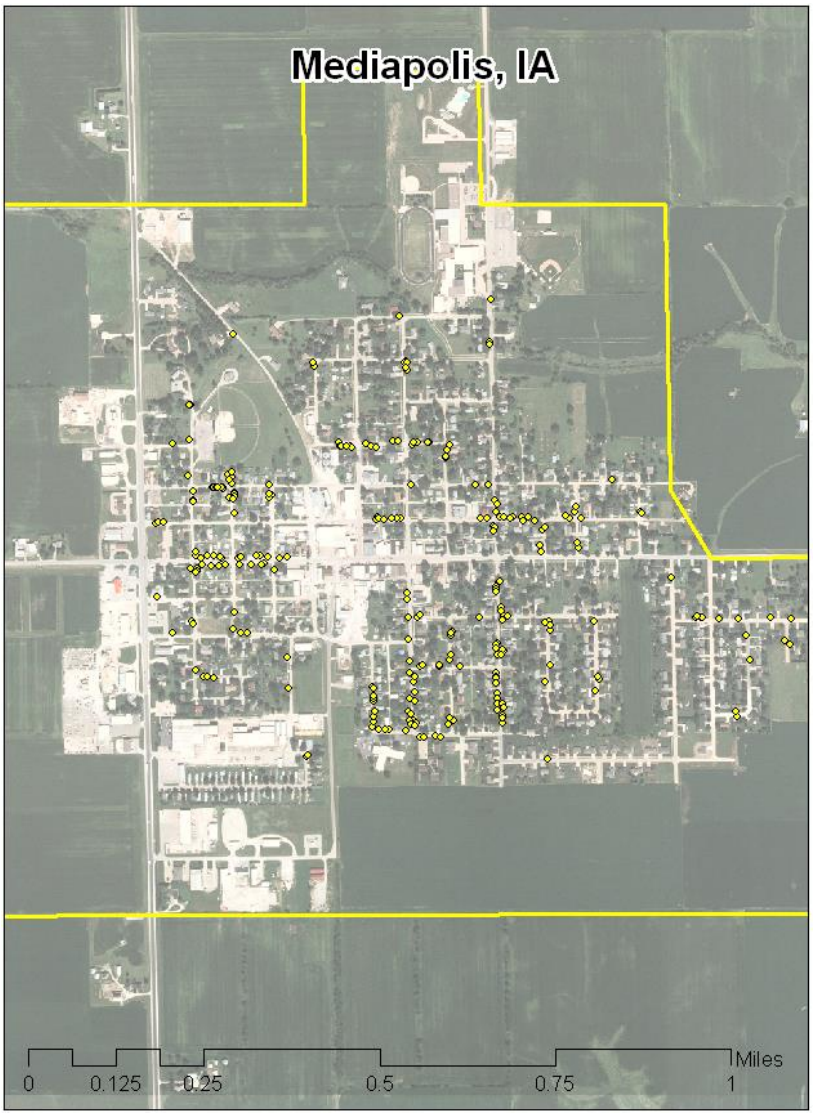
Mediapolis, IA



2010 Management Plan
Prepared by Lisa Louck
Bureau of Forestry, Iowa DNR

Table of Contents

Executive Summary

Overview

This plan was developed to assist the City of Mediapolis 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 11% of Mediapolis'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 trees. Below are some key findings of the 260 trees inventoried.

- Mediapolis's trees provide $37,900 of benefits annually, an average of $146 a tree
- There are over 29 species of trees
- The top three genus are: Maple 45%, Ash 11%, and Oak 6%
- 23% of trees are in need of some type of management
- 3 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 3 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*
- 5 of the 28 ash trees are in need of follow up because they are displaying signs and symptoms associated with EAB
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With the current budget it could take 14 years to remove ash – Suggestion: request a budget increase to $3,000 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2010, a tree inventory was conducted that included 100% of the city owned street trees. 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 260 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. Mediapolis's trees reduce energy related costs by approximately $10,100 annually (Appendix A, Table 1). These savings are both in Electricity (48.1 MWh) and in Natural Gas (6,577.9 Therms).

Annual Stormwater Benefits

Mediapolis's trees intercept about 488,266 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $13,233 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 Mediapolis, it is estimated that trees remove 599.5 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 $1,680 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Mediapolis, trees sequester about 192,238 lbs of carbon a year with an associated value of $1,442 (Appendix A, Table 4). In addition, the trees store 1,730,588 lbs of carbon, with a yearly benefit of $12,879 (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. Mediapolis receives $11,445 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, Mediapolis's trees provide $37,900 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 260 trees in Mediapolis provide approximately $146 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Mediapolis has over 29 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genus is as follows:

Maple	116	45%
Ash	28	11%
Oak	15	6%
Apple	15	6%
Pine	11	4%
Spruce	10	4%
Hackberry	8	3%
Arborvitae	7	3%
Walnut	7	3%
Elm	6	2%
Honey Locust	4	2%
Redbud	3	1%
Sycamore	2	<1%
Pear	2	<1%
Linden/Basswood	2	<1%
Chestnut	1	<1%
Cottonwood	1	<1%
Birch	1	<1%
Other deciduous	21	8%

Age Class

Most of Mediapolis's trees (41%) 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. Mediapolis'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 Mediapolis indicate that 71% of the trees are in good health, with only 2% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 66% of Mediapolis'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 6% 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	46	18%
Crown Raising	5	2%
Tree Staking	0	0%
Tree Removal	3	1%
Crown Reduction	4	1.5%

Canopy Cover

The canopy cover of Mediapolis is approximately 5 acres (Appendix A, Figure 4). According to the 2000 census, Mediapolis occupies 767.9 acres. Thus the canopy cover on city land is about 1%.

Land Use and Location

The majority of Mediapolis'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	93.4%
Park/vacant/other	0%
Industrial/Large commercial	1.2%
Small commercial	.8%
Multifamily residential	2.3%

Location	
Planting strip	0%
Other maintained locations	3.1%
Cutout (surrounded by pavement)	0%
Front yard	90.2%

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

Mediapolis has 3 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). It is recommended to start with the large diameter critical concern trees first. There are 3 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance that do not include trimming. There are a total of 10 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 10 removals, 6 are ash trees. There are a total of 28 ash trees, and 5 of those have signs and symptoms that have been associated with EAB. In addition, there are 23 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 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 Mediapolis.

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 (45%) and Ash (11%) (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. All trees

planted must meet the restrictions in city ordinance (Appendix C). Consider developing a more in depth ordinance that includes a recommended tree list.

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: 2-3 largest critical concern trees
Planting and Replacement: 5 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 2

Removal: Any critical concern trees, monitor additional immediate concern or ash trees with poor health
Planting and Replacement: 6 trees in open locations from year one removals
Routine trimming: Recommendation to residents, possible training or information
Visual Survey for signs and symptoms of EAB

Year 3

Removal: 2-3 trees - removal of immediate concern and any new critical concern trees and ash in poor health
Planting and Replacement: 5 trees to be planted in open locations and locations from previous removals
Visual Survey for signs and symptoms of EAB

Year 4

Removal: 2 trees - removal of any new critical concern trees and ash in poor health
Planting and Replacement: 5 trees in open locations from previous removals
Routine trimming:
Visual Survey for signs and symptoms of EAB

Year 5

Removal: 2 trees - removal of any new critical concern trees and ash in poor health
Planting and Replacement: 5 trees to be planted in open locations and locations from previous removals
Visual Survey for signs and symptoms of EAB

Year 6

Removal: 2 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:
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: Approximately 5 ash trees removed (approximately 18% of ash). It will take approximately 14 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 $4,600 a year. If the budget were increased to $2,000 a year all ash could be removed in 13 years.

Emerald Ash Borer Plan

Ash Tree Removal

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

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 (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.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB. City Code 12.08.010 and 12.08.020 states “The abutting property owner shall have the responsibility for the care, removal, and maintenance of all trees and shrubbery upon the public streets. This includes the area between the sidewalk and curbline. This chapter specifically refers to the removal of diseased trees and the removal of limbs or trees felled by storms or other means. In the event that trees and shrubbery are not properly maintained or that fallen trees and limbs are not removed within a reasonable length of time, the city will have the power to so maintain or remove trees and shrubbery and assess the actual cost thereof against the property owner.”

Budget

Current Budget
Total $12,000 over 6 years ($2,000/year)

FY 2011 Budget
Removal: $1,500
Planting:
Watering & Maintenance: $500

FY 2012 Budget
Removal: $2,000
Planting:
Routine trimming:
Watering & Maintenance:

FY 2013 Budget
Removal: $2,000
Planting:
Watering & Maintenance:

FY 2014 Budget
Removal: $1,500
Planting: $500
Routine trimming:
Watering & Maintenance:

FY 2015 Budget
Removal: $2,000
Planting:
Watering & Maintenance:

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

*Reduction of ash over 6 years: approximately 5 ash trees removed (approximately 18% of ash).
It will take approximately 14 years to remove all ash with the current budget.

Purposed Budget Increase
EAB could potentially kill all ash trees in Mediapolis within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $4,600 a year. If the budget were increased to $2,000 a year all ash could be removed within 13 years. Additionally, it is recommended that Mediapolis 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.

Works Cited

Census Bureau. 2000. http://censtats.census.gov/data/IA/1601964290.pdf (April, 2010)

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

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

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

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

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees 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
Sugar maple	8.6	649	1,136.1	1,113	1,763	(N/A)	13.5	17.5	50.36
Norway maple	6.4	487	909.7	891	1,379	(N/A)	12.7	13.7	41.77
Silver maple	9.8	741	1,286.9	1,261	2,002	(N/A)	12.7	19.8	60.68
Green ash	4.7	355	640.9	628	984	(N/A)	8.9	9.7	42.76
Red maple	1.9	144	246.2	241	385	(N/A)	5.8	3.8	25.68
Apple	1.0	74	155.0	152	226	(N/A)	5.4	2.2	16.15
Pin oak	3.3	247	418.6	410	658	(N/A)	3.9	6.5	65.75
Northern hackberry	2.6	197	375.3	368	565	(N/A)	3.1	5.6	70.57
Blue spruce	0.4	29	61.9	61	90	(N/A)	3.1	0.9	11.19
Black walnut	1.7	128	228.9	224	352	(N/A)	2.7	3.5	50.28
Northern white cedar	0.4	30	66.5	65	95	(N/A)	2.7	0.9	13.58
Broadleaf Deciduous	1.7	130	232.7	228	359	(N/A)	2.3	3.6	59.75
Eastern white pine	0.3	19	42.6	42	61	(N/A)	2.3	0.6	10.14
Broadleaf Deciduous	0.1	4	9.4	9	13	(N/A)	1.9	0.1	2.68
Broadleaf Deciduous	0.1	4	9.5	9	13	(N/A)	1.9	0.1	2.68
White ash	0.9	71	117.8	115	187	(N/A)	1.9	1.9	37.30
Conifer Evergreen Small	0.0	2	4.5	4	6	(N/A)	1.5	0.1	1.60
Honeylocust	0.5	41	77.8	76	117	(N/A)	1.5	1.2	29.34
Northern pin oak	0.9	69	135.2	132	201	(N/A)	1.5	2.0	50.37
Eastern redbud	0.0	4	8.2	8	12	(N/A)	1.2	0.1	3.89
Other street trees	3.0	227	414.3	406	633	(N/A)	9.3	6.3	26.38
Citywide total	48.1	3,653	6,577.9	6,446	10,100	(N/A)	100.0	100.0	38.99

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
Sugar maple	86,698	2,350	(N/A)	13.5	17.8	67.13
Norway maple	49,721	1,348	(N/A)	12.7	10.2	40.83
Silver maple	131,665	3,568	(N/A)	12.7	27.0	108.13
Green ash	46,422	1,258	(N/A)	8.9	9.5	54.70
Red maple	12,118	328	(N/A)	5.8	2.5	21.90
Apple	3,466	94	(N/A)	5.4	0.7	6.71
Pin oak	33,815	916	(N/A)	3.9	6.9	91.65
Northern hackberry	22,010	597	(N/A)	3.1	4.5	74.56
Blue spruce	4,328	117	(N/A)	3.1	0.9	14.66
Black walnut	15,253	413	(N/A)	2.7	3.1	59.05
Northern white cedar	4,168	113	(N/A)	2.7	0.9	16.14
Broadleaf Deciduous	17,349	470	(N/A)	2.3	3.6	78.37
Eastern white pine	2,643	72	(N/A)	2.3	0.5	11.94
Broadleaf Deciduous	212	6	(N/A)	1.9	0.0	1.15
Broadleaf Deciduous	160	4	(N/A)	1.9	0.0	0.87
White ash	11,597	314	(N/A)	1.9	2.4	62.86
Conifer Evergreen Small	257	7	(N/A)	1.5	0.1	1.74
Honeylocust	3,894	106	(N/A)	1.5	0.8	26.38
Northern pin oak	10,019	272	(N/A)	1.5	2.1	67.89
Eastern redbud	145	4	(N/A)	1.2	0.0	1.31
Other street trees	32,324	876	(N/A)	9.3	6.6	36.50
Citywide total	488,266	13,233	(N/A)	100.0	100.0	51.09

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species

11/22/2010

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
Sugar maple	11.0	1.9	5.6	0.5	60	40.5	5.9	5.6	38.8	253	-8.7	-33	101.0	280	(N/A)	13.5	8.01
Norway maple	8.9	1.5	4.6	0.4	49	31.0	4.5	4.3	29.1	192	-2.2	-8	82.1	233	(N/A)	12.7	7.05
Silver maple	21.9	3.7	10.9	1.0	118	46.1	6.7	6.4	44.2	288	-11.9	-45	128.9	362	(N/A)	12.7	10.96
Green ash	5.2	0.8	2.6	0.2	28	22.4	3.3	3.1	21.2	139	0.0	0	58.7	167	(N/A)	8.9	7.26
Red maple	2.3	0.4	1.2	0.1	13	8.9	1.3	1.2	8.6	56	-0.8	-3	23.2	65	(N/A)	5.8	4.35
Apple	0.7	0.1	0.4	0.0	4	4.9	0.7	0.7	4.4	30	0.0	0	11.9	34	(N/A)	5.4	2.42
Pin oak	5.9	1.0	3.0	0.3	32	15.3	2.2	2.1	14.8	96	-11.0	-41	33.7	87	(N/A)	3.9	8.70
Northern hackberry	3.0	0.5	1.6	0.1	17	12.6	1.8	1.7	11.8	78	0.0	0	33.2	95	(N/A)	3.1	11.83
Blue spruce	0.4	0.1	0.4	0.0	3	1.9	0.3	0.3	1.7	12	-1.3	-5	3.7	9	(N/A)	3.1	1.17
Black walnut	1.5	0.2	0.8	0.1	8	8.0	1.2	1.1	7.6	50	0.0	0	20.6	58	(N/A)	2.7	8.33
Northern white cedar	0.4	0.1	0.4	0.0	3	2.0	0.3	0.3	1.8	12	-1.2	-4	4.0	10	(N/A)	2.7	1.48
Broadleaf Deciduous	2.0	0.3	1.0	0.1	11	8.2	1.2	1.1	7.8	51	0.0	0	21.7	62	(N/A)	2.3	10.27
Eastern white pine	0.2	0.0	0.2	0.0	2	1.3	0.2	0.2	1.1	8	-0.7	-3	2.5	7	(N/A)	2.3	1.09
Broadleaf Deciduous	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	0.0	0	0.6	2	(N/A)	1.9	0.35
Broadleaf Deciduous	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.2	2	0.0	0	0.6	2	(N/A)	1.9	0.35
White ash	2.3	0.4	1.0	0.1	12	4.4	0.6	0.6	4.2	27	0.0	0	13.7	40	(N/A)	1.9	7.91
Conifer Evergreen Small	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	-0.1	0	0.2	0	(N/A)	1.5	0.11
Honeylocust	0.6	0.1	0.3	0.0	3	2.6	0.4	0.4	2.5	16	-0.4	-2	6.5	18	(N/A)	1.5	4.50
Northern pin oak	2.2	0.4	1.1	0.1	12	4.4	0.6	0.6	4.1	27	-0.5	-2	13.1	37	(N/A)	1.5	9.36
Eastern redbud	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	2	(N/A)	1.2	0.51
Other street trees	4.5	0.7	2.2	0.2	24	14.3	2.1	2.0	13.6	89	-0.6	-2	39.0	111	(N/A)	9.3	4.63
Citywide total	73.1	12.4	37.3	3.3	398	229.6	33.4	31.9	218.1	1,431	-39.5	-148	599.5	1,680	(N/A)	100.0	6.49

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
Sugar maple	316,658	2,375	(N/A)	13.5	18.3	67.86
Norway maple	149,257	1,119	(N/A)	12.7	8.6	33.92
Silver maple	511,288	3,835	(N/A)	12.7	29.5	116.20
Green ash	170,534	1,279	(N/A)	8.9	9.9	55.61
Red maple	27,273	205	(N/A)	5.8	1.6	13.64
Apple	13,155	99	(N/A)	5.4	0.8	7.05
Pin oak	154,378	1,158	(N/A)	3.9	8.9	115.78
Northern	42,390	318	(N/A)	3.1	2.5	39.74
Blue spruce	1,509	11	(N/A)	3.1	0.1	1.41
Black walnut	49,524	371	(N/A)	2.7	2.9	53.06
Northern white	1,797	13	(N/A)	2.7	0.1	1.93
Broadleaf	63,120	473	(N/A)	2.3	3.7	78.90
Eastern white pine	1,067	8	(N/A)	2.3	0.1	1.33
Broadleaf	286	2	(N/A)	1.9	0.0	0.43
Broadleaf	397	3	(N/A)	1.9	0.0	0.60
White ash	34,957	262	(N/A)	1.9	2.0	52.44
Conifer Evergreen	51	0	(N/A)	1.5	0.0	0.09
Honeylocust	8,006	60	(N/A)	1.5	0.5	15.01
Northern pin oak	36,522	274	(N/A)	1.5	2.1	68.48
Eastern redbud	369	3	(N/A)	1.2	0.0	0.92
Other street trees	67,141	1,110	(N/A)	9.3	8.6	46.26
Citywide total	1,730,558	12,979	(N/A)	100.0	100.0	50.11

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees by Species

11/22/2010

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Sugar maple	17,778	133	-1,520	-7	-11	14,349	108	30,600	230	(N/A)	13.5	15.9	6.56
Norway maple	9,990	75	-716	-6	-5	10,763	81	20,030	150	(N/A)	12.7	10.4	4.55
Silver maple	39,133	293	-2,454	-6	-18	16,380	123	53,052	398	(N/A)	12.7	27.6	12.06
Green ash	10,816	81	-819	-4	-6	7,856	59	17,848	134	(N/A)	8.9	9.3	5.82
Red maple	3,623	27	-131	-3	-1	3,180	24	6,669	50	(N/A)	5.8	3.5	3.33
Apple	1,493	11	-63	-3	0	1,640	12	3,067	23	(N/A)	5.4	1.6	1.64
Pin oak	14,361	108	-741	-2	-6	5,466	41	19,084	143	(N/A)	3.9	9.9	14.31
Northern hackberry	3,114	23	-203	-2	-2	4,349	33	7,258	54	(N/A)	3.1	3.8	6.80
Blue spruce	219	2	-7	-2	0	638	5	848	6	(N/A)	3.1	0.4	0.80
Black walnut	3,935	30	-238	-1	-2	2,821	21	6,517	49	(N/A)	2.7	3.4	6.98
Northern white cedar	368	3	-9	-1	0	661	5	1,019	8	(N/A)	2.7	0.5	1.09
Broadleaf Deciduous	4,121	31	-303	-1	-2	2,884	22	6,701	50	(N/A)	2.3	3.5	8.38
Eastern white pine	232	2	-5	-1	0	422	3	647	5	(N/A)	2.3	0.3	0.81
Broadleaf Deciduous	117	1	-1	-1	0	93	1	208	2	(N/A)	1.9	0.1	0.31
Broadleaf Deciduous	102	1	-2	-1	0	91	1	190	1	(N/A)	1.9	0.1	0.29
White ash	2,963	22	-168	-1	-1	1,570	12	4,365	33	(N/A)	1.9	2.3	6.55
Conifer Evergreen	15	0	0	-1	0	45	0	59	0	(N/A)	1.5	0.0	0.11
Honeylocust	1,227	9	-38	-1	0	908	7	2,096	16	(N/A)	1.5	1.1	3.93
Northern pin oak	475	4	-175	-1	-1	1,524	11	1,824	14	(N/A)	1.5	1.0	3.42
Eastern redbud	85	1	-2	-1	0	80	1	162	1	(N/A)	1.2	0.1	0.41
Other street trees	5,689	43	-711	-5	-5	5,020	38	9,993	75	(N/A)	9.3	5.2	3.12
Citywide total	119,856	899	-8,307	-51	-63	80,739	606	192,238	1,442	(N/A)	100.0	100.0	5.57

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

11/22/2010

Species	Total ($)	Standar d Error	% of Total Trees	% of Total $	Avg. $/tree
Sugar maple	1,909	(N/A)	13.5	16.7	54.54
Norway maple	1,023	(N/A)	12.7	8.9	31.00
Silver maple	3,123	(N/A)	12.7	27.3	94.64
Green ash	1,008	(N/A)	8.9	8.8	43.81
Red maple	513	(N/A)	5.8	4.5	34.21
Apple	84	(N/A)	5.4	0.7	6.00
Pin oak	1,092	(N/A)	3.9	9.5	109.17
Northern hackberry	439	(N/A)	3.1	3.8	54.91
Blue spruce	135	(N/A)	3.1	1.2	16.88
Black walnut	359	(N/A)	2.7	3.1	51.27
Northern white cedar	108	(N/A)	2.7	0.9	15.42
Broadleaf Deciduous	346	(N/A)	2.3	3.0	57.70
Eastern white pine	74	(N/A)	2.3	0.7	12.38
Broadleaf Deciduous	24	(N/A)	1.9	0.2	4.77
Broadleaf Deciduous	4	(N/A)	1.9	0.0	0.84
White ash	324	(N/A)	1.9	2.8	64.85
Conifer Evergreen Small	26	(N/A)	1.5	0.2	6.55
Honeylocust	241	(N/A)	1.5	2.1	60.33
Northern pin oak	46	(N/A)	1.5	0.4	11.45
Eastern redbud	4	(N/A)	1.2	0.0	1.38
Other street trees	562	(N/A)	9.3	4.9	23.43
Citywide total	11,445	(N/A)	100.0	100.0	44.19

Table 7: Summary of Benefits in Dollars

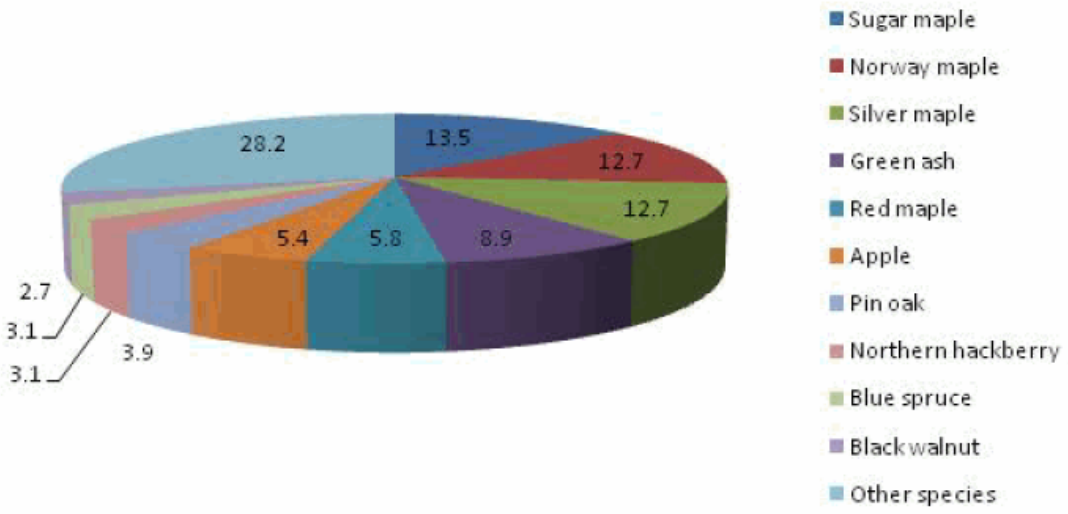
Total Annual Benefits of Public Trees by Species ($)

11/22/20

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Sugar maple	1,763	230	280	2,350	1,909	6,531	(±0)	17.2
Norway maple	1,378	150	233	1,348	1,023	4,132	(±0)	10.9
Silver maple	2,002	398	362	3,568	3,123	9,453	(±0)	24.9
Green ash	984	134	167	1,258	1,008	3,550	(±0)	9.4
Red maple	385	50	65	328	513	1,342	(±0)	3.5
Apple	226	23	34	94	84	461	(±0)	1.2
Pin oak	657	143	87	916	1,092	2,896	(±0)	7.6
Northern hackberry	565	54	95	597	439	1,749	(±0)	4.6
Blue spruce	90	6	9	117	135	358	(±0)	0.9
Black walnut	352	49	58	413	359	1,231	(±0)	3.2
Northern white cedar	95	8	10	113	108	334	(±0)	0.9
Broadleaf Deciduous	359	50	62	470	346	1,287	(±0)	3.4
Eastern white pine	61	5	7	72	74	218	(±0)	0.6
Broadleaf Deciduous	13	2	2	6	24	46	(±0)	0.1
Broadleaf Deciduous	13	1	2	4	4	25	(±0)	0.1
White ash	187	33	40	314	324	897	(±0)	2.4
Conifer Evergreen	6	0	0	7	26	40	(±0)	0.1
Honeylocust	117	16	18	106	241	498	(±0)	1.3
Northern pin oak	201	14	37	272	46	570	(±0)	1.5
Eastern redbud	12	1	2	4	4	22	(±0)	0.1
Other street trees	633	75	111	876	562	2,257	(±0)	6.0
Citywide Total	10,100	1,442	1,680	13,233	11,445	37,900	(±0)	100.0

Species Distribution of Public Trees (%)

11/22/2010

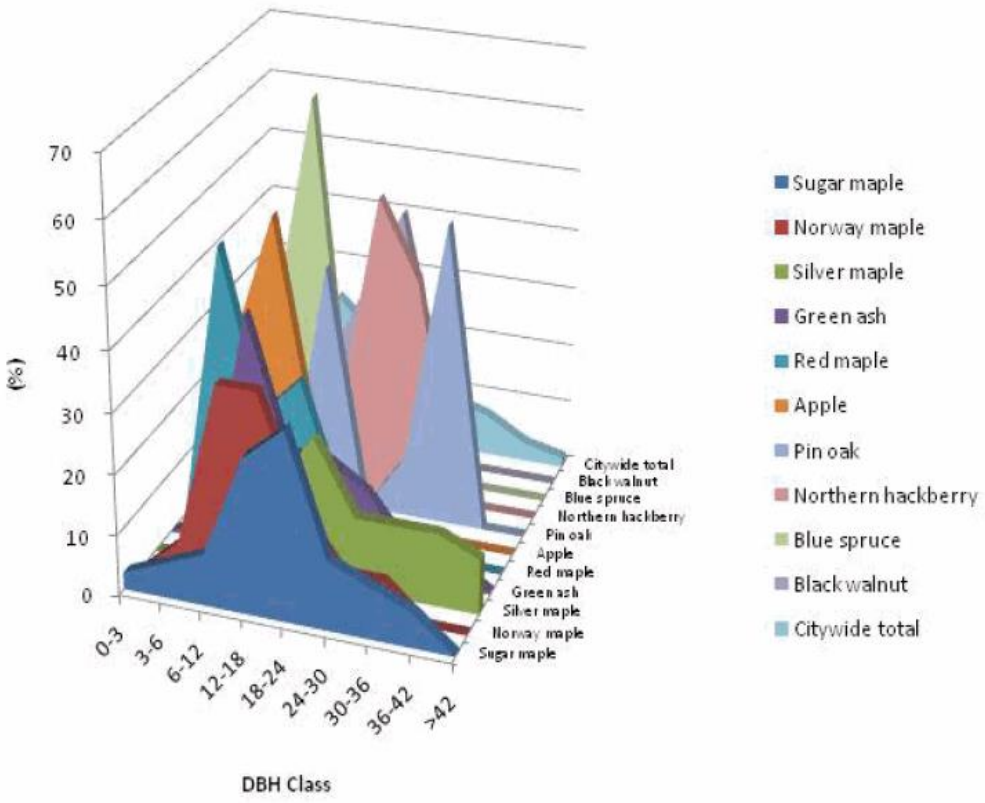


Species	Percent
Sugar maple	13.5
Norway maple	12.7
Silver maple	12.7
Green ash	8.9
Red maple	5.8
Apple	5.4
Pin oak	3.9
Northern hackberry	3.1
Blue spruce	3.1
Black walnut	2.7
Other species	28.2
Total	100.0

Figure 1: Species Distribution

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

11/22/2010



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Sugar maple	2.9	5.7	8.6	25.7	31.4	11.4	8.6	5.7	0.0
Norway maple	0.0	6.1	33.3	33.3	15.2	6.1	6.1	0.0	0.0
Silver maple	0.0	0.0	15.2	15.2	24.2	12.1	12.1	12.1	9.1
Green ash	0.0	4.3	39.1	17.4	17.4	13.0	4.3	4.3	0.0
Red maple	0.0	46.7	20.0	26.7	6.7	0.0	0.0	0.0	0.0
Apple	7.1	28.6	50.0	14.3	0.0	0.0	0.0	0.0	0.0
Pin oak	0.0	0.0	0.0	40.0	0.0	10.0	50.0	0.0	0.0
Northern hackberry	0.0	0.0	0.0	12.5	50.0	37.5	0.0	0.0	0.0
Blue spruce	12.5	25.0	62.5	0.0	0.0	0.0	0.0	0.0	0.0
Black walnut	0.0	0.0	14.3	28.6	42.9	14.3	0.0	0.0	0.0
Citywide total	8.5	13.5	23.9	17.8	15.8	8.9	6.9	3.1	1.5

Figure 2: Relative Age Class

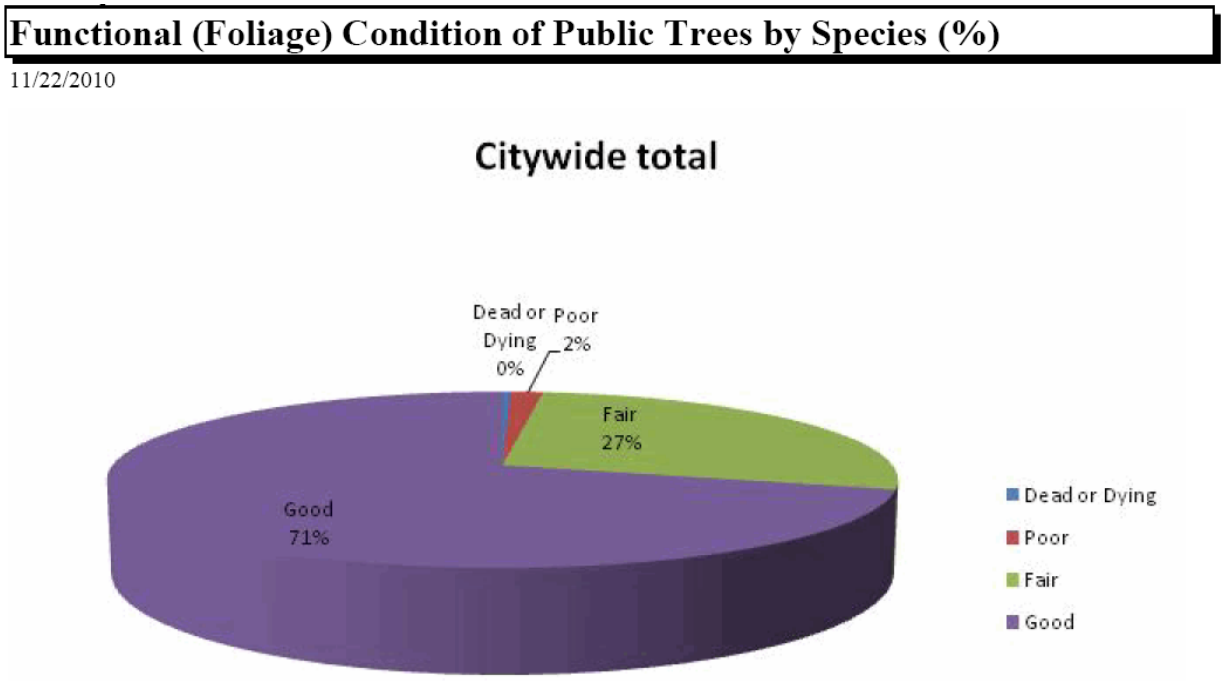


Figure 3: Foliage Condition

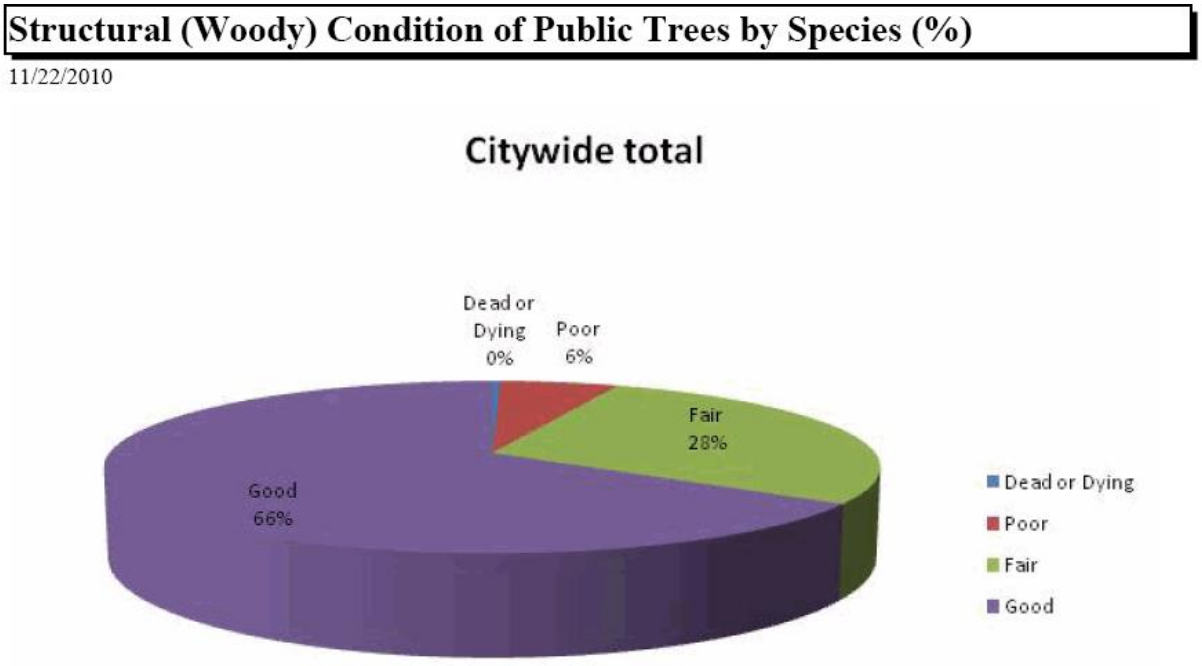
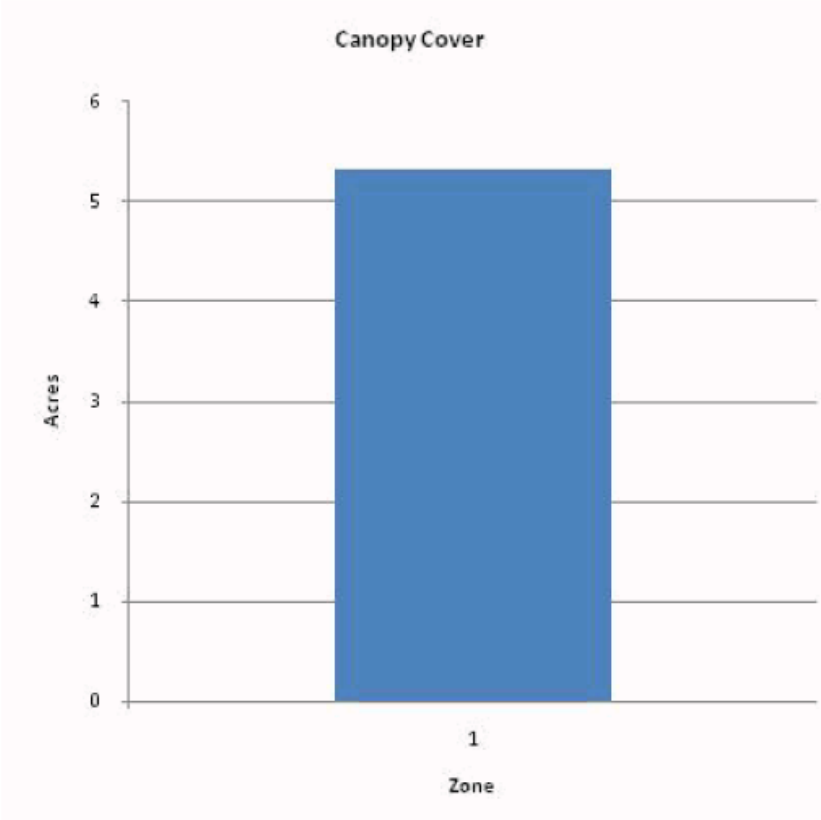


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

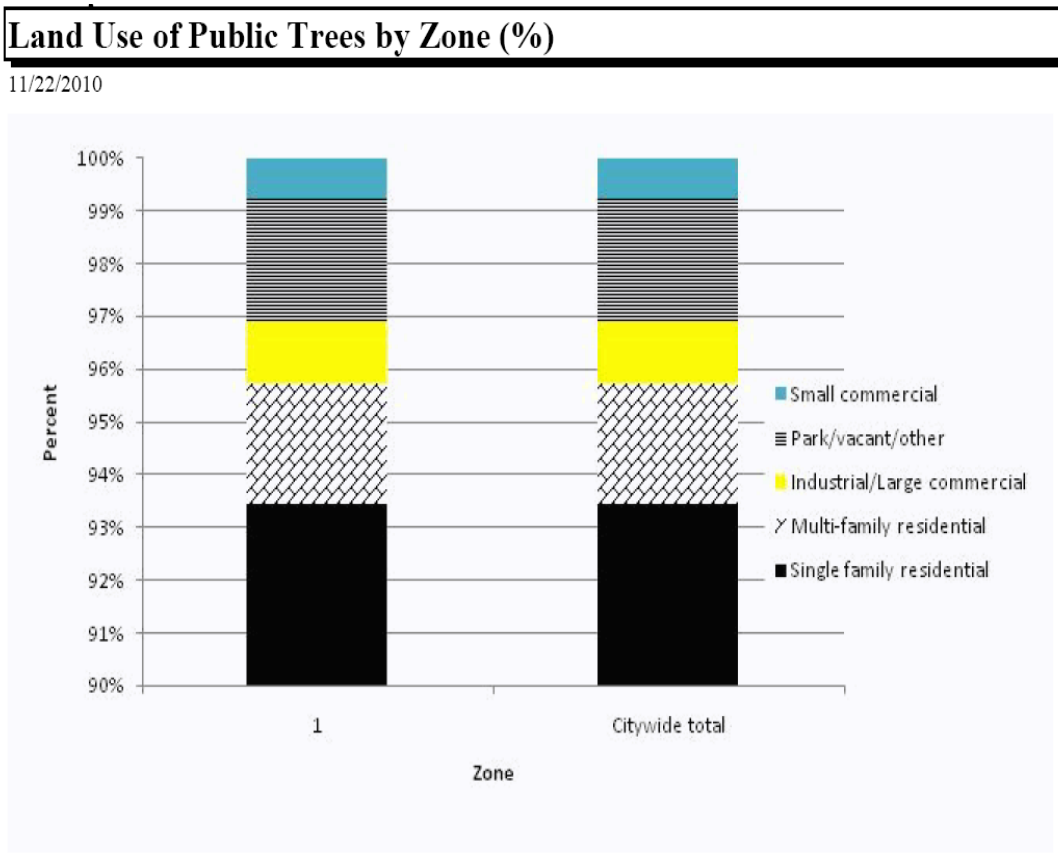
11/22/2010



Zone	Acres	% of Total Canopy Cover
1	5	100.0
Citywide total	5	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	5		

Figure 5: Canopy Cover in Acres

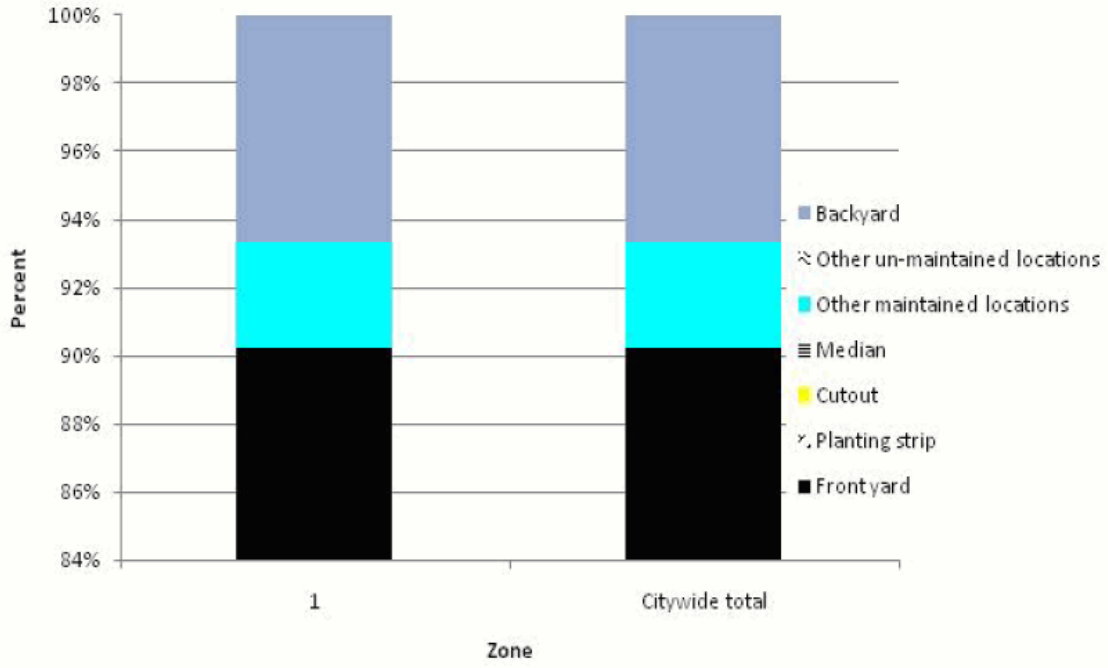


Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	93.4	2.3	1.2	2.3	0.8
Citywide total	93.4	2.3	1.2	2.3	0.8

Figure 6: Land Use of city/park trees

Location of Public Trees by Zone (%)

11/22/2010



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	90.2	0.0	0.0	0.0	3.1	0.0	6.6
Citywide total	90.2	0.0	0.0	0.0	3.1	0.0	6.6

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

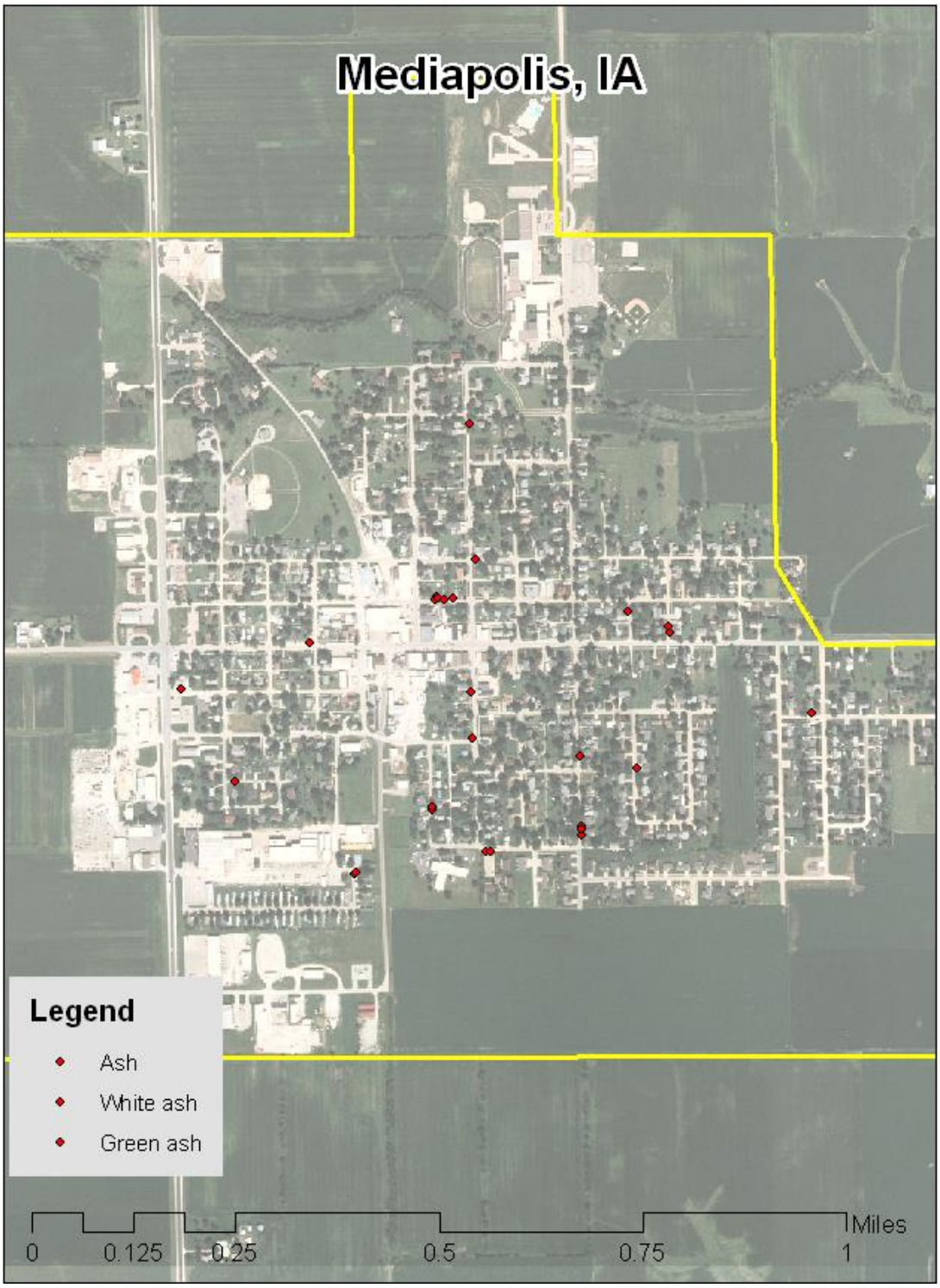


Figure 1: Location of Ash Trees

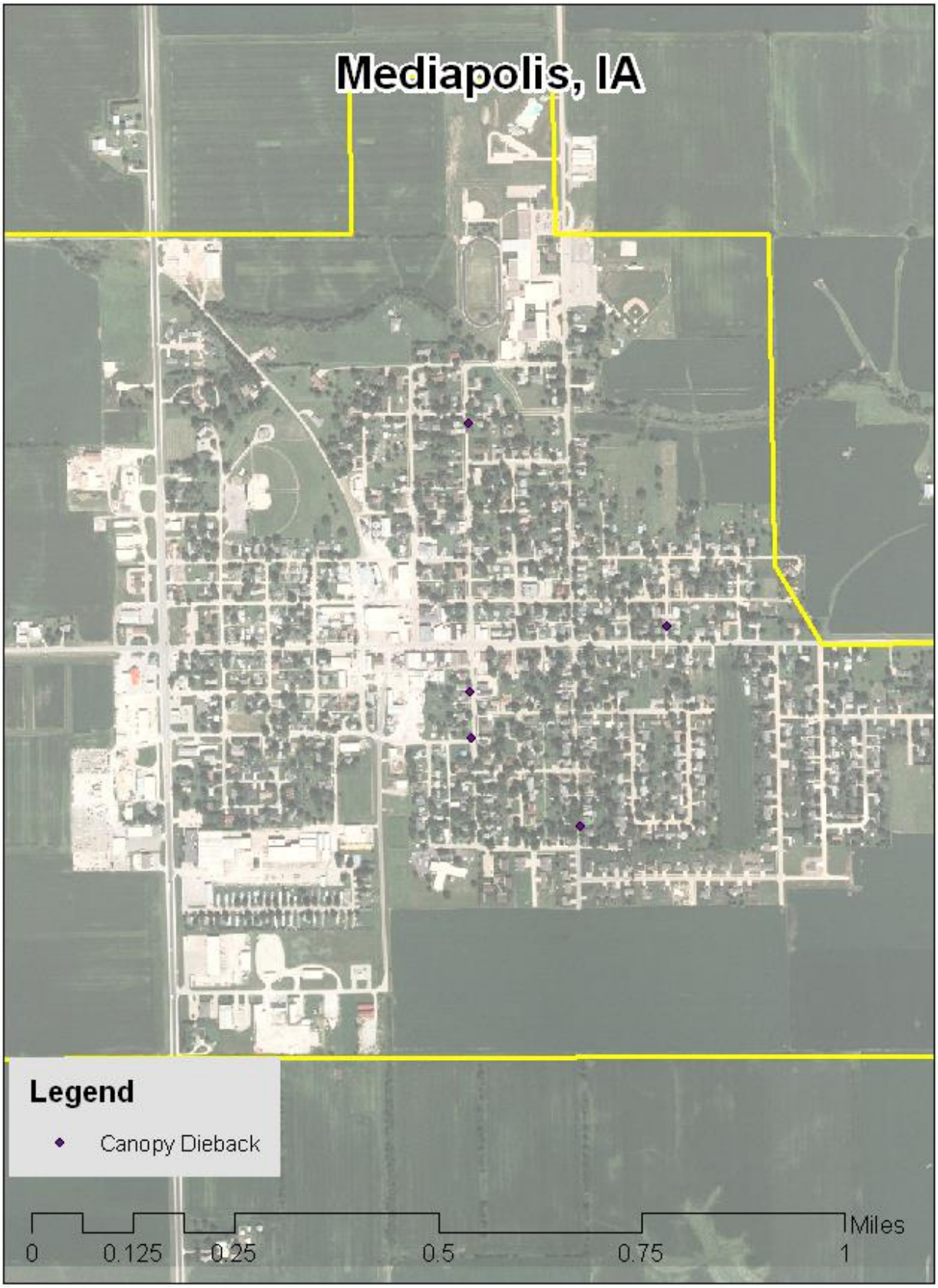


Figure 2: Location of EAB symptoms

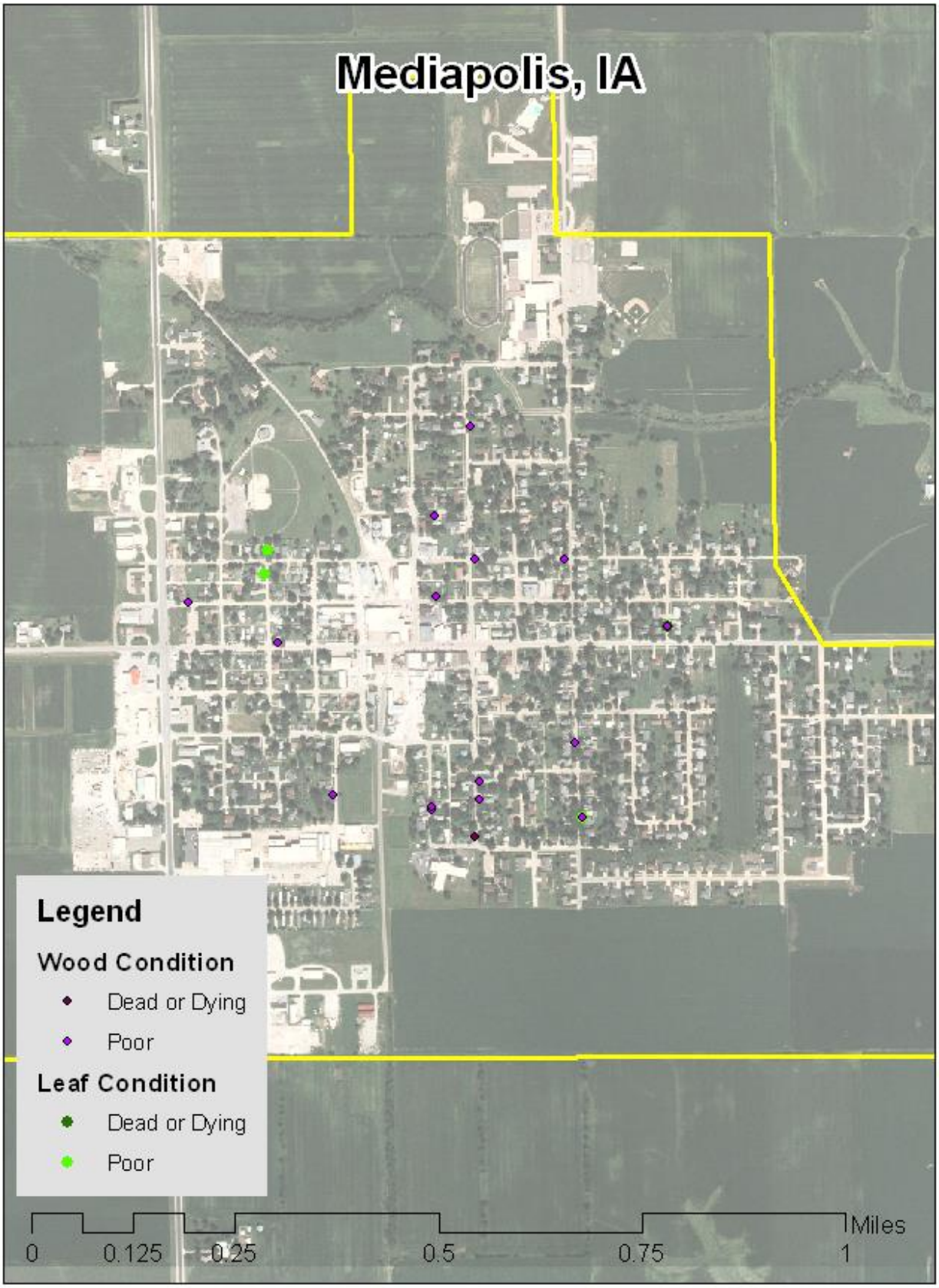


Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance*City ownership of the trees recommended for removal should be verified prior to any removal*

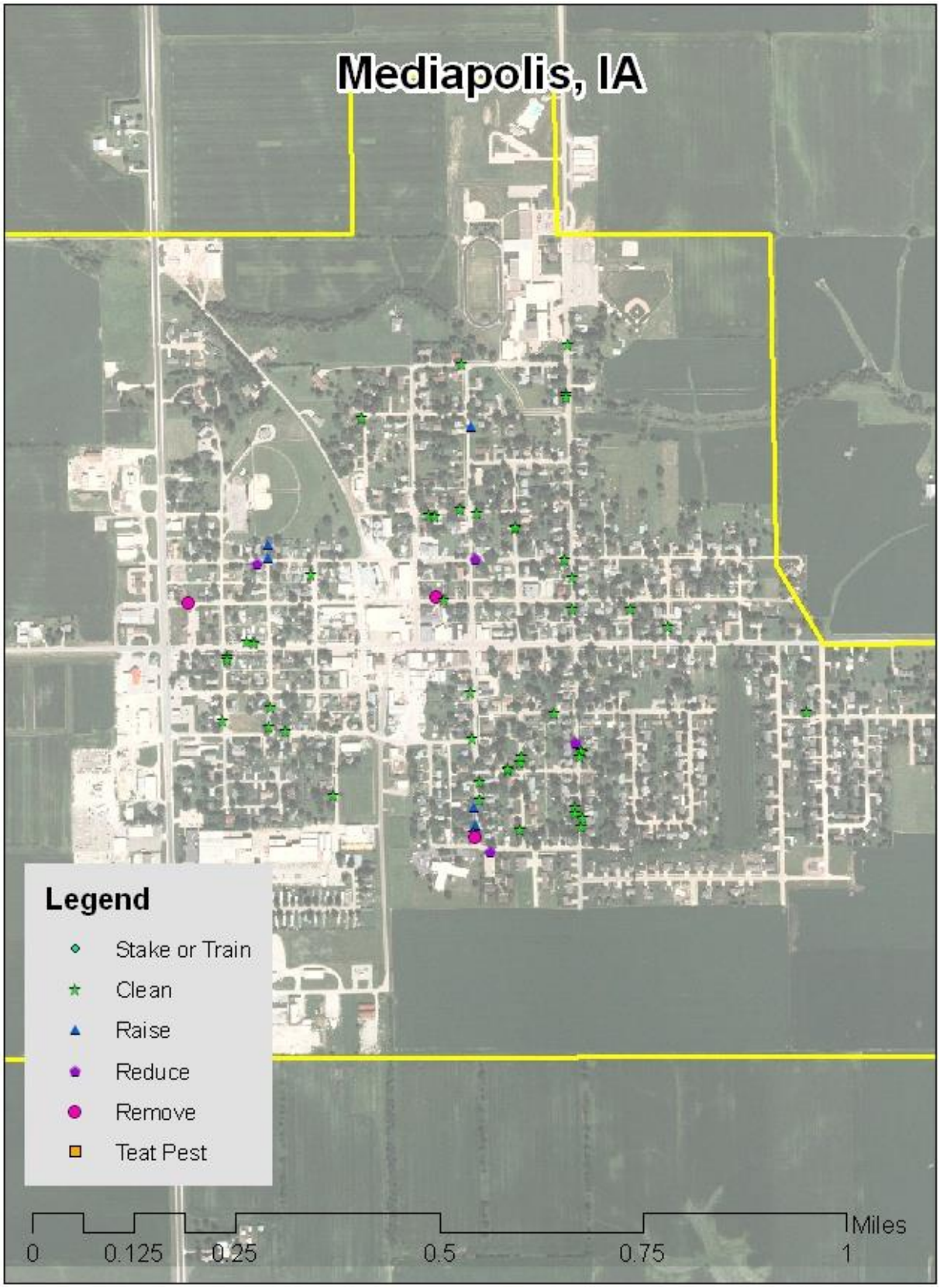


Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal****

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

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

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