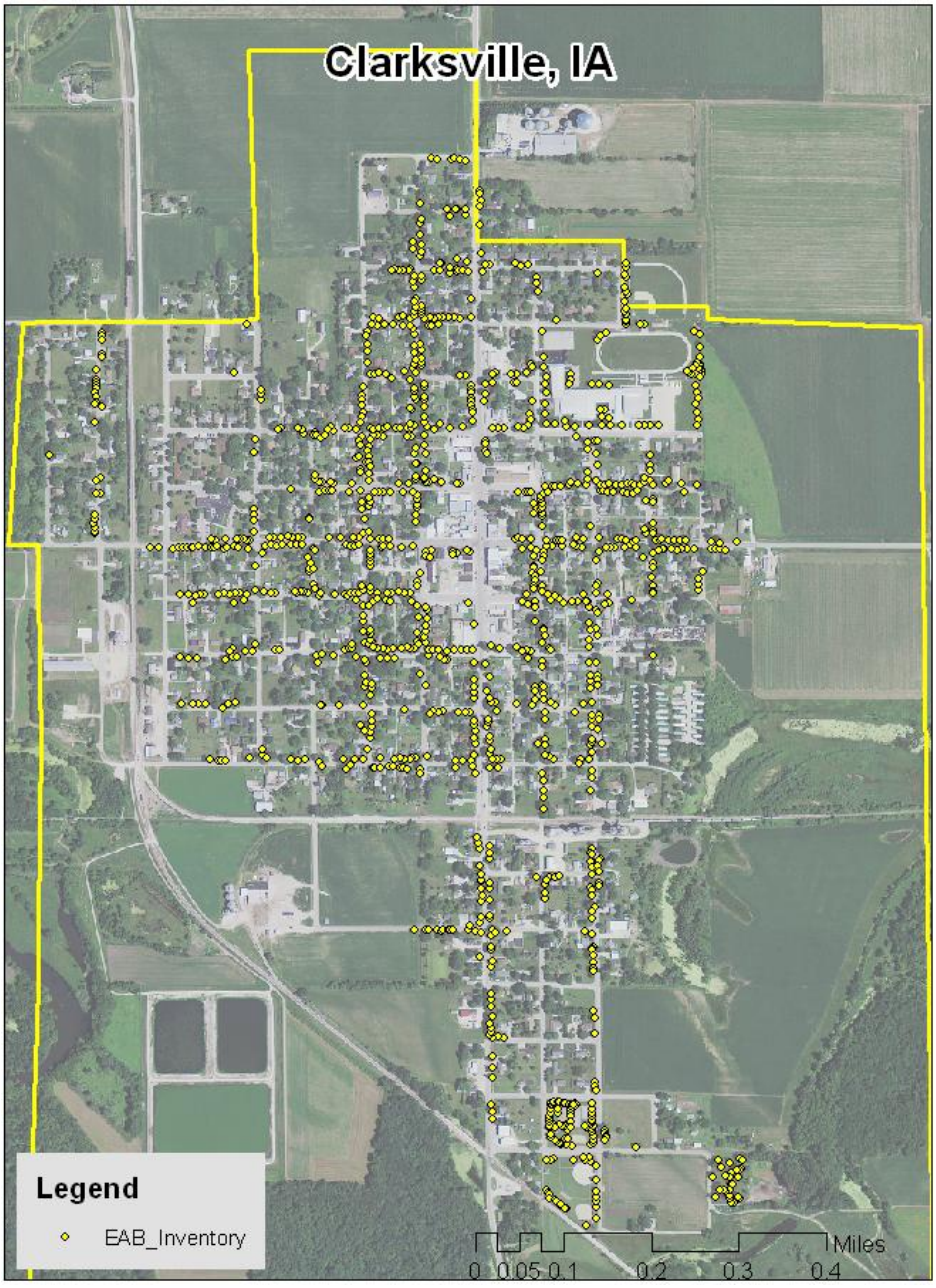
Clarksville, IA



2013 Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Clarksville with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 12% of Clarksville's city owned trees (ash) will die once EAB becomes established in the community. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2012, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 1,196 trees inventoried.

- Clarksville's trees provide $174,121 of benefits annually, an average of $145 a tree
- There are over 52 species of trees
- The top three genus are: maple 32%, oak 15%, hackberry 14%
- 7% of trees are in need of some type of management
- 28 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 28 trees needing removal, 3 trees are critical concerns and must be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- 36 of the 148 ash trees are in need of follow up because they are displaying signs and symptoms associated with EAB
- Marked 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: Boxelder, Green Ash, White Ash, Black Ash, Cottonwood, Mulberry, Willow, Black Locust, Lombardy and White Poplar, Tree of Heaven, Silver Maple, Russian Olive, Walnut or Maple
- Check ash trees with a visual survey yearly
- A budget increase is necessary to plan for EAB

Introduction

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

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

Inventory

In 2012, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. Additionally, the trees at Clarksville High School were included as well. 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 1,196 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool (STREETS) as 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. Clarksville's trees reduce energy related costs by approximately $49,411 annually (Appendix A, Table 1). These savings are both in Electricity (236.6 MWh) and in Natural Gas (32092.1 Therms).

Annual Stormwater Benefits

Clarksville's trees intercept about 2,277,401 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $ 61,722 of benefits to the city.

Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and emitting volatile organic mater (ozone). In Clarksville, it is estimated that trees remove 2,921.5 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 $ 8,185 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Clarksville, trees sequester about 816,602 lbs of carbon a year with an associated value of $ 6,125 (Appendix A, Table 4). In addition, the trees store 7,134,914 lbs of carbon, with a yearly benefit of $ 53,512 (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. Clarksville receives $ 48,679 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, Clarksville's trees provide $174,121 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 1,196 trees in Clarksville provide approximately $146 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Clarksville has over 52 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Maple	384	32%
Oak	183	15%
Northern hackberry	163	14%
Ash	148	12%
Linden	51	4%
Pine	36	3%
Black walnut	32	3%
American sycamore	26	2%
Apple	25	2%
Spruce	22	2%
Elm	20	2%
Honeylocust	18	2%
Tulip tree	8	1%
Eastern red cedar	7	1%
Pear	7	1%
Dogwood	6	1%
Ginkgo	6	1%
Kentucky coffeetree	6	1%
Eastern hophornbeam	4	<1%
Plum	3	<1%
Ohio buckeye	1	<1%
Catalpa	1	<1%
Southern magnolia	1	<1%
Mulberry	1	<1%
Eastern cottonwood	1	<1%
Black cherry	1	<1%
Japanese tree lilac	1	<1%
Northern white cedar	1	<1%
Broadleaf Deciduous Medium	**25**	**2%**
Broadleaf Deciduous Large	3	<1%
Broadleaf Deciduous Small	3	<1%
Broadleaf Evergreen Medium	1	<1%
Conifer Evergreen Medium	1	<1%

Age Class

Most of Clarksville's trees (45.6%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, a Bell Curve is preferred and shows the highest amount of trees around

18 inches in diameter at 4.5 ft. Clarksville's size curve is on the smaller side, indicating a younger than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Clarksville indicate that 84% of the trees are in good health, with only 3% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Additionally, 43% of Clarksville'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 8% of the population. This 8% is an estimate of trees that need management follow up.

Management Needs

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

Crown Cleaning	43	4%
Tree Staking	2	2%
Tree Removal	28	2%
Crown Raising	5	1%
Crown Reduction	4	<1%

Canopy Cover

The canopy cover of Clarksville is approximately 25 acres (Appendix A, Figure 4). According to the 2010 census, Clarksville occupies 877 acres. Thus the canopy cover on city land is about 3%.

Land Use and Location

The majority of Clarksville'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	82%
Park/vacant/other	17%
Industrial/Large commercial	< 1%

Location	
Planting strip	60%
Front yard	22%
Other maintained locations	18%
Other unmaintained locations	<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 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

Clarksville has 10 critical concern trees with 3 that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 5). It is recommended to start with the large diameter critical concern trees first. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 54 trees with these needs.

Poor tree species

After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 28 removals, 1 is an ash tree. There are a total of 148 ash trees, and 36 of those have signs and symptoms that have been associated with EAB. In addition, there are 21 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 trees be assessed for pruning 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 Clarksville.

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 (32%) (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: Boxelder, Green Ash, White Ash, Black Ash, Cottonwood, Mulberry, Willow, Black Locust, Lombardy and White Poplar, Tree of Heaven, Silver Maple, Russian Olive, Walnut or Soft Maple as outlined in section 151.04 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.04 (Appendix C).

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

Year 1

Removal: 10 critical concern trees
Planting and Replacement: 12 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 6 immediate trees
Planting and Replacement: 7 trees in open locations
Routine trimming: Contract to trim 1/3 of the city trees in need (18 trees)
Visual Survey for signs and symptoms of EAB

Year 3

Removal: 10 immediate trees
Planting and Replacement: 12 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 4

Removal: 2 trees immediate trees and removal of any new critical concern trees and ash in poor health (8)
Planting and Replacement: 7 trees in open locations
Routine trimming: Contract to trim 1/3 of the city trees (18 trees)
Visual Survey for signs and symptoms of EAB

Year 5

Removal: Removal of any new critical concern trees and ash in poor health (18 trees)
Planting and Replacement: 12 trees to be planted in open locations previous removals
Visual Survey for signs and symptoms of EAB

Year 6

Removal: 6 trees - removal of any new critical concern trees and ash in poor health
Planting and Replacement: 7 trees in open locations from previous removals

Routine trimming: Contract to trim 1/3 of the city trees (14 trees)
Visual Survey for signs and symptoms of EAB

*If EAB treatment is not used: Approximately 148 ash trees will be removed It will take approximately 18 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 years of its arrival.
** To remove all ash trees within 6 years, the budget would need to be increased to $21,183 a year. If the budget were increased to $10,000 a year all ash could be removed in 14 years.

Emerald Ash Borer: See Appendix C for Plan

Emerald Ash Borer Plan

Clarksville developed an emerald ash borer plan that outlines strategies and goals to prepare for the invasive pest. Included in the plan is conducting an inventory and the development of this urban forest management plan. The full EAB plan can be found in Appendix D.

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

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of over 25 million ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

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

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

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed ash trees will be replaced. All trees will meet the restrictions in city ordinance 151.04 (Appendix C). The new plantings will be a diverse mix and will not include Boxelder, Green Ash, White Ash, Black Ash, Cottonwood, Mulberry, Willow, Black Locust, Lombardy and White Poplar, Tree of Heaven, Silver Maple, Russian Olive, Walnut or Soft Maple.

Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genus other than ash will be prioritized by hazardous or emergency situations only.

Monitoring

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

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB. City Code 151.08 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 fourteen (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
Total $48,000 over 6 years ($6,800/year)

FY 2013 Budget
Removal: $5,000
Planting: $1,200
Watering & Maintenance: $600

FY 2014 Budget
Removal: $3,000
Planting: $700
Routine trimming: $2,700
Watering & Maintenance: $50

FY 2015 Budget
Removal: $5,000
Planting: $1,200
Watering & Maintenance: $600

FY 2016 Budget
Removal: $3,000
Planting: $700
Routine trimming: $2,700
Watering & Maintenance: $50

FY 2017 Budget
Removal: $5,000
Planting: $1,200
Watering & Maintenance: $600

FY 2018 Budget
Removal: $3,000
Planting: $700
Routine trimming: $2,700
Watering & Maintenance: $50

* If EAB treatment is not used: Approximately 148 ash trees will be removed It will take approximately 18 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 years of its arrival.

Purposed Budget Increase

EAB could potentially kill all ash trees in Clarksville within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $21,183 a year. If the budget were increased to $10,000 a year all ash could be removed within 14 years. Additionally, it is recommended that Clarksville 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

Clarksville

Annual Energy Benefits of Public Trees by Species

1/14/2013

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern hackberry	52.8	4,006	7,328.5	7,182	11,188	(N/A)	13.6	22.6	68.64
Green ash	27.7	2,100	3,618.1	3,546	5,646	(N/A)	10.9	11.4	43.43
Norway maple	27.7	2,104	3,860.0	3,783	5,887	(N/A)	10.8	11.9	45.63
Sugar maple	34.8	2,645	4,640.9	4,548	7,193	(N/A)	9.9	14.6	60.96
Northern red oak	6.3	478	867.1	850	1,328	(N/A)	5.8	2.7	19.25
Black maple	14.0	1,061	1,817.4	1,781	2,842	(N/A)	4.9	5.8	48.17
Bur oak	9.2	696	1,243.5	1,219	1,915	(N/A)	4.9	3.9	33.02
Silver maple	16.2	1,228	2,109.6	2,067	3,296	(N/A)	4.6	6.7	59.92
American basswood	6.7	511	999.8	980	1,491	(N/A)	3.6	3.0	34.67
Swamp white oak	3.2	243	456.6	448	690	(N/A)	3.2	1.4	18.17
Black walnut	7.4	560	977.8	958	1,518	(N/A)	2.7	3.1	47.44
American sycamore	2.1	161	293.4	288	448	(N/A)	2.2	0.9	17.24
Broadleaf Deciduous	1.2	93	182.5	179	271	(N/A)	2.1	0.6	10.86
Apple	1.2	95	208.8	205	299	(N/A)	2.1	0.6	11.98
Red maple	2.8	209	367.2	360	569	(N/A)	1.7	1.2	28.45
Eastern white pine	3.2	246	427.4	419	665	(N/A)	1.6	1.4	35.00
White ash	1.5	115	194.9	191	306	(N/A)	1.5	0.6	17.01
Honeylocust	3.0	224	387.9	380	604	(N/A)	1.5	1.2	33.57
Scotch pine	1.8	139	223.1	219	358	(N/A)	1.4	0.7	21.03
White oak	1.1	86	149.3	146	232	(N/A)	1.3	0.5	15.49
Other street trees	12.7	961	1,738.3	1,703	2,664	(N/A)	10.0	5.4	22.39
Citywide total	236.6	17,960	32,092.1	31,450	49,411	(N/A)	100.0	100.0	41.31

Table 2: Annual Stormwater Benefits

Clarksville

Annual Stormwater Benefits of Public Trees by Species

1/14/2013

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern hackberry	473,724	12,839	(N/A)	13.6	20.8	78.77
Green ash	242,012	6,559	(N/A)	10.9	10.6	50.45
Norway maple	219,440	5,947	(N/A)	10.8	9.6	46.10
Sugar maple	413,404	11,204	(N/A)	9.9	18.2	94.95
Northern red oak	49,369	1,338	(N/A)	5.8	2.2	19.39
Black maple	109,403	2,965	(N/A)	4.9	4.8	50.25
Bur oak	84,946	2,302	(N/A)	4.9	3.7	39.69
Silver maple	210,107	5,694	(N/A)	4.6	9.2	103.53
American basswood	68,096	1,846	(N/A)	3.6	3.0	42.92
Swamp white oak	17,540	475	(N/A)	3.2	0.8	12.51
Black walnut	70,995	1,924	(N/A)	2.7	3.1	60.13
American sycamore	24,267	658	(N/A)	2.2	1.1	25.30
Broadleaf Deciduous	9,275	251	(N/A)	2.1	0.4	10.05
Apple	4,346	118	(N/A)	2.1	0.2	4.71
Red maple	17,436	473	(N/A)	1.7	0.8	23.63
Eastern white pine	75,707	2,052	(N/A)	1.6	3.3	107.99
White ash	9,407	255	(N/A)	1.5	0.4	14.16
Honeylocust	18,208	493	(N/A)	1.5	0.8	27.41
Scotch pine	21,440	581	(N/A)	1.4	0.9	34.18
White oak	7,164	194	(N/A)	1.3	0.3	12.94
Other street trees	131,117	3,554	(N/A)	10.0	5.8	29.86
Citywide total	2,277,401	61,722	(N/A)	100.0	100.0	51.61

Table 3: Annual Air Quality Benefits

Clarksville

Annual Air Quality Benefits of Public Trees by Species

1/14/2013

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
Northern hackberry	71.2	12.3	36.8	3.2	390	253.3	36.8	35.1	239.4	1,575	0.0	0	688.1	1,965	(N/A)	13.6	12.06
Green ash	24.6	3.9	12.8	1.1	134	130.6	19.1	18.3	125.4	817	0.0	0	335.8	951	(N/A)	10.9	7.32
Norway maple	40.7	7.0	20.6	1.8	222	133.2	19.3	18.4	125.8	828	-9.9	-37	357.0	1,012	(N/A)	10.8	7.85
Sugar maple	57.1	9.7	28.0	2.5	308	165.0	24.1	23.0	157.8	1,031	-44.5	-167	422.8	1,172	(N/A)	9.9	9.93
Northern red oak	9.2	1.6	4.7	0.4	50	30.1	4.4	4.2	28.6	187	-13.2	-49	69.9	188	(N/A)	5.8	2.73
Black maple	25.0	4.3	11.8	1.1	134	65.8	9.6	9.2	63.3	412	-8.6	-32	181.6	514	(N/A)	4.9	8.71
Bur oak	8.8	1.4	4.5	0.4	48	43.7	6.4	6.1	41.6	272	0.0	0	112.8	320	(N/A)	4.8	5.52
Silver maple	33.8	5.7	16.9	1.5	183	76.1	11.2	10.7	73.2	477	-18.0	-68	211.0	592	(N/A)	4.6	10.77
American basswood	8.6	1.5	4.3	0.4	47	32.9	4.7	4.5	30.6	203	-7.5	-28	79.9	222	(N/A)	3.6	5.15
Swamp white oak	2.1	0.4	1.3	0.1	12	15.5	2.2	2.1	14.5	96	-0.6	-2	37.6	106	(N/A)	3.2	2.78
Black walnut	7.9	1.3	3.9	0.4	43	34.9	5.1	4.9	33.4	218	0.0	0	91.8	261	(N/A)	2.7	8.15
American sycamore	3.0	0.5	1.4	0.1	16	10.1	1.5	1.4	9.6	63	0.0	0	27.6	79	(N/A)	2.2	3.03
Broadleaf Deciduous	1.6	0.3	0.8	0.1	9	6.0	0.9	0.8	5.5	37	-0.4	-2	15.6	44	(N/A)	2.1	1.77
Apple	0.8	0.1	0.4	0.0	4	6.3	0.9	0.8	5.7	38	0.0	0	15.0	43	(N/A)	2.1	1.70
Red maple	3.2	0.5	1.6	0.1	17	13.0	1.9	1.8	12.5	82	-1.2	-4	33.5	94	(N/A)	1.7	4.71
Eastern white pine	9.3	1.8	7.3	1.1	60	15.3	2.2	2.1	14.7	96	-45.6	-171	8.3	-15	(N/A)	1.6	-0.79
White ash	0.4	0.1	0.3	0.0	2	7.1	1.0	1.0	6.9	45	0.0	0	16.8	47	(N/A)	1.5	2.62
Honeylocust	2.9	0.5	1.5	0.1	16	13.9	2.0	1.9	13.4	87	-1.9	-7	34.4	96	(N/A)	1.5	5.32
Scotch pine	2.3	0.5	2.0	0.3	15	8.5	1.3	1.2	8.3	53	-7.4	-28	16.9	41	(N/A)	1.4	2.42
White oak	0.4	0.1	0.3	0.0	2	5.4	0.8	0.7	5.1	33	0.0	0	12.7	36	(N/A)	1.3	2.38
Other street trees	21.4	3.7	12.3	1.4	122	60.5	8.8	8.4	57.4	377	-21.6	-81	152.2	417	(N/A)	9.9	3.51
Citywide total	334.2	57.1	173.6	16.2	1,833	1,127.2	164.3	156.7	1,072.6	7,029	-180.4	-677	2,921.5	8,185	(N/A)	100.0	6.84

Table 4: Annual Carbon Stored

Clarksville

Stored CO2 Benefits of Public Trees by Species

1/14/2013

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern	1,063,137	7,974	(N/A)	13.6	14.9	48.92
Green ash	811,160	6,084	(N/A)	10.9	11.4	46.80
Norway maple	675,564	5,067	(N/A)	10.8	9.5	39.28
Sugar maple	1,651,196	12,384	(N/A)	9.9	23.1	104.95
Northern red oak	188,110	1,411	(N/A)	5.8	2.6	20.45
Black maple	274,287	2,057	(N/A)	4.9	3.8	34.87
Bur oak	290,689	2,180	(N/A)	4.9	4.1	37.59
Silver maple	745,057	5,588	(N/A)	4.6	10.4	101.60
American	313,864	2,354	(N/A)	3.6	4.4	54.74
Swamp white oak	38,191	286	(N/A)	3.2	0.5	7.54
Black walnut	259,265	1,944	(N/A)	2.7	3.6	60.77
American	98,843	741	(N/A)	2.2	1.4	28.51
Broadleaf	28,035	210	(N/A)	2.1	0.4	8.41
Apple	15,007	113	(N/A)	2.1	0.2	4.50
Red maple	37,543	282	(N/A)	1.7	0.5	14.08
Eastern white pine	118,294	887	(N/A)	1.6	1.7	46.70
White ash	16,930	127	(N/A)	1.5	0.2	7.05
Honeylocust	36,312	272	(N/A)	1.5	0.5	15.13
Scotch pine	15,326	115	(N/A)	1.4	0.2	6.76
White oak	14,156	106	(N/A)	1.3	0.2	7.08
Other street trees	201,372	3,330	(N/A)	10.0	6.2	27.98
Citywide total	7,134,914	53,512	(N/A)	100.0	100.0	44.74

Table 5: Annual Carbon Sequestered

Clarksville

Annual CO_2 Benefits of Public Trees by Species

1/14/2013

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
Northern hackberry	62,027	465	-5,103	-32	-39	88,526	664	145,418	1,091	(N/A)	13.6	17.8	6.69
Green ash	61,302	460	-3,894	-25	-29	46,404	348	103,788	778	(N/A)	10.9	12.7	5.99
Norway maple	43,950	330	-3,243	-25	-25	46,494	349	87,176	654	(N/A)	10.8	10.7	5.07
Sugar maple	81,444	611	-7,926	-23	-60	58,454	438	131,949	990	(N/A)	9.9	16.2	8.39
Northern red oak	8,508	64	-903	-13	-7	10,572	79	18,163	136	(N/A)	5.8	2.2	1.97
Black maple	21,010	158	-1,317	-12	-10	23,445	176	43,127	323	(N/A)	4.9	5.3	5.48
Bur oak	21,102	158	-1,395	-11	-11	15,387	115	35,083	263	(N/A)	4.9	4.3	4.54
Silver maple	60,687	455	-3,576	-11	-27	27,143	204	84,242	632	(N/A)	4.6	10.3	11.49
American basswood	19,385	145	-1,507	-8	-11	11,294	85	29,164	219	(N/A)	3.6	3.6	5.09
Swamp white oak	6,241	47	-183	-7	-1	5,369	40	11,420	86	(N/A)	3.2	1.4	2.25
Black walnut	16,714	125	-1,244	-6	-9	12,374	93	27,837	209	(N/A)	2.7	3.4	6.52
American sycamore	5,199	39	-474	-5	-4	3,549	27	8,268	62	(N/A)	2.2	1.0	2.39
Broadleaf Deciduous	2,157	16	-135	-5	-1	2,048	15	4,065	30	(N/A)	2.1	0.5	1.22
Apple	1,955	15	-72	-5	-1	2,094	16	3,973	30	(N/A)	2.1	0.5	1.19
Red maple	5,075	38	-180	-4	-1	4,621	35	9,512	71	(N/A)	1.7	1.2	3.57
Eastern white pine	2,007	15	-568	-4	-4	5,438	41	6,874	52	(N/A)	1.6	0.8	2.71
White ash	2,907	22	-81	-4	-1	2,545	19	5,368	40	(N/A)	1.5	0.7	2.24
Honeylocust	5,661	42	-174	-4	-1	4,952	37	10,435	78	(N/A)	1.5	1.3	4.35
Scotch pine	1,650	12	-74	-3	-1	3,070	23	4,643	35	(N/A)	1.4	0.6	2.05
White oak	2,376	18	-68	-3	-1	1,902	14	4,207	32	(N/A)	1.3	0.5	2.10
Other street trees	22,807	171	-2,131	-23	-16	21,236	159	41,889	314	(N/A)	10.0	5.1	2.64
Citywide total	454,165	3,406	-34,248	-233	-259	396,918	2,977	816,602	6,125	(N/A)	100.0	100.0	5.12

Table 6: Annual Social and Aesthetic Benefits

Clarksville

Annual Aesthetic/Other Benefits of Public Trees by Species

1/14/2013

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern hackberry	8,696	(N/A)	13.6	17.9	53.35
Green ash	5,844	(N/A)	10.9	12.0	44.95
Norway maple	4,372	(N/A)	10.8	9.0	33.89
Sugar maple	8,279	(N/A)	9.9	17.0	70.16
Northern red oak	783	(N/A)	5.8	1.6	11.34
Black maple	2,835	(N/A)	4.9	5.8	48.05
Bur oak	2,087	(N/A)	4.9	4.3	35.98
Silver maple	4,981	(N/A)	4.6	10.2	90.57
American basswood	1,493	(N/A)	3.6	3.1	34.72
Swamp white oak	730	(N/A)	3.2	1.5	19.20
Black walnut	1,513	(N/A)	2.7	3.1	47.29
American sycamore	555	(N/A)	2.2	1.1	21.35
Broadleaf Deciduous	265	(N/A)	2.1	0.5	10.61
Apple	109	(N/A)	2.1	0.2	4.34
Red maple	752	(N/A)	1.7	1.5	37.58
Eastern white pine	285	(N/A)	1.6	0.6	14.98
White ash	486	(N/A)	1.5	1.0	26.98
Honeylocust	1,210	(N/A)	1.5	2.5	67.25
Scotch pine	465	(N/A)	1.4	1.0	27.35
White oak	328	(N/A)	1.3	0.7	21.89
Other street trees	2,612	(N/A)	10.0	5.4	21.95
Citywide total	48,679	(N/A)	100.0	100.0	40.70

Table 7: Summary of Benefits in Dollars

Clarksville

Total Annual Benefits of Public Trees by Species ($)

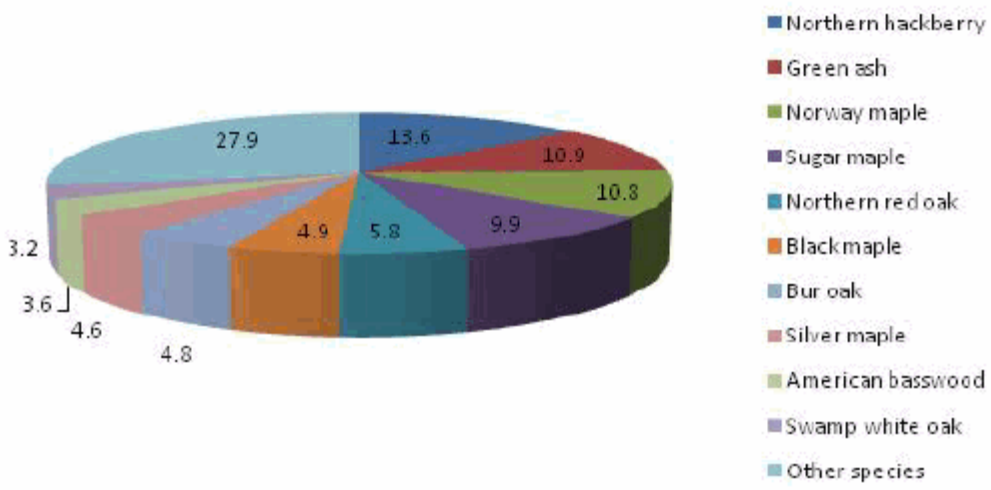
1/14/201

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Northern hackberry	11,188	1,091	1,965	12,839	8,696	35,779	(±0)	20.5
Green ash	5,646	778	951	6,559	5,844	19,778	(±0)	11.4
Norway maple	5,887	654	1,012	5,947	4,372	17,872	(±0)	10.3
Sugar maple	7,193	990	1,172	11,204	8,279	28,838	(±0)	16.6
Northern red oak	1,328	136	188	1,338	783	3,773	(±0)	2.2
Black maple	2,842	323	514	2,965	2,835	9,479	(±0)	5.4
Bur oak	1,915	263	320	2,302	2,087	6,887	(±0)	4.0
Silver maple	3,296	632	592	5,694	4,981	15,195	(±0)	8.7
American basswood	1,491	219	222	1,846	1,493	5,270	(±0)	3.0
Swamp white oak	690	86	106	475	730	2,087	(±0)	1.2
Black walnut	1,518	209	261	1,924	1,513	5,425	(±0)	3.1
American sycamore	448	62	79	658	555	1,802	(±0)	1.0
Broadleaf Deciduous	271	30	44	251	265	863	(±0)	0.5
Apple	299	30	43	118	109	598	(±0)	0.3
Red maple	569	71	94	473	752	1,959	(±0)	1.1
Eastern white pine	665	52	-15	2,052	285	3,038	(±0)	1.7
White ash	306	40	47	255	486	1,134	(±0)	0.7
Honeylocust	604	78	96	493	1,210	2,482	(±0)	1.4
Scotch pine	358	35	41	581	465	1,480	(±0)	0.8
White oak	232	32	36	194	328	822	(±0)	0.5
Other street trees	2,664	314	417	3,554	2,612	9,561	(±0)	5.5
Citywide Total	49,411	6,125	8,185	61,722	48,679	174,121	(±0)	100.0

Clarksville

Species Distribution of Public Trees (%)

1/14/2013



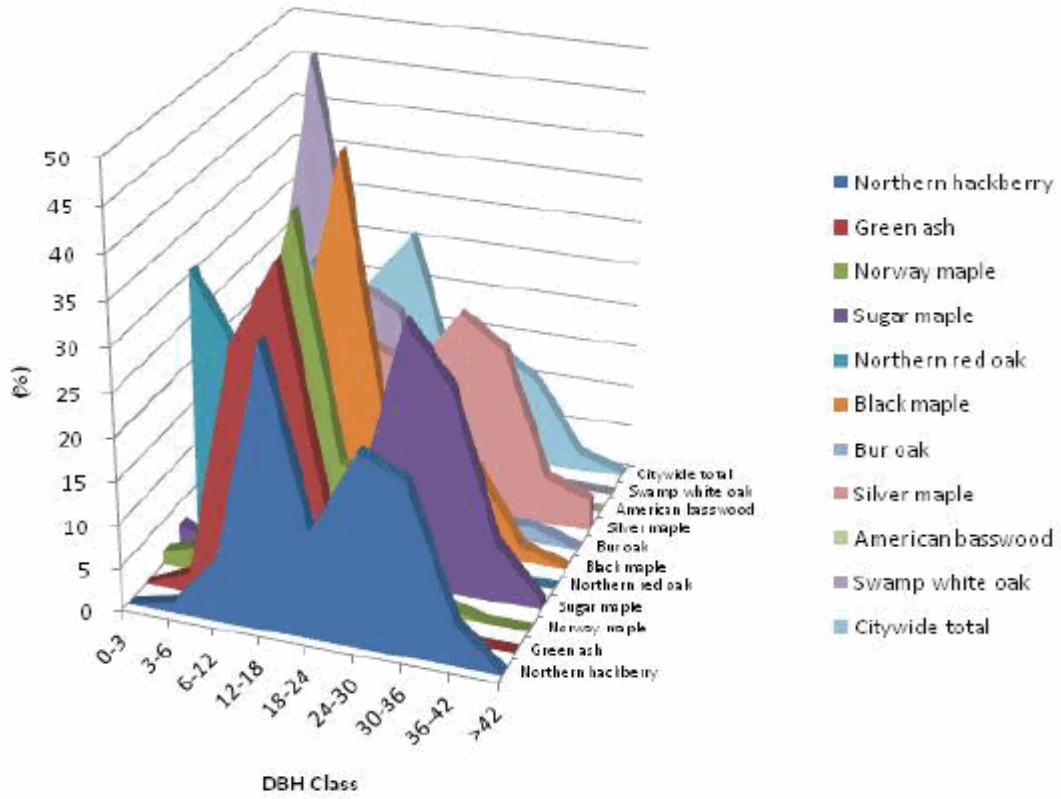
Species	Percent
Northern hackberry	13.6
Green ash	10.9
Norway maple	10.8
Sugar maple	9.9
Northern red oak	5.8
Black maple	4.9
Bur oak	4.8
Silver maple	4.6
American basswood	3.6
Swamp white oak	3.2
Other species	27.9
Total	100.0

Figure 1: Species Distribution

Clarksville

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

1/14/2013



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Northern hackberry	0.0	1.2	7.4	32.5	12.3	22.1	19.6	4.9	0.0
Green ash	0.0	2.3	29.2	39.2	12.3	9.2	7.7	0.0	0.0
Norway maple	1.6	3.1	21.7	42.6	15.5	14.0	1.6	0.0	0.0
Sugar maple	2.5	0.0	5.9	20.3	9.3	30.5	23.7	6.8	0.8
Northern red oak	30.4	21.7	20.3	13.0	2.9	8.7	2.9	0.0	0.0
Black maple	0.0	0.0	20.3	44.1	11.9	11.9	10.2	1.7	0.0
Bur oak	12.1	13.8	29.3	17.2	12.1	12.1	1.7	1.7	0.0
Silver maple	1.8	1.8	9.1	18.2	16.4	23.6	20.0	5.5	3.6
American basswood	20.9	7.0	30.2	2.3	7.0	18.6	14.0	0.0	0.0
Swamp white oak	13.2	47.4	21.1	18.4	0.0	0.0	0.0	0.0	0.0
Citywide total	9.9	9.5	19.6	26.0	8.9	13.7	9.9	1.9	0.4

Figure 2: Relative Age Class

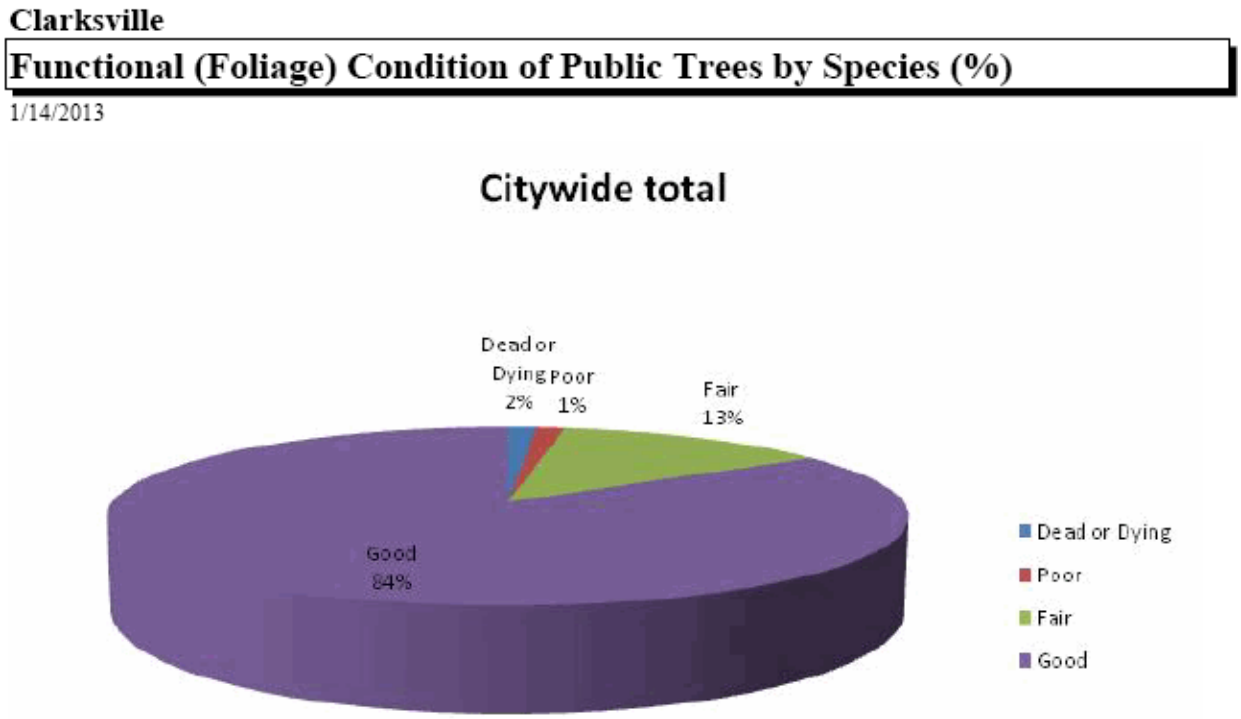


Figure 3: Foliage Condition

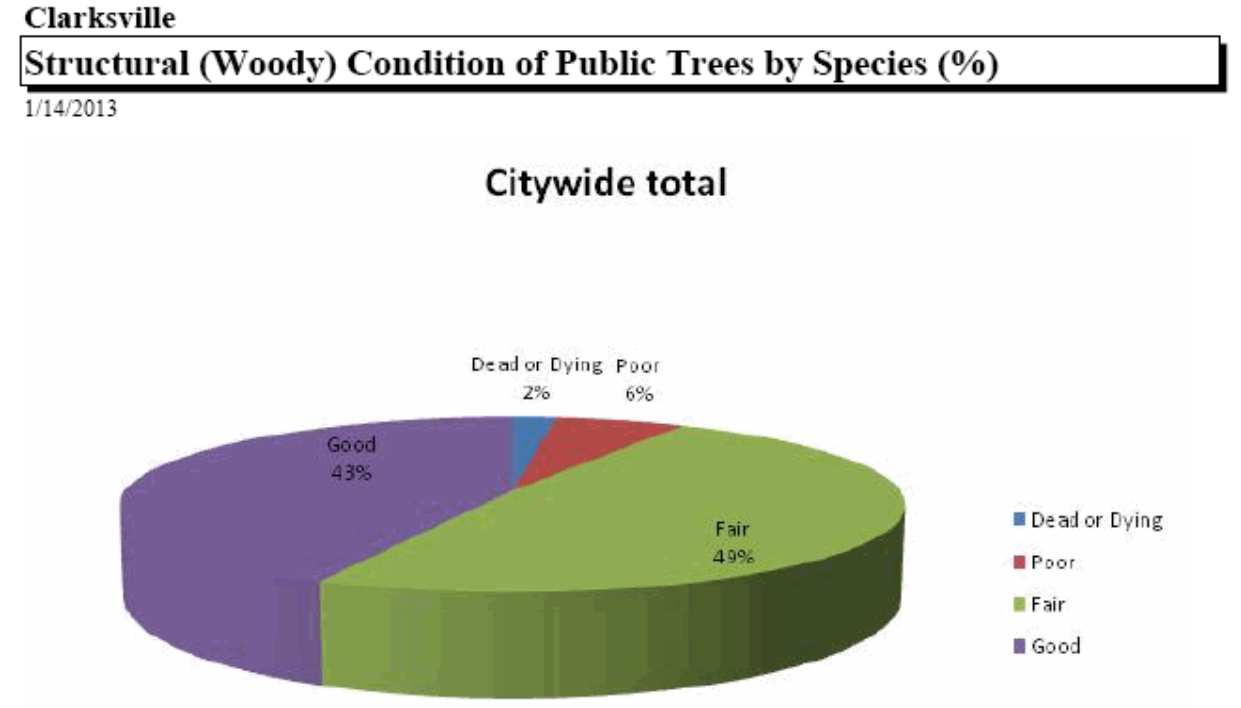
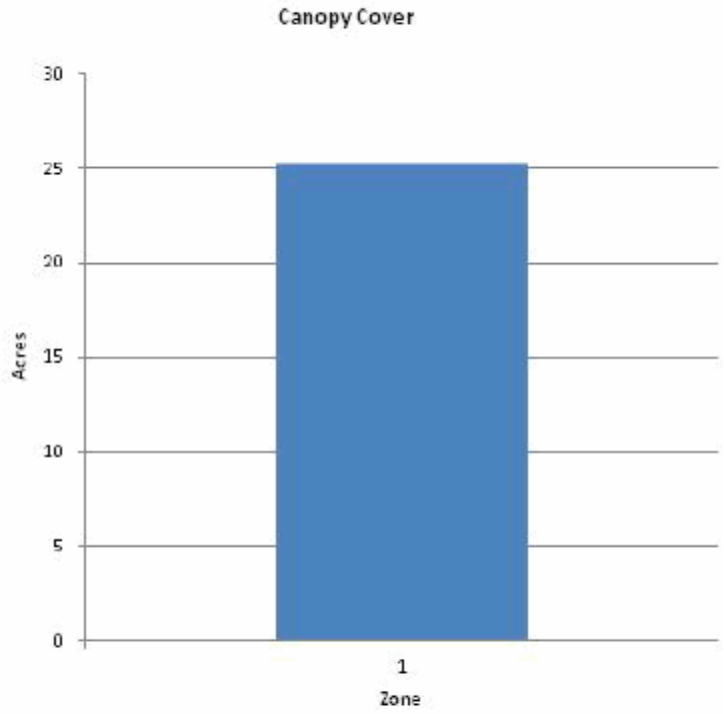


Figure 4: Wood Condition

Clarksville

Canopy Cover of Public Trees (Acres)

1/14/2013



Zone	Acres	% of Total Canopy Cover
1	25	100.0
Citywide total	25	100.0

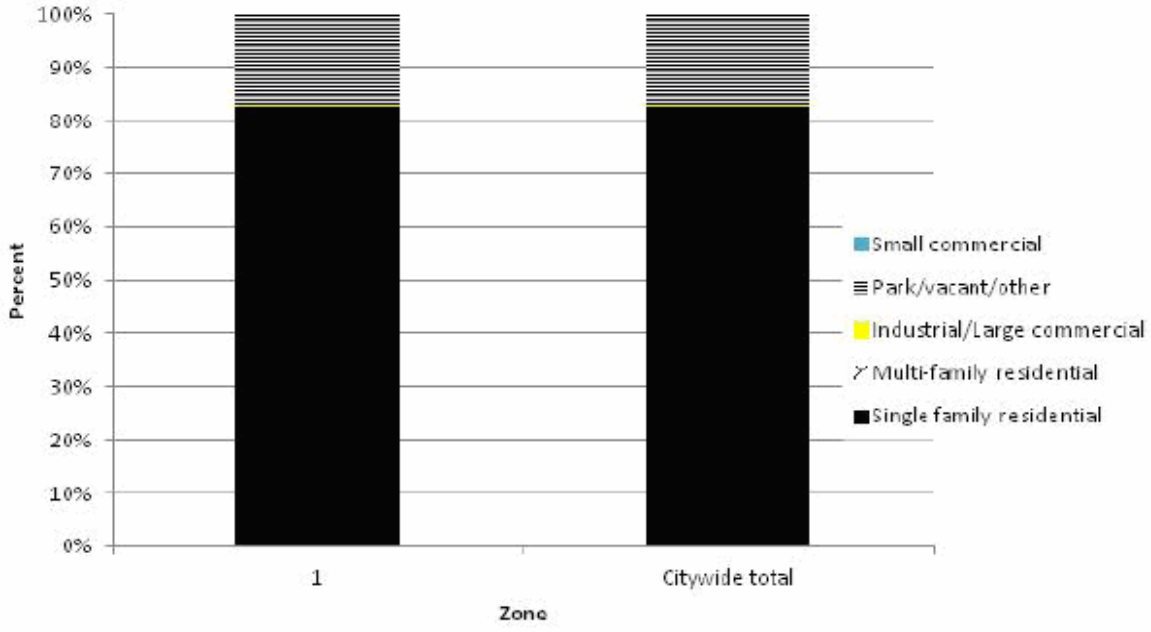
	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide	0	0	25		

Figure 5: Canopy Cover in Acres

Clarksville

Land Use of Public Trees by Zone (%)

1/14/2013



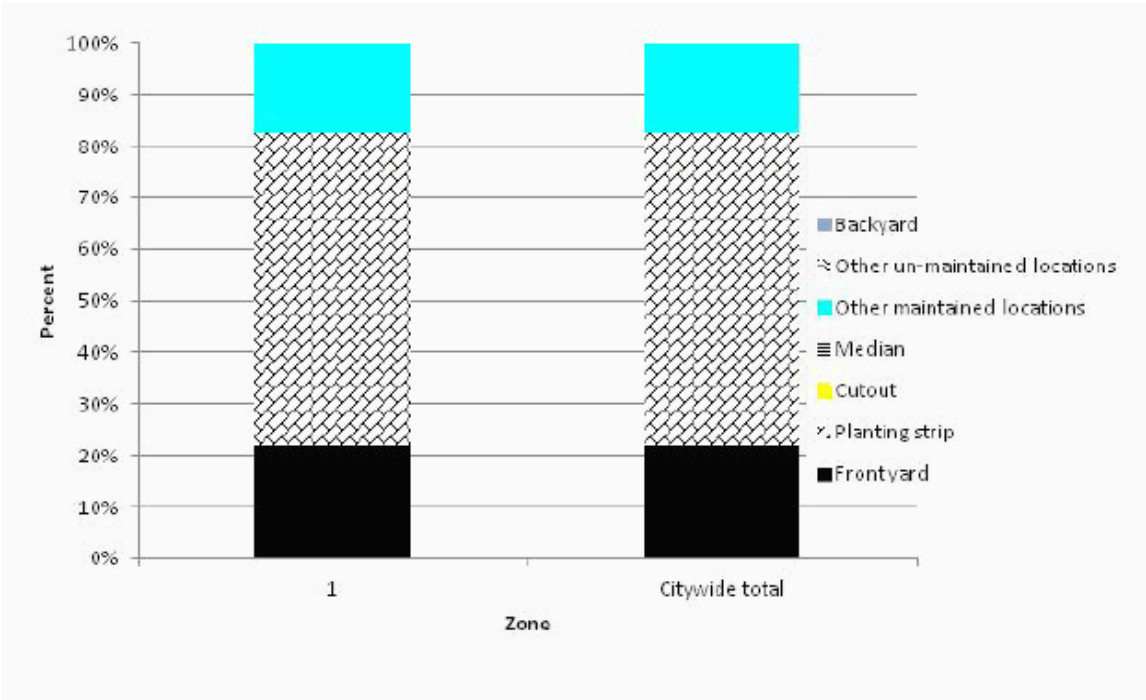
Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	82.4	0.0	0.4	17.1	0.0
Citywide total	82.4	0.0	0.4	17.1	0.0

Figure 6: Land Use of city/park trees

Clarksville

Location of Public Trees by Zone (%)

1/14/2013



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	22.1	60.4	0.0	0.0	17.5	0.1	0.0
Citywide total	22.1	60.4	0.0	0.0	17.5	0.1	0.0

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

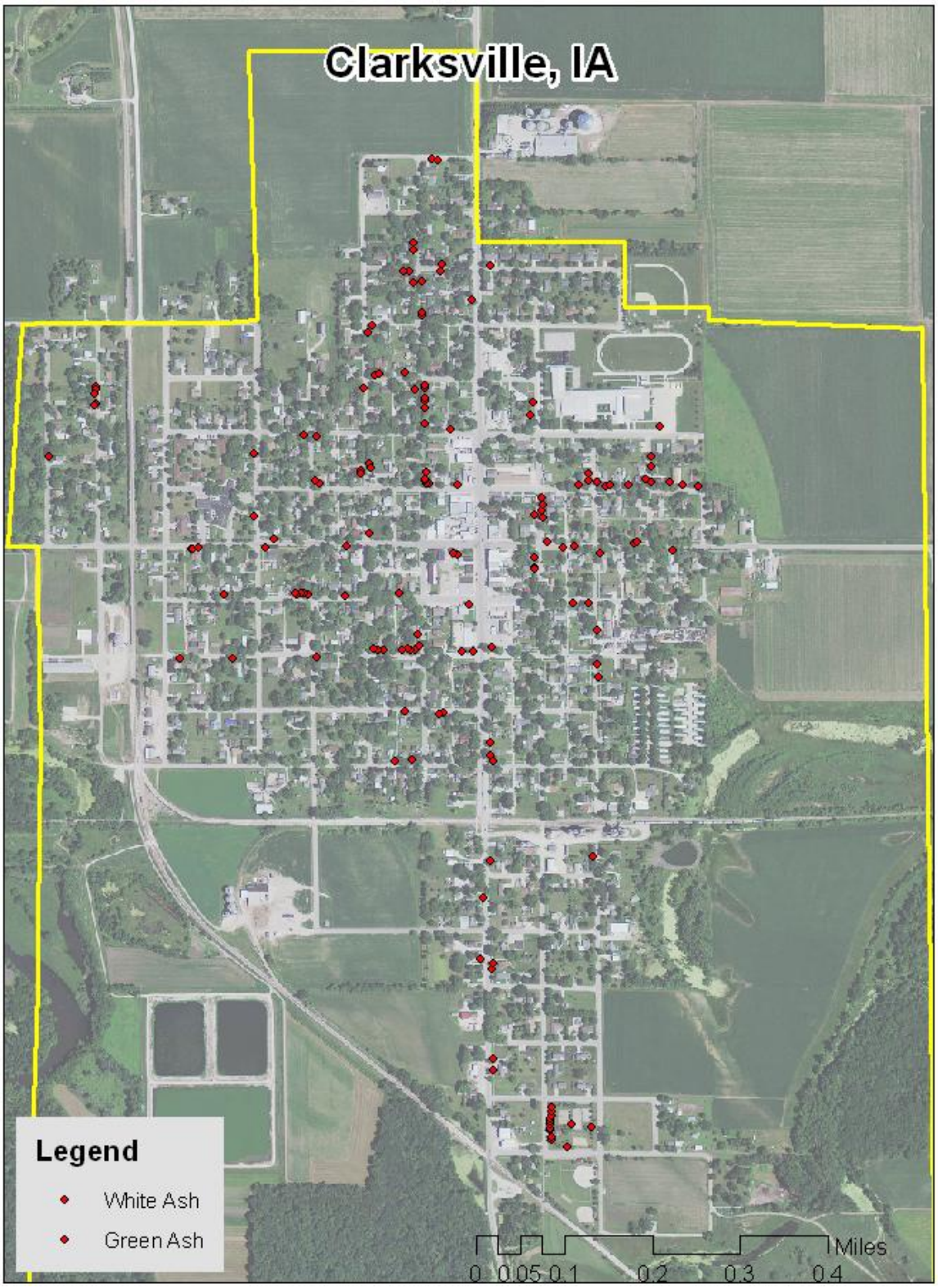


Figure 1: Location of Ash Trees

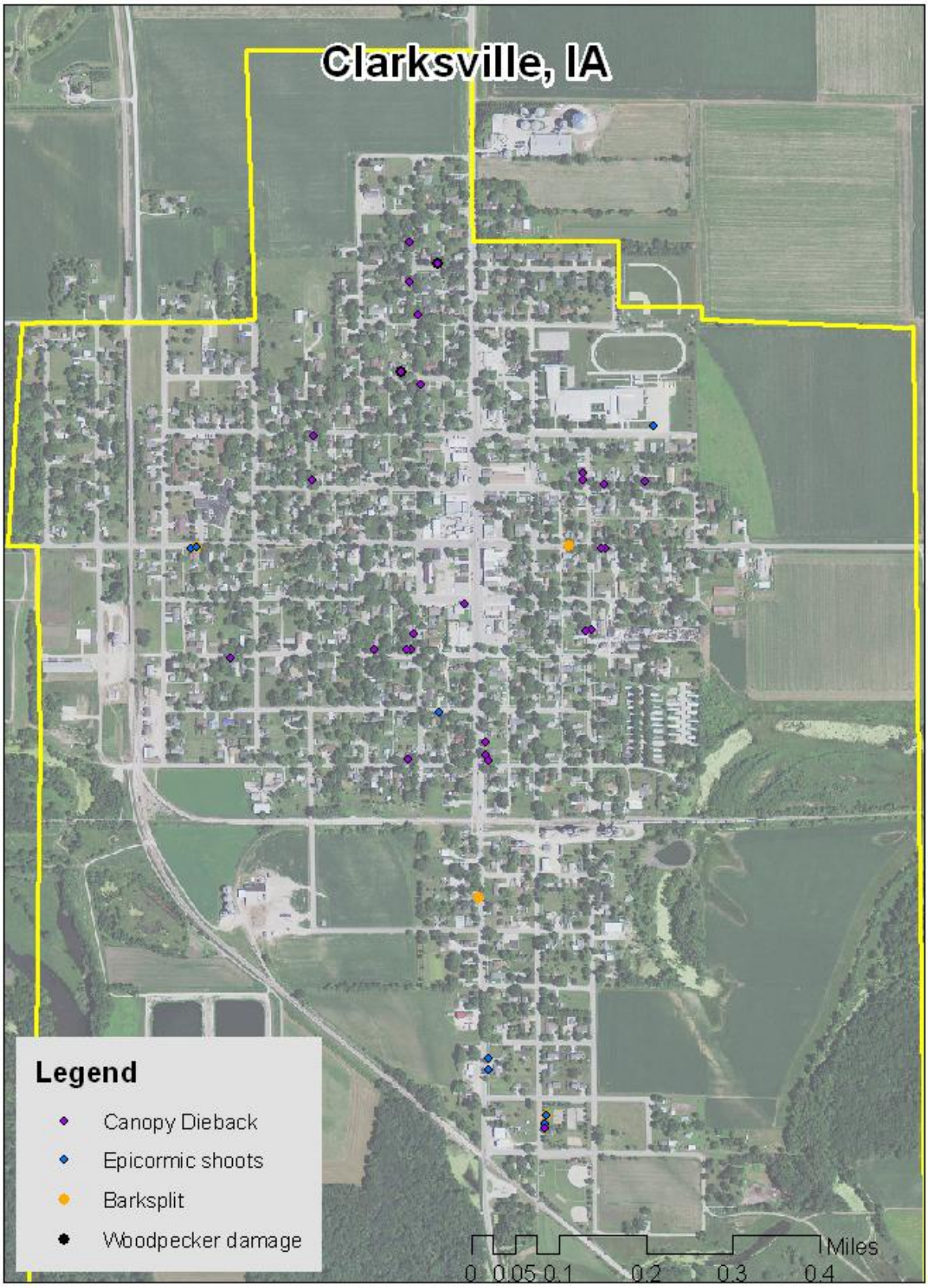


Figure 2: Location of EAB symptoms

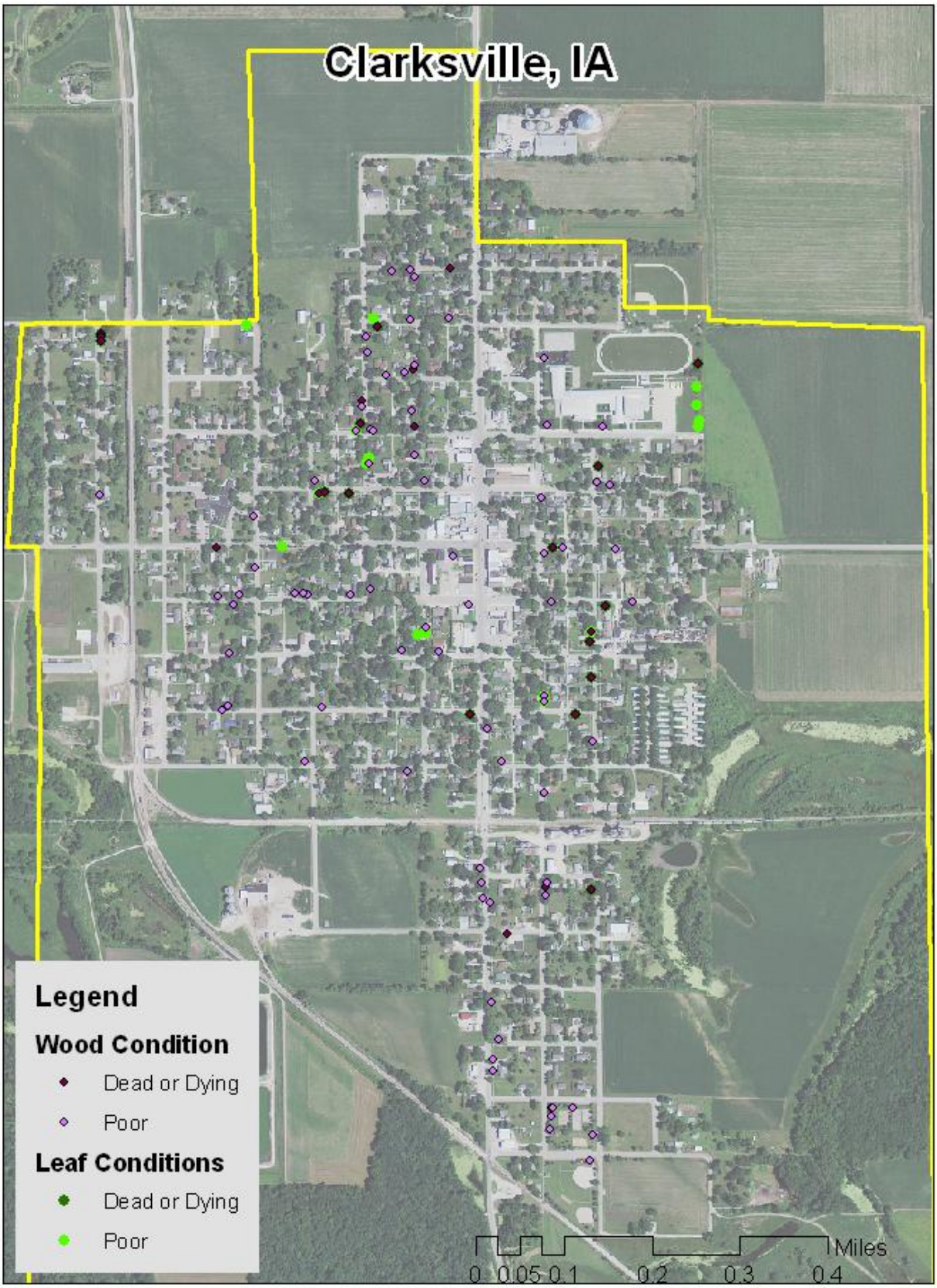


Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

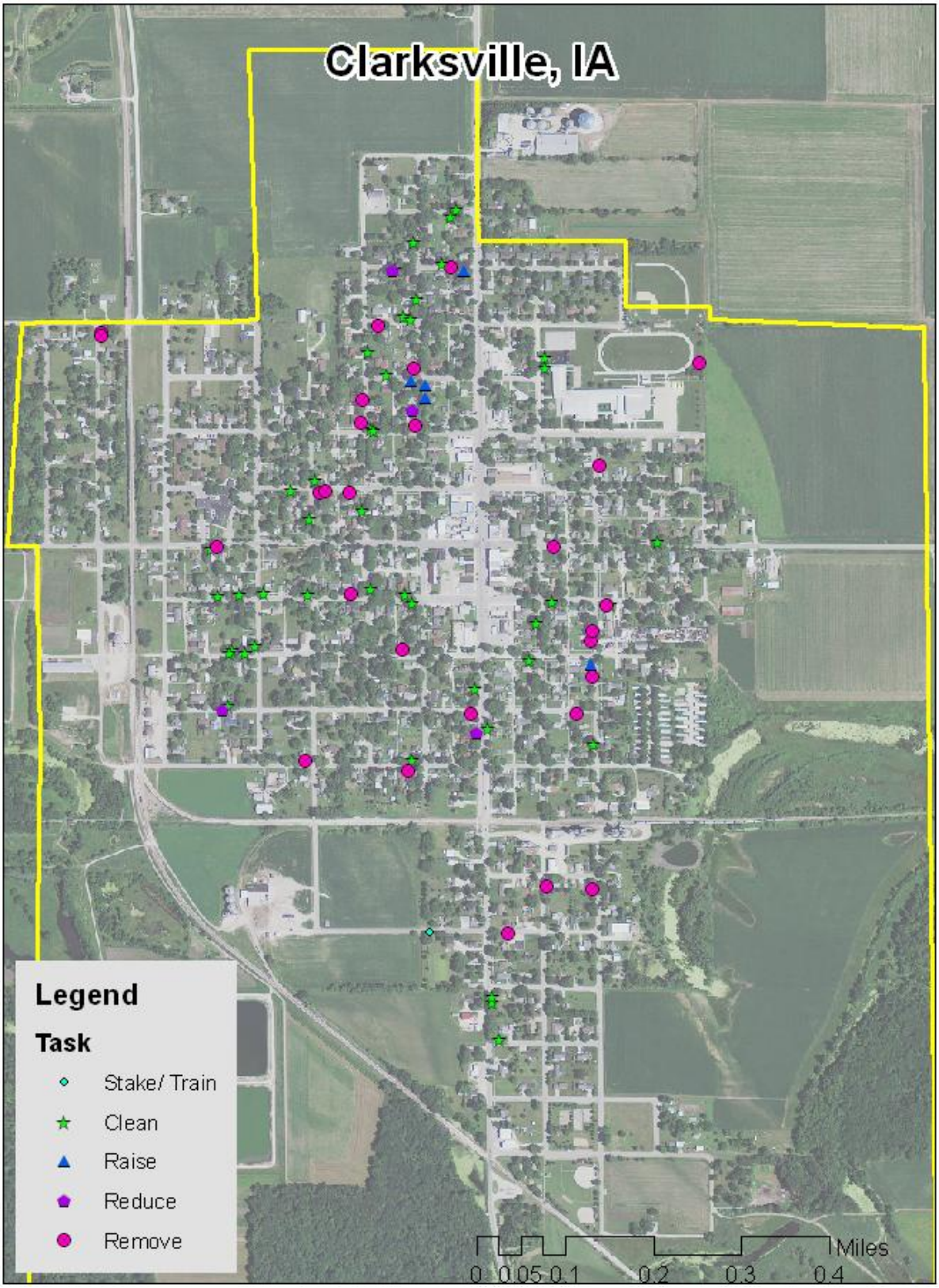


Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

Appendix C: Clarksville Tree Ordinances

CHAPTER 151

TREES

151.01 DEFINITIONS. For use in this chapter, "parking" or "R.O.W." 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. "Hazard tree" is a tree that has a defect that creates an unreasonable risk of branch, stem, or root failure and has a target present so if the tree fails, damage to property or personal injury could result.

151.02 TREE BOARD. The City shall have a Tree Board, a.k.a. Clarksville Trees Forever, with a membership of no less than 5 people, approved by the City Council for the purpose of encouraging the planting and care of trees in Clarksville. The Tree Board shall meet at least once annually, select its own officers, and maintain regular minutes of its meetings. The duties of the Tree Board are to offer recommendations on planting and care of trees located in the R.O.W. and on determining hazard trees. In addition, the Tree Board will review permits to plant or remove trees in the R.O.W.

151.03 PERMIT REQUIRED. A permit is required to plant or remove a tree in the city R.O.W. area. The permit is free.

151.04 PLANTING RESTRICTIONS. No tree shall be planted in any parking area 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 on a line ten (10) feet from the property line.

2. Spacing. Trees shall not be planted on any parking which is less than (4 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 thirty (20) feet from street intersections (property lines extended), ten (10) feet from driveways.

3. Prohibited Trees. No Boxelder, Green Ash, White Ash, Black Ash, Cottonwood, Mulberry, Willow, Black Locust, Lombardy and White Poplar, Tree of Heaven, Silver Maple, Russian Olive, Evergreens, Walnut or Soft Maple shall be planted in the parking.

151.05 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])

151.06 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.

151.07 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.

151.08 HAZARD TREES. The Council, Public Works Director, and Tree Board members shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased, damaged, or a hazard tree. The City Council will make the final determination and take action. The following guidelines will be used to determine a total risk rating of hazard trees:

Future Potential/Defect Severity	Points
• Critical Defect -Failure Imminent	10
• Severe Defect – Failure likely in storms	7
• Moderate Defect –Failure possible in severe storms	4
• Slight Defect – Failure unlikely	1

Size of Plant Part

• Branch/leader > 20” DBH	5
• Branch 15 – 20”	4
• Branch 9 – 14”	3
• Branch 3 – 8”	2
• Branch < 3”	1

Total Risk Rating

- 13-15 Highest Risk/Critical
- 11-12 Severe Risk
- 9-10 Moderate Risk
- <9 Low Risk

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, pruning, 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. No unauthorized person shall remove any tree or shrub on City property without the completion of a permit and approval by City Council., if the tree is determined to be a hazard tree then the City is responsible for removal, stump-grinding, and associated costs. If the tree is considered objectionable but not a hazard and permit is approved by City Council, then the homeowner is responsible for removal, stump-grinding, and associated costs, plus $100 to replant a tree elsewhere in town.

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 fourteen (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])

Appendix D: Clarksville Tree Ordinances

Clarksville Emerald Ash Borer Plan
July, 2012

I. Conduct a Street and Public Property Tree Inventory
- Work with Iowa DNR Urban Forester to conduct an inventory
- Discuss how to utilize information after inventory– keep it current
- Review tree ordinance and go through EAB Planning Worksheet
- Utilize Lloyd's existing map of ash trees
- Estimate removal and treatment costs

II. Develop Management Plan
- Prioritize removal and/or treatment by location, condition, and financial considerations
- Discuss option to treat a portion of ash trees
- Review of in house equipment and capabilities
- Review options for contracted removal
- Identify locations for stockpiling and destroying wood
- Inspect all removed wood and dispose properly

III. Develop Communication Plan
- Share educational materials with public including ash identification, quarantine regulations, firewood transportation regulations, places where ash can be stored, use of ash wood, removals on public property

- Communicate with council, school, Butler CCB, golf course (probably has ~30% ash trees), other local TF groups (Greene, Allison, Parkersburg- more efficient to work with contractor to treat ash trees if have several trees in one area to treat)
- Continually update decision makers
- Communicate in a variety of ways – public meetings, article in newspaper, city website, Facebook, city newsletter, electronic sign, and handouts at library? city bills?
- Develop recommendations on trees to replant for homeowners (not all maples!)

IV. Develop Funding Strategies
- Involve external partners in discussions- Iowa DNR Forestry, Trees Forever, CCB
- Explore market for usable wood
- Research grants