Grandview, 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 Grandview 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 7% of Grandview's city owned trees (ash) will die once EAB becomes established in the community. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2010, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 172 trees inventoried.

- Grandview's trees provide $23,414 of benefits annually, an average of $136 a tree
- There are over 27 species of trees
- The top three genus are: Maple 42%, Walnut !0%, Ash 7%
- 51% of trees are in need of some type of management
- 10 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 10 trees needing removal, 5 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*
- 2 of the 17 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 8-10 years to remove ash – Suggestion: request a budget increase to $2,000 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2011, 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 172 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. Grandview's trees reduce energy related costs by approximately $6,123 annually (Appendix A, Table 1). These savings are both in Electricity (29.4 MWh) and in Natural Gas (3,973.9 Therms).

Annual Stormwater Benefits

Grandview's trees intercept about 297,052 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $8,051 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 Grandview, it is estimated that trees remove 352 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 $979 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Grandview, trees sequester about 117,624 lbs of carbon a year with an associated value of $882 (Appendix A, Table 4). In addition, the trees store 899,472 lbs of carbon, with a yearly benefit of $6,746 (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. Grandview receives $7,378 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, Grandview's trees provide $23,414 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 172 trees in Grandview provide approximately $136 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Grandview has over 27 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Maple	74	42%
Walnut	17	10%
Ash	12	7%
Apple	10	6%
Arborvitae	8	5%
Spruce	9	5%
Aspen	6	3%
Pine	6	3%
Oak	5	3%
Pear	3	2%
Elm	3	2%
Cedar	2	1%
Redbud	2	1%
Birch	1	<1%
Lilac	1	<1%
Locust	1	<1%
Mulberry	1	<1%
Cherry	1	<1%
Other Evergreen/broadleaf	10	6%

Age Class

Most of Grandview's trees (42%) 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. Grandview'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 Grandview indicate that 63% of the trees are in good health, with 11% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 56% of Grandview'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 12% of the population. This 12% 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	23	13%
Crown Raising	27	16%
Tree Staking	2	1%
Tree Removal	10	6%
Crown Reduction	29	17%

Canopy Cover

The canopy cover of Grandview is approximately 3 acres (Appendix A, Figure 4). According to the 2000 census, Grandview occupies 128 acres. Thus the canopy cover on city land is about 2%.

Land Use and Location

The majority of Grandview'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	90.7%
Park/vacant/other	5.8%
Industrial/Large commercial	0%
Small commercial	1%
Multifamily residential	2.3%

Location	
Planting strip	0%
Other maintained locations	7%
Cutout (surrounded by pavement)	0%
Front yard	86.6%
Back yard	6.4%

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

Grandview has 2 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 34 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, none are ash trees. There are a total of 12 ash trees, and 2 of those have signs and symptoms that have been associated with EAB. Refer to the wood and foliage conditions in figure 3. *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 Grandview.

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 (42%) and Walnut (10%) (Appendix A, Figure 1). Maples and Walnuts 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, and

you may consider outlining this in your city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 135.10 (Appendix C).

Continual Monitoring

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

Six Year Maintenance Plan with No Additional Funding

Year 1

Removal: 2 critical concern trees
Planting and Replacement: 4 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 2 large immediate concern trees and ash trees with poor health
Planting and Replacement: 4 trees in open locations from year one removals
Routine trimming:
Visual Survey for signs and symptoms of EAB

Year 3

Removal: 2 largest immediate concern trees trees - removal of any new critical concern trees and ash in poor health
Planting and Replacement: 4 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: Contract to trim 1/3 of the city trees, landowner?
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: 4 trees to be planted in open locations and locations from previous removals
Visual Survey for signs and symptoms of EAB

Year 6

Removal: Removal of any new critical concern trees and ash in poor health
Planting and Replacement: 4 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees?
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: Possibly 2 ash trees to be removed (approximately 17% of ash). It will take approximately 6-10 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 4 years, the budget would need to be increased to $2,000 a year. If the budget were increased to $1,000 a year all ash could be removed in 9 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 135.10 (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 135.10 states "It shall be the responsibility of the abutting property owner to maintain all property outside the lot and property lines and inside the curb lines upon the public streets, except that the abutting property owner shall not be required to remove diseased trees or dead wood on the publicly owned property right of way. Maintenance includes timely mowing, trimming trees and shrubs and picking up litter."

Budget

Current Budget
Total $6,000 over 6 years ($1,000/year)

FY 2011 Budget
Removal: $750
Planting: $250
Watering & Maintenance: $500

FY 2012 Budget
Removal: $1,000
Planting: $
Routine trimming: $
Watering & Maintenance: $500

FY 2013 Budget
Removal: $1,000
Planting: $
Watering & Maintenance: $500

FY 2014 Budget
Removal: $1,000
Planting: $
Routine trimming: $
Watering & Maintenance: $500

FY 2015 Budget
Removal: $1,000
Planting: $
Watering & Maintenance: $500

FY 2016 Budget
Removal: $1,000
Planting: $
Routine trimming: $
Watering & Maintenance: $500

*Reduction of ash over 6 years: 2 ash trees may need to be removed (approximately 17% of ash). **It will take approximately 6-10 years to remove all ash with the current budget.**

Purposed Budget Increase

EAB could potentially kill all ash trees in Grandview within 4 years of its arrival. To remove all ash trees within 4 years the budget would need to be increased to at least $2,000 a year. If the budget were increased to $1,500 a year all ash could be removed within 7 years. Additionally, it is recommended that Grandview 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
Silver maple	10.1	768	1,331.0	1,304	2,072	(N/A)	25.0	33.8	48.19
Sugar maple	5.2	393	695.8	682	1,075	(N/A)	12.2	17.6	51.17
Black walnut	3.0	231	419.5	411	642	(N/A)	9.9	10.5	37.75
Green ash	2.5	193	333.6	327	520	(N/A)	7.0	8.5	43.33
Apple	0.5	39	89.0	87	126	(N/A)	5.8	2.1	12.62
Norway spruce	0.9	66	108.1	106	172	(N/A)	4.7	2.8	21.50
Northern white cedar	0.2	19	42.8	42	61	(N/A)	4.7	1.0	7.60
Red maple	0.9	72	127.8	125	197	(N/A)	3.5	3.2	32.83
Eastern white pine	0.3	23	51.5	50	74	(N/A)	3.5	1.2	12.25
Quaking aspen	1.5	114	208.7	205	319	(N/A)	3.5	5.2	53.14
Broadleaf Deciduous	1.4	110	192.6	189	299	(N/A)	2.9	4.9	59.74
Northern pin oak	0.2	17	36.1	35	52	(N/A)	2.9	0.9	10.45
Norway maple	0.4	29	52.5	51	80	(N/A)	1.7	1.3	26.74
Pear	0.1	6	14.1	14	20	(N/A)	1.7	0.3	6.64
Eastern redbud	0.0	2	4.4	4	6	(N/A)	1.2	0.1	3.13
Eastern red cedar	0.2	17	32.9	32	49	(N/A)	1.2	0.8	24.57
Siberian elm	0.3	25	40.5	40	65	(N/A)	1.2	1.1	32.39
Other street trees	1.4	106	192.9	189	295	(N/A)	7.6	4.8	22.72
Citywide total	29.4	2,229	3,973.9	3,894	6,123	(N/A)	100.0	100.0	35.60

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
Silver maple	110,361	2,991	(N/A)	25.0	37.2	69.56
Sugar maple	54,228	1,470	(N/A)	12.2	18.3	69.99
Black walnut	24,802	672	(N/A)	9.9	8.4	39.54
Green ash	25,135	681	(N/A)	7.0	8.5	56.77
Apple	1,800	49	(N/A)	5.8	0.6	4.88
Norway spruce	12,736	345	(N/A)	4.7	4.3	43.15
Northern white cedar	2,467	67	(N/A)	4.7	0.8	8.36
Red maple	7,986	216	(N/A)	3.5	2.7	36.07
Eastern white pine	3,190	86	(N/A)	3.5	1.1	14.41
Quaking aspen	15,335	416	(N/A)	3.5	5.2	69.27
Broadleaf Deciduous	14,954	405	(N/A)	2.9	5.0	81.06
Northern pin oak	1,208	33	(N/A)	2.9	0.4	6.55
Norway maple	2,158	58	(N/A)	1.7	0.7	19.49
Pear	279	8	(N/A)	1.7	0.1	2.52
Eastern redbud	76	2	(N/A)	1.2	0.0	1.03
Eastern red cedar	3,269	89	(N/A)	1.2	1.1	44.30
Siberian elm	1,991	54	(N/A)	1.2	0.7	26.98
Other street trees	15,076	409	(N/A)	7.6	5.1	31.43
Citywide total	297,052	8,051	(N/A)	100.0	100.0	46.81

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
Silver maple	15.1	2.6	7.9	0.7	83	47.7	7.0	6.7	45.8	298	-9.0	-34	124.4	348	(N/A)	25.0	8.09
Sugar maple	6.9	1.2	3.5	0.3	38	24.6	3.6	3.4	23.4	153	-5.5	-21	61.5	170	(N/A)	12.2	8.12
Black walnut	2.1	0.3	1.2	0.1	12	14.5	2.1	2.0	13.8	90	0.0	0	36.2	102	(N/A)	9.9	6.01
Green ash	2.9	0.5	1.4	0.1	16	12.0	1.8	1.7	11.5	75	0.0	0	31.9	91	(N/A)	7.0	7.56
Apple	0.3	0.0	0.2	0.0	2	2.6	0.4	0.3	2.3	16	0.0	0	6.2	18	(N/A)	5.8	1.75
Norway spruce	1.4	0.3	1.2	0.2	9	4.0	0.6	0.6	3.9	25	-5.1	-19	7.1	16	(N/A)	4.7	1.96
Northern white cedar	0.1	0.0	0.2	0.0	1	1.3	0.2	0.2	1.1	8	-0.7	-3	2.4	6	(N/A)	4.7	0.79
Red maple	1.9	0.3	0.9	0.1	10	4.5	0.7	0.6	4.3	28	-0.6	-2	12.6	36	(N/A)	3.5	5.96
Eastern white pine	0.3	0.1	0.3	0.0	2	1.5	0.2	0.2	1.4	9	-0.9	-3	3.1	8	(N/A)	3.5	1.32
Quaking aspen	1.7	0.3	0.9	0.1	9	7.2	1.0	1.0	6.8	45	0.0	0	19.0	54	(N/A)	3.5	9.02
Broadleaf Deciduous	1.8	0.3	0.9	0.1	9	6.9	1.0	1.0	6.6	43	0.0	0	18.4	52	(N/A)	2.9	10.47
Northern pin oak	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.0	7	0.0	0	2.6	7	(N/A)	2.9	1.47
Norway maple	0.3	0.0	0.2	0.0	2	1.8	0.3	0.3	1.7	11	-0.1	0	4.5	13	(N/A)	1.7	4.20
Pear	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	3	0.0	0	1.0	3	(N/A)	1.7	0.92
Eastern redbud	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)	1.2	0.41
Eastern red cedar	0.7	0.1	0.5	0.1	4	1.1	0.2	0.1	1.0	7	-1.8	-7	2.0	4	(N/A)	1.2	2.19
Siberian elm	0.1	0.0	0.1	0.0	1	1.5	0.2	0.2	1.5	10	0.0	0	3.7	10	(N/A)	1.2	5.23
Other street trees	2.4	0.4	1.7	0.2	15	6.7	1.0	0.9	6.3	42	-4.4	-17	15.2	40	(N/A)	7.6	3.05
Citywide total	38.2	6.5	21.1	2.0	214	139.6	20.4	19.4	133.0	871	-28.2	-106	352.1	979	(N/A)	100.0	5.69

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
Silver maple	334,004	2,505	(N/A)	25.0	37.1	58.26
Sugar maple	198,821	1,491	(N/A)	12.2	22.1	71.01
Black walnut	70,038	525	(N/A)	9.9	7.8	30.90
Green ash	96,389	723	(N/A)	7.0	10.7	60.24
Apple	5,995	45	(N/A)	5.8	0.7	4.50
Norway spruce	11,626	87	(N/A)	4.7	1.3	10.90
Northern white	742	6	(N/A)	4.7	0.1	0.70
Red maple	20,649	155	(N/A)	3.5	2.3	25.81
Eastern white pine	1,322	10	(N/A)	3.5	0.2	1.65
Quaking aspen	56,023	420	(N/A)	3.5	6.2	70.03
Broadleaf	57,517	431	(N/A)	2.9	6.4	86.28
Northern pin oak	2,252	17	(N/A)	2.9	0.3	3.38
Norway maple	4,943	37	(N/A)	1.7	0.6	12.36
Pear	935	7	(N/A)	1.7	0.1	2.34
Eastern redbud	192	1	(N/A)	1.2	0.0	0.72
Eastern red cedar	2,204	17	(N/A)	1.2	0.3	8.27
Siberian elm	3,945	30	(N/A)	1.2	0.4	14.79
Other street trees	14,458	239	(N/A)	7.6	3.5	18.39
Citywide total	899,472	6,746	(N/A)	100.0	100.0	39.22

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
Silver maple	32,628	245	-1,603	-8	-12	16,965	127	47,981	360	(N/A)	25.0	40.8	8.37
Sugar maple	11,085	83	-954	-4	-7	8,678	65	18,805	141	(N/A)	12.2	16.0	6.72
Black walnut	6,965	52	-336	-3	-3	5,097	38	11,722	88	(N/A)	9.9	10.0	5.17
Green ash	5,633	42	-463	-2	-3	4,266	32	9,434	71	(N/A)	7.0	8.0	5.90
Apple	806	6	-29	-2	0	862	6	1,637	12	(N/A)	5.8	1.4	1.23
Norway spruce	893	7	-56	-2	0	1,459	11	2,295	17	(N/A)	4.7	2.0	2.15
Northern white cedar	213	2	-4	-2	0	416	3	624	5	(N/A)	4.7	0.5	0.58
Red maple	2,501	19	-99	-1	-1	1,584	12	3,984	30	(N/A)	3.5	3.4	4.98
Eastern white pine	281	2	-6	-1	0	510	4	783	6	(N/A)	3.5	0.7	0.98
Quaking aspen	3,593	27	-269	-1	-2	2,526	19	5,849	44	(N/A)	3.5	5.0	7.31
Broadleaf Deciduous	3,367	25	-276	-1	-2	2,429	18	5,519	41	(N/A)	2.9	4.7	8.28
Northern pin oak	464	3	-11	-1	0	373	3	826	6	(N/A)	2.9	0.7	1.24
Norway maple	706	5	-24	-1	0	635	5	1,317	10	(N/A)	1.7	1.1	3.29
Pear	131	1	-4	-1	0	135	1	262	2	(N/A)	1.7	0.2	0.65
Eastern redbud	47	0	-1	0	0	43	0	88	1	(N/A)	1.2	0.1	0.33
Eastern red cedar	86	1	-11	0	0	374	3	448	3	(N/A)	1.2	0.4	1.68
Siberian elm	475	4	-19	0	0	555	4	1,011	8	(N/A)	1.2	0.9	3.79
Other street trees	2,844	21	-153	-3	-1	2,351	18	5,039	38	(N/A)	7.6	4.3	2.91
Citywide total	72,717	545	-4,317	-34	-33	49,258	369	117,624	882	(N/A)	100.0	100.0	5.13

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
Silver maple	3,000	(N/A)	25.0	40.7	69.77
Sugar maple	1,173	(N/A)	12.2	15.9	55.88
Black walnut	712	(N/A)	9.9	9.7	41.89
Green ash	517	(N/A)	7.0	7.0	43.10
Apple	45	(N/A)	5.8	0.6	4.46
Norway spruce	245	(N/A)	4.7	3.3	30.58
Northern white cedar	72	(N/A)	4.7	1.0	8.98
Red maple	314	(N/A)	3.5	4.3	52.32
Eastern white pine	84	(N/A)	3.5	1.1	13.99
Quaking aspen	314	(N/A)	3.5	4.3	52.35
Broadleaf Deciduous	282	(N/A)	2.9	3.8	56.32
Northern pin oak	61	(N/A)	2.9	0.8	12.13
Norway maple	78	(N/A)	1.7	1.1	26.09
Pear	6	(N/A)	1.7	0.1	2.16
Eastern redbud	2	(N/A)	1.2	0.0	1.05
Eastern red cedar	27	(N/A)	1.2	0.4	13.68
Siberian elm	54	(N/A)	1.2	0.7	27.03
Other street trees	392	(N/A)	7.6	5.3	30.16
Citywide total	7,378	(N/A)	100.0	100.0	42.90

Table 7: Summary of Benefits in Dollars

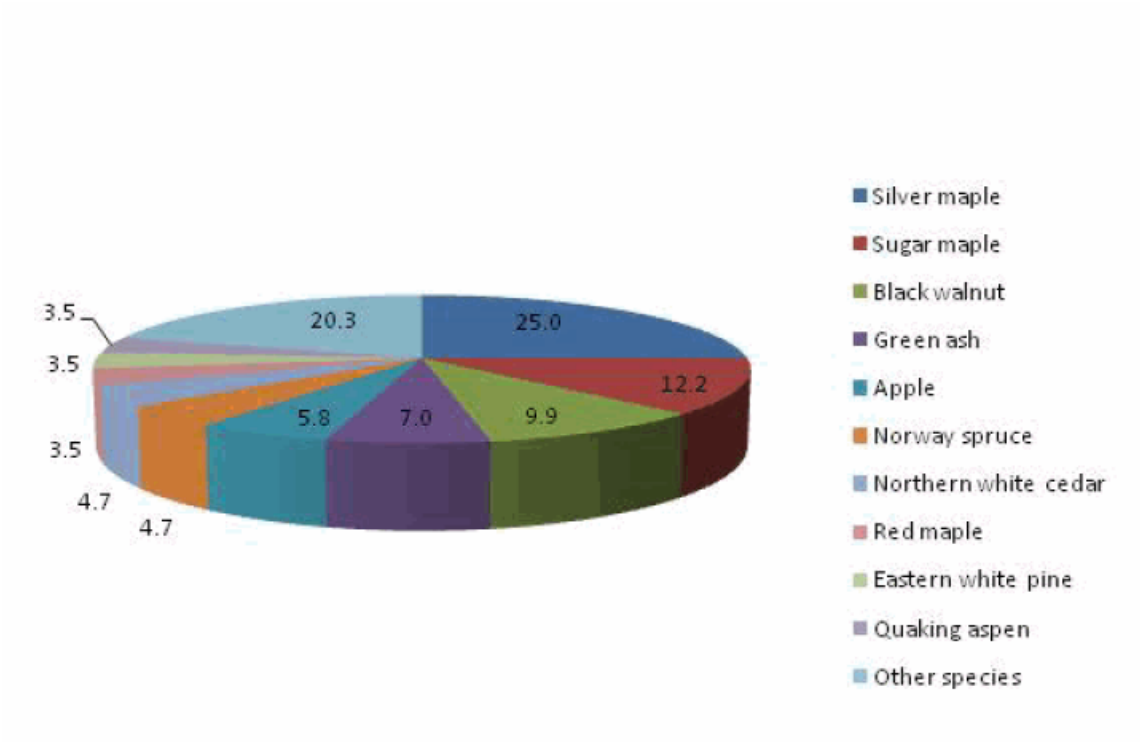
Total Annual Benefits of Public Trees by Species ($)

11/22/20

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	2,072	360	348	2,991	3,000	8,771	(±0)	37.5
Sugar maple	1,075	141	170	1,470	1,173	4,029	(±0)	17.2
Black walnut	642	88	102	672	712	2,216	(±0)	9.5
Green ash	520	71	91	681	517	1,880	(±0)	8.0
Apple	126	12	18	49	45	249	(±0)	1.1
Norway spruce	172	17	16	345	245	795	(±0)	3.4
Northern white cedar	61	5	6	67	72	210	(±0)	0.9
Red maple	197	30	36	216	314	793	(±0)	3.4
Eastern white pine	73	6	8	86	84	258	(±0)	1.1
Quaking aspen	319	44	54	416	314	1,147	(±0)	4.9
Broadleaf Deciduous	299	41	52	405	282	1,079	(±0)	4.6
Northern pin oak	52	6	7	33	61	159	(±0)	0.7
Norway maple	80	10	13	58	78	239	(±0)	1.0
Pear	20	2	3	8	6	39	(±0)	0.2
Eastern redbud	6	1	1	2	2	12	(±0)	0.1
Eastern red cedar	49	3	4	89	27	173	(±0)	0.7
Siberian elm	65	8	10	54	54	191	(±0)	0.8
Other street trees	295	38	40	409	392	1,174	(±0)	5.0
Citywide Total	6,123	882	979	8,051	7,378	23,414	(±0)	100.0

Species Distribution of Public Trees (%)

11/22/2010

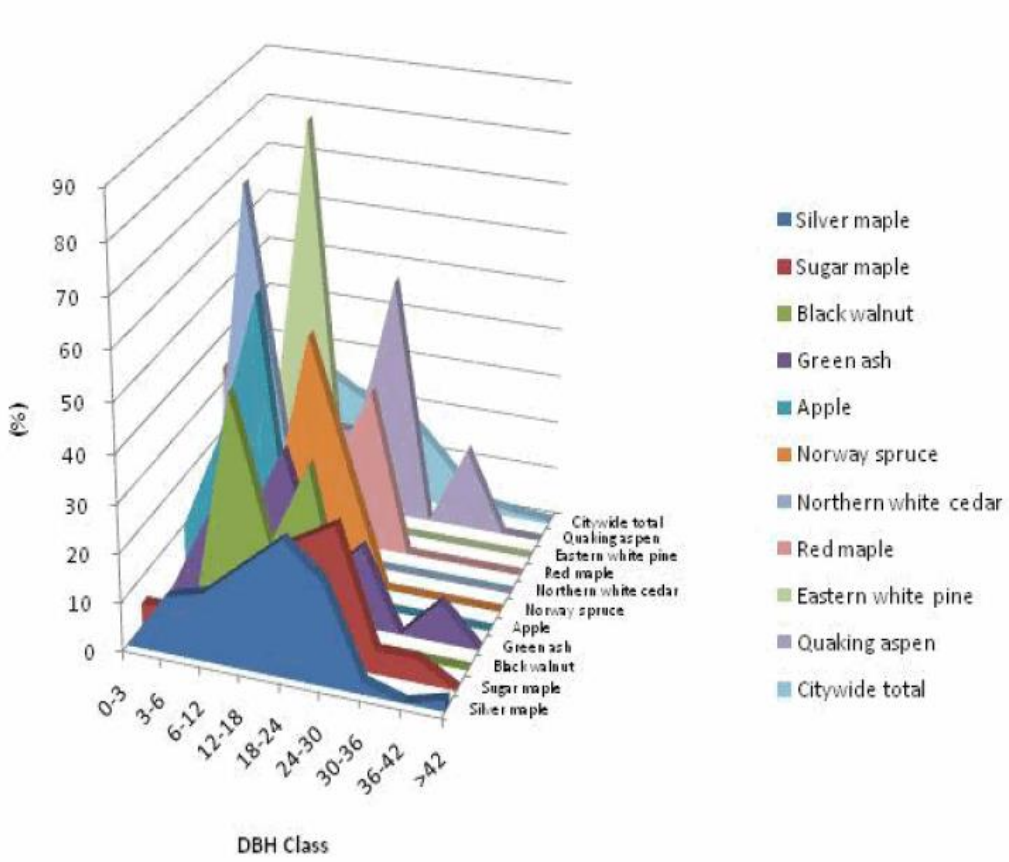


Species	Percent
Silver maple	25.0
Sugar maple	12.2
Black walnut	9.9
Green ash	7.0
Apple	5.8
Norway spruce	4.7
Northern white cedar	4.7
Red maple	3.5
Eastern white pine	3.5
Quaking aspen	3.5
Other species	20.3
Total	100.0

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
Silver maple	0.0	11.6	14.0	20.9	27.9	20.9	2.3	0.0	2.3
Sugar maple	4.8	4.8	9.5	19.0	23.8	28.6	4.8	4.8	0.0
Black walnut	0.0	0.0	47.1	17.6	35.3	0.0	0.0	0.0	0.0
Green ash	0.0	16.7	16.7	33.3	8.3	16.7	0.0	8.3	0.0
Apple	10.0	30.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0
Norway spruce	12.5	0.0	12.5	50.0	25.0	0.0	0.0	0.0	0.0
Northern white cedar	0.0	75.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0
Red maple	33.3	0.0	16.7	16.7	33.3	0.0	0.0	0.0	0.0
Eastern white pine	0.0	16.7	83.3	0.0	0.0	0.0	0.0	0.0	0.0
Quaking aspen	0.0	0.0	16.7	16.7	50.0	0.0	16.7	0.0	0.0
Citywide total	8.1	13.4	24.4	19.8	19.2	11.0	2.3	1.2	0.6

Figure 2: Relative Age Class

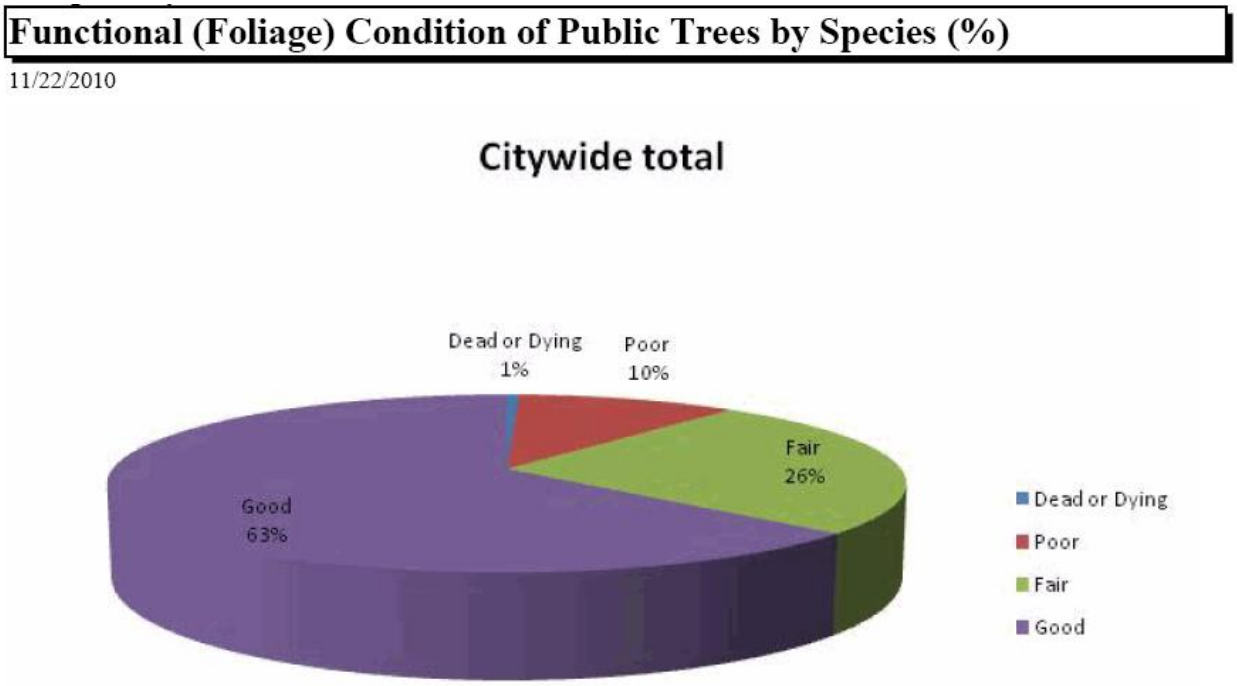


Figure 3: Foliage Condition

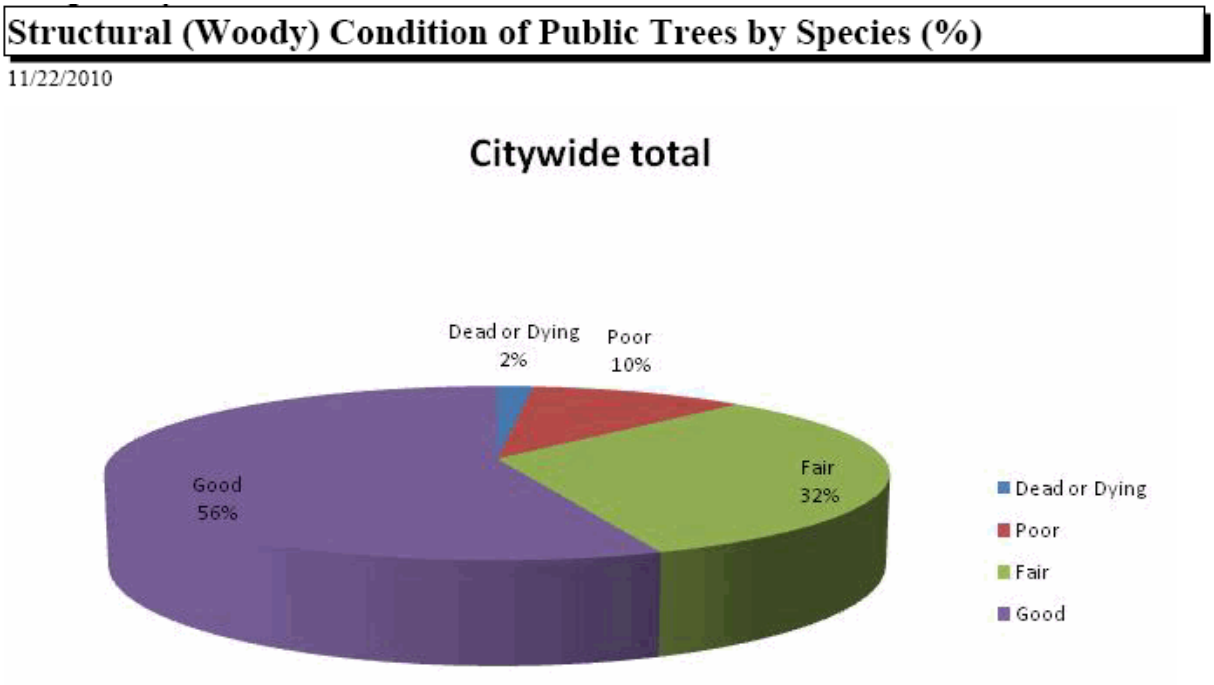
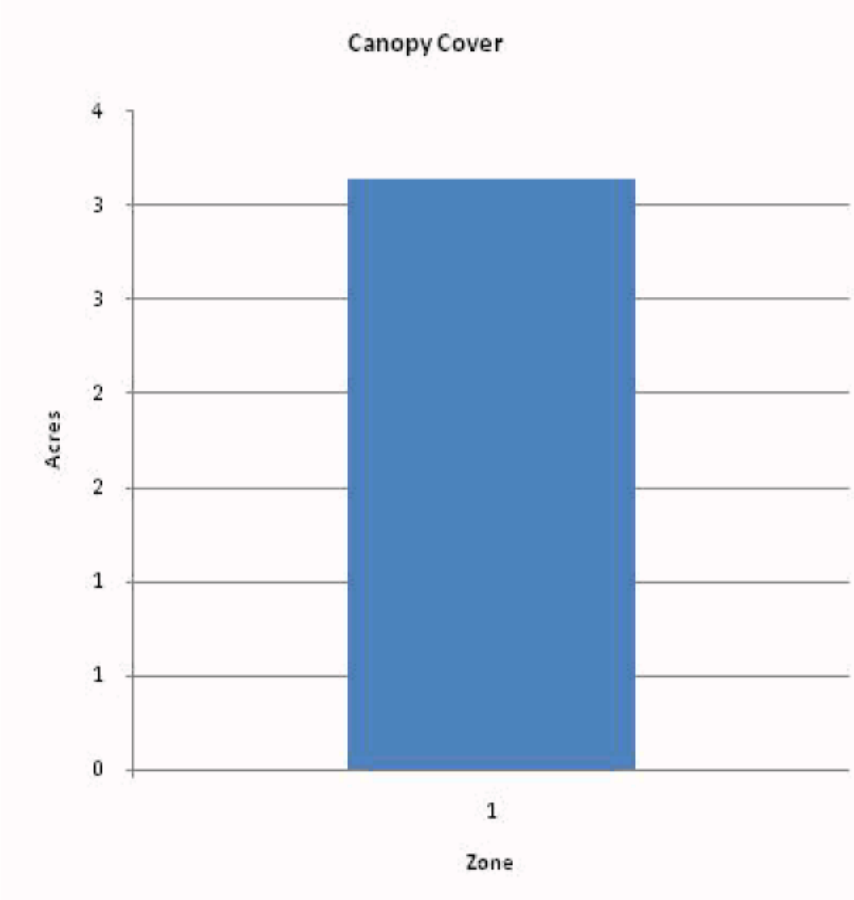


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

11/22/2010



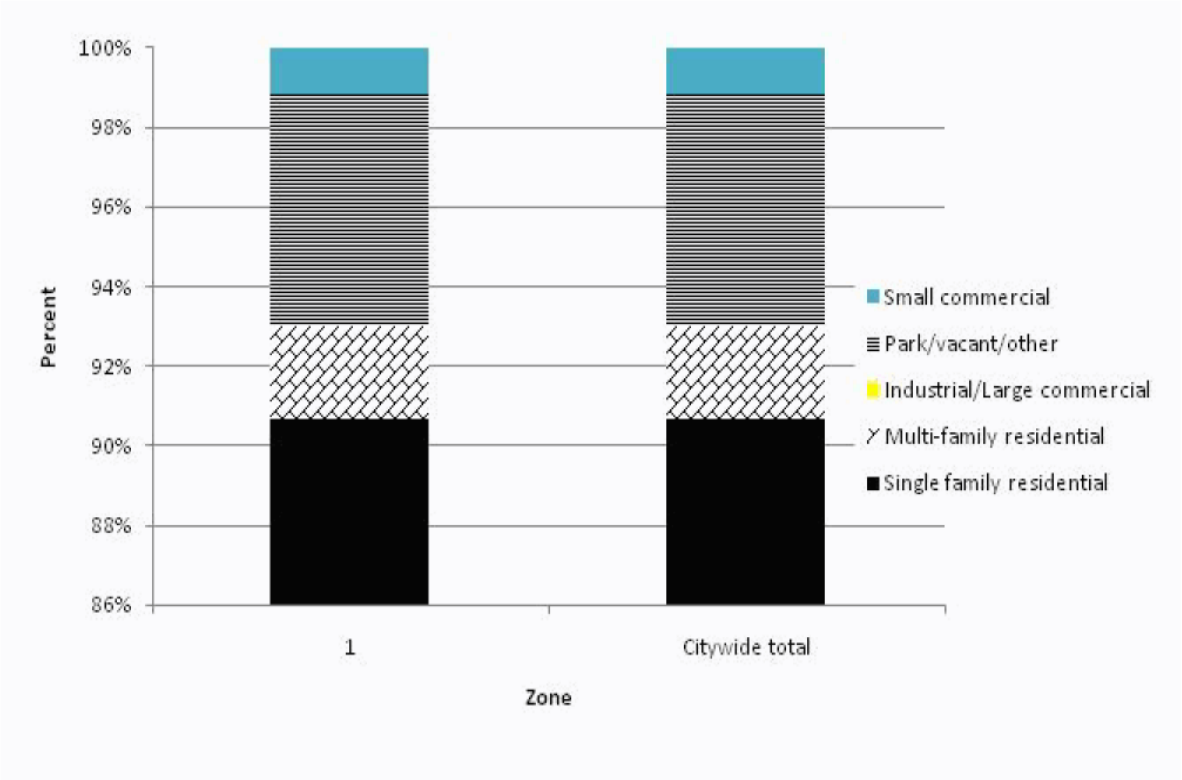
Zone	Acres	% of Total Canopy Cover
1	3	100.0
Citywide total	3	100.0

	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	3		

Figure 5: Canopy Cover in Acres

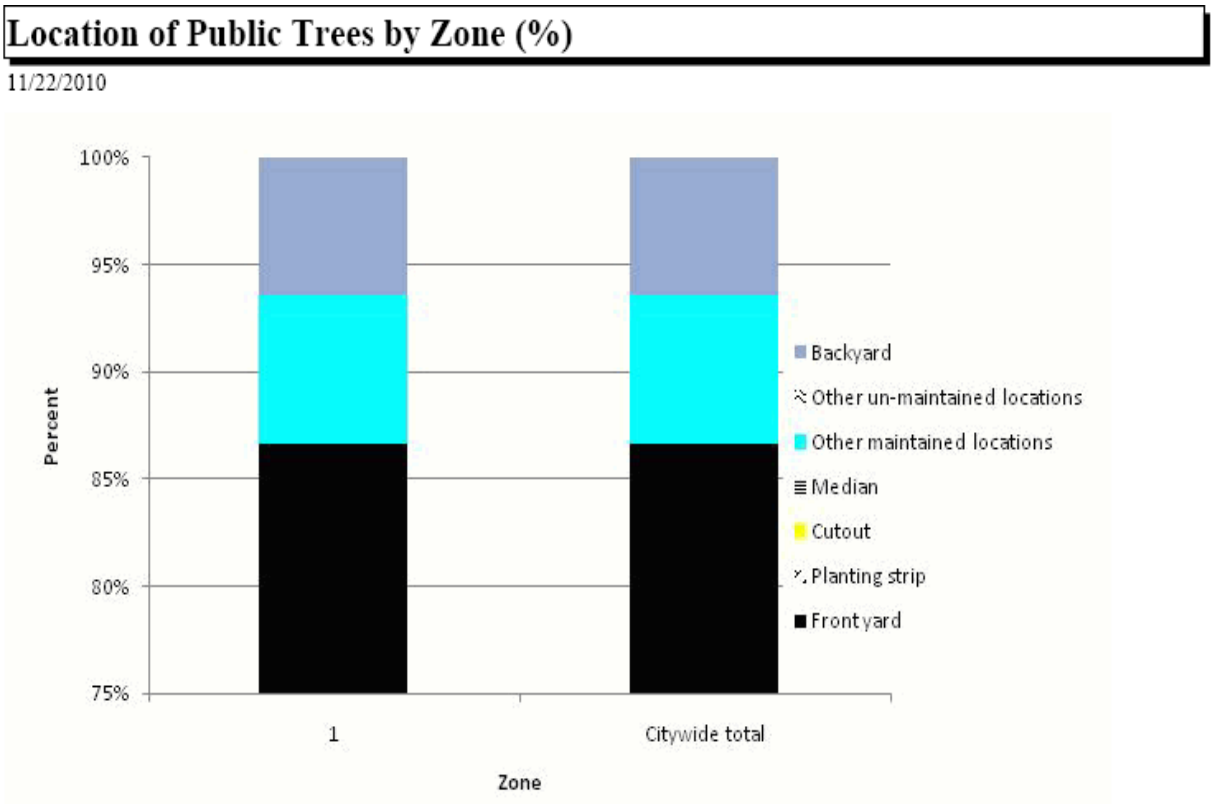
Land Use of Public Trees by Zone (%)

11/22/2010



Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	90.7	2.3	0.0	5.8	1.2
Citywide total	90.7	2.3	0.0	5.8	1.2

Figure 6: Land Use of city/park trees



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	86.6	0.0	0.0	0.0	7.0	0.0	6.4
Citywide total	86.6	0.0	0.0	0.0	7.0	0.0	6.4

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*

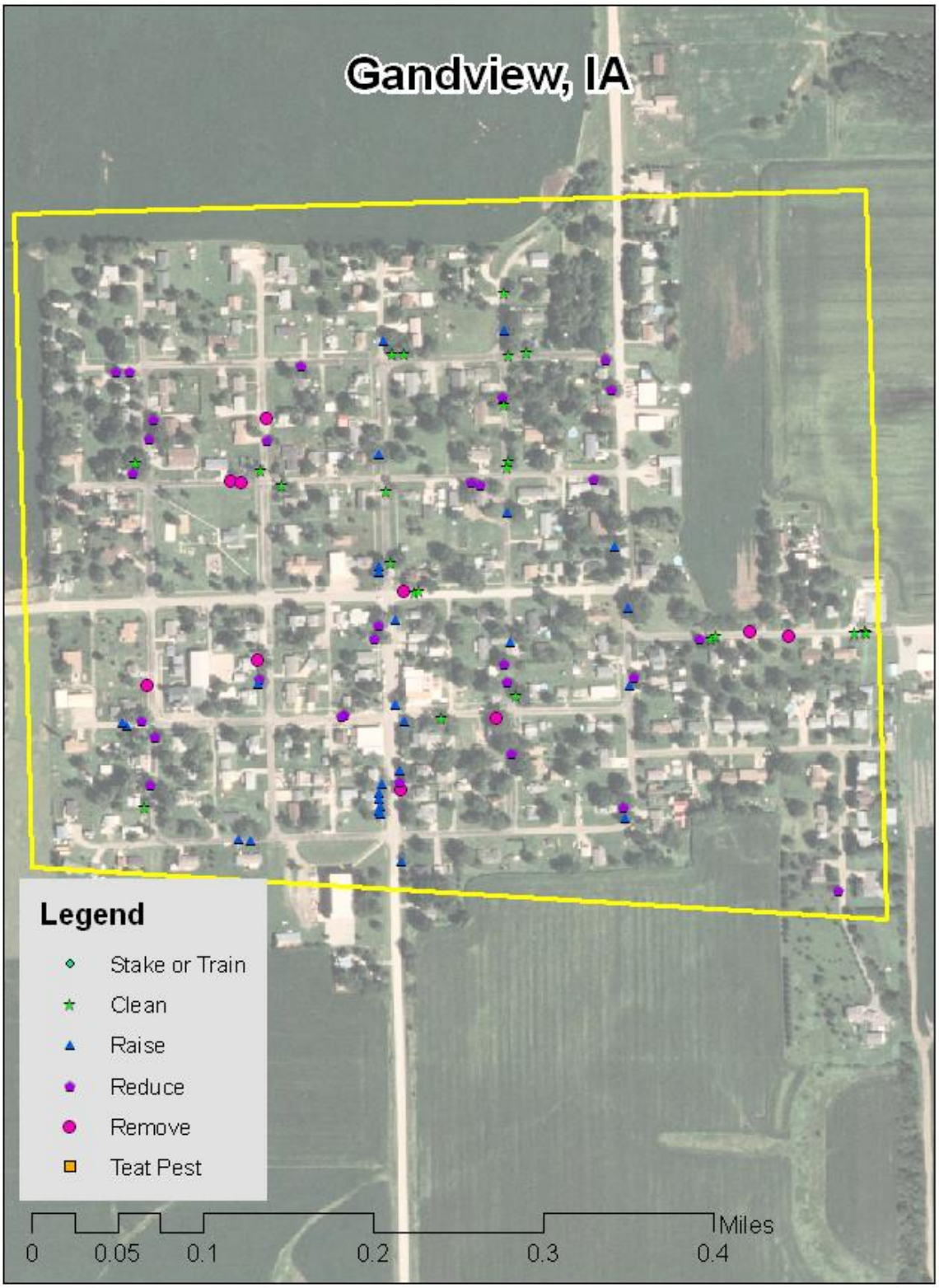


Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

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.