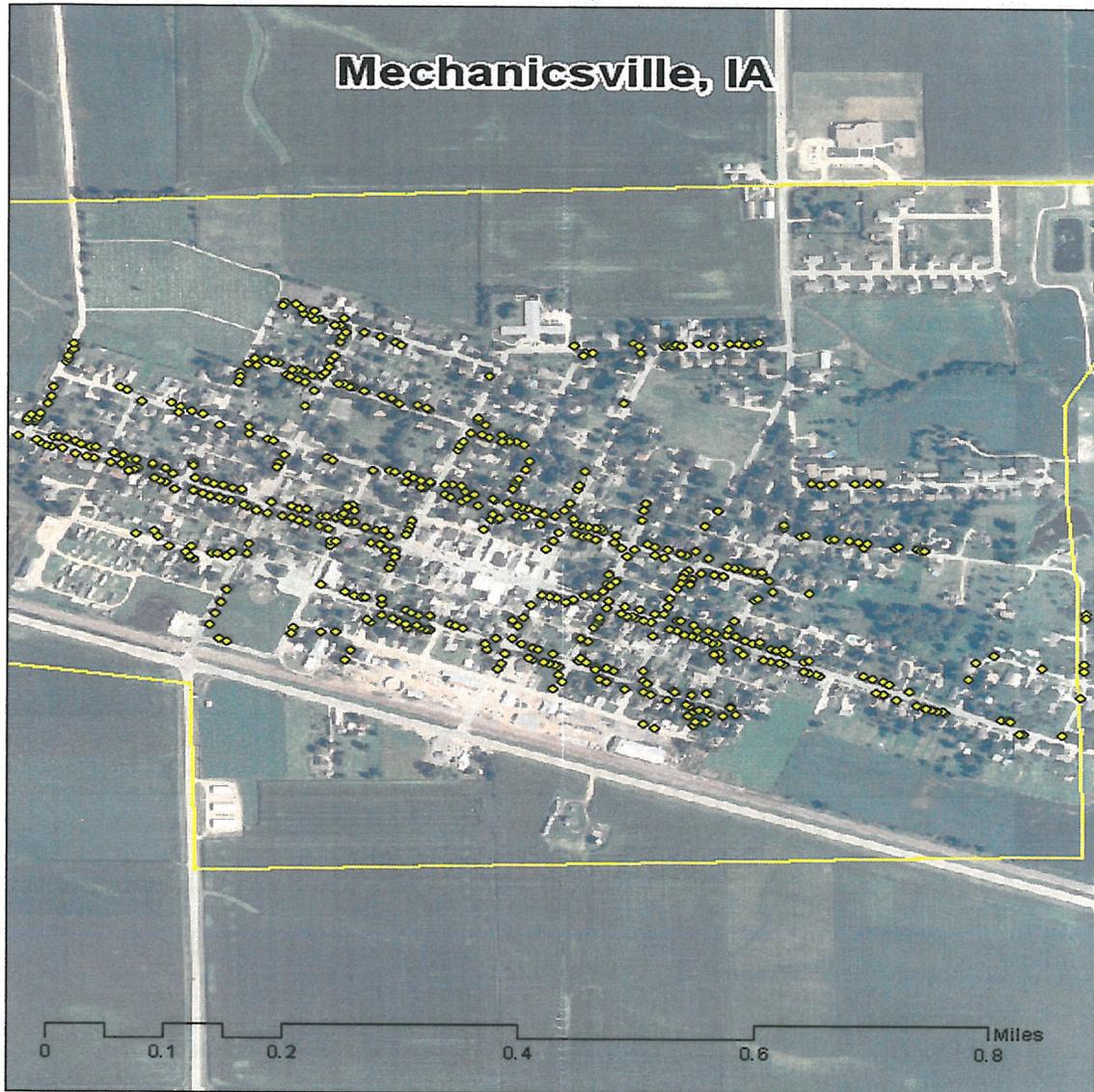


Mechanicsville, IA



2010 Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Mechanicsville 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 32% of Mechanicsville'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 2010, 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 559 trees inventoried.

- Mechanicsville's trees provide \$97,577 of benefits annually, an average of \$174 a tree
- There are over 40 species of trees
- The top three genus are: Ash 32%, Maple 39.8%, Apple/crabapple 4.1%
- 8% of trees are in need of some type of management
- 16 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 16 trees needing removal, 15 trees are over 18 inches in diameter at 4.5 ft and must be addressed immediately **City ownership of the trees recommended for removal should be verified prior to any removal**
- 45 of the 179 ash trees are in need of follow up because they are displaying signs and symptoms associated with EAB, with 37 of 45 trees showing canopy dieback (7 of those 37 slated for immediate removal). The other 8 of 45 trees have bark splitting, D shaped exit holes, or epicormic branching which are less serious than canopy dieback. There are an additional 134 ash trees present in city.
- 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
- With the current budget it could take 44 years to remove ash – Suggestion: request a budget increase to \$10,000 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2010, a tree inventory was conducted that included 100% of the city owned trees on streets. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms of EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

The data collected for the 559 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis. Findings

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Mechanicsville's trees reduce energy related costs by approximately \$26,753 annually (Appendix A, Table 1). These savings are both in Electricity (126.8 MWh) and in Natural Gas (17,475.4 Therms).

Annual Stormwater Benefits

Mechanicsville's trees intercept about 1,316,071 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$35,668 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 Mechanicsville, it is estimated that trees remove 1,606 lbs of air pollution (ozone (O₃), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$4,527 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Mechanicsville, trees sequester about 286,935 lbs of carbon a year with an associated value of \$3,576 (Appendix A, Table 4). In addition, the trees store 4,739,726 lbs of carbon, with a yearly benefit of \$35,548 (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. Mechanicsville receives \$27,053 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, Mechanicsville's trees provide \$97,577 of benefits annually. Benefits of individual trees vary based on size, species, health and

location, but on average each of the 559 trees in Mechanicsville provide approximately \$174 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Mechanicsville has over 40 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genus is as follows:

Maple	223	40%
Ash	179	32%
Oak	21	4%
Spruce	20	3%
Apple (Crab)	23	4%
Linden/Basswood	17	3%
Mountain Ash	3	<1%
Birch	1	<1%
Pear	2	<1%
Hackberry	9	2%
Walnut	4	<1%
Arborvitae	10	2%
Locust	9	1.5%
Willow	2	<1%
Cherry	2	<1%
Pine	1	<1%
Elm	3	<1%
Mountain Ash	3	<1%
Juniper	2	<1%
Poplar	2	<1%
Redbud	1	<1%
Mulberry	2	<1%
Sycamore	1	<1%
Alder	1	<1%
Kentucky Coffee Tree	1	<1%
Other Large Broadleaves	21	4 %

Age Class

Most of Mechanicsville's trees (45%) are between 12 and 24 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. Mechanicsville's size curve is where it should be. As old trees die out or are removed it is important to keep replacing a diversity of trees to maintain similar curve.

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 Mechanicsville indicate that 88% of the trees are in good health, with less than 1% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 67% of Mechanicsville'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 4% of the population. This 4% is an estimate of trees that need management follow up.

Management Needs

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

Crown Cleaning	21	4%
Crown Raising	0	0%
Tree Staking	0	0%
Tree Removal	16	3%
Crown Reduction	0	0%

Canopy Cover

The canopy cover of Mechanicsville is approximately 14 acres (Appendix A, Figure 5). According to the 2000 census, Mechanicsville occupies 448 acres. Thus the canopy cover on city land is about 3.2%.

Land Use and Location

The majority of Mechanicsville'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	93.7%
Park/vacant/other	4.1%
Industrial/Large commercial	> 1%
Small commercial	>1%
Multifamily residential	>1%

Location

Planting strip	75.8%
Other maintained locations	1.1%
Cutout (surrounded by pavement)	>1%
Front yard	16.3%
Back Yard	6.3%

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

Mechanicsville has 0 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). There are 20 trees over 18 inches diameter that are immediate concern. Please refer to the six year maintenance plan at the end of this section. Since no trees were designated critical concern, there should be follow up on the trees marked as needing maintenance that do not include trimming. There are also 6 young trees for a total of 26 trees with these needs (immediate concern).

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 16 removals, 7 are ash trees. There are a total of 179 ash trees, there are 7 for removal and another 38 of those have signs and symptoms that have been associated with EAB. In addition, there are 6 additional young trees that are in poor health of foliage, wood or both. *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 6 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 Mechanicsville.

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 Ash (32%) and Norway Maple (19.9%) (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

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 No Additional Funding

Year 1

Removal: 4 of 16 largest trees recommended for removal (These are immediate concern trees. Of 16 with immediate concern, 7 of those are ash, with 38 additional ash showing one or more EAB symptoms). All 16 large trees recommended for removal should be evaluated and prioritized based on size, condition, and nearby hazards to determine order of removal.

Planting and Replacement: 6 trees to be planted in open locations

Visual Survey for signs and symptoms of EAB

Year 2

Removal: 4 largest immediate concern trees recommended for removal

Planting and Replacement: 6 trees in open locations and from year one removals

Routine trimming: Contract to trim the 21 trees slated for "clean"

Visual Survey for signs and symptoms of EAB

Year 3

Removal: 4 largest immediate concern trees - removal of any new critical concern trees and ash in poor health if possible

Planting and Replacement: 6 trees to be planted in open locations and locations from previous removals

Visual Survey for signs and symptoms of EAB

Year 4

Removal: 4 immediate concern trees - removal of any new critical concern trees and ash in poor health

Planting and Replacement: 6 trees in open locations and from previous removals

Routine trimming: Contract to trim trees as needed

Visual Survey for signs and symptoms of EAB

Year 5

Removal: removal of any new critical concern trees and 4 ash in poor health

Planting and Replacement: 9 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 4 ash in poor health

Planting and Replacement: 9 trees in open locations and from previous removals

Routine trimming: Contract to trim trees as needed

Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: 7 of the 16 trees slated for removal in first 4 years are ash. Approximately 30 additional ash trees currently showing canopy dieback should be removed (approximately 18% of total ash). The recommendation is to remove all 37 ash showing dieback within the first six years (16 removal trees, 30 additional ash trees showing dieback).

Removing approximately 8 trees per year for 6 years would remove all "recommended removal" and all "ash with canopy dieback". EAB could potentially kill all ash within 4 years of its arrival. This would include 142 remaining ash that are not "recommended removal" or ash with canopy dieback".

** To remove all ash trees showing dieback within 6 years, the budget would need to be increased to remove 8 trees (\$5600) per year rather than 4 (\$2800) (On December 29th the city clerk approximated an average of 4 trees removed per year to date). If the budget were increased to allow this, all ash showing dieback could be removed in 6 years. If removal is approximately \$700/tree and all ash were removed, it would take \$125,300 to remove 179 total ash trees.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). [*City ownership of the tree recommended for removal should be verified prior to any removal*](#)

EAB Quarantines

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

A regulated article under the USDA's quarantine includes any of the following items:

- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)

- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

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

Wood Disposal

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

Canopy Replacement

As budget permits, all removed ash trees will be replaced. All trees will meet the restrictions in city ordinance 151.02 (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Postponed Work

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

Monitoring

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

Budget

Current Budget

Total \$16,800 over 6 years (\$2,800/year) for removal alone

FY 2011 Budget

Removal: \$2,800 (based on estimated 4 trees per year @\$700/tree)

Planting: \$500 (based on trees forever and grant availability)

Watering & Maintenance: \$500

FY 2012 Budget

Removal: \$2,800

Planting: \$600

Routine trimming: \$500

Watering & Maintenance: \$500

FY 2013 Budget

Removal: \$2,800

Planting: \$600

Watering & Maintenance: \$500

FY 2014 Budget

Removal: \$2,800

Planting: \$600

Routine trimming: \$500

Watering & Maintenance: \$500

FY 2015 Budget

Removal: \$2,800

Planting: \$900

Watering & Maintenance: \$500

FY 2016 Budget

Removal: \$2,800

Planting: \$900

Routine trimming: \$500

Watering & Maintenance: \$500

*Reduction of ash over 6 years: approximately 30 to 37 ash trees removed (approximately 16% of ash). **It will take approximately 44 years to remove all ash with the current budget.**

Purposed Budget Increase

EAB could potentially kill all ash trees in Mechanicsville within 4 years of its arrival. To remove all 179 ash trees within 6 years the budget would need to be increased to \$20,883 a year. If the budget were increased to \$10,000 a year all ash could be removed within 13 years.

Additionally, it is recommended that Mechanicsville 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

Annual Energy Benefits of Public Trees by Species

11/22/2010

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total Standard Error (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	49.3	3,739	6,792.8	6,657	10,396 (N/A)	32.0	38.9	58.08
Norway maple	26.5	2,013	3,742.5	3,668	5,680 (N/A)	19.9	21.2	51.17
Sugar maple	14.2	1,078	1,911.1	1,873	2,951 (N/A)	9.1	11.0	57.86
Red maple	3.1	233	406.1	398	631 (N/A)	5.4	2.4	21.03
Silver maple	9.5	720	1,250.0	1,225	1,944 (N/A)	5.4	7.3	64.82
Apple	1.3	102	218.5	214	316 (N/A)	4.1	1.2	13.74
American basswood	2.1	158	296.6	291	449 (N/A)	2.7	1.7	29.94
Broadleaf Deciduous	0.8	60	125.0	123	183 (N/A)	2.5	0.7	13.04
Blue spruce	1.3	100	179.9	176	276 (N/A)	2.3	1.0	21.27
Northern white cedar	1.0	79	140.6	138	217 (N/A)	1.8	0.8	21.66
Northern hackberry	3.6	274	491.0	481	755 (N/A)	1.6	2.8	83.92
Honeylocust	2.9	219	384.2	377	596 (N/A)	1.6	2.2	66.19
Pin oak	2.8	216	376.2	369	584 (N/A)	1.4	2.2	73.04
Bur oak	1.4	106	189.9	186	292 (N/A)	1.1	1.1	48.67
Other street trees	7.0	531	971.1	952	1,482 (N/A)	9.1	5.5	29.06
Citywide total	126.8	9,627	17,475.4	17,126	26,753 (N/A)	100.0	100.0	47.86

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species

11/22/2010

Species	Total rainfall interception (Gal)	Total Standard Error (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	517,873	14,035 (N/A)	32.0	39.4	78.41
Norway maple	228,576	6,195 (N/A)	19.9	17.4	55.81
Sugar maple	163,380	4,428 (N/A)	9.1	12.4	86.82
Red maple	19,034	516 (N/A)	5.4	1.5	17.19
Silver maple	130,639	3,541 (N/A)	5.4	9.9	118.02
Apple	4,757	129 (N/A)	4.1	0.4	5.61
American basswood	16,190	439 (N/A)	2.7	1.2	29.25
Broadleaf Deciduous	5,111	139 (N/A)	2.5	0.4	9.89
Blue spruce	17,490	474 (N/A)	2.3	1.3	36.46
Northern white cedar	16,802	455 (N/A)	1.8	1.3	45.54
Northern hackberry	41,165	1,116 (N/A)	1.6	3.1	123.96
Honeylocust	32,764	888 (N/A)	1.6	2.5	98.66
Pin oak	33,546	909 (N/A)	1.4	2.6	113.65
Bur oak	15,816	429 (N/A)	1.1	1.2	71.44
Other street trees	72,926	1,976 (N/A)	9.1	5.5	38.75
Citywide total	1,316,071	35,668 (N/A)	100.0	100.0	63.81

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species

11/22/2010

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								
Green ash	60.6	9.7	29.6	2.7	324	235.6	34.3	32.7	223.3	1,467	0.0	0	628.5	1,791 (N/A)	32.0	10.01	
Norway maple	44.7	7.7	22.2	2.0	242	127.8	18.5	17.7	120.3	794	-10.7	-40	350.4	996 (N/A)	19.9	8.97	
Sugar maple	22.0	3.7	10.9	1.0	119	67.4	9.8	9.4	64.3	421	-17.2	-64	171.3	475 (N/A)	9.1	9.32	
Red maple	3.4	0.6	1.7	0.2	19	14.5	2.1	2.0	13.9	91	-1.3	-5	37.2	105 (N/A)	5.4	3.49	
Silver maple	21.7	3.7	10.8	1.0	118	44.7	6.5	6.2	42.9	280	-11.6	-44	126.0	354 (N/A)	5.4	11.79	
Apple	1.0	0.2	0.5	0.0	5	6.7	1.0	0.9	6.1	41	0.0	0	16.4	46 (N/A)	4.1	2.02	
American basswood	1.7	0.3	0.9	0.1	9	10.1	1.5	1.4	9.5	63	-1.6	-6	23.8	66 (N/A)	2.7	4.39	
Broadleaf/Deciduous	0.7	0.1	0.4	0.0	4	3.9	0.6	0.5	3.6	24	-0.2	-1	9.7	27 (N/A)	2.5	1.95	
Blue spruce	2.3	0.4	1.9	0.3	15	6.3	0.9	0.9	6.0	39	-6.2	-23	12.7	31 (N/A)	2.3	2.38	
Northern white cedar	1.9	0.4	1.6	0.2	13	4.9	0.7	0.7	4.7	31	-8.2	-31	7.0	13 (N/A)	1.8	1.27	
Northern hackberry	8.6	1.5	4.2	0.4	46	17.2	2.5	2.4	16.4	107	0.0	0	53.2	154 (N/A)	1.6	17.09	
Honeylocust	6.4	1.1	2.9	0.3	34	13.7	2.0	1.9	13.1	85	-5.0	-19	36.3	100 (N/A)	1.6	11.16	
Pin oak	6.2	1.1	3.1	0.3	34	13.4	2.0	1.9	12.9	84	-11.3	-43	29.4	75 (N/A)	1.4	9.39	
Bur oak	2.0	0.3	0.9	0.1	11	6.7	1.0	0.9	6.3	41	0.0	0	18.2	52 (N/A)	1.1	8.68	
Other street trees	10.8	1.8	5.7	0.6	60	33.5	4.9	4.6	31.7	208	-7.0	-26	86.6	242 (N/A)	9.1	4.74	
Citywide total	194.0	32.6	97.5	9.1	1,052	606.6	88.2	84.1	574.9	3,776	-80.3	-301	1,606.6	4,527 (N/A)	100.0	8.10	

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees by Species

11/22/2010

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	1,960,149	14,701	(N/A)	32.0	41.4	82.13
Norway maple	737,017	5,528	(N/A)	19.9	15.6	49.80
Sugar maple	633,951	4,755	(N/A)	9.1	13.4	93.23
Red maple	41,042	308	(N/A)	5.4	0.9	10.26
Silver maple	498,961	3,742	(N/A)	5.4	10.5	124.74
Apple	17,585	132	(N/A)	4.1	0.4	5.73
American	61,358	460	(N/A)	2.7	1.3	30.68
Broadleaf	12,424	93	(N/A)	2.5	0.3	6.66
Blue spruce	14,851	111	(N/A)	2.3	0.3	8.57
Northern white	19,775	148	(N/A)	1.8	0.4	14.83
Northern	144,119	1,081	(N/A)	1.6	3.0	120.10
Honeylocust	82,360	618	(N/A)	1.6	1.7	68.63
Pin oak	164,475	1,234	(N/A)	1.4	3.5	154.20
Bur oak	65,236	489	(N/A)	1.1	1.4	81.54
Other street trees	129,920	2,148	(N/A)	9.1	6.0	42.12
Citywide total	4,739,726	35,548	(N/A)	100.0	100.0	63.59

Table 5: Annual Carbon Sequestered

Annual CO₂ Benefits of Public Trees by Species

11/22/2010

Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Avoided (lb)	Avoided (\$)	Net Total (lb)	Total Standard Error (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	118,460	888	-9,409	-35	-71	82,630	620	191,646	1,437 (N/A)	32.0	40.2	8.03
Norway maple	38,831	291	-3,538	-22	-27	44,477	334	79,749	598 (N/A)	19.9	16.7	5.39
Sugar maple	32,431	243	-3,043	-10	-23	23,822	179	53,200	399 (N/A)	9.1	11.2	7.82
Red maple	5,565	42	-197	-6	-2	5,149	39	10,511	79 (N/A)	5.4	2.2	2.63
Silver maple	38,136	286	-2,395	-6	-18	15,901	119	51,636	387 (N/A)	5.4	10.8	12.91
Apple	2,068	16	-84	-4	-1	2,252	17	4,231	32 (N/A)	4.1	0.9	1.38
American basswood	4,460	33	-295	-3	-2	3,501	26	7,664	57 (N/A)	2.7	1.6	3.83
Broadleaf Deciduous	1,647	12	-60	-3	0	1,326	10	2,911	22 (N/A)	2.5	0.6	1.56
Blue spruce	1,021	8	-71	-3	-1	2,214	17	3,161	24 (N/A)	2.3	0.7	1.82
Northern white cedar	1,122	8	-95	-2	-1	1,743	13	2,768	21 (N/A)	1.8	0.6	2.08
Northern hackberry	4,901	37	-692	-2	-5	6,057	45	10,264	77 (N/A)	1.6	2.2	8.55
Honeylocust	7,468	56	-395	-2	-3	4,843	36	11,914	89 (N/A)	1.6	2.5	9.93
Pin oak	14,539	109	-789	-2	-6	4,766	36	18,514	139 (N/A)	1.4	3.9	17.36
Bur oak	3,307	25	-313	-1	-2	2,342	18	5,335	40 (N/A)	1.1	1.1	6.67
Other street trees	12,980	97	-1,375	-10	-10	11,727	88	23,322	175 (N/A)	9.1	4.9	3.43
Citywide total	286,935	2,152	-22,751	-109	-171	212,750	1,596	476,825	3,576 (N/A)	100.0	100.0	6.40

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

11/22/2010

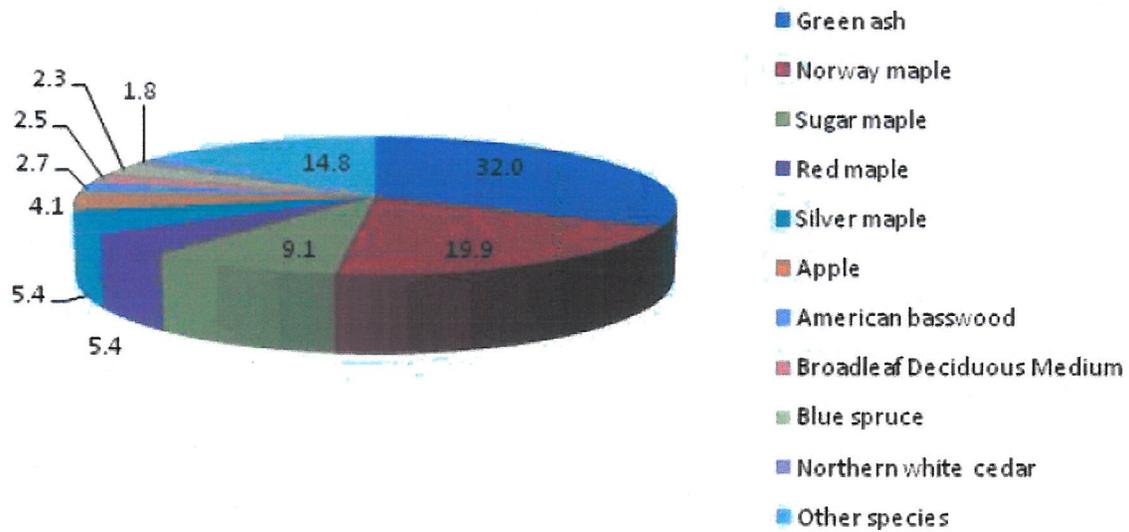
Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	9,972	(N/A)	32.0	36.9	55.71
Norway maple	3,758	(N/A)	19.9	13.9	33.86
Sugar maple	3,350	(N/A)	9.1	12.4	65.69
Red maple	817	(N/A)	5.4	3.0	27.23
Silver maple	3,015	(N/A)	5.4	11.1	100.49
Apple	114	(N/A)	4.1	0.4	4.96
American basswood	376	(N/A)	2.7	1.4	25.09
Broadleaf Deciduous	200	(N/A)	2.5	0.7	14.27
Blue spruce	285	(N/A)	2.3	1.1	21.96
Northern white cedar	227	(N/A)	1.8	0.8	22.66
Northern hackberry	582	(N/A)	1.6	2.2	64.62
Honeylocust	1,782	(N/A)	1.6	6.6	198.00
Pin oak	1,081	(N/A)	1.4	4.0	135.11
Bur oak	280	(N/A)	1.1	1.0	46.67
Other street trees	1,215	(N/A)	9.1	4.5	23.82
Citywide total	27,053	(N/A)	100.0	100.0	48.40

Table 7: Summary of Benefits in Dollars

Total Annual Benefits of Public Trees by Species (\$)							
11/22/20							
Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total Standard (\$ Error)	% of Total \$
Green ash	10,396	1,437	1,791	14,035	9,972	37,632 (±0)	38.6
Norway maple	5,680	598	996	6,195	3,758	17,227 (±0)	17.7
Sugar maple	2,951	399	475	4,428	3,350	11,603 (±0)	11.9
Red maple	631	79	105	516	817	2,147 (±0)	2.2
Silver maple	1,944	387	354	3,541	3,015	9,241 (±0)	9.5
Apple	316	32	46	129	114	637 (±0)	0.7
American basswood	449	57	66	439	376	1,388 (±0)	1.4
Broadleaf Deciduous	183	22	27	139	200	570 (±0)	0.6
Blue spruce	276	24	31	474	285	1,091 (±0)	1.1
Northern white cedar	217	21	13	455	227	932 (±0)	1.0
Northern hackberry	755	77	154	1,116	582	2,683 (±0)	2.7
Honeylocust	596	89	100	888	1,782	3,456 (±0)	3.5
Pin oak	584	139	75	909	1,081	2,788 (±0)	2.9
Bur oak	292	40	52	429	280	1,093 (±0)	1.1
Other street trees	1,482	175	242	1,976	1,215	5,090 (±0)	5.2
Citywide Total	26,753	3,576	4,527	35,668	27,053	97,577 (±0)	100.0

Species Distribution of Public Trees (%)

11/22/2010

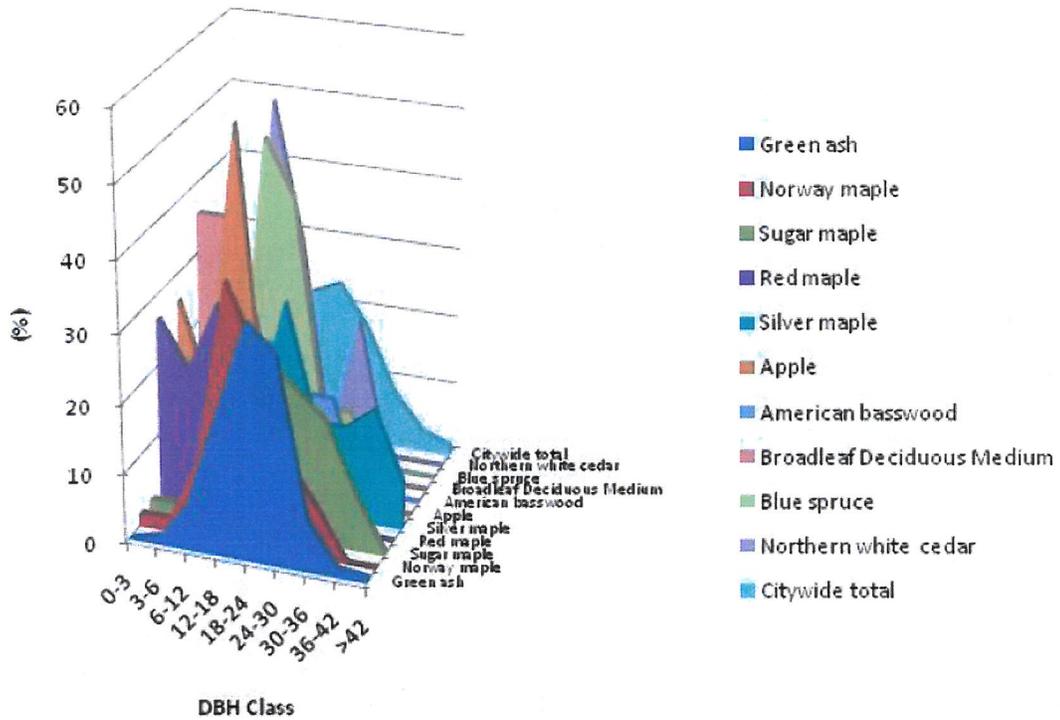


Species	Percent
Green ash	32.0
Norway maple	19.9
Sugar maple	9.1
Red maple	5.4
Silver maple	5.4
Apple	4.1
American basswood	2.7
Broadleaf Deciduous	2.5
Blue spruce	2.3
Northern white cedar	1.8
Other species	14.8
Total	100.0

Figure 1: Species Distribution

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

11/22/2010



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Green ash	0.0	1.1	6.7	20.1	33.5	29.6	7.3	1.1	0.6
Norway maple	1.8	1.8	10.8	36.9	27.9	13.5	7.2	0.0	0.0
Sugar maple	2.0	2.0	7.8	15.7	25.5	21.6	17.6	7.8	0.0
Red maple	26.7	20.0	30.0	20.0	3.3	0.0	0.0	0.0	0.0
Silver maple	0.0	0.0	6.7	13.3	30.0	13.3	13.3	16.7	6.7
Apple	26.1	13.0	52.2	8.7	0.0	0.0	0.0	0.0	0.0
American basswood	13.3	20.0	20.0	20.0	13.3	13.3	0.0	0.0	0.0
Broadleaf Deciduous	35.7	35.7	21.4	0.0	7.1	0.0	0.0	0.0	0.0
Blue spruce	0.0	0.0	46.2	38.5	7.7	7.7	0.0	0.0	0.0
Northern white cedar	0.0	0.0	50.0	30.0	0.0	20.0	0.0	0.0	0.0
Citywide total	6.1	5.7	14.3	21.5	23.3	17.2	7.9	2.9	1.3

Figure 2: Relative Age Class

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

11/22/2010

Citywide total

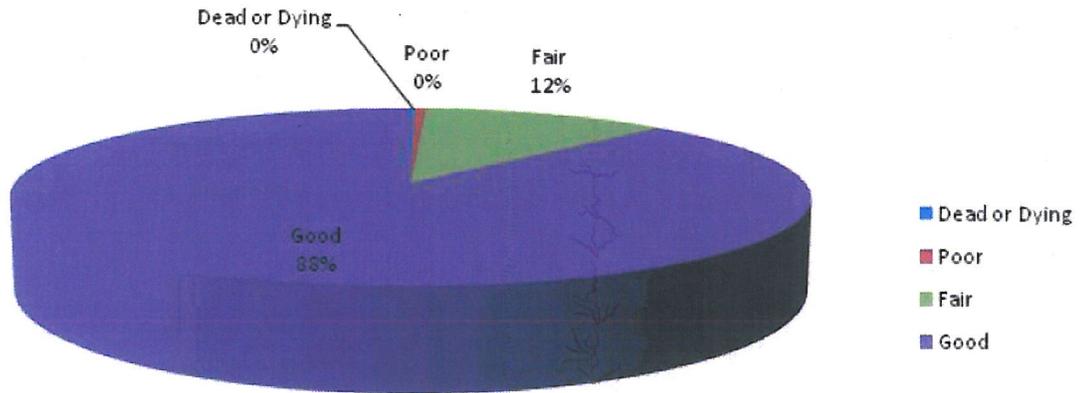


Figure 3: Foliage Condition

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

11/22/2010

Citywide total

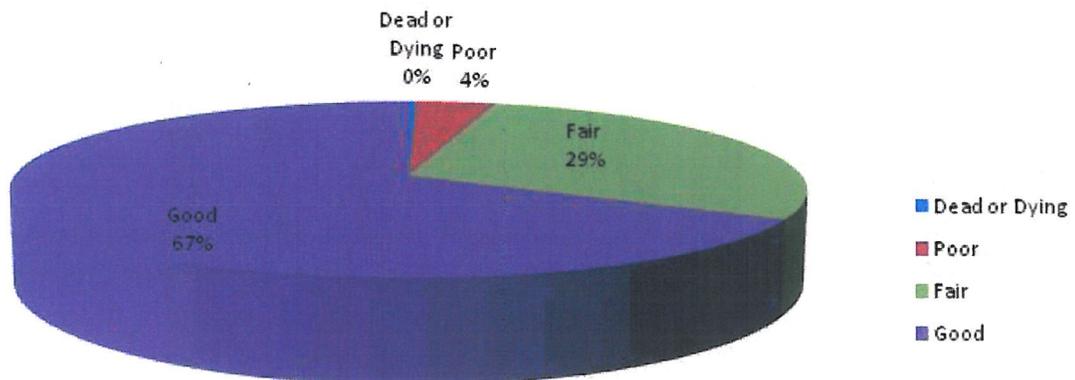
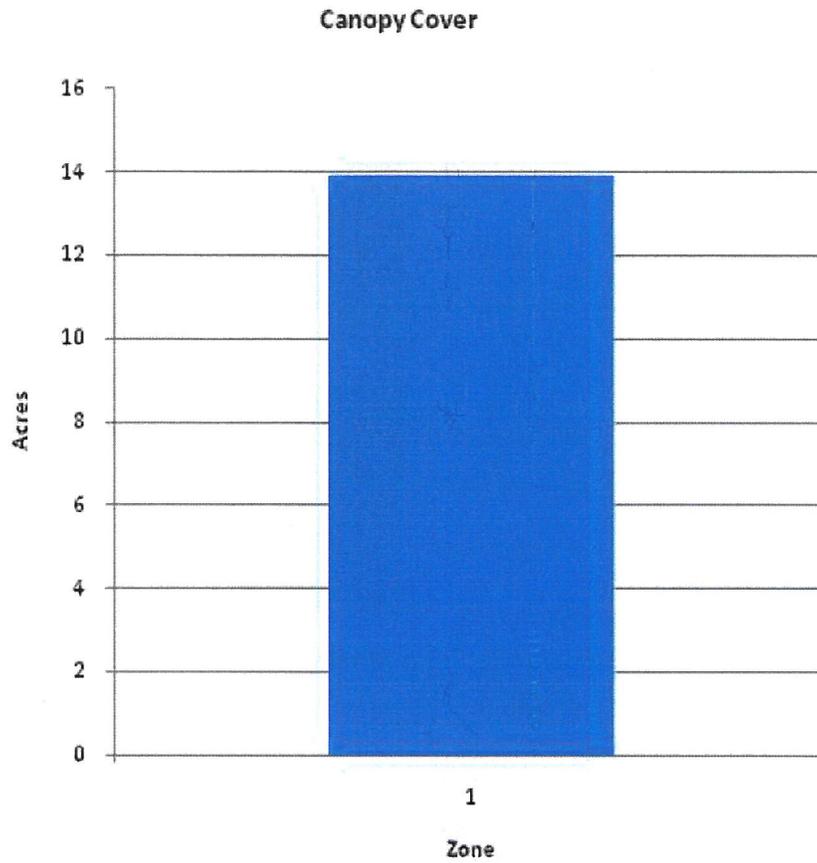


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

11/22/2010



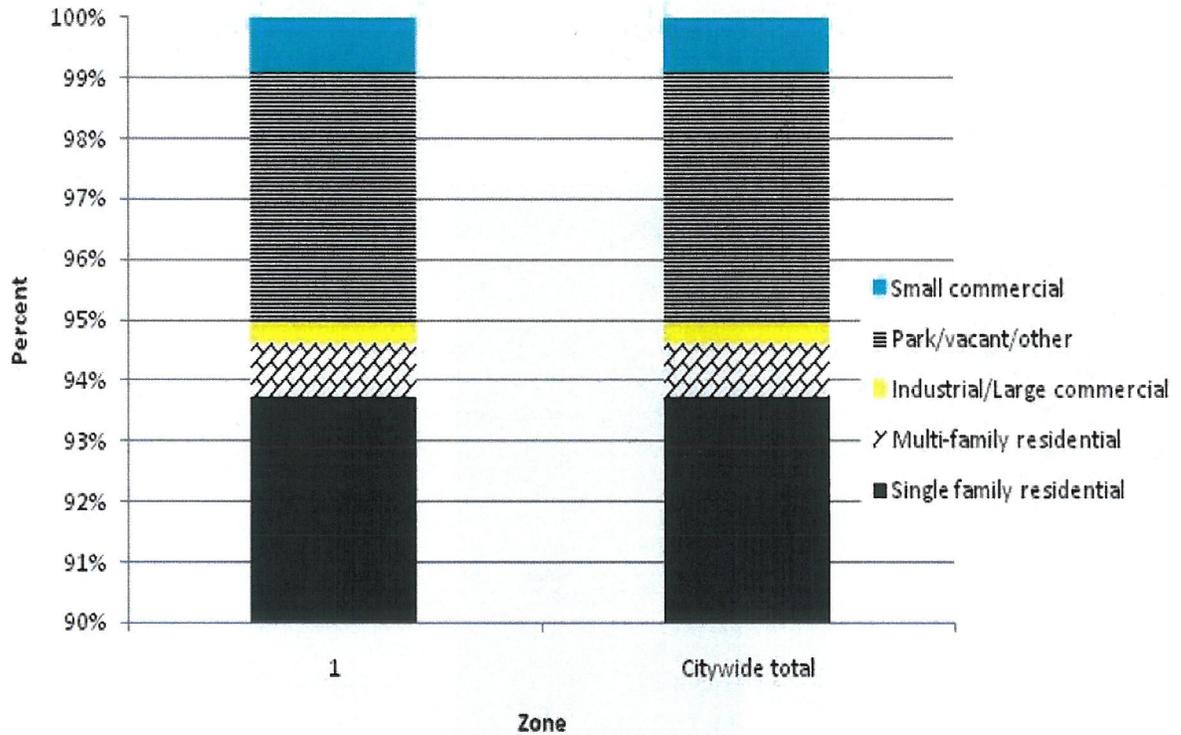
Zone	Acres	% of Total Canopy Cover
1	14	100.0
Citywide total	14	100.0

	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	14		

Figure 5: Canopy Cover in Acres

Land Use of Public Trees by Zone (%)

11/22/2010



Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	93.7	0.9	0.4	4.1	0.9
Citywide total	93.7	0.9	0.4	4.1	0.9

Figure 6: Land Use of city/park trees

Location of Public Trees by Zone (%)

11/22/2010

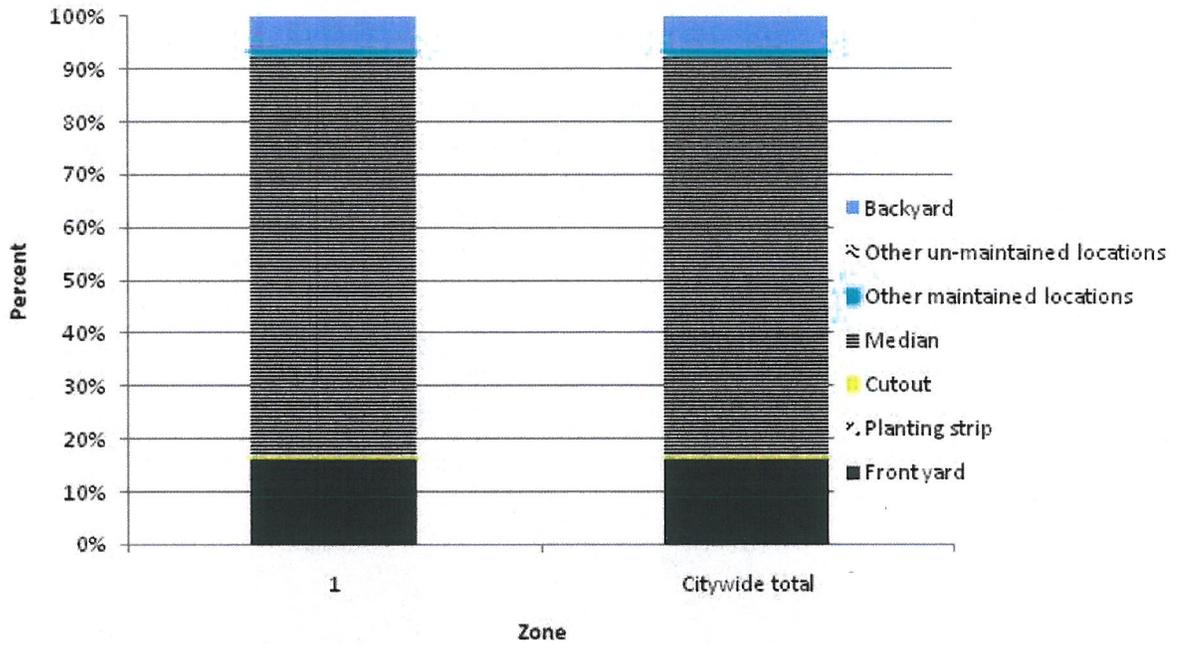


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

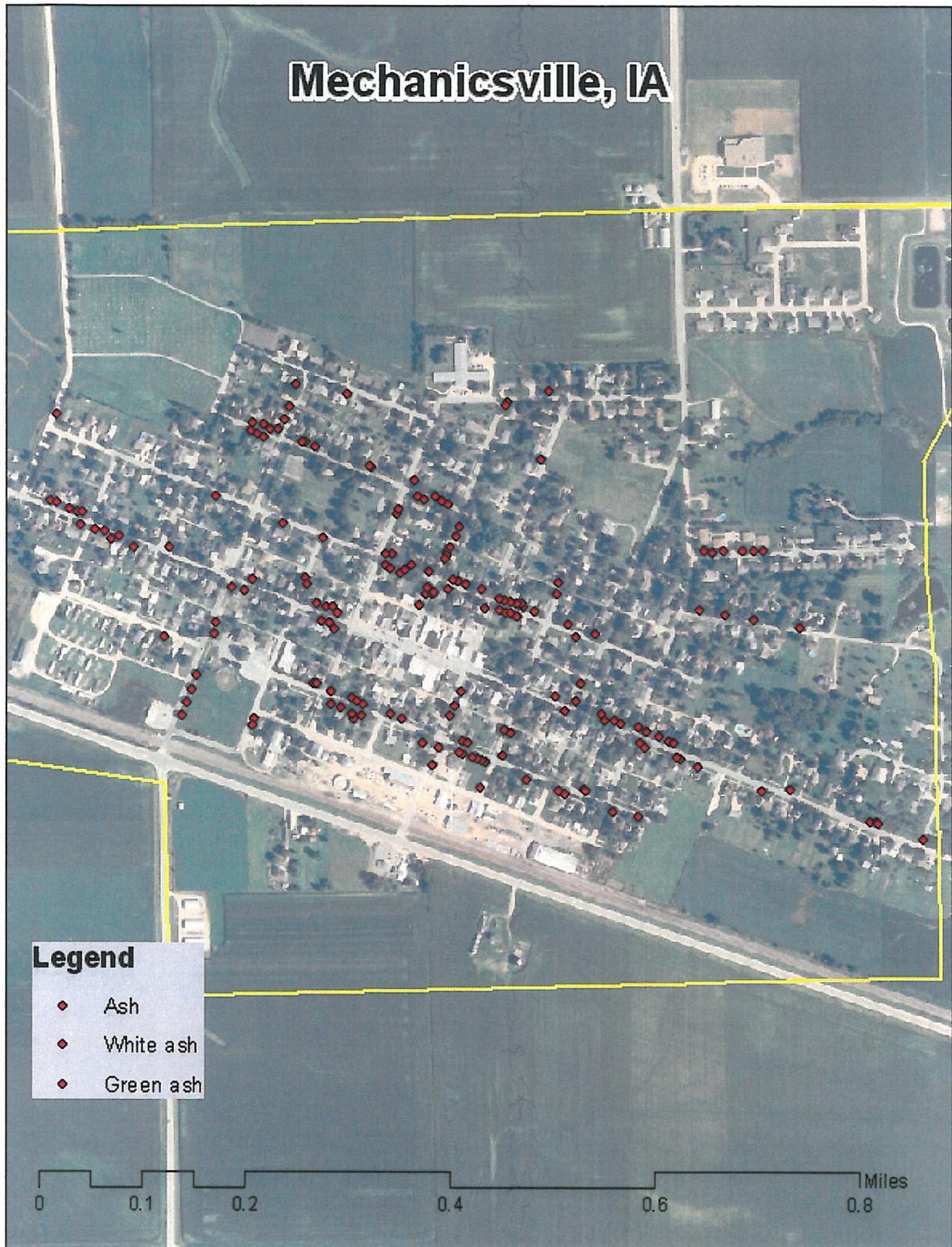


Figure 1: Location of Ash Trees



Figure 2: Location of EAB symptoms

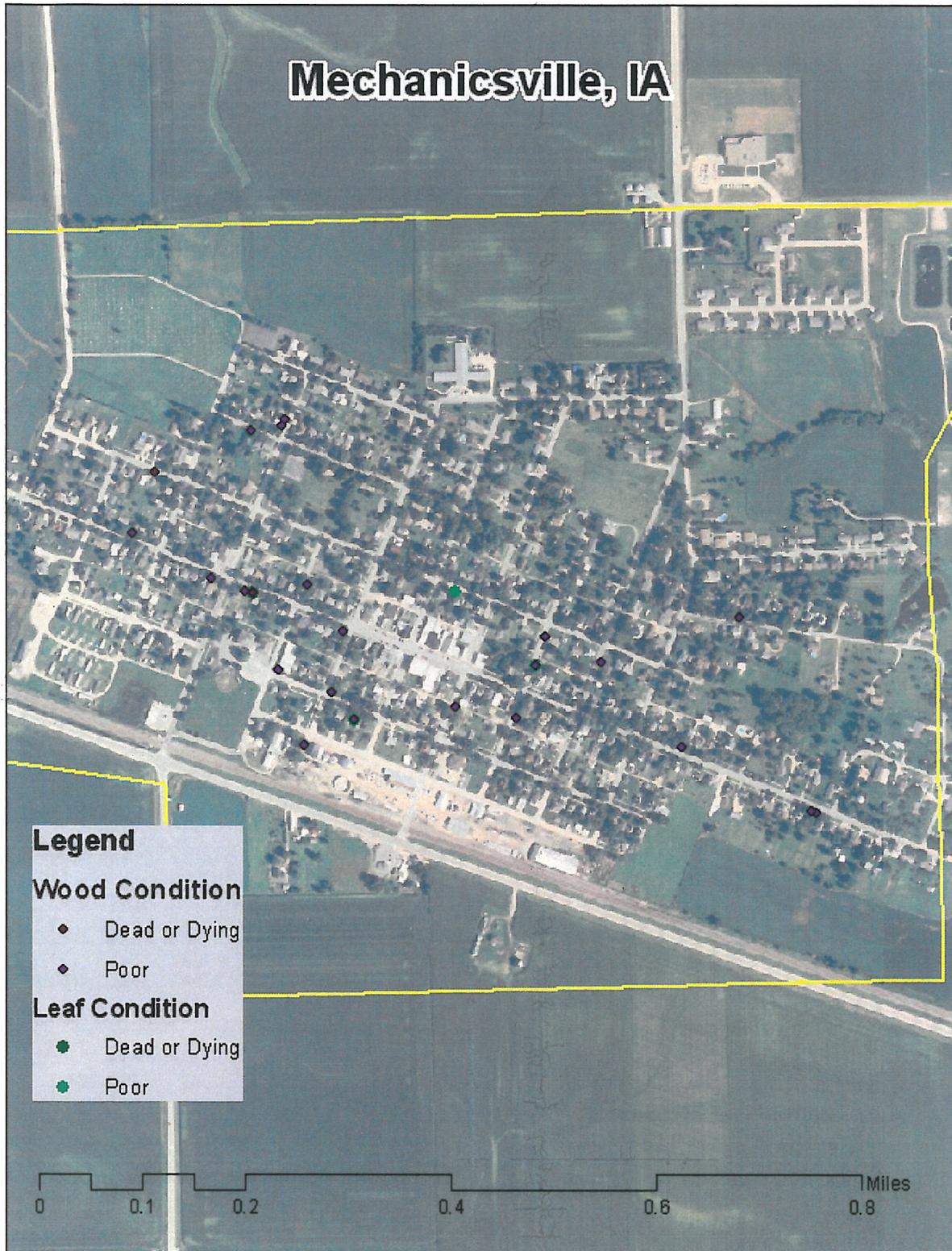


Figure 3: Location of Poor Condition Trees



Figure 4: Location of Trees with Recommended Maintenance

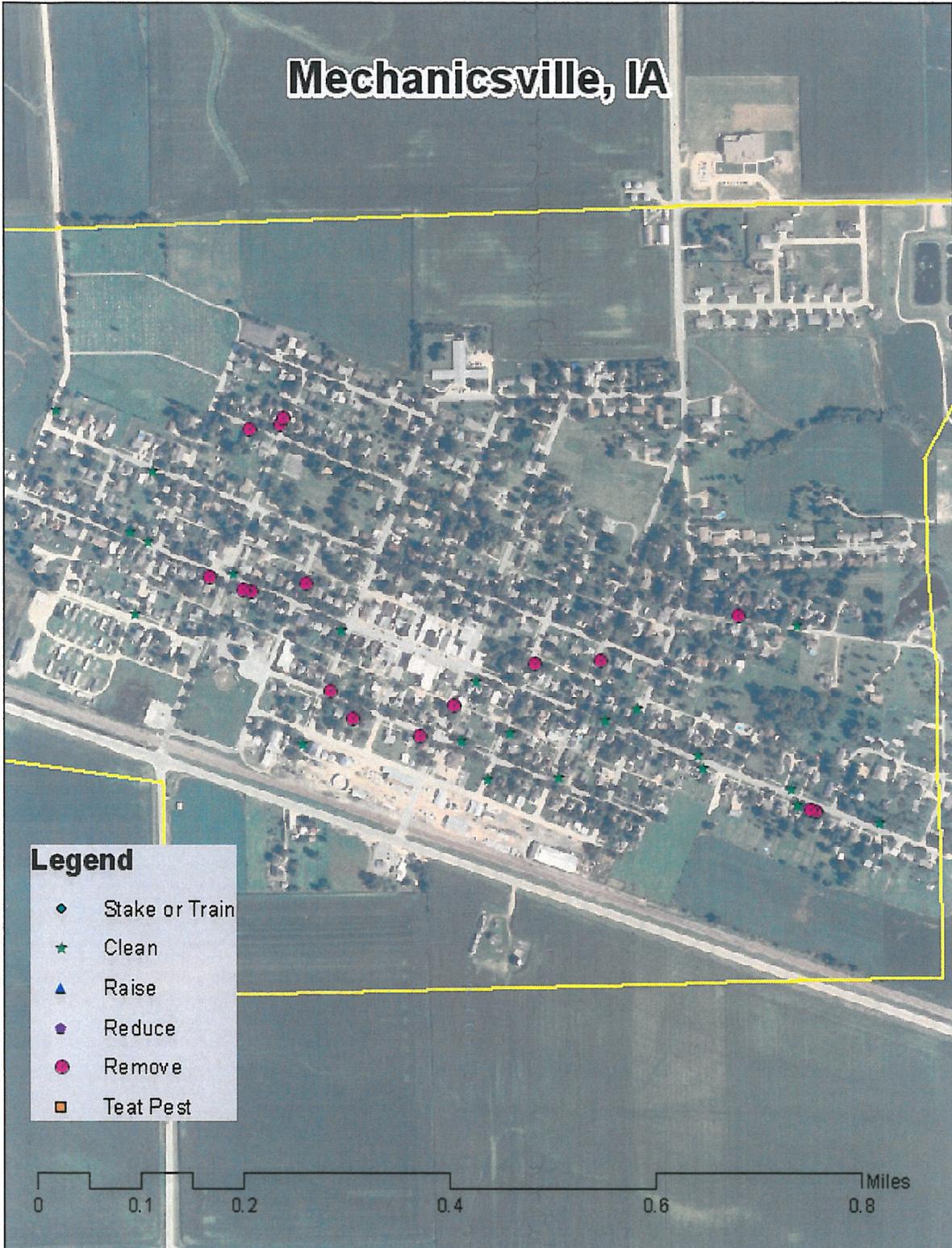


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

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