

LA MOTTE, IA



2011 Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of LaMotte with managing its park trees, 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 16% of LaMotte's city park 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 2011, 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 64 trees inventoried.

- LaMotte's trees provide \$5,130 of benefits annually, an average of \$80 a tree
- There are 16 species of trees
- The top three genus are: Maple 38%, Crab apple 17% and Ash 16%
- 14% of trees are in need of some type of management
- 2 tree is 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 2 tree needing removal, both tree is about 12 inches in diameter at 4.5 ft and are both Norway maple. They must be addressed in the near future. [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)
- 2 of the 10 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 half of the park trees every other year, then wait 3 years.
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Siberian elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly

Introduction

This plan was developed to assist LaMotte with the management, budgeting and future planning of their park trees. 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 tree canopy in LaMotte, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2011, a tree inventory was conducted that included 100% of the city owned trees in the parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

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

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms 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 64 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.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. LaMotte's trees reduce energy related costs by approximately \$1,730 annually (Appendix A, Table 1). These savings are both in Electricity (8 MWh) and in Natural Gas (1,147.1 Therms).

Annual Stormwater Benefits

LaMotte's trees intercept about 60,631 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$1,643 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 LaMotte, it is estimated that trees remove 99.2 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 \$279 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In LaMotte, trees sequester about 23,450 lbs of carbon a year with an associated value of \$176 (Appendix A, Table 4). In addition, the trees store 199,994 lbs of carbon, with a yearly benefit of \$1,500 (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. LaMotte receives \$1,302 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, LaMotte's trees provide \$5,130 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 20 trees in LaMotte provide approximately \$80 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

LaMotte has 8 different tree species in its parks (Appendix A, Figure 1).

The distribution of trees by genus is as follows:

Maple(Red,Norway,Sugar,Boxelder)	24	38%
Crab Apple	11	17%
Ash	10	16%

Size Class

Most of LaMotte's trees (44%) are between 6 and 12 inches in diameter at 4.5 ft (Appendix A, Figure 2). For size, a Bell Curve is preferred and shows the highest amount of trees around 10 inches in diameter at 4.5 ft. LaMotte's size curve is on the average side, indicating an average stand. Generally with trees size does not indicate age.

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 LaMotte indicate that 94% of the trees are in good health, with 3% foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 77% of LaMotte'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 3% of the population. This 14% 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	7	11%
Tree Removal	2	3%

Canopy Cover

The canopy cover of LaMotte is approximately 1 acre (Appendix A, Figure 4). According to the 2000 census, LaMotte occupies 87 acres. Thus the canopy cover on city land is about 2%.

Land Use and Location

The all of LaMotte's city trees are in the city parks (Appendix A, Figure 6 & Appendix A, Figure 7). The following describes the land use and locations for the street and park trees.

Land Use

Park/vacant/other	100%
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Location

Park

100%

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

LaMotte has 2 critical concern tree that need removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). The removal is critical concerns and should be address as soon as possible. These trees are not large diameter and are both Norway maples. One tree is in the park in the middle of town and the other tree is in the park across from the fire station. Please refer to the six year maintenance plan at the end of this section. After the critical concern tree is addressed, there should be follow up on the trees marked as needing maintenance that do not include trimming.

Poor tree species

Ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). There are a total of 10 ash trees, and 2 of those have signs and symptoms that have been associated with EAB. *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 trees in the parks in LaMotte.

It is important to plant a diverse mix of species in the parks 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 parks trees. Presently, the forest is moderately planted with Maple (38%) (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, Siberian elm, evergreen, willow or black walnut. All trees planted must meet the restrictions in city ordinance.

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: 1 critical concern Norway maple tree²
- Visual Survey for signs and symptoms of EAB
- Replant 2 trees

Year 2

- Removal: none needed
- Routine trimming: Contract to trim ½ of the city trees
- Visual Survey for signs and symptoms of EAB
- Replant 1 tree

Year 3

- Visual Survey for signs and symptoms of EAB

Year 4

- Routine trimming: Contract to trim 1/2 of the city trees
- Visual Survey for signs and symptoms of EAB

Year 5

- Visual Survey for signs and symptoms of EAB

Year 6

- Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: EAB could potentially start killing ash within 6 years of its arrival. This should leave adequate time for a strategy, the tree removals will increase once it arrives, but if they are kept up, the EAB population will be reduced decreasing their impact.

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. The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Siberian/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.

Budget

Current Budget

Total \$2,700 over 6 years (\$450/year)

FY 2012 Budget

Removal: \$1,000

Replanting 2 trees: \$200

FY 2013 Budget

Routine trimming: \$700

Replanting 1 tree: \$100

FY 2014 Budget

FY 2015 Budget

Routine trimming: \$700

FY 2016 Budget

FY 2017 Budget

*Reduction of ash over 6 years: EAB could potentially start killing ash within 6 years of its arrival. This should leave adequate time for a strategy, the tree removals will increase once it arrives, but if they are kept up, the EAB population will be reduced, decreasing their impact.

Purposed Budget Increase

EAB could potentially kill all ash trees in LaMotte's city park within 10-12 years of its arrival. To remove all ash trees within 10-12 years after the discovery of EAB the budget would need to be increased to \$500 a year. If the budget were increased to \$5,000 a year all ash could be removed within 1 year. Additionally, it is recommended that LaMotte 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									
10/14/2011									
Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Red maple	1.3	101	189.7	186	287 (N/A)		25.0	16.6	17.93
Apple	0.5	34	77.9	76	111 (N/A)		17.2	6.4	10.05
Ash	2.1	161	308.2	302	463 (N/A)		15.6	26.7	46.26
Norway maple	1.0	77	139.0	136	214 (N/A)		9.4	12.4	35.62
Northern red oak	0.7	53	91.4	90	143 (N/A)		6.3	8.3	35.71
Honeylocust	0.4	30	60.7	60	90 (N/A)		4.7	5.2	29.94
Northern hackberry	0.2	18	38.1	37	55 (N/A)		3.1	3.2	27.70
Blue spruce	0.3	19	30.4	30	49 (N/A)		3.1	2.8	24.51
Pear	0.0	3	7.6	7	11 (N/A)		3.1	0.6	5.40
Swamp white oak	0.1	11	23.0	23	33 (N/A)		3.1	1.9	16.73
Sugar maple	0.1	8	14.8	15	22 (N/A)		1.6	1.3	22.22
River birch	0.3	24	47.4	46	71 (N/A)		1.6	4.1	70.84
Black walnut	0.3	20	38.1	37	57 (N/A)		1.6	3.3	57.32
American sycamore	0.5	37	63.1	62	99 (N/A)		1.6	5.7	98.63
Bur oak	0.1	7	13.7	13	21 (N/A)		1.6	1.2	20.64
Japanese tree lilac	0.0	2	3.8	4	5 (N/A)		1.6	0.3	5.40
Other street trees	0.0	0	0.0	0	0 (N/A)		0.0	0.0	0.00
Citywide total	8.0	606	1,147.1	1,124	1,730 (N/A)		100.0	100.0	27.04

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species						
10/14/2011						
Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Red maple	7,315	198 (N/A)		25.0	12.1	12.39
Apple	1,538	42 (N/A)		17.2	2.5	3.79
Ash	18,933	513 (N/A)		15.6	31.2	51.31
Norway maple	5,985	162 (N/A)		9.4	9.9	27.03
Northern red oak	4,954	134 (N/A)		6.3	8.2	33.56
Honeylocust	1,881	51 (N/A)		4.7	3.1	17.00
Northern hackberry	1,234	33 (N/A)		3.1	2.0	16.73
Blue spruce	3,088	84 (N/A)		3.1	5.1	41.85
Pear	137	4 (N/A)		3.1	0.2	1.86
Swamp white oak	749	20 (N/A)		3.1	1.2	10.14
Sugar maple	546	15 (N/A)		1.6	0.9	14.81
River birch	3,764	102 (N/A)		1.6	6.2	102.01
Black walnut	2,591	70 (N/A)		1.6	4.3	70.21
American sycamore	7,238	196 (N/A)		1.6	11.9	196.17
Bur oak	608	16 (N/A)		1.6	1.0	16.47
Japanese tree lilac	69	2 (N/A)		1.6	0.1	1.86
Other street trees	0	0 (N/A)		0.0	0.0	0.00
Citywide total	60,631	1,643 (N/A)		100.0	100.0	25.68

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species

10/14/2011

Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total (\$ Error)	Standard % of Total Trees	Avg. \$/tree
	O ₃	NO ₂	PM ₁₀	SO ₂		NO ₂	PM ₁₀	VOC	SO ₂							
Red maple	1.0	0.2	0.6	0.0	6	6.4	0.9	0.9	6.0	40	-0.4	-2	15.6	44 (N/A)	25.0	2.73
Apple	0.2	0.0	0.1	0.0	1	2.3	0.3	0.3	2.0	14	0.0	0	5.4	15 (N/A)	17.2	1.38
Ash	3.7	0.6	1.9	0.2	20	10.3	1.5	1.4	9.6	64	-0.9	-3	28.3	81 (N/A)	15.6	8.06
Norway maple	0.8	0.1	0.5	0.0	5	4.9	0.7	0.7	4.6	30	-0.2	-1	12.1	34 (N/A)	9.4	5.69
Northern red oak	0.9	0.2	0.5	0.0	5	3.3	0.5	0.5	3.2	21	-1.3	-5	7.7	21 (N/A)	6.3	5.24
Honeylocust	0.2	0.0	0.1	0.0	1	2.0	0.3	0.3	1.8	12	-0.1	0	4.6	13 (N/A)	4.7	4.28
Northern hackberry	0.1	0.0	0.1	0.0	0	1.2	0.2	0.2	1.1	7	0.0	0	2.7	8 (N/A)	3.1	3.84
Blue spruce	0.4	0.1	0.3	0.0	3	1.2	0.2	0.2	1.1	7	-1.1	-4	2.4	6 (N/A)	3.1	2.89
Pear	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1 (N/A)	3.1	0.71
Swamp white oak	0.1	0.0	0.0	0.0	0	0.7	0.1	0.1	0.7	4	0.0	0	1.7	5 (N/A)	3.1	2.34
Sugar maple	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.1	3 (N/A)	1.6	3.12
River birch	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14 (N/A)	1.6	13.58
Black walnut	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.3	9 (N/A)	1.6	9.34
American sycamore	1.6	0.3	0.7	0.1	8	2.3	0.3	0.3	2.2	14	0.0	0	7.7	23 (N/A)	1.6	22.55
Bur oak	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3 (N/A)	1.6	2.99
Japanese tree lilac	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1 (N/A)	1.6	0.71
Other street trees	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.0	0.00
Citywide total	10.2	1.7	5.3	0.5	56	38.6	5.6	5.3	36.2	239	-4.3	-16	99.2	279 (N/A)	100.0	4.36

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees by Species

10/14/2011

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Red maple	13,556	102	(N/A)	25.0	6.8	6.35
Apple	4,876	37	(N/A)	17.2	2.4	3.32
Ash	62,437	468	(N/A)	15.6	31.2	46.83
Norway maple	14,174	106	(N/A)	9.4	7.1	17.72
Northern red oak	16,433	123	(N/A)	6.3	8.2	30.81
Honeylocust	2,724	20	(N/A)	4.7	1.4	6.81
Northern	851	6	(N/A)	3.1	0.4	3.19
Blue spruce	2,236	17	(N/A)	3.1	1.1	8.39
Pear	356	3	(N/A)	3.1	0.2	1.33
Swamp white oak	1,319	10	(N/A)	3.1	0.7	4.95
Sugar maple	1,101	8	(N/A)	1.6	0.6	8.26
River birch	14,280	107	(N/A)	1.6	7.1	107.10
Black walnut	8,458	63	(N/A)	1.6	4.2	63.43
American	55,982	420	(N/A)	1.6	28.0	419.86
Bur oak	1,035	8	(N/A)	1.6	0.5	7.76
Japanese tree lilac	178	1	(N/A)	1.6	0.1	1.33
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	199,994	1,500	(N/A)	100.0	100.0	23.44

Table 5: Annual Carbon Sequestered

Annual CO₂ Benefits of Public Trees by Species

10/14/2011

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
Red maple	2,005	15	-65	-3	-1	2,231	17	4,167	31 (N/A)	25.0	17.8	1.95
Apple	721	5	-23	-2	0	757	6	1,452	11 (N/A)	17.2	6.2	0.99
Ash	2,508	19	-300	-2	-2	3,549	27	5,755	43 (N/A)	15.6	24.5	4.32
Norway maple	1,830	14	-68	-1	-1	1,713	13	3,473	26 (N/A)	9.4	14.8	4.34
Northern red oak	1,092	8	-79	-1	-1	1,177	9	2,189	16 (N/A)	6.3	9.3	4.10
Honeylocust	604	5	-13	-1	0	670	5	1,261	9 (N/A)	4.7	5.4	3.15
Northern hackberry	157	1	-4	0	0	398	3	551	4 (N/A)	3.1	2.4	2.07
Blue spruce	181	1	-11	0	0	426	3	596	4 (N/A)	3.1	2.5	2.23
Pear	76	1	-2	0	0	74	1	148	1 (N/A)	3.1	0.6	0.56
Swamp white oak	320	2	-6	0	0	240	2	553	4 (N/A)	3.1	2.4	2.07
Sugar maple	150	1	-5	0	0	170	1	314	2 (N/A)	1.6	1.3	2.36
River birch	0	0	-69	0	-1	539	4	470	4 (N/A)	1.6	2.0	3.52
Black walnut	660	5	-41	0	0	441	3	1,060	8 (N/A)	1.6	4.5	7.95
American sycamore	479	4	-269	0	-2	813	6	1,023	8 (N/A)	1.6	4.4	7.67
Bur oak	209	2	-5	0	0	159	1	362	3 (N/A)	1.6	1.6	2.72
Japanese tree lilac	38	0	-1	0	0	37	0	74	1 (N/A)	1.6	0.3	0.56
Other street trees	0	0	0	0	0	0	0	0	0 (N/A)	0.0	0.0	0.00
Citywide total	11,028	83	-960	-12	-7	13,395	100	23,450	176 (N/A)	100.0	100.0	2.75

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

10/14/2011

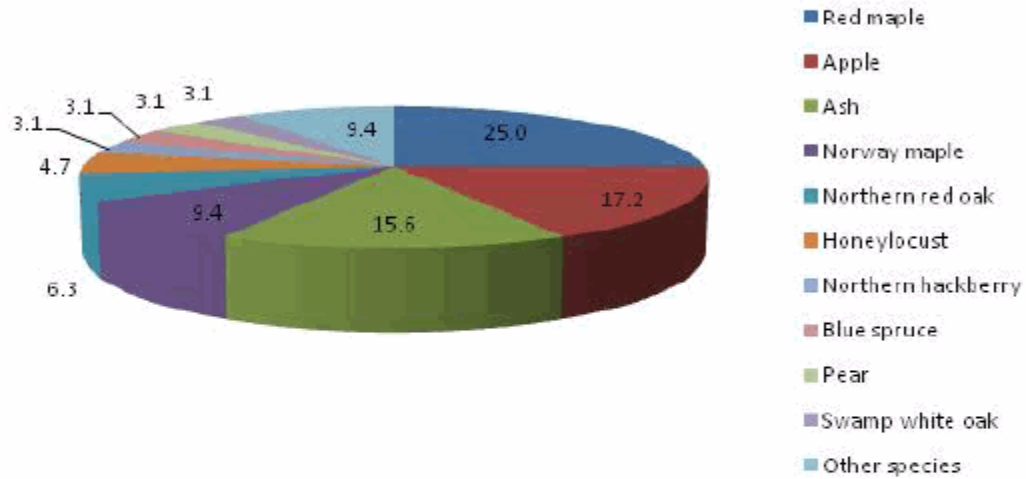
Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Red maple	341	(N/A)	25.0	26.2	21.32
Apple	40	(N/A)	17.2	3.1	3.64
Ash	258	(N/A)	15.6	19.8	25.77
Norway maple	196	(N/A)	9.4	15.1	32.69
Northern red oak	92	(N/A)	6.3	7.1	22.97
Honeylocust	94	(N/A)	4.7	7.3	31.49
Northern hackberry	49	(N/A)	3.1	3.7	24.25
Blue spruce	50	(N/A)	3.1	3.9	25.23
Pear	4	(N/A)	3.1	0.3	2.06
Swamp white oak	39	(N/A)	3.1	3.0	19.55
Sugar maple	21	(N/A)	1.6	1.6	21.31
River birch	0	(N/A)	1.6	0.0	0.00
Black walnut	58	(N/A)	1.6	4.4	57.69
American sycamore	29	(N/A)	1.6	2.2	28.57
Bur oak	29	(N/A)	1.6	2.2	28.56
Japanese tree lilac	2	(N/A)	1.6	0.2	2.06
Other street trees	0	(±NaN)	0.0	0.0	0.00
Citywide total	1,302	(N/A)	100.0	100.0	20.34

Table 7: Summary of Benefits in Dollars

Total Annual Benefits of Public Trees by Species (\$)								
10/14/20								
Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Red maple	287	31	44	198	341	901 (±0)		17.6
Apple	111	11	15	42	40	218 (±0)		4.3
Ash	463	43	81	513	258	1,357 (±0)		26.5
Norway maple	214	26	34	162	196	632 (±0)		12.3
Northern red oak	143	16	21	134	92	406 (±0)		7.9
Honeylocust	90	9	13	51	94	258 (±0)		5.0
Northern hackberry	55	4	8	33	49	149 (±0)		2.9
Blue spruce	49	4	6	84	50	193 (±0)		3.8
Pear	11	1	1	4	4	21 (±0)		0.4
Swamp white oak	33	4	5	20	39	102 (±0)		2.0
Sugar maple	22	2	3	15	21	64 (±0)		1.2
River birch	71	4	14	102	0	190 (±0)		3.7
Black walnut	57	8	9	70	58	203 (±0)		3.9
American sycamore	99	8	23	196	29	354 (±0)		6.9
Bur oak	21	3	3	16	29	71 (±0)		1.4
Japanese tree lilac	5	1	1	2	2	11 (±0)		0.2
Other street trees	0	0	0	0	0	0 (±0)		0.0
Citywide Total	1,730	176	279	1,643	1,302	5,130 (±0)		100.0

Species Distribution of Public Trees (%)

10/14/2011

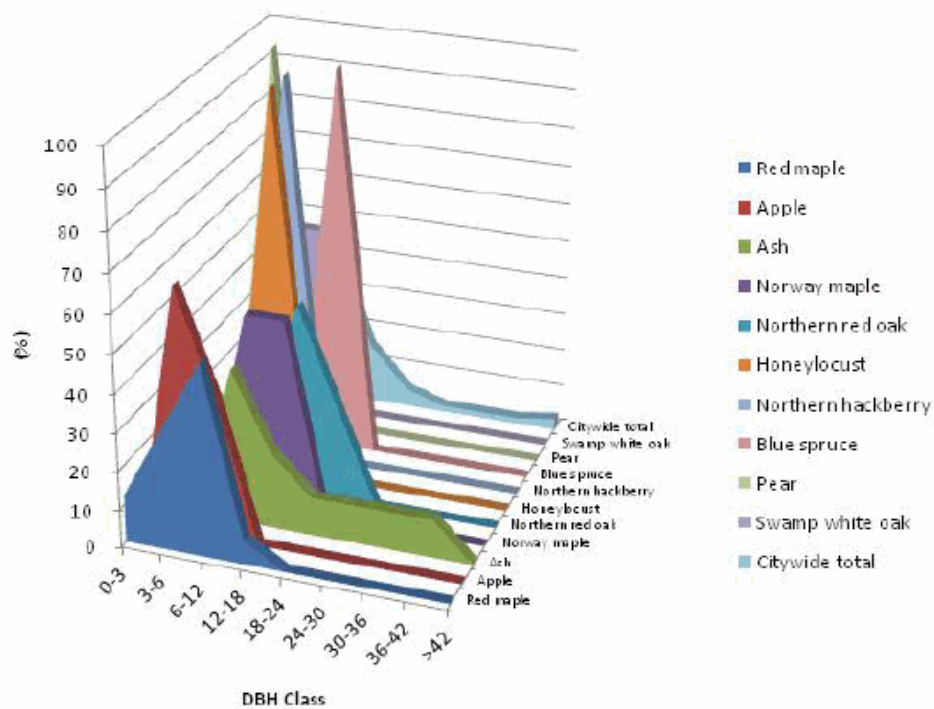


Species	Percent
Red maple	25.0
Apple	17.2
Ash	15.6
Norway maple	9.4
Northern red oak	6.3
Honeylocust	4.7
Northern hackberry	3.1
Blue spruce	3.1
Pear	3.1
Swamp white oak	3.1
Other species	9.4
Total	100.0

Figure 1: Species Distribution

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

10/14/2011



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Red maple	12.5	31.3	50.0	6.3	0.0	0.0	0.0	0.0	0.0
Apple	0.0	63.6	36.4	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	40.0	20.0	10.0	10.0	10.0	10.0	0.0
Norway maple	0.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0
Northern red oak	0.0	0.0	25.0	50.0	25.0	0.0	0.0	0.0	0.0
Honeylocust	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Northern hackberry	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Blue spruce	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Pear	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Swamp white oak	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0
Citywide total	3.1	25.0	43.8	15.6	4.7	1.6	1.6	1.6	3.1

Figure 2: Relative Age Class

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

10/14/2011

Citywide total

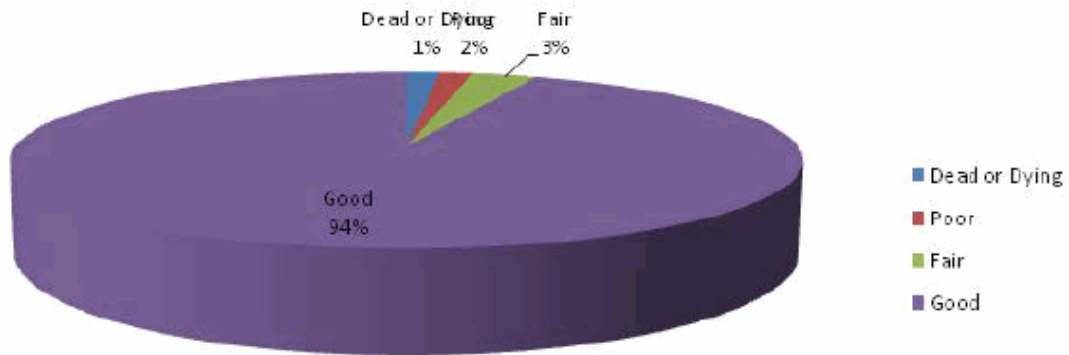


Figure 3: Foliage Condition

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

10/14/2011

Citywide total

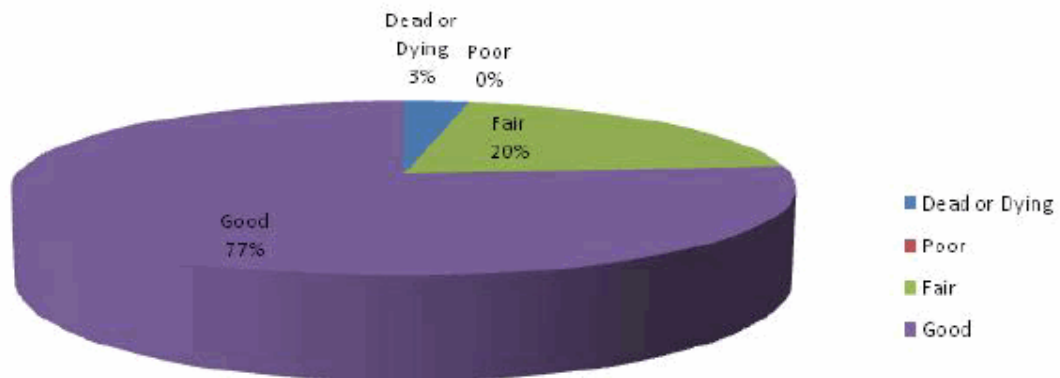
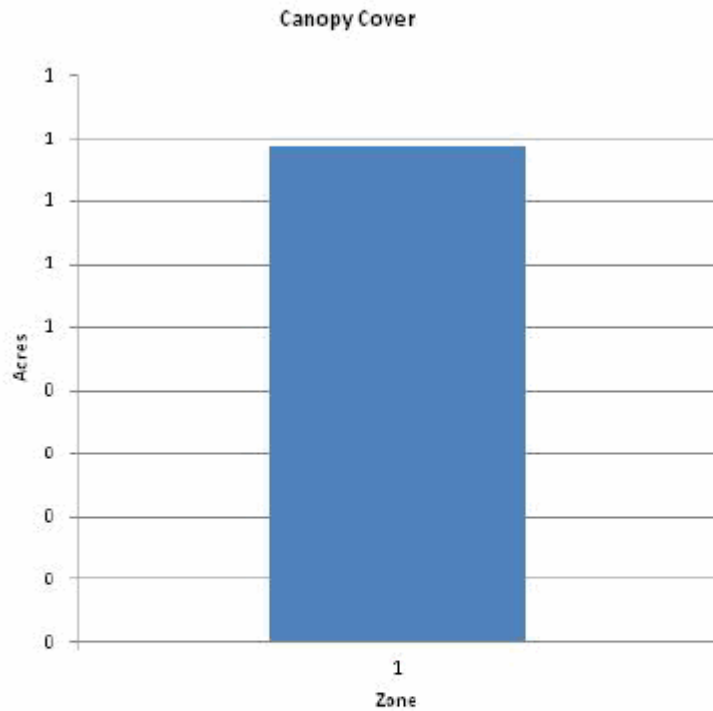


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

10/14/2011



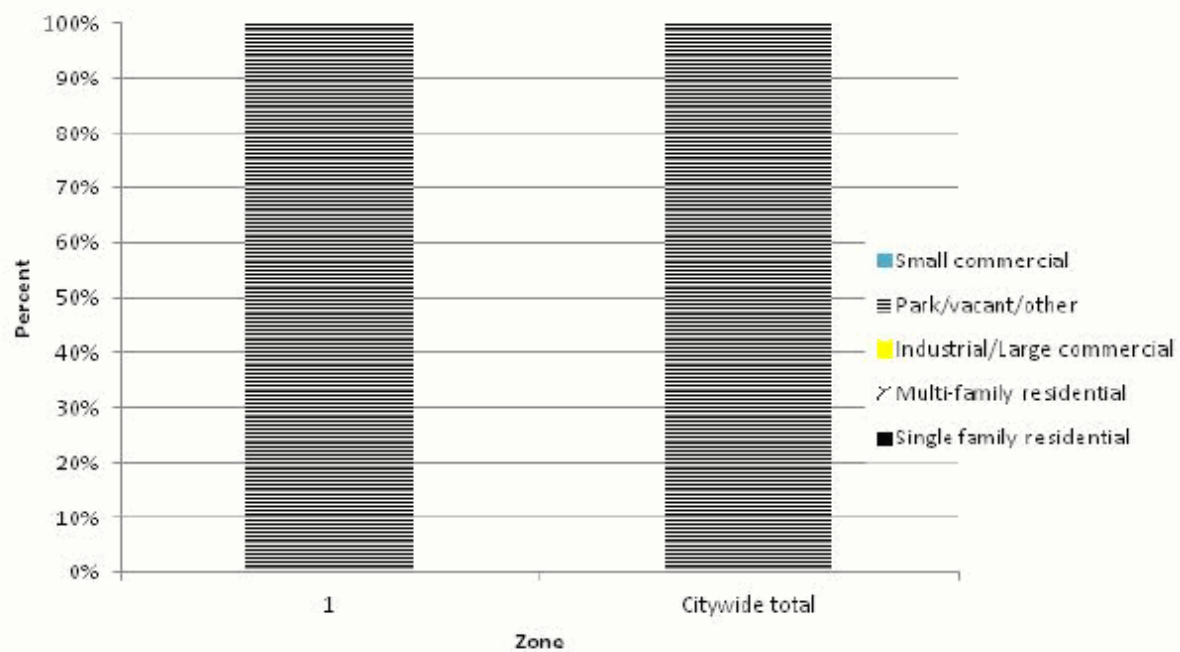
Zone	Acres	% of Total Canopy Cover
1	1	100.0
Citywide total	1	100.0

	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	1		

Figure 5: Canopy Cover in Acres

Land Use of Public Trees by Zone (%)

10/14/2011



Zone	Single family residential	Multi-family residential	Industrial/Large commercial	Park/vacant/other	Small commercial
1	0.0	0.0	0.0	100.0	0.0
Citywide total	0.0	0.0	0.0	100.0	0.0

Figure 6: Land Use of city/park trees

Location of Public Trees by Zone (%)

10/14/2011

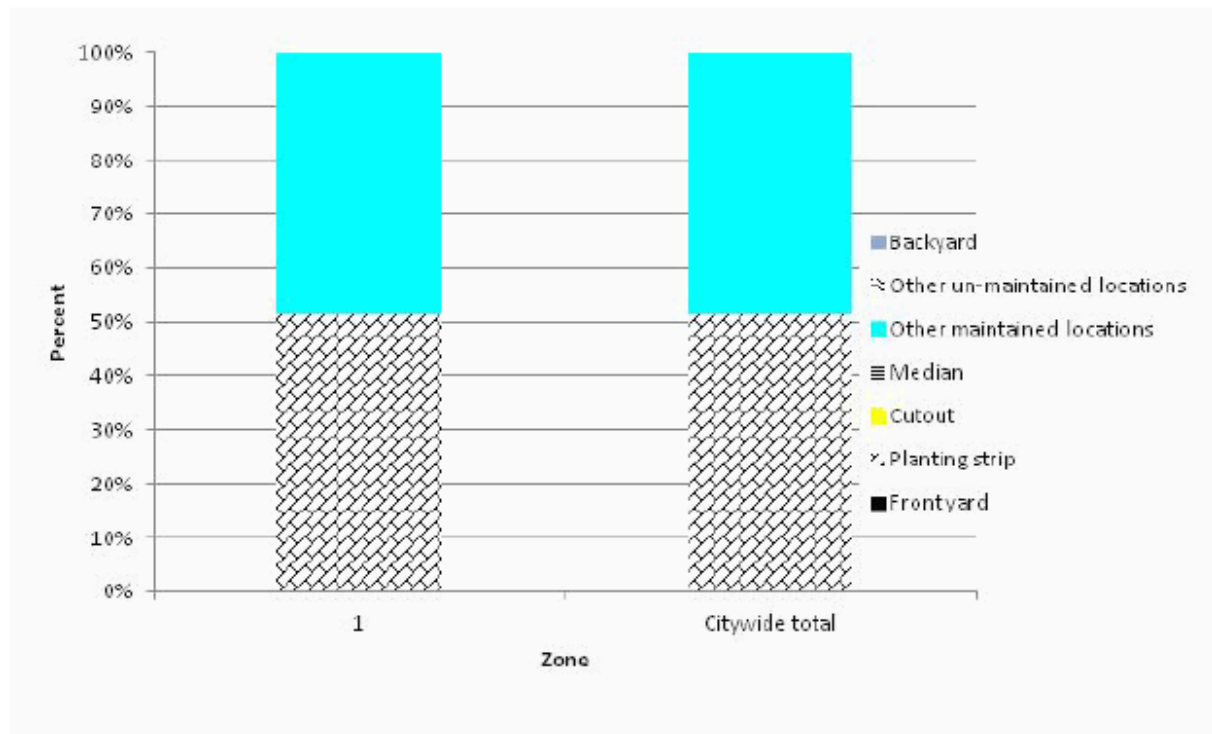


Figure 7: Location of city/park trees

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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