0	0.1	0.0	1	0.6	0.1	0.1	0.5	4	-0.4	-1	1.2	3	(N/A)	1.9	1.00
Broadleaf Deciduous Small	0.1	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.0	6	(N/A)	1.9	1.93
Tulip tree	0.0	0.0	0.0	0.0	0	0.9	0.1	0.1	0.9	6	0.0	0	2.1	6	(N/A)	1.2	2.99
Maple	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1	(N/A)	1.2	0.62
Eastern red cedar	0.1	0.0	0.1	0.0	1	0.5	0.1	0.1	0.4	3	-0.7	-3	0.6	1	(N/A)	1.2	0.62
Cottonwood	2.3	0.4	1.0	0.1	12	4.2	0.6	0.6	4.0	26	0.0	0	13.1	38	(N/A)	1.2	19.04
American sycamore	2.0	0.3	0.9	0.1	10	3.9	0.6	0.5	3.7	25	0.0	0	12.0	35	(N/A)	1.2	17.37
Ginkgo	1.1	0.2	0.5	0.0	6	2.2	0.3	0.3	2.1	14	-0.3	-1	6.5	19	(N/A)	1.2	9.29
Plum	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1	(N/A)	0.6	0.71
American basswood	1.0	0.2	0.5	0.0	5	1.9	0.3	0.3	1.8	12	-0.8	-3	5.2	14	(N/A)	0.6	14.28
Northern hackberry	0.1	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.1	9	(N/A)	0.6	8.66
Red maple	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1	(N/A)	0.6	1.12
Bur oak	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7	(N/A)	0.6	7.42
Citywide total	96.2	16.1	46.4	4.3	516	227.1	33.1	31.5	215.4	1,414	-39.6	-148	630.6	1,782	(N/A)	100.0	11.00

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

1/15/2016

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	724,074	5,431	(N/A)	22.2	29.7	150.85
Green ash	557,828	4,184	(N/A)	18.5	22.9	139.46
Norway maple	257,125	1,928	(N/A)	17.3	10.5	68.87
Sugar maple	325,985	2,445	(N/A)	14.2	13.4	106.30
Pin oak	112,959	847	(N/A)	4.9	4.6	105.90
Black walnut	99,741	748	(N/A)	4.3	4.1	106.87
Elm	136,956	1,027	(N/A)	2.5	5.6	256.79
Mulberry	16,523	124	(N/A)	1.9	0.7	41.31
Spruce	516	4	(N/A)	1.9	0.0	1.29
Broadleaf Deciduous	1,994	15	(N/A)	1.9	0.1	4.98
Tulip tree	2,069	16	(N/A)	1.2	0.1	7.76
Maple	235	2	(N/A)	1.2	0.0	0.88
Eastern red cedar	554	4	(N/A)	1.2	0.0	2.08
Cottonwood	78,517	589	(N/A)	1.2	3.2	294.44
American sycamore	65,202	489	(N/A)	1.2	2.7	244.51
Ginkgo	15,601	117	(N/A)	1.2	0.6	58.50
Plum	178	1	(N/A)	0.6	0.0	1.33
American basswood	37,616	282	(N/A)	0.6	1.5	282.12
Northern hackberry	1,679	13	(N/A)	0.6	0.1	12.60
Red maple	218	2	(N/A)	0.6	0.0	1.64
Bur oak	3,672	28	(N/A)	0.6	0.2	27.54
Citywide total	2,439,242	18,294	(N/A)	100.0	100.0	112.93

Table 5: Annual Carbon Sequestered

Annual CO Benefits of Public Trees

1/15/2016

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	53,224	399	-3,476	-140	-27	21,309	160	70,917	532 (N/A)	22.2	36.1	14.77
Green ash	24,931	187	-2,678	-108	-21	16,878	127	39,024	293 (N/A)	18.5	19.8	9.76
Norway maple	7,071	53	-1,234	-82	-10	11,981	90	17,736	133 (N/A)	17.3	9.0	4.75
Sugar maple	16,480	124	-1,565	-77	-12	11,885	89	26,723	200 (N/A)	14.2	13.6	8.71
Pin oak	11,005	83	-542	-27	-4	4,329	32	14,766	111 (N/A)	4.9	7.5	13.84
Black walnut	4,797	36	-479	-21	-4	3,384	25	7,680	58 (N/A)	4.3	3.9	8.23
Elm	3,207	24	-657	-19	-5	2,750	21	5,281	40 (N/A)	2.5	2.7	9.90
Mulberry	746	6	-79	-8	-1	978	7	1,637	12 (N/A)	1.9	0.8	4.09
Spruce	109	1	-2	-3	0	195	1	299	2 (N/A)	1.9	0.2	0.75
Broadleaf Deciduous Smal	266	2	-10	-3	0	285	2	539	4 (N/A)	1.9	0.3	1.35
Tulip tree	418	3	-10	-2	0	318	2	723	5 (N/A)	1.2	0.4	2.71
Maple	42	0	-1	-1	0	67	1	107	1 (N/A)	1.2	0.1	0.40
Eastern red cedar	80	1	-3	-2	0	164	1	239	2 (N/A)	1.2	0.1	0.89
Cottonwood	1,824	14	-377	-10	-3	1,469	11	2,906	22 (N/A)	1.2	1.5	10.90
American sycamore	1,872	14	-313	-9	-2	1,384	10	2,934	22 (N/A)	1.2	1.5	11.00
Ginkgo	319	2	-75	-7	-1	792	6	1,029	8 (N/A)	1.2	0.5	3.86
Plum	38	0	-1	-1	0	37	0	74	1 (N/A)	0.6	0.0	0.55
American basswood	1,940	15	-181	-5	-1	673	5	2,428	18 (N/A)	0.6	1.2	18.21
Northern hackberry	200	1	-8	-2	0	450	3	640	5 (N/A)	0.6	0.3	4.80
Red maple	39	0	-1	-1	0	60	0	97	1 (N/A)	0.6	0.0	0.73
Bur oak	445	3	-18	-2	0	393	3	819	6 (N/A)	0.6	0.4	6.14
Citywide total	129,053	968	-11,708	-530	-92	79,781	598	196,596	1,474 (N/A)	100.0	100.0	9.10

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

1/15/2016

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	4,120	(N/A)	22.2	39.2	114.43
Green ash	1,872	(N/A)	18.5	17.8	62.41
Norway maple	679	(N/A)	17.3	6.5	24.24
Sugar maple	1,682	(N/A)	14.2	16.0	73.11
Pin oak	870	(N/A)	4.9	8.3	108.70
Black walnut	387	(N/A)	4.3	3.7	55.32
Elm	219	(N/A)	2.5	2.1	54.77
Mulberry	44	(N/A)	1.9	0.4	14.76
Spruce	37	(N/A)	1.9	0.3	12.20
Broadleaf Deciduous Small	15	(N/A)	1.9	0.1	4.95
Tulip tree	57	(N/A)	1.2	0.5	28.56
Maple	7	(N/A)	1.2	0.1	3.66
Eastern red cedar	43	(N/A)	1.2	0.4	21.34
Cottonwood	117	(N/A)	1.2	1.1	58.34
American sycamore	125	(N/A)	1.2	1.2	62.47
Ginkgo	23	(N/A)	1.2	0.2	11.47
Plum	2	(N/A)	0.6	0.0	2.06
American basswood	119	(N/A)	0.6	1.1	119.43
Northern hackberry	40	(N/A)	0.6	0.4	39.57
Red maple	7	(N/A)	0.6	0.1	7.28
Bur oak	46	(N/A)	0.6	0.4	45.86
Citywide total	10,510	(N/A)	100.0	100.0	64.88

Table 7: Summary of Benefits in Dollars

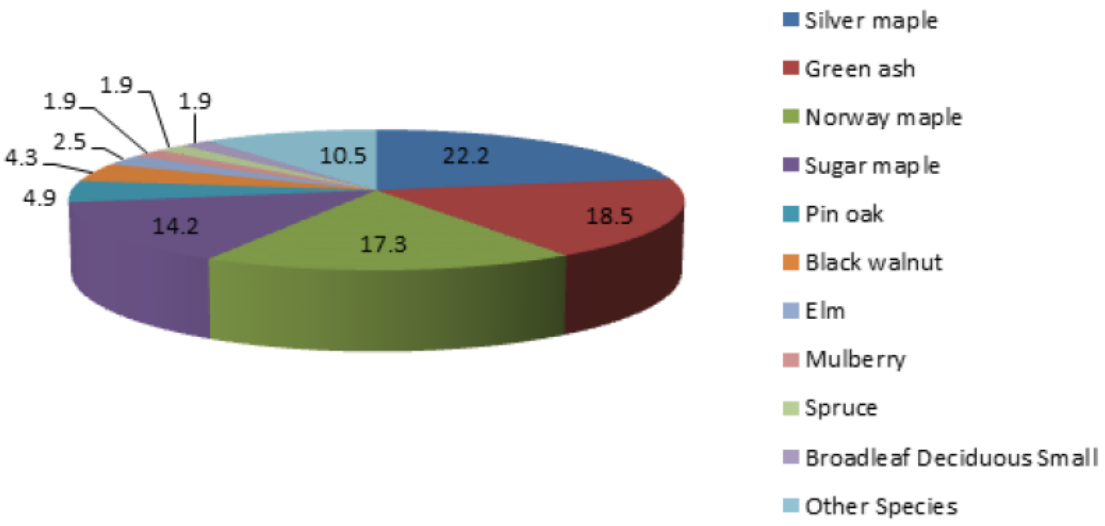
Total Annual Benefits of Public Trees by Species ($)

1/15/2016

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	2,606	532	488	5,121	4,120	12,866	(N/A)	32.2
Green ash	2,136	293	391	3,464	1,872	8,156	(N/A)	20.4
Norway maple	1,572	133	285	1,974	679	4,644	(N/A)	11.6
Sugar maple	1,470	200	238	2,270	1,682	5,860	(N/A)	14.7
Pin oak	538	111	70	723	870	2,310	(N/A)	5.8
Black walnut	426	58	76	643	387	1,590	(N/A)	4.0
Elm	343	40	70	648	219	1,319	(N/A)	3.3
Mulberry	130	12	23	82	44	292	(N/A)	0.7
Spruce	28	2	3	34	37	104	(N/A)	0.3
Broadleaf Deciduous Sn	42	4	6	16	15	83	(N/A)	0.2
Tulip tree	41	5	6	33	57	143	(N/A)	0.4
Maple	9	1	1	4	7	22	(N/A)	0.1
Eastern red cedar	23	2	1	36	43	104	(N/A)	0.3
Cottonwood	182	22	38	392	117	751	(N/A)	1.9
American sycamore	173	22	35	345	125	700	(N/A)	1.8
Ginkgo	99	8	19	101	23	248	(N/A)	0.6
Plum	5	1	1	2	2	11	(N/A)	0.0
American basswood	86	18	14	165	119	403	(N/A)	1.0
Northern hackberry	53	5	9	39	40	145	(N/A)	0.4
Red maple	8	1	1	4	7	21	(N/A)	0.1
Bur oak	44	6	7	40	46	143	(N/A)	0.4
Citywide Total	10,014	1,474	1,782	16,134	10,510	39,914	(N/A)	100.0

Species Distribution of Public Trees

1/15/2016

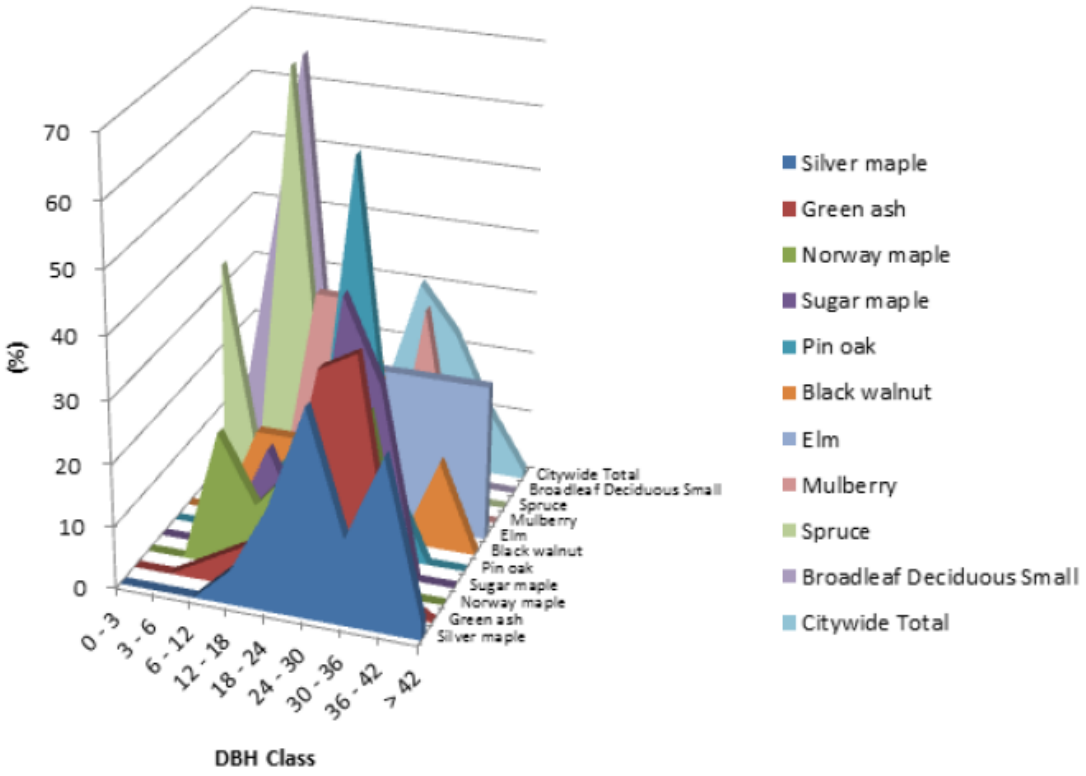


Species	Percent
Silver maple	22.2
Green ash	18.5
Norway maple	17.3
Sugar maple	14.2
Pin oak	4.9
Black walnut	4.3
Elm	2.5
Mulberry	1.9
Spruce	1.9
Broadleaf Deciduous Small	1.9
Other Species	10.5
Total	100.0

Figure 1: Species Distribution

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

1/15/2016



	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	5.56	16.67	33.33	13.89	27.78	2.78
Green ash	0.00	0.00	3.33	6.67	10.00	36.67	40.00	3.33	0.00
Norway maple	0.00	0.00	21.43	10.71	17.86	21.43	28.57	0.00	0.00
Sugar maple	0.00	0.00	4.35	17.39	4.35	43.48	30.43	0.00	0.00
Pin oak	0.00	0.00	0.00	12.50	12.50	62.50	12.50	0.00	0.00
Black walnut	0.00	0.00	14.29	14.29	14.29	42.86	0.00	14.29	0.00
Elm	0.00	0.00	0.00	0.00	0.00	25.00	25.00	25.00	25.00
Mulberry	0.00	0.00	0.00	33.33	33.33	0.00	33.33	0.00	0.00
Spruce	33.33	0.00	66.67	0.00	0.00	0.00	0.00	0.00	0.00
Broadleaf Deciduous Sm	0.00	33.33	66.67	0.00	0.00	0.00	0.00	0.00	0.00
Citywide Total	1.23	2.47	10.49	9.88	11.11	30.25	22.84	10.49	1.23

Figure 2: Relative Age Class

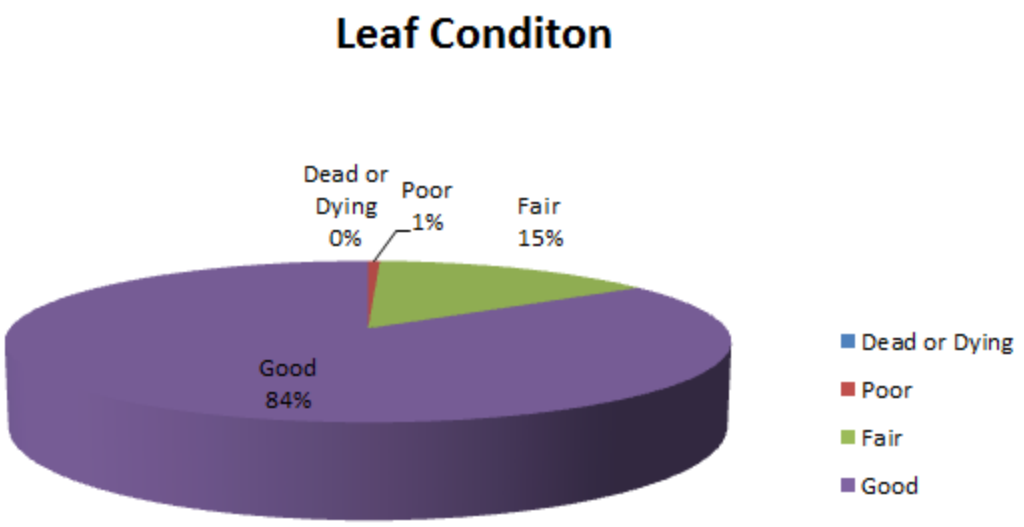


Figure 3: Foliage Condition

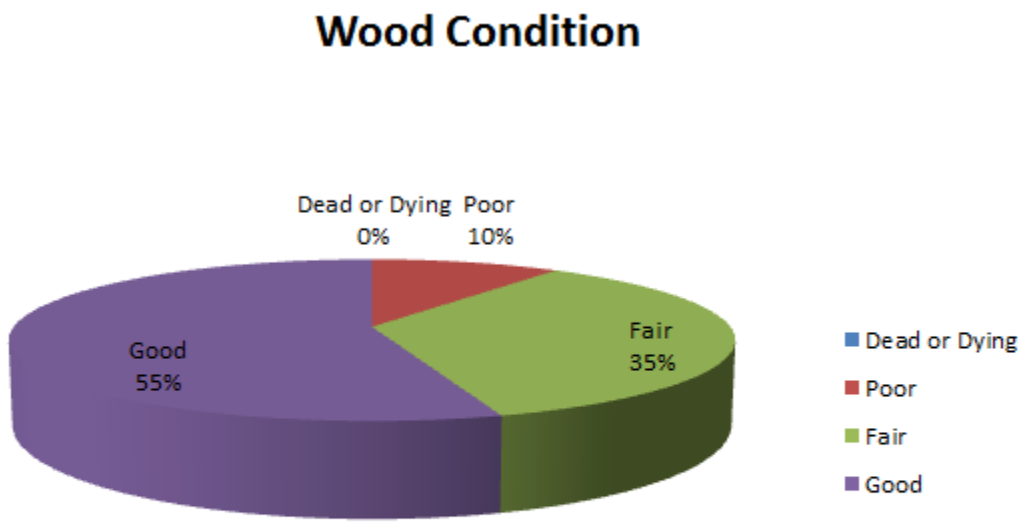
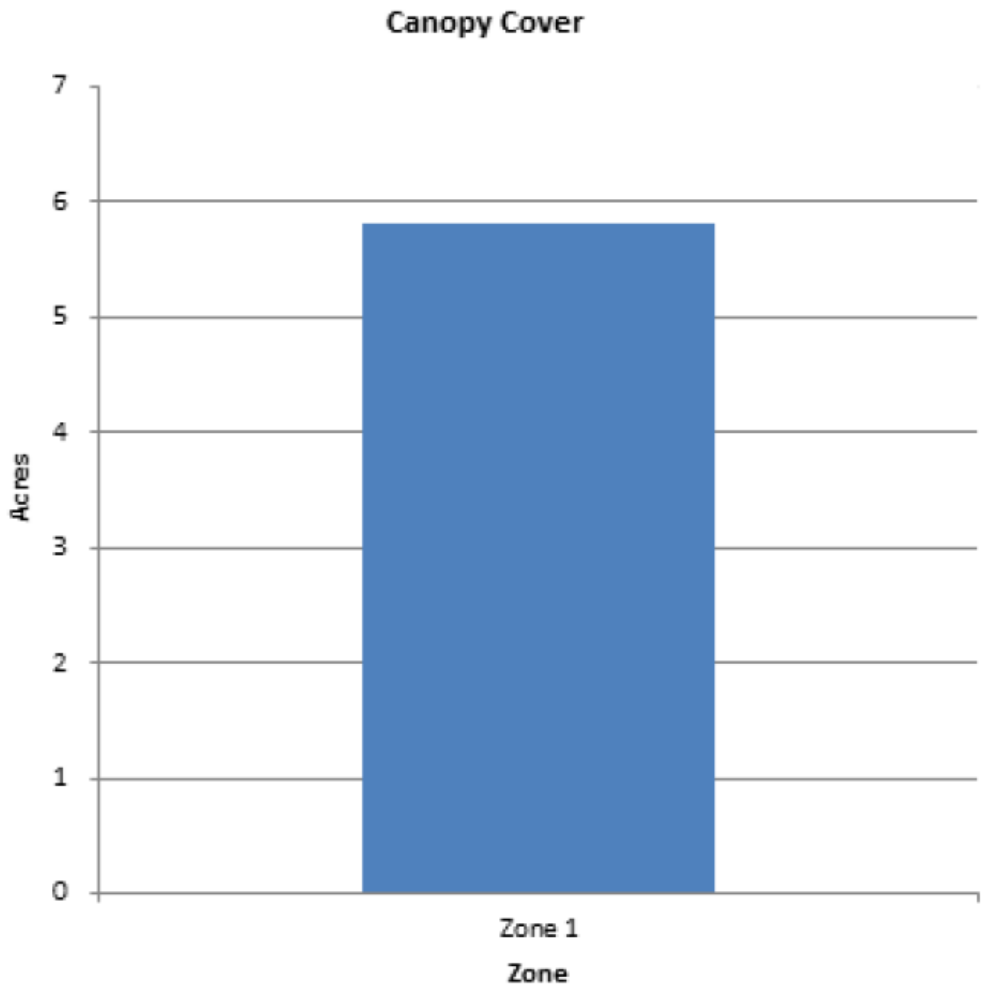


Figure 4: Wood Condition

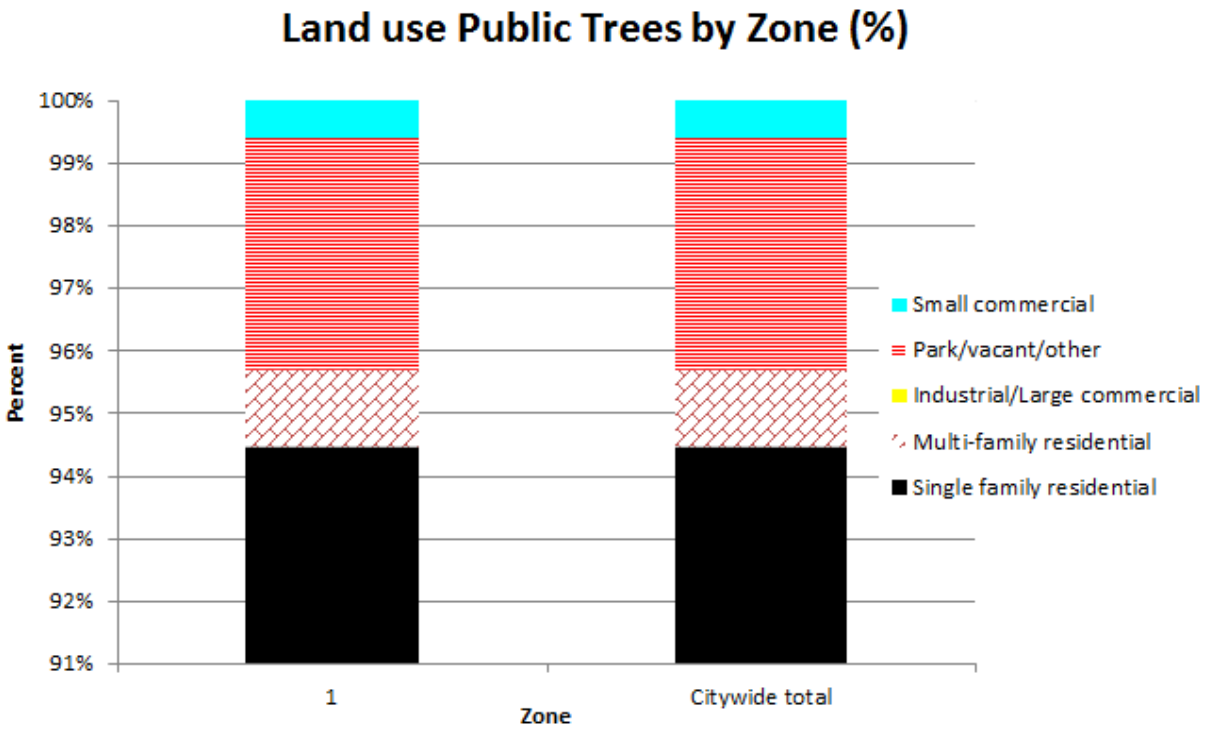
Canopy Cover of Public Trees (Acres)

1/15/2016



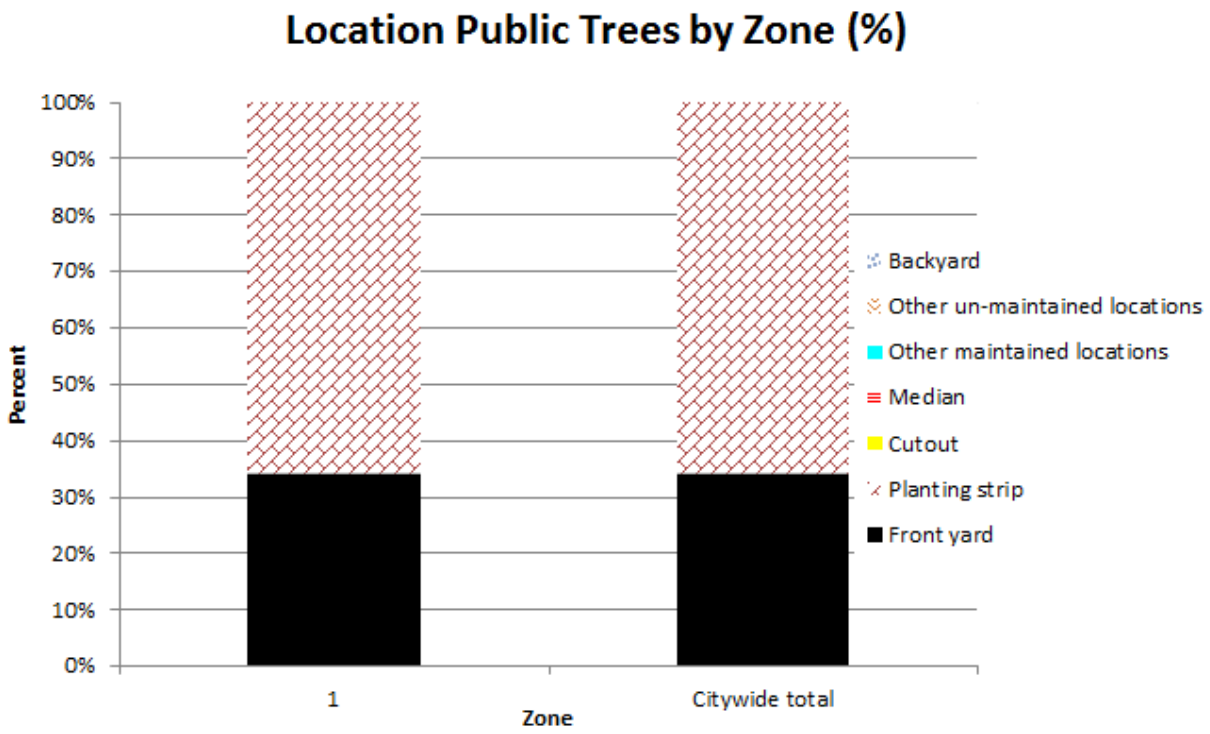
Zone	Acres	% of Total Canopy Cover
Zone 1	6	100.0
Citywide total	6	100.0

Figure 5: Canopy Cover in Acres



Zone	Single family residential	Multi-family residential	Industrial/Large commercial	Park/vacant /other	Small commercial
1	94.44	1.23	0.00	3.70	0.62
Citywide total	94.44	1.23	0.00	3.70	0.62

Figure 6: Land Use of city/park trees



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	33.95	66.05	0.00	0.00	0.00	0.00	0.00
Citywide total	33.95	66.05	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

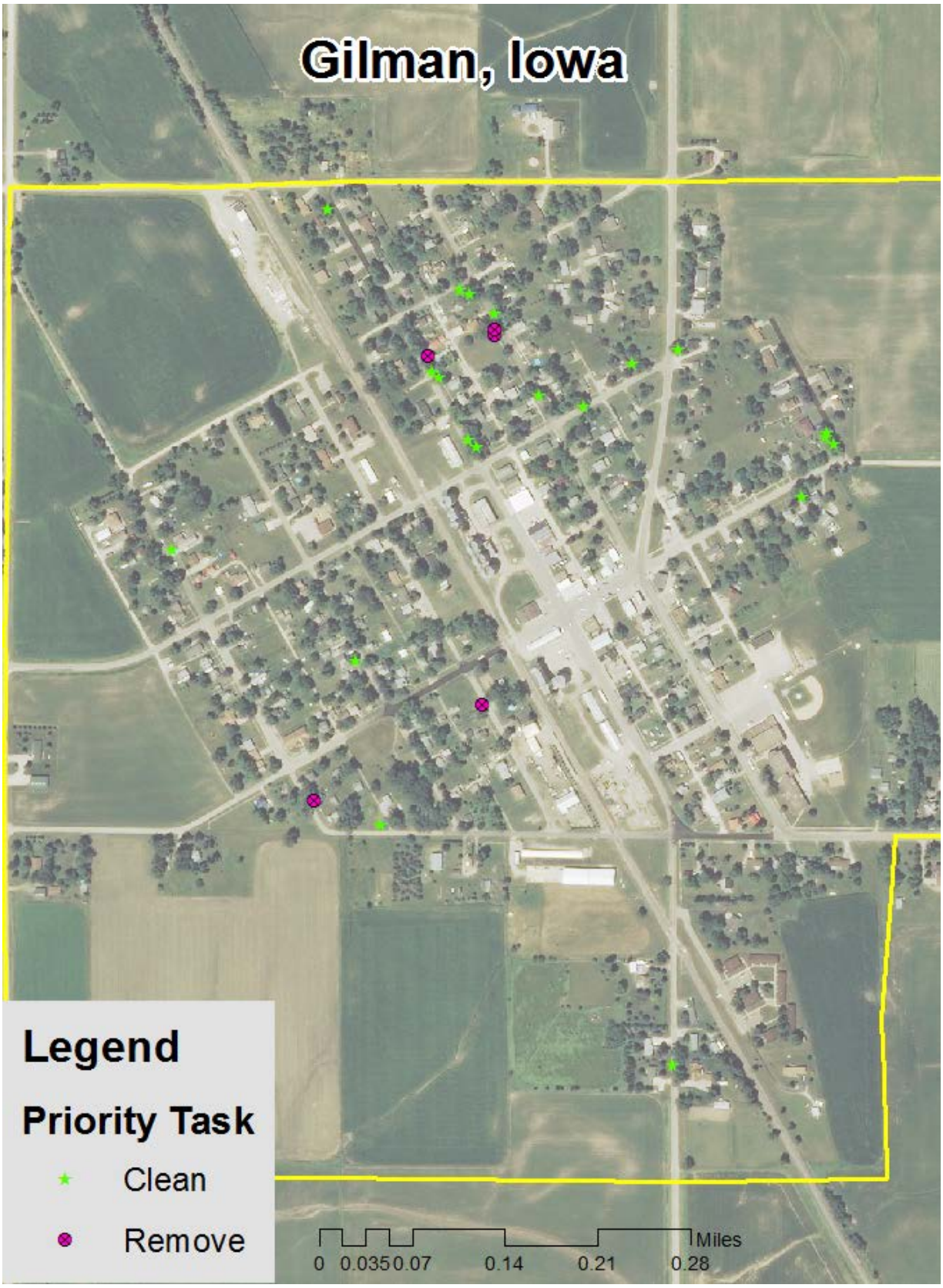


Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior any removal***

Appendix C: Gilman Tree Ordinances

Statewide Notification Center and provide the center with the information required under Section 480.4 of the Code of Iowa.

11. Permit Issued. Upon approval of the application and filing of bond and insurance certificate, a permit shall be issued. A separate permit shall be required for each excavation.

135.10 MAINTENANCE OF PARKING OR TERRACE. It shall be the responsibility of the abutting property owner to maintain all property outside the lot and property lines and inside the curb lines upon the public streets, except that the abutting property owner shall not be required to remove diseased trees or dead wood on the publicly owned property or right-of-way. Maintenance includes timely mowing, trimming trees and shrubs and picking up litter.

(Code of Iowa, Sec. 364.12[2c])

135.11 FAILURE TO MAINTAIN PARKING OR TERRACE. If the abutting property owner does not perform an action required under the above section within a reasonable time, the City may perform the required action and assess the cost against the abutting property for collection in the same manner as a property tax.

(Code of Iowa, Sec. 364.12[2e])

135.12 DUMPING OF SNOW. It is unlawful for any person to throw, push, or place or cause to be thrown, pushed or placed, any ice or snow from private property, sidewalks, or driveways ortto the traveled way of a street or alley so as to obstruct gutters, or impede the passage of vehicles upon the street or alley or to create a hazardous condition therein; except where, in the cleaning of large commercial drives in the business district it is absolutely necessary to move the snow onto the street or alley temporarily, such accumulation shall be removed promptly by the property owner or agent. Arrangements for the prompt removal of such accumulations shall be made prior to moving the snow.

(Code of Iowa, Sec. 364.12 [2])

135.13 DRIVEWAY CULVERTS. The property owner shall, at the owner's expense, install any culvert deemed necessary under any driveway or any other access to the owner's property, and before installing a culvert, permission must first be obtained from the City. In the event repairs are needed at any time with respect to culverts, it shall be the responsibility of the property owner to make such repairs, and, in the event the owner fails to do so, the City shall have the right to make the repairs. If the property owner fails to reimburse the City for the cost of said repairs, the cost shall be certified to the County Treasurer and specially assessed against the property as by law provided.

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 the Director at 515-725-8200.