

ANDREW, IA



2011 Management Plan
Prepared by Steven Swinonos
Bureau of Forestry, Iowa DNR



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Executive Summary

Overview

This plan was developed to assist the City of Andrew 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 9% of Andrew'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 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 23 trees inventoried.

- Andrew's trees provide \$3,281 of benefits annually, an average of \$143 a tree
- There are over 11 species of trees
- The top three genus are: Maple 52%, Crab Apple 13%, and Ash 9%
- 22% of trees are in need of some type of management
- No 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.

- No trees need removal [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)
- 1 of the 2 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 city every other year
- 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 Andrew 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 tree canopy in Andrew, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

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

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

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms 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 23 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. Andrew's trees reduce energy related costs by approximately \$919 annually (Appendix A, Table 1). These savings are both in Electricity (4.3 MWh) and in Natural Gas (601.6 Therms).

Annual Stormwater Benefits

Andrew's trees intercept about 46,645 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$1,264 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 Andrew, it is estimated that trees remove 50.8 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 \$139 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Andrew, trees sequester about 14,762 lbs of carbon a year with an associated value of \$111 (Appendix A, Table 4). In addition, the trees store 153,509 lbs of carbon, with a yearly benefit of \$1,151 (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. Andrew receives \$849 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, Andrew's trees provide \$3,281 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 183 trees in Andrew provide approximately \$143 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Andrew has over 11 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Maple(Amur,Red,Norway,Sugar)	12	52%
Ash	2	9%
Concolor Fir	2	9%
Apple (Crab)	3	13%
Elm(Siberian)	1	4%
Red Cedar	1	4%
Norway Spruce	1	4%

Size Class

Most of Andrew's trees (56%) are between 6 and 18 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 12 inches in diameter at 4.5 ft. Andrew's size curve is on the average side, indicating a 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 Andrew indicate that 96% 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, 78% of Andrew'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 less than 1% of the population. This 22% 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	5	22%
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Canopy Cover

The canopy cover of Andrew is less than 1 acre (Appendix A, Figure 4). According to the 2000 census, Andrew occupies 120 acres. Thus the canopy cover on city land is less than 1%.

Land Use and Location

The majority of Andrew's city and park trees are planted in the city park in the center of the town. (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	22%
Park/vacant/other	78%

Location

Planting strip	100%
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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

Andrew has no critical concern trees. There are 5 trees that can be cleaned of branches but this can happen on a routine basis. Please refer to the six year maintenance plan at the end of this section.

Poor tree species

There are a total of 2 ash trees, and 1 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 forest in Andrew.

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 (52%) (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

Clean: 5 routine tree
Visual Survey for signs and symptoms of EAB

Year 2

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

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

Routine trimming: Contract to trim ¼ of the city trees
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, 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 \$700 over 6 years (\$117/year)

FY 2012 Budget

Cleaning: \$200

FY 2013 Budget

Routine trimming: \$250

FY 2014 Budget

FY 2015 Budget

Routine trimming: \$250

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 Andrew 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 \$1,000 a year all ash could be removed within 1 year. Additionally, it is recommended that Andrew 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

9/29/2011

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Sugar maple	2.0	149	263.8	259	407	(N/A)	30.4	44.3	58.19
Norway maple	0.7	54	88.5	87	140	(N/A)	13.0	15.3	46.78
Apple	0.2	17	38.5	38	55	(N/A)	13.0	5.9	18.19
Ash	0.4	32	64.3	63	95	(N/A)	8.7	10.4	47.66
Amur maple	0.1	6	12.8	13	18	(N/A)	4.4	2.0	18.19
Red maple	0.0	3	5.2	5	8	(N/A)	4.4	0.9	7.85
Broadleaf Deciduous	0.1	6	12.8	13	18	(N/A)	4.4	2.0	18.19
Conifer Evergreen Large	0.1	11	19.7	19	30	(N/A)	4.4	3.3	30.47
Conifer Evergreen	0.1	5	10.2	10	15	(N/A)	4.4	1.6	14.80
Eastern red cedar	0.0	4	7.9	8	11	(N/A)	4.4	1.3	11.47
Norway spruce	0.2	14	24.6	24	38	(N/A)	4.4	4.2	38.17
Siberian elm	0.4	30	53.2	52	82	(N/A)	4.4	8.9	82.09
Other street trees	0.0	0	0.0	0	0	(N/A)	0.0	0.0	0.00
Citywide total	4.3	329	601.6	590	919	(N/A)	100.0	100.0	39.95

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees by Species

9/29/2011

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Sugar maple	23,053	625	(N/A)	30.4	49.4	89.26
Norway maple	4,227	115	(N/A)	13.0	9.1	38.19
Apple	793	22	(N/A)	13.0	1.7	7.17
Ash	4,350	118	(N/A)	8.7	9.3	58.95
Amur maple	264	7	(N/A)	4.4	0.6	7.17
Red maple	137	4	(N/A)	4.4	0.3	3.72
Broadleaf Deciduous	264	7	(N/A)	4.4	0.6	7.17
Conifer Evergreen Large	2,969	80	(N/A)	4.4	6.4	80.47
Conifer Evergreen	755	20	(N/A)	4.4	1.6	20.47
Eastern red cedar	659	18	(N/A)	4.4	1.4	17.86
Norway spruce	4,604	125	(N/A)	4.4	9.9	124.79
Siberian elm	4,567	124	(N/A)	4.4	9.8	123.78
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	46,645	1,264	(N/A)	100.0	100.0	54.96

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees by Species																	
9/29/2011																	
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								
Sugar maple	3.1	0.5	1.5	0.1	17	9.3	1.4	1.3	8.9	58	-2.5	-9	23.7	66 (N/A)	30.4	9.40	
Norway maple	0.7	0.1	0.3	0.0	4	3.3	0.5	0.5	3.2	21	-0.2	-1	8.4	24 (N/A)	13.0	7.92	
Apple	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.0	7	0.0	0	2.7	8 (N/A)	13.0	2.55	
Ash	0.9	0.2	0.5	0.0	5	2.1	0.3	0.3	1.9	13	-0.2	-1	6.0	17 (N/A)	8.7	8.52	
Amur maple	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	4.3	2.55	
Red maple	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1 (N/A)	4.3	1.12	
Broadleaf Deciduous	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	4.3	2.55	
Conifer Evergreen Large	0.3	0.1	0.3	0.0	2	0.7	0.1	0.1	0.7	4	-1.4	-5	0.9	1 (N/A)	4.3	1.45	
Conifer Evergreen	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2 (N/A)	4.3	1.53	
Eastern red cedar	0.1	0.0	0.1	0.0	0	0.2	0.0	0.0	0.2	1	-0.3	-1	0.3	1 (N/A)	4.3	0.62	
Norway spruce	0.6	0.1	0.4	0.1	4	0.9	0.1	0.1	0.8	5	-2.9	-11	0.3	-3 (N/A)	4.3	-1.58	
Siberian elm	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.6	16 (N/A)	4.3	16.11	
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	6.8	1.2	3.7	0.4	38	20.8	3.0	2.9	19.7	129	-7.7	-29	50.8	139 (N/A)	100.0	6.03	

Table 4: Annual Carbon Stored

Stored CO₂ Benefits of Public Trees by Species						
9/29/2011						
Species	Total Stored CO ₂ (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Sugar maple	91,376	685	(N/A)	30.4	59.5	97.90
Norway maple	10,872	82	(N/A)	13.0	7.1	27.18
Apple	2,724	20	(N/A)	13.0	1.8	6.81
Ash	15,381	115	(N/A)	8.7	10.0	57.68
Amur maple	908	7	(N/A)	4.4	0.6	6.81
Red maple	218	2	(N/A)	4.4	0.1	1.64
Broadleaf	908	7	(N/A)	4.4	0.6	6.81
Conifer Evergreen	3,343	25	(N/A)	4.4	2.2	25.07
Conifer Evergreen	284	2	(N/A)	4.4	0.2	2.13
Eastern red cedar	277	2	(N/A)	4.4	0.2	2.08
Norway spruce	7,490	56	(N/A)	4.4	4.9	56.18
Siberian elm	19,728	148	(N/A)	4.4	12.9	147.96
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	153,509	1,151	(N/A)	100.0	100.0	50.06

Table 5: Annual Carbon Sequestered

Annual CO₂ Benefits of Public Trees by Species													
9/29/2011													
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
Sugar maple	4,549	34	-439	-1	-3	3,288	25	7,397	55 (N/A)	30.4	50.1	7.93	
Norway maple	1,158	9	-52	-1	0	1,185	9	2,290	17 (N/A)	13.0	15.5	5.73	
Apple	342	3	-13	-1	0	372	3	700	5 (N/A)	13.0	4.7	1.75	
Ash	594	4	-74	0	-1	714	5	1,234	9 (N/A)	8.7	8.4	4.63	
Amur maple	114	1	-4	0	0	124	1	233	2 (N/A)	4.4	1.6	1.75	
Red maple	39	0	-1	0	0	60	0	98	1 (N/A)	4.4	0.7	0.73	
Broadleaf Deciduous	114	1	-4	0	0	124	1	233	2 (N/A)	4.4	1.6	1.75	
Conifer Evergreen	187	1	-16	0	0	246	2	418	3 (N/A)	4.4	2.8	3.13	
Conifer Evergreen	39	0	-1	0	0	106	1	143	1 (N/A)	4.4	1.0	1.07	
Eastern red cedar	40	0	-1	0	0	82	1	120	1 (N/A)	4.4	0.8	0.90	
Norway spruce	256	2	-36	0	0	311	2	531	4 (N/A)	4.4	3.6	3.98	
Siberian elm	797	6	-95	0	-1	662	5	1,363	10 (N/A)	4.4	9.2	10.23	
Other street trees	0	0	0	0	0	0	0	0	0 (N/A)	0.0	0.0	0.00	
Citywide total	8,227	62	-737	-4	-6	7,276	55	14,762	111 (N/A)	100.0	100.0	4.81	

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees by Species

9/29/2011

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Sugar maple	468	(N/A)	30.4	55.1	66.83
Norway maple	117	(N/A)	13.0	13.8	39.16
Apple	19	(N/A)	13.0	2.3	6.40
Ash	58	(N/A)	8.7	6.8	28.84
Amur maple	6	(N/A)	4.4	0.8	6.40
Red maple	7	(N/A)	4.4	0.9	7.28
Broadleaf Deciduous	6	(N/A)	4.4	0.8	6.40
Conifer Evergreen Large	47	(N/A)	4.4	5.6	47.08
Conifer Evergreen	21	(N/A)	4.4	2.5	21.08
Eastern red cedar	21	(N/A)	4.4	2.5	21.34
Norway spruce	26	(N/A)	4.4	3.1	26.25
Siberian elm	51	(N/A)	4.4	6.0	50.67
Other street trees	0	(±NaN)	0.0	0.0	0.00
Citywide total	849	(N/A)	100.0	100.0	36.90

Table 7: Summary of Benefits in Dollars

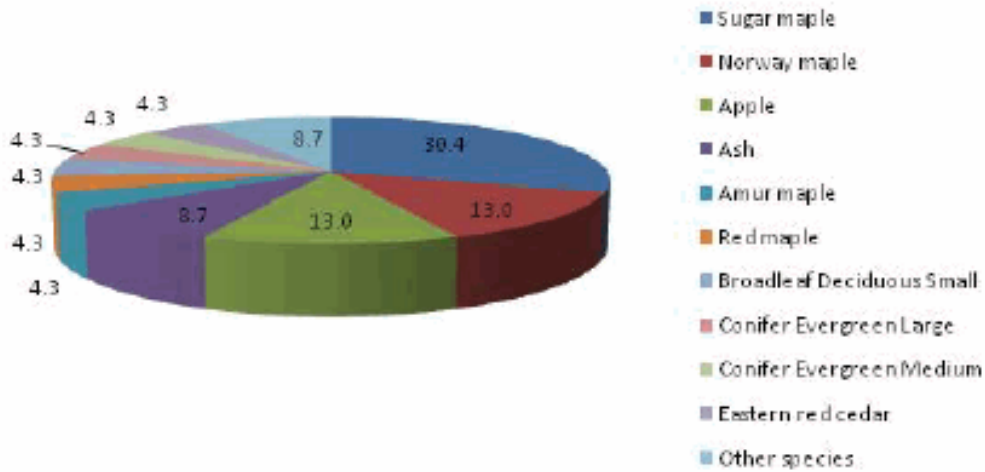
Total Annual Benefits of Public Trees by Species (\$)

9/29/2011

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Sugar maple	407	55	66	625	468	1,621	(±0)	49.4
Norway maple	140	17	24	115	117	413	(±0)	12.6
Apple	55	5	8	22	19	108	(±0)	3.3
Ash	95	9	17	118	58	297	(±0)	9.1
Amur maple	18	2	3	7	6	36	(±0)	1.1
Red maple	8	1	1	4	7	21	(±0)	0.6
Broadleaf Deciduous	18	2	3	7	6	36	(±0)	1.1
Conifer Evergreen	30	3	1	80	47	163	(±0)	5.0
Conifer Evergreen	15	1	2	20	21	59	(±0)	1.8
Eastern red cedar	11	1	1	18	21	52	(±0)	1.6
Norway spruce	38	4	-2	125	26	192	(±0)	5.8
Siberian elm	82	10	16	124	51	283	(±0)	8.6
Other street trees	0	0	0	0	0	0	(±0)	0.0
Citywide Total	919	111	139	1,264	849	3,281	(±0)	100.0

Species Distribution of Public Trees (%)

9/29/2011

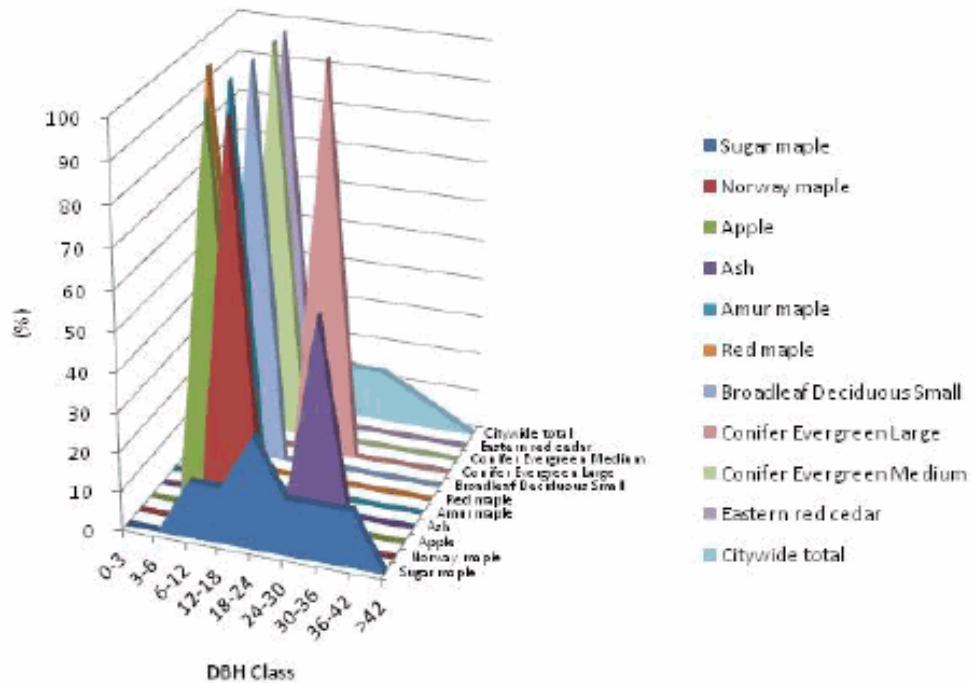


Species	Percent
Sugar maple	30.4
Norway maple	13.0
Apple	13.0
Ash	8.7
Amur maple	4.3
Red maple	4.3
Broadleaf Deciduous	4.3
Conifer Evergreen	4.3
Conifer Evergreen	4.3
Eastern red cedar	4.3
Other species	8.7
Total	100.0

Figure 1: Species Distribution

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

9/29/2011



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Sugar maple	0.0	0.0	14.3	14.3	28.6	14.3	14.3	14.3	0.0
Norway maple	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Apple	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Ash	0.0	0.0	50.0	0.0	0.0	50.0	0.0	0.0	0.0
Amur maple	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Red maple	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Broadleaf Deciduous	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Conifer Evergreen	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Conifer Evergreen	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Eastern red cedar	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Citywide total	0.0	4.3	39.1	17.4	13.0	13.0	8.7	4.3	0.0

Figure 2: Relative Age Class

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

9/29/2011

Citywide total

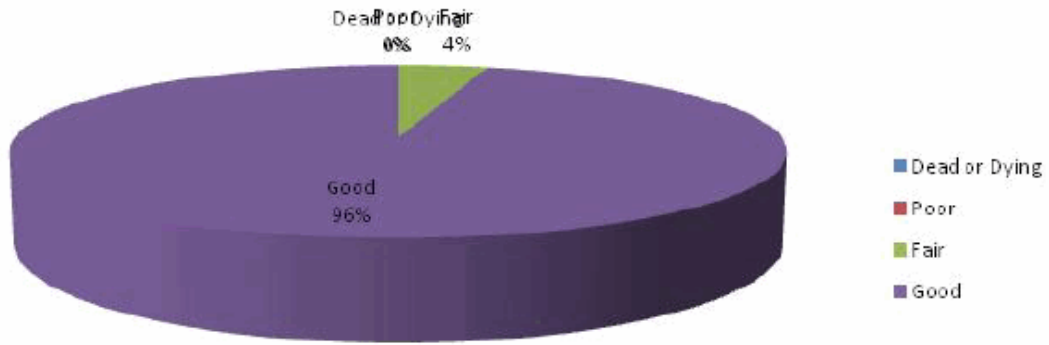


Figure 3: Foliage Condition

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

9/29/2011

Citywide total

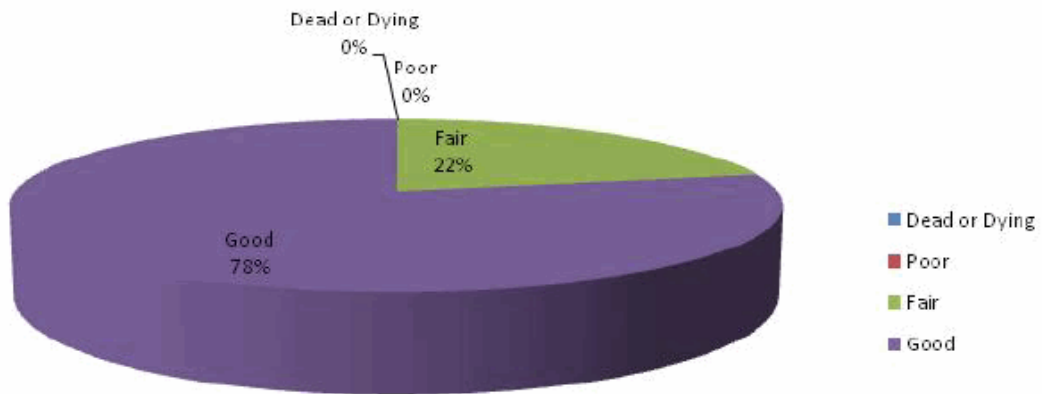
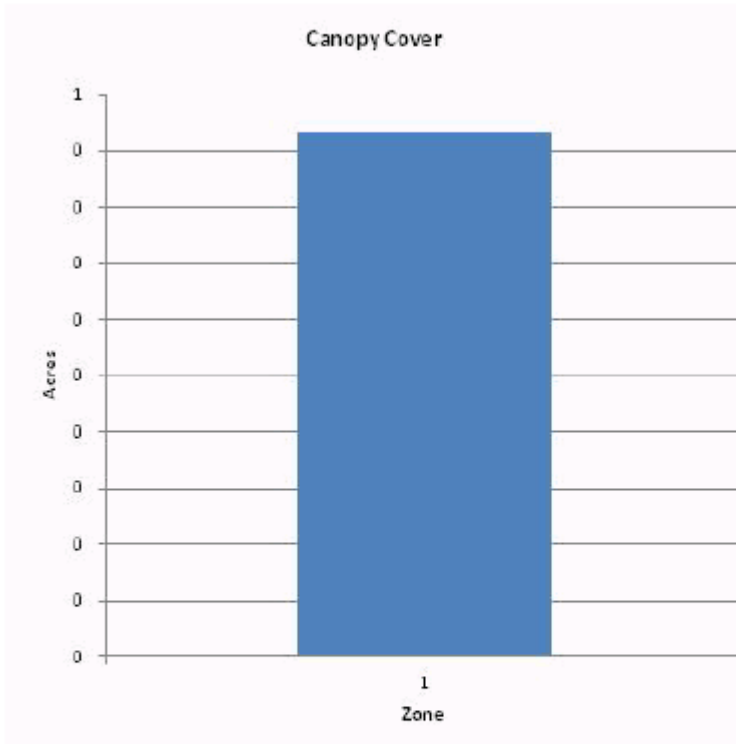


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

9/29/2011



Zone	Acres	% of Total Canopy Cover
1	0	100.0
Citywide total	0	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	0		

Figure 5: Canopy Cover in Acres

Land Use of Public Trees by Zone (%)

9/29/2011

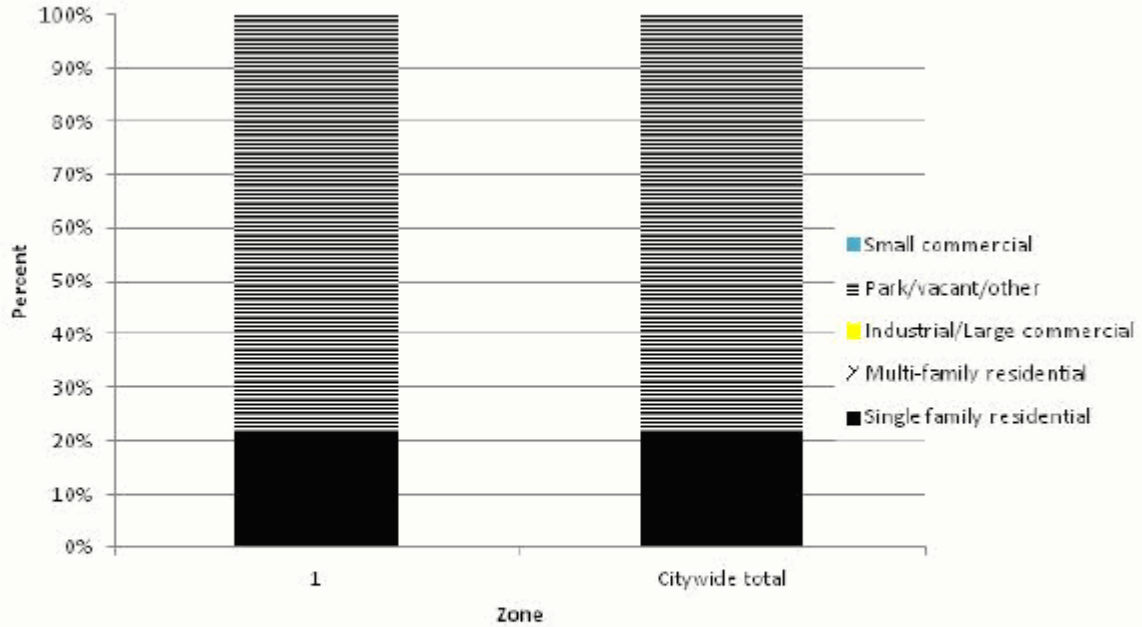


Figure 6: Land Use of city/park trees

Location of Public Trees by Zone (%)

9/29/2011

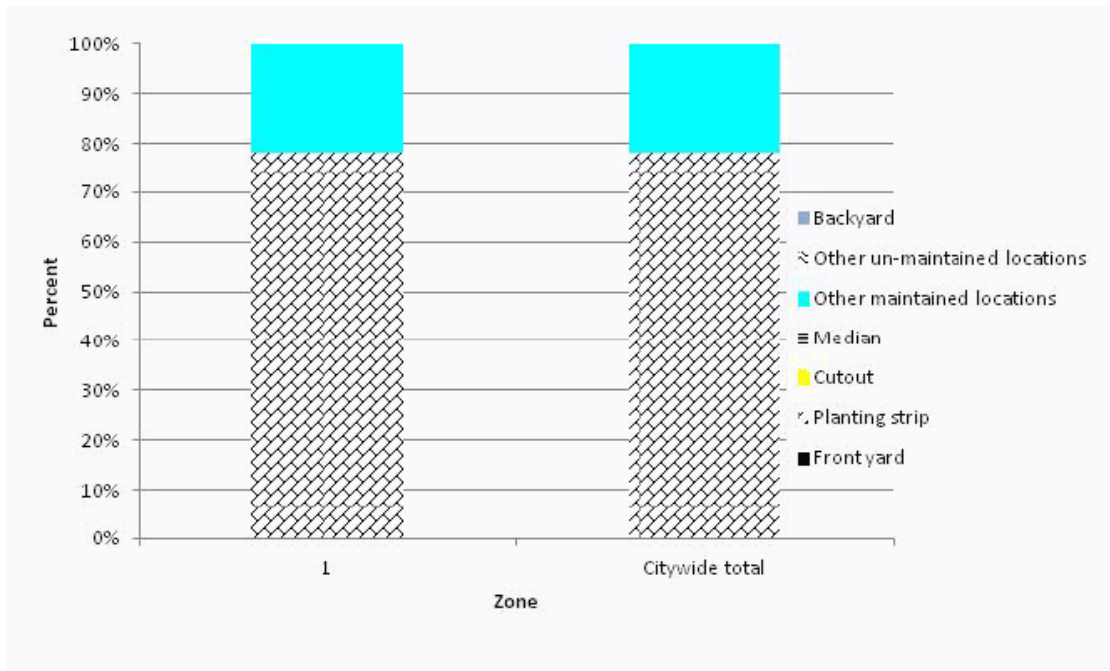


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping



Figure 1: Location of Ash Trees



Figure 2: Location of EAB symptoms

NO POOR CONDITION TREES

Figure 3: Location of Poor Condition Trees

NO IMMEDIATE ISSUES

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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