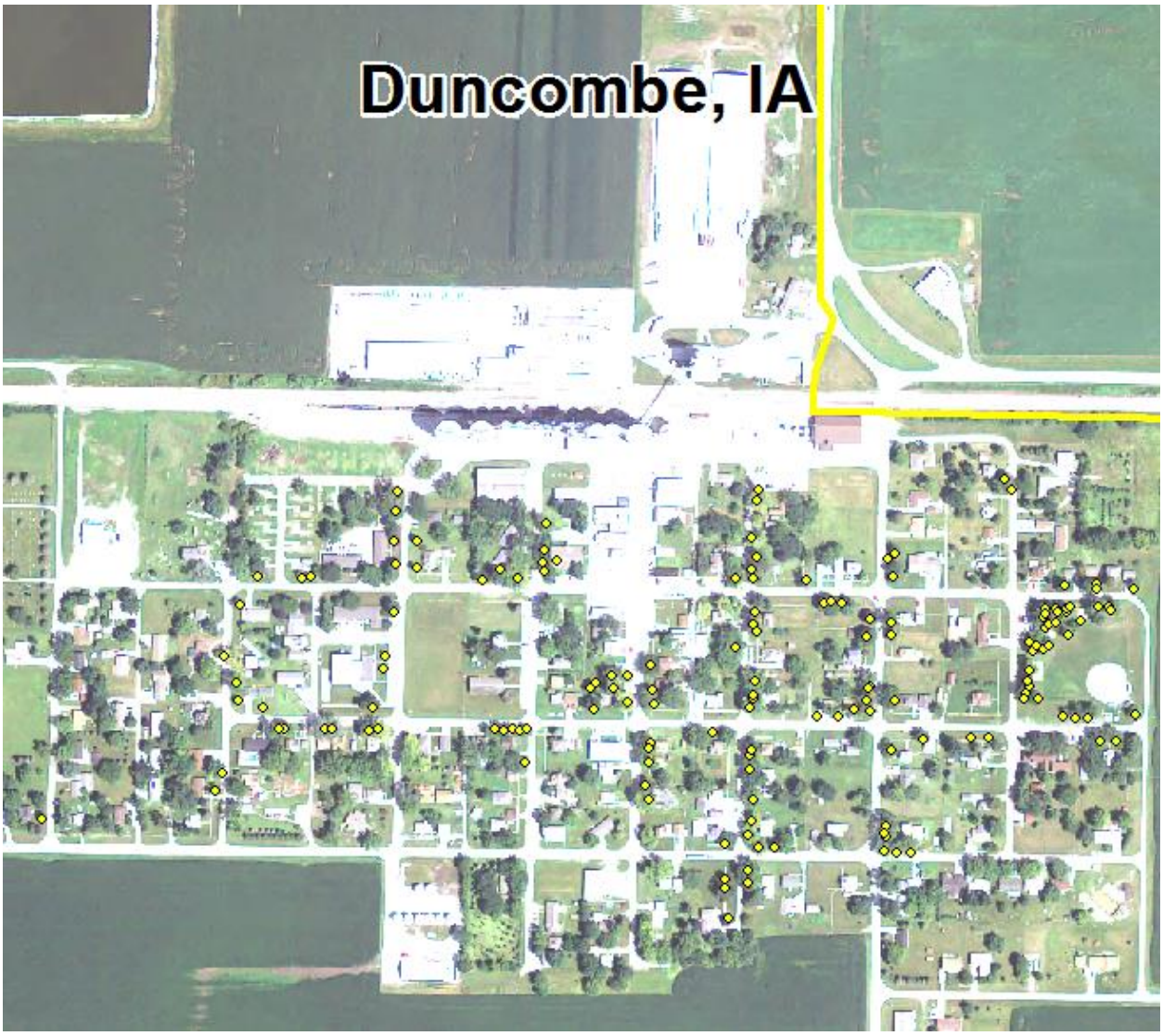
Duncombe, IA



2015 Urban Forest Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Duncombe 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 over 41% of Duncombe's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. 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 2015, 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 154 trees inventoried.

- Duncombe's trees provide $39,561 of benefits annually, an average of $256 a tree
- There are over 19 species of trees
- The top three genera are: Ash 41.6%, Maple 34.4%, and Hackberry 4.5%
- Over 27% of trees are in need of some type of management
- 3 trees are recommended for removal

Recommendations

The core recommendations are detailed in the Recommendations Section. The Emerald Ash Borer Plan includes management recommendations as well. Below are some key recommendations.

- Of the 3 trees needing removal, 2 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 63 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees
- Check ash trees with a visual survey yearly

Introduction

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

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

Inventory

In 2015, 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 associated with 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 154 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. Duncombe's trees reduce energy related costs by approximately $10,064 annually (Appendix A, Table 1). These savings are both in Electricity (48.2 MWh) and in Natural Gas (6,535.3 Therms).

Annual Stormwater Benefits

Duncombe's trees intercept about 584,713 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $15,846 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 Duncombe, it is estimated that trees remove 644.4 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 $1,831 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Duncombe, trees sequester about 131,255 lbs of carbon a year with an associated value of $984 (Appendix A, Table 5). In addition, the trees store 2,451,681 lbs of carbon, with a yearly benefit of $18,388 (Appendix A, Table 4).

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. Duncombe receives $10,927 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, Duncombe's trees provide $39,561 of benefits annually. Benefits of individual trees vary based on size, species, health and

location, but on average each of the 154 trees in Duncombe provide approximately $257 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Duncombe has over 17 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by species is as follows:

Green ash	41.6%
Silver maple	29.9%
Norway maple	4.6%
Northern hackberry	4.6%
Black walnut	4.6%
Sugar maple	2%
Siberian elm	2%
Spruce	1.3%
Willow	1.3%

Age Class

Most of Duncombe's trees (49%) are between 18 and 30 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Duncombe's size curve is on the larger side, indicating an older 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 Duncombe indicate that 83% of the trees are in good health, with only 3% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 43% of Duncombe'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 13% of the population. This 13% 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	33	21%
Crown Reduction	6	4%
Tree Removal	3	2%

Canopy Cover

The total canopy with both private and public trees is 38.47 acres. The canopy cover included in the Duncombe inventory includes approximately 6 acres (Appendix A, Figure 4). The City of Duncombe is approximately 3% forest; this number is smaller than what might be expected because of the large amount of farmland the city has annexed.

Land Use and Location

The majority of Duncombe'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	60%
Park/vacant/other	33%
Multifamily residential	5.5%
Industrial/Large commercial	1.5%
Small commercial	0%

Location	
Planting strip	50%
Front yard	50%

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

Duncombe has 0 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There should be follow up on the trees marked as needing maintenance. There are a total of 42 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 3 removals, 2 are ash trees. There are a total of 63 ash trees, and 2 of those have signs and symptoms that have been

associated with EAB. In addition, there are 8 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

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

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Duncombe.

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 (34.4%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

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 decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

PROPOSED WORK SCHEDULE AND ESTIMATED COSTS

YEAR 1	**ESTIMATED COSTS**
Remove 2 recommended	$1,400
Plant 3 trees in open locations	grant funds
Inspect ash trees for signs of Emerald Ash Borer	
Ash removal over 10 years	$4,200

YEAR 2	
Removal: 1 recommended	$700
*Or saving for ash tree treatment and/or future ash removal	
Plant 2 trees in open locations	grant funds
Prune 1/3 of city owned trees	$800
Ash removal over 10 years	$4,200
Inspect ash trees for signs of Emerald Ash Borer	

YEAR 3	
Removal: 2 trees - removal of any new critical concern trees in poor health	$1,400
Planting and Replacement: 6 trees to be planted in open locations and locations from previous removals	grant funds
Ash removal over 10 years	$4,200
Visual Survey for signs and symptoms of EAB	

YEAR 4	
Removal: 1 any new critical concern tree	$700
Plant 2 trees in open locations	grant funds
Prune 1/3 of city owned trees	$800
Ash removal over 10 years	$4,200
Inspect ash trees for signs of Emerald Ash Borer	

YEAR 5	
Removal: 2 trees - removal of any new critical concern trees in poor health	$1,400
Planting and Replacement: 6 trees to be planted in open locations and locations from previous removals	grant funds
Ash removal over 10 years	$4,200

Visual Survey for signs and symptoms of EAB

YEAR 6

Removal: 1 any new critical concern tree	$700
Plant 2 trees in open locations	grant funds
Prune 1/3 of city owned trees	$800
Ash removal over 10 years	$4,200
Inspect ash trees for signs of Emerald Ash Borer	

YEAR 7-10

Annual Ash removal over 10 years	$4,200

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*

Treatment of Ash Trees

Chemical treatment can be effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit http://extension.entm.purdue.edu/treecomputer/

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of 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 trees will be replaced. All trees will meet the restrictions in city ordinance.

Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genera 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.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Duncombe

Annual Energy Benefits of Public Trees

12/8/2015

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	18.8	1,428	2,558.0	2,507	3,935	(N/A)	41.6	39.1	61.48
Silver maple	15.5	1,176	2,068.6	2,027	3,203	(N/A)	29.9	31.8	69.64
Norway maple	1.8	137	257.7	252	389	(N/A)	4.5	3.9	55.60
Northern hackberry	2.9	221	410.2	402	623	(N/A)	4.5	6.2	89.06
Black walnut	2.3	175	316.4	310	485	(N/A)	4.5	4.8	69.26
Sugar maple	1.1	85	150.0	147	232	(N/A)	1.9	2.3	77.21
Siberian elm	1.2	93	162.0	159	252	(N/A)	1.9	2.5	83.87
Broadleaf Deciduous Large	1.5	110	189.3	186	296	(N/A)	1.9	2.9	98.63
American basswood	0.7	52	97.5	96	147	(N/A)	1.3	1.5	73.73
Willow	0.6	49	94.8	93	142	(N/A)	1.3	1.4	70.84
Spruce	0.2	14	24.1	24	38	(N/A)	1.3	0.4	18.86
Apple	0.2	14	24.7	24	38	(N/A)	0.6	0.4	38.13
Maple	0.0	0	0.7	1	1	(N/A)	0.6	0.0	1.03
Scotch pine	0.0	2	4.0	4	6	(N/A)	0.6	0.1	5.61
Honeylocust	0.4	28	47.4	46	74	(N/A)	0.6	0.7	74.28
Pear	0.2	14	24.7	24	38	(N/A)	0.6	0.4	38.13
Pin oak	0.2	19	28.4	28	46	(N/A)	0.6	0.5	46.43
Cottonwood	0.5	37	63.1	62	99	(N/A)	0.6	1.0	98.63
Sweetgum	0.1	7	13.7	13	21	(N/A)	0.6	0.2	20.64
Total	48.2	3,660	6,535.3	6,405	10,064	(N/A)	100.0	100.0	65.35

Table 2: Annual Stormwater Benefits

Duncombe

Annual Stormwater Benefits of Public Trees

12/8/2015

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	206,107	5,585	(N/A)	41.6	35.2	87.27
Silver maple	211,990	5,745	(N/A)	29.9	36.3	124.89
Norway maple	17,176	465	(N/A)	4.5	2.9	66.50
Northern hackberry	32,625	884	(N/A)	4.5	5.6	126.31
Black walnut	28,810	781	(N/A)	4.5	4.9	111.54
Sugar maple	15,990	433	(N/A)	1.9	2.7	144.44
Siberian elm	15,278	414	(N/A)	1.9	2.6	138.01
Broadleaf Deciduous Large	21,717	589	(N/A)	1.9	3.7	196.17
American basswood	9,890	268	(N/A)	1.3	1.7	134.01
Willow	7,529	204	(N/A)	1.3	1.3	102.01
Spruce	2,134	58	(N/A)	1.3	0.4	28.92
Apple	667	18	(N/A)	0.6	0.1	18.06
Maple	12	0	(N/A)	0.6	0.0	0.32
Scotch pine	213	6	(N/A)	0.6	0.0	5.77
Honeylocust	4,685	127	(N/A)	0.6	0.8	126.96
Pear	667	18	(N/A)	0.6	0.1	18.06
Pin oak	1,378	37	(N/A)	0.6	0.2	37.35
Cottonwood	7,239	196	(N/A)	0.6	1.2	196.17
Sweetgum	608	16	(N/A)	0.6	0.1	16.47
Citywide total	584,713	15,846	(N/A)	100.0	100.0	102.89

Table 3: Annual Air Quality Benefits

Duncombe

Annual Air Quality Benefits of Public Trees

12/8/2015

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2								
Green ash	26.2	4.2	12.5	1.2	139	89.7	13.1	12.5	85.3	559	0.0	0	244.5	698	(N/A)	41.6	10.91
Silver maple	36.0	6.1	17.8	1.6	195	73.3	10.7	10.2	70.1	458	-19.2	-72	206.6	580	(N/A)	29.9	12.62
Norway maple	3.6	0.6	1.8	0.2	19	8.7	1.3	1.2	8.2	54	-0.8	-3	24.6	70	(N/A)	4.5	10.03
Northern hackberry	6.0	1.0	3.0	0.3	33	14.0	2.0	1.9	13.2	87	0.0	0	41.6	120	(N/A)	4.5	17.12
Black walnut	3.9	0.6	1.8	0.2	21	11.0	1.6	1.5	10.4	69	0.0	0	31.0	89	(N/A)	4.5	12.72
Sugar maple	2.4	0.4	1.1	0.1	13	5.3	0.8	0.7	5.1	33	-1.8	-7	14.0	39	(N/A)	1.9	12.96
Siberian elm	3.0	0.5	1.4	0.1	16	5.8	0.8	0.8	5.5	36	0.0	0	18.0	52	(N/A)	1.9	17.40
Broadleaf Deciduous Large	4.8	0.8	2.1	0.2	25	6.9	1.0	1.0	6.6	43	0.0	0	23.2	68	(N/A)	1.9	22.55
American basswood	1.6	0.3	0.7	0.1	8	3.3	0.5	0.5	3.1	20	-1.3	-5	8.7	24	(N/A)	1.3	12.03
Willow	1.7	0.3	0.8	0.1	9	3.1	0.5	0.4	2.9	19	-0.4	-1	9.5	27	(N/A)	1.3	13.58
Spruce	0.2	0.0	0.2	0.0	2	0.9	0.1	0.1	0.8	5	-0.7	-3	1.7	4	(N/A)	1.3	2.15
Apple	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7	(N/A)	0.6	6.56
Maple	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)	0.6	0.13
Scotch pine	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	-0.1	0	0.2	1	(N/A)	0.6	0.56
Honeylocust	0.9	0.2	0.4	0.0	5	1.7	0.3	0.2	1.7	11	-0.8	-3	4.7	13	(N/A)	0.6	12.87
Pear	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7	(N/A)	0.6	6.56
Pin oak	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.3	-1	2.5	7	(N/A)	0.6	6.75
Cottonwood	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)	0.6	22.55
Sweetgum	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)	0.6	2.99
Citywide total	92.4	15.4	44.6	4.1	495	229.5	33.5	31.9	218.4	1,431	-25.4	-95	644.4	1,831	(N/A)	100.0	11.89

Table 4: Annual Carbon Stored

Duncombe

Stored CO2 Benefits of Public Trees

12/8/2015

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	858,987	6,442	(N/A)	41.6	35.0	100.66
Silver maple	829,100	6,218	(N/A)	29.9	33.8	135.18
Norway maple	59,135	444	(N/A)	4.5	2.4	63.36
Northern hackberry	96,696	725	(N/A)	4.5	3.9	103.60
Black walnut	127,505	956	(N/A)	4.5	5.2	136.61
Sugar maple	68,417	513	(N/A)	1.9	2.8	171.04
Siberian elm	73,237	549	(N/A)	1.9	3.0	183.09
Broadleaf Deciduous	167,946	1,260	(N/A)	1.9	6.9	419.86
American basswood	61,684	463	(N/A)	1.3	2.5	231.32
Willow	28,560	214	(N/A)	1.3	1.2	107.10
Spruce	1,427	11	(N/A)	1.3	0.1	5.35
Apple	3,037	23	(N/A)	0.6	0.1	22.78
Maple	17	0	(N/A)	0.6	0.0	0.13
Scotch pine	38	0	(N/A)	0.6	0.0	0.29
Honeylocust	12,245	92	(N/A)	0.6	0.5	91.84
Pear	3,037	23	(N/A)	0.6	0.1	22.78
Pin oak	3,595	27	(N/A)	0.6	0.1	26.96
Cottonwood	55,982	420	(N/A)	0.6	2.3	419.86
Sweetgum	1,035	8	(N/A)	0.6	0.0	7.76
Citywide total	2,451,681	18,388	(N/A)	100.0	100.0	119.40

Table 5: Annual Carbon Sequestered

Duncombe

Annual CO Benefits of Public Trees

12/8/2015

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	43,294	325	-4,123	-194	-1	0	0	38,977	292 (N/A)	41.6	32.8	4.57
Silver maple	62,882	472	-3,980	-168	-1	0	0	58,734	441 (N/A)	29.9	49.4	9.58
Norway maple	2,206	17	-284	-19	0	0	0	1,903	14 (N/A)	4.5	1.6	2.04
Northern hackberry	4,040	30	-464	-29	0	0	0	3,546	27 (N/A)	4.5	3.0	3.80
Black walnut	5,453	41	-612	-25	0	0	0	4,816	36 (N/A)	4.5	4.0	5.16
Sugar maple	2,982	22	-328	-13	0	0	0	2,641	20 (N/A)	1.9	2.2	6.60
Siberian elm	2,419	18	-352	-14	0	0	0	2,054	15 (N/A)	1.9	1.7	5.14
Broadleaf Deciduous Larg	1,437	11	-806	-18	0	0	0	613	5 (N/A)	1.9	0.5	1.53
American basswood	3,171	24	-296	-9	0	0	0	2,866	21 (N/A)	1.3	2.4	10.75
Willow	0	0	-137	-9	0	0	0	-146	-1 (N/A)	1.3	-0.1	-0.55
Spruce	168	1	-7	-3	0	0	0	158	1 (N/A)	1.3	0.1	0.59
Apple	268	2	-15	-2	0	0	0	251	2 (N/A)	0.6	0.2	1.88
Maple	3	0	0	0	0	0	0	2	0 (N/A)	0.6	0.0	0.02
Scotch pine	18	0	0	-1	0	0	0	17	0 (N/A)	0.6	0.0	0.13
Honeylocust	1,486	11	-59	-3	0	0	0	1,424	11 (N/A)	0.6	1.2	10.68
Pear	268	2	-15	-2	0	0	0	251	2 (N/A)	0.6	0.2	1.88
Pin oak	473	4	-17	-2	0	0	0	454	3 (N/A)	0.6	0.4	3.40
Cottonwood	479	4	-269	-6	0	0	0	204	2 (N/A)	0.6	0.2	1.53
Sweetgum	209	2	-5	-1	0	0	0	203	2 (N/A)	0.6	0.2	1.52
Citywide total	131,255	984	-11,768	-516	-4	0	0	118,970	892 (N/A)	100.0	100.0	5.79

Table 6: Annual Social and Aesthetic Benefits

Duncombe

Annual Aesthetic/Other Benefits of Public Trees

12/8/2015

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	3,570	(N/A)	41.6	32.7	55.79
Silver maple	4,936	(N/A)	29.9	45.2	107.31
Norway maple	211	(N/A)	4.5	1.9	30.07
Northern hackberry	484	(N/A)	4.5	4.4	69.19
Black walnut	418	(N/A)	4.5	3.8	59.77
Sugar maple	291	(N/A)	1.9	2.7	97.04
Siberian elm	151	(N/A)	1.9	1.4	50.24
Broadleaf Deciduous Large	86	(N/A)	1.9	0.8	28.57
American basswood	201	(N/A)	1.3	1.8	100.38
Willow	0	(N/A)	1.3	0.0	0.00
Spruce	48	(N/A)	1.3	0.4	23.87
Apple	15	(N/A)	0.6	0.1	15.48
Maple	0	(N/A)	0.6	0.0	0.04
Scotch pine	7	(N/A)	0.6	0.1	6.83
Honeylocust	389	(N/A)	0.6	3.6	388.90
Pear	15	(N/A)	0.6	0.1	15.48
Pin oak	48	(N/A)	0.6	0.4	47.55
Cottonwood	29	(N/A)	0.6	0.3	28.57
Sweetgum	29	(N/A)	0.6	0.3	28.56
Citywide total	10,927	(N/A)	100.0	100.0	70.96

Table 7: Summary of Benefits in Dollars

Duncombe

Total Annual Benefits of Public Trees by Species ($)

12/8/2015

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Green ash	3,935	292	698	5,585	3,570	14,081	(N/A)	35.6
Silver maple	3,203	441	580	5,745	4,936	14,905	(N/A)	37.7
Norway maple	389	14	70	465	211	1,150	(N/A)	2.9
Northern hackberry	623	27	120	884	484	2,138	(N/A)	5.4
Black walnut	485	36	89	781	418	1,809	(N/A)	4.6
Sugar maple	232	20	39	433	291	1,015	(N/A)	2.6
Siberian elm	252	15	52	414	151	884	(N/A)	2.2
Broadleaf Deciduous La	296	5	68	589	86	1,042	(N/A)	2.6
American basswood	147	21	24	268	201	662	(N/A)	1.7
Willow	142	-1	27	204	0	372	(N/A)	0.9
Spruce	38	1	4	58	48	149	(N/A)	0.4
Apple	38	2	7	18	15	80	(N/A)	0.2
Maple	1	0	0	0	0	2	(N/A)	0.0
Scotch pine	6	0	1	6	7	19	(N/A)	0.0
Honeylocust	74	11	13	127	389	614	(N/A)	1.6
Pear	38	2	7	18	15	80	(N/A)	0.2
Pin oak	46	3	7	37	48	141	(N/A)	0.4
Cottonwood	99	2	23	196	29	347	(N/A)	0.9
Sweetgum	21	2	3	16	29	70	(N/A)	0.2
Citywide Total	10,064	892	1,831	15,846	10,927	39,561	(N/A)	100.0

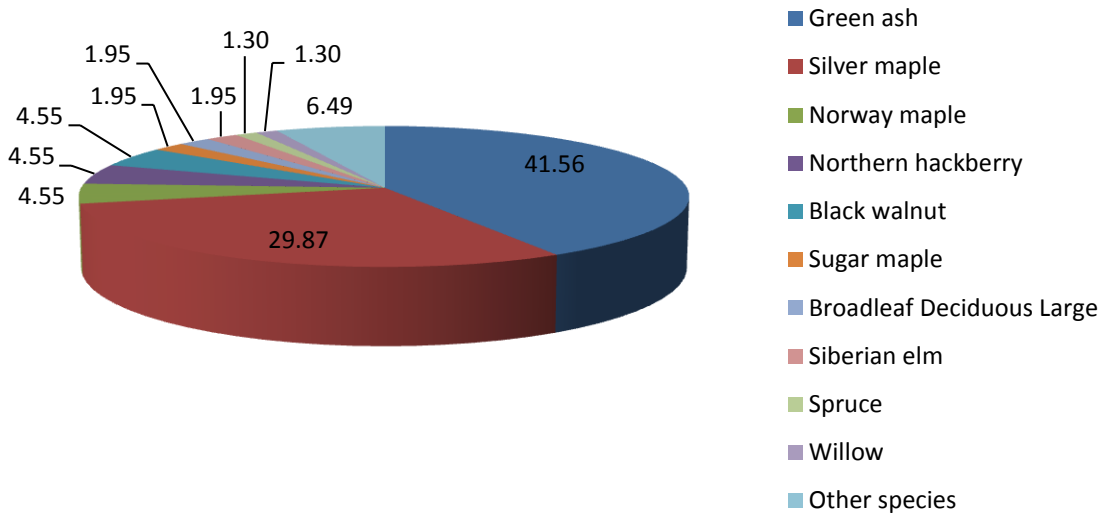

Figure 1: Species Distribution

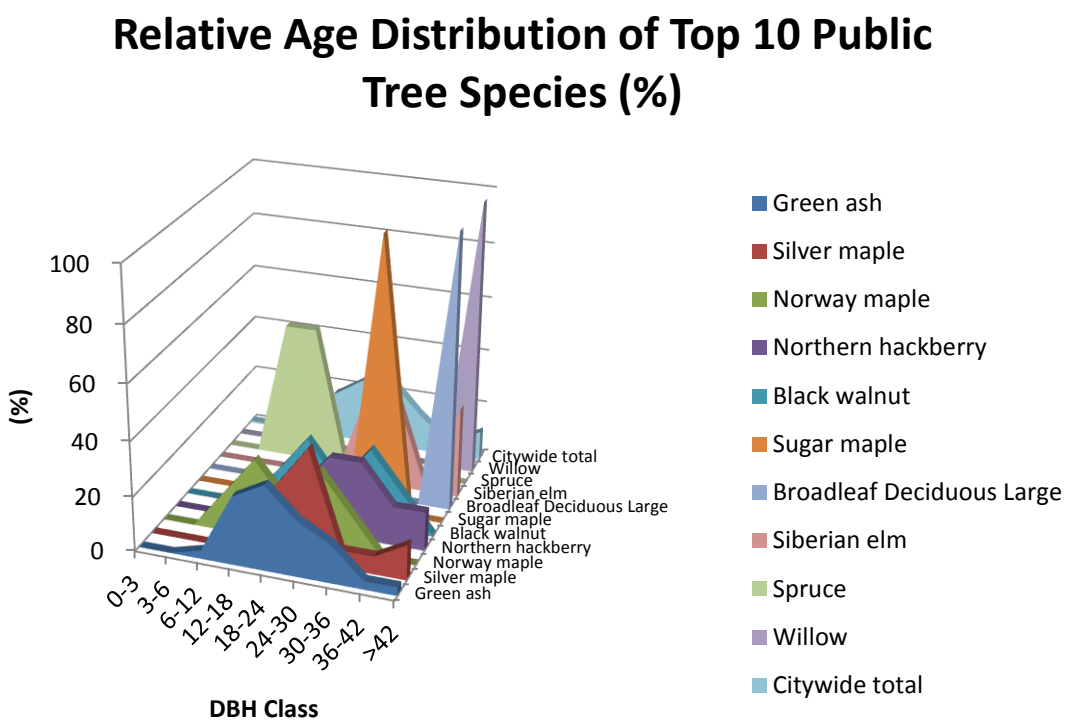

Figure 2: Relative Age Class

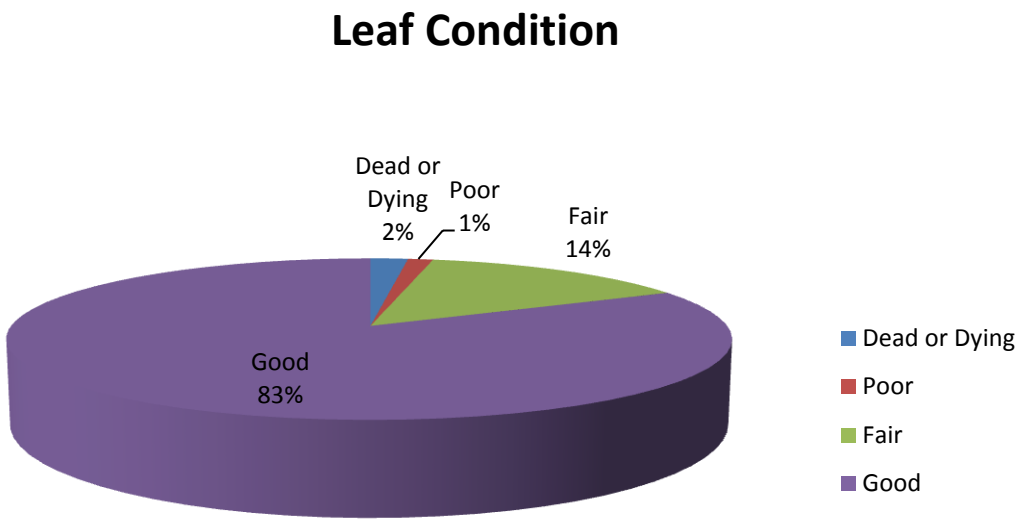

Figure 3: Foliage Condition

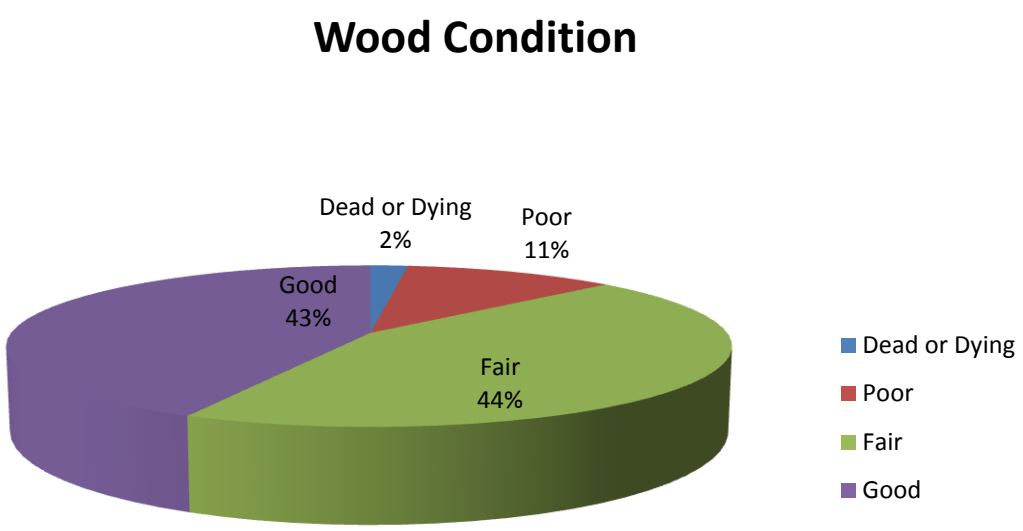

Figure 4: Wood Condition

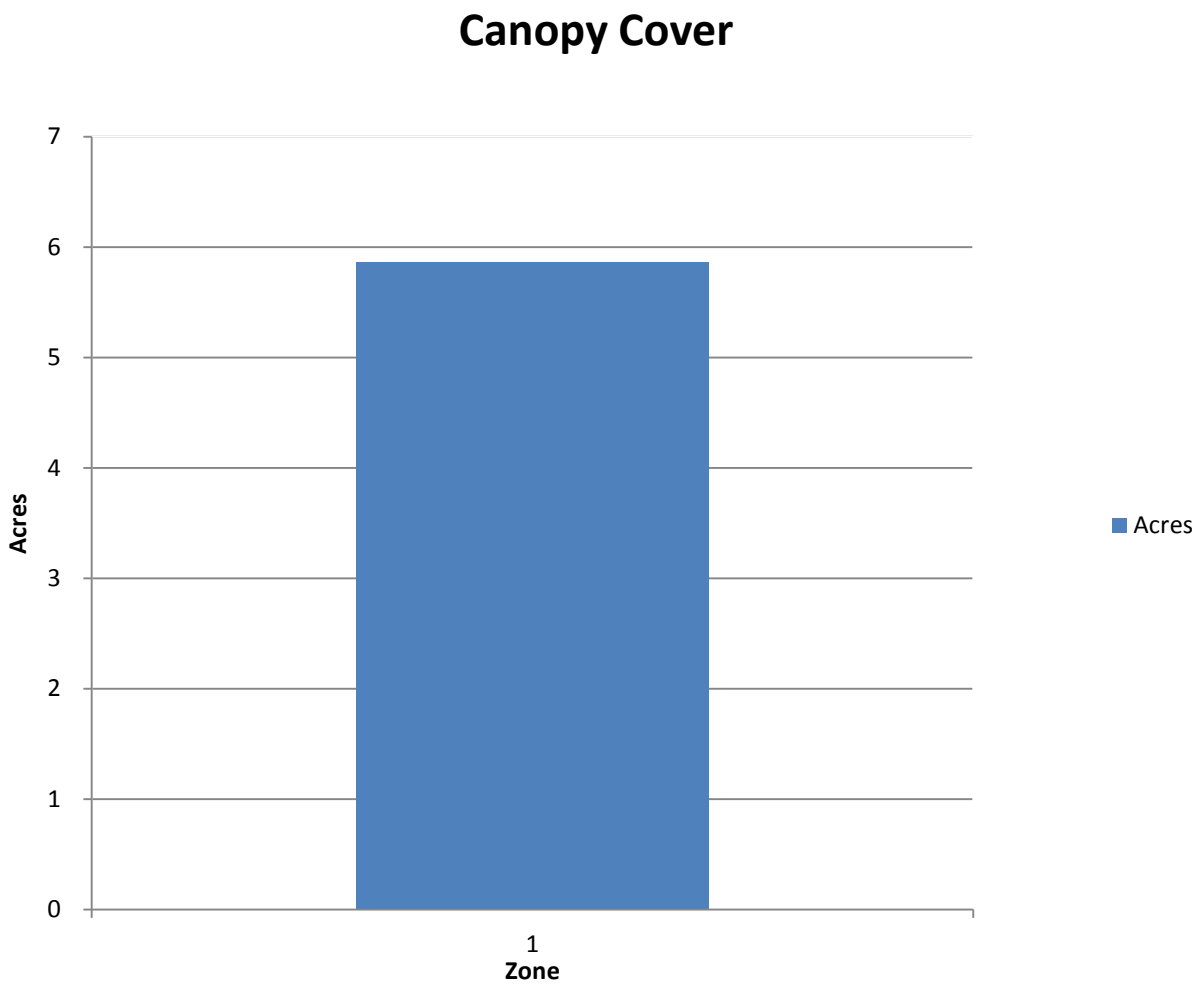

Figure 5: Canopy Cover in Acres

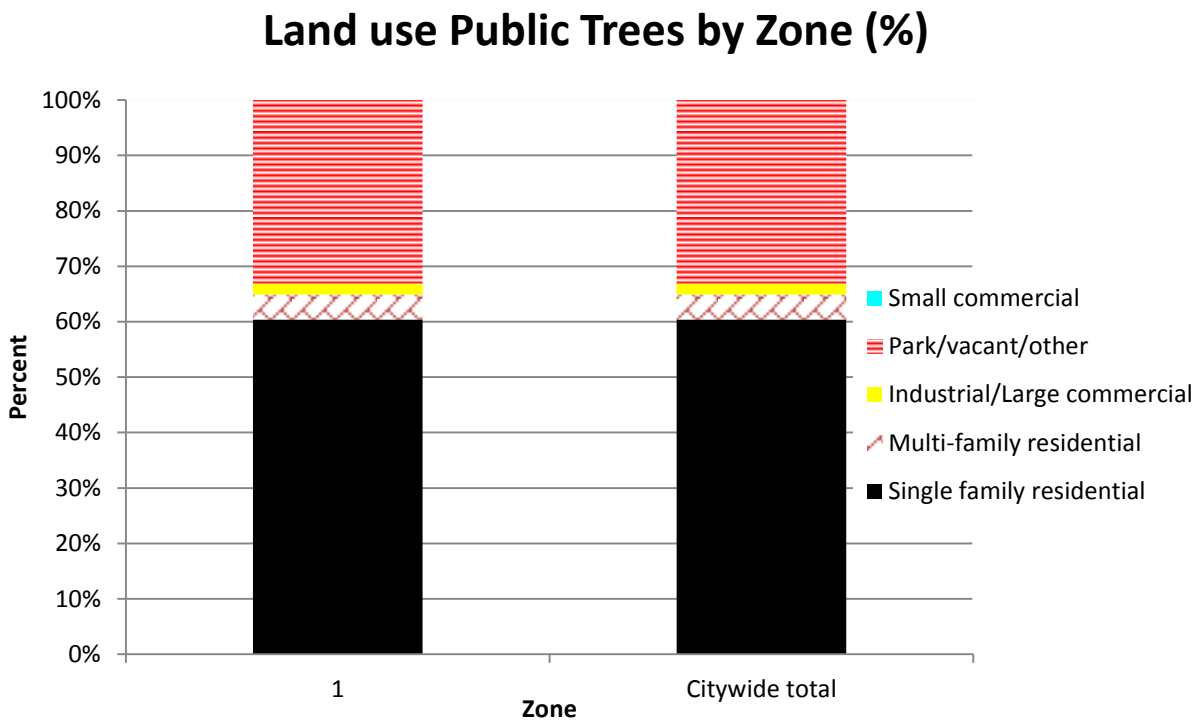

Figure 6: Land Use of city/park trees

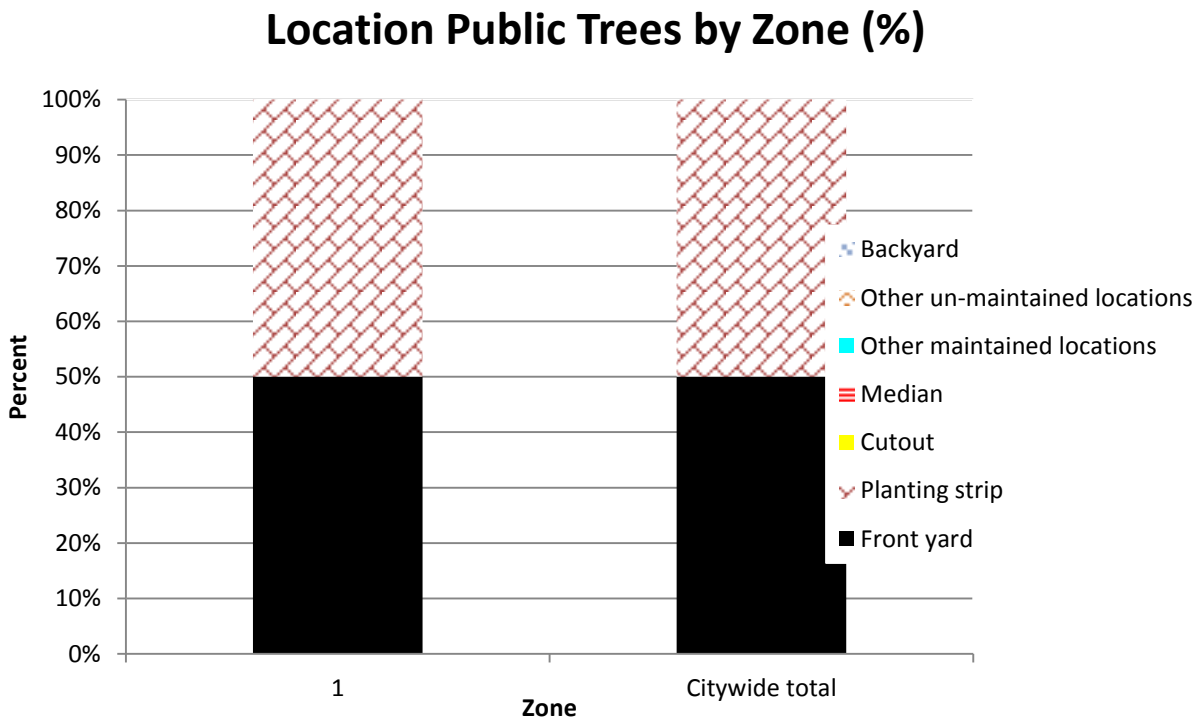

Figure 7: Location of city/park trees

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*

Appendix C: Duncombe Tree Ordinances

CHAPTER 151
TREES AND GRASS

151.01 Definition 151.05 Disease Control
151.02 Planting Restrictions 151.06 Inspection and Removal
151.03 Duty to Trim Trees 151.07 Cutting or Mowing of Grass
151.04 Trimming Trees to be Supervised

151.01 DEFINITION. For use in this chapter, "boulevard" means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

151.02 PLANTING RESTRICTIONS. No tree shall be planted in any boulevard or street except in accordance with the following:
1. Alignment. All tress planted in any street shall be planted in the boulevard midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any boulevard which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

151.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least eighteen (18) feet above the surface of a street, twenty (20) feet above the surface of a primary highway, and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the
City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.
(Code of Iowa, Sec. 364.12[2c, d, & e])

151.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 151.03, it is unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

151.05 DISEASE CONTROL. Any dead, diseased or damaged tree or shrub which may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance.

151.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:
1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.
(Code of Iowa, Sec. 364.12[3b & h])

151.07 CUTTING OR MOWING OF GRASS.
1. Duty to Cut and Mow Lawns and Lots. The owner of any property shall cut and mow all lawns and lots so that such growth shall be less than four (4) inches at all times.
2. Cutting and Mowing by City. If a property owner refuses or fails to cut and mow lawns and lots within forty-eight (48) hours after being delivered a notice from the City to perform such action, the Council may require said work to be done and the cost and expenses thereof shall be assessed to the property owner after due notice is given. The amount of such assessment shall be certified to the County Auditor as provided by law and the same shall be collected with and in the same manner as general property taxes.

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 the Director at 515-725-8200.