Hartford, IA

2014 Urban Forest Plan
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Executive Summary

Overview

This plan was developed to assist the City of Hartford 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 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.

Inventory and Results

In 2013, 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 41 trees inventoried.

- Hartford's trees provide $4,360 of benefits annually, an average of $106 a tree
- There are over 17 species of trees
- The top three genus are: Conifers 32%, Maple 17%, and Hackberry 10%
- Thankfully, only 1 public ash tree
- 24% 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, 1 is ash, none are critical concern and need addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- no ash trees 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, conifers, willow or black walnut
- Check ash trees with a visual survey yearly

Introduction

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

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

Inventory

In 2013, 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 41 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. Hartford's trees reduce energy related costs by approximately $1,196 annually (Appendix A, Table 1). These savings are both in Electricity (6 MWh) and in Natural Gas (774 Therms).

Annual Stormwater Benefits

Hartford's trees intercept about 63,126 gallons of rainfall or snowmelt a year (Appendix A, Table 2). This interception provides $1,711 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 Hartford, it is estimated that trees remove 79 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 $226 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Hartford, trees store about 277,151 lbs. of carbon a year with an associated value of $2,079 (Appendix A, Table 4). In addition, the trees sequester 19,067 lbs. of carbon, with a yearly benefit of $143 (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. Hartford receives $1,084 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, Hartford's trees provide $4,360 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 41 trees in Hartford provide approximately $106 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

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

Genus Distribution of Public Trees (%)

10/21/2013

Species	Percent
Conifer Evergreen Small	31.71
Silver maple	9.76
Northern hackberry	9.76
Norway maple	4.88
Black walnut	4.88
Mulberry	4.88
Blue spruce	4.88
Bur oak	4.88
Siberian elm	4.88
Amur maple	2.44
Other species	17.07
Total	100.00

Age Class

Most of Hartford's trees (29%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). The maximum annual benefits are often provided by trees near 18" DBH due to high vigor with a healthy, fully grown canopy.

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 Hartford indicate that 66% of the trees are in good health, with only 7% of the foliage in poor health, 0% dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 44% of Hartford'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 22% of the population.

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).

None	32	78%
Crown Raising	4	10%
Tree Removal	3	7%
Crown Cleaning	2	5%
Tree Staking	0	0%
Crown Reduction	0	0%

Canopy Cover

The canopy cover of Hartford is approximately 0.7 acre (Appendix A, Figure 5). According to the 2000 census, Hartford occupies 576 acres. Thus the canopy cover on city land is less than 1%.

Land Use and Location

The majority of Hartford'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	71%
Park/vacant/other	27%
Small commercial	2%
Industrial/Large commercial	0%
Multifamily residential	0%

Location	
Front yard	54%
Planting strip	46%
Other maintained locations	0%
Cutout (surrounded by pavement)	0%

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

Hartford has no critical concern trees that need immediate removal. Please refer to the six year maintenance plan at the end of this section.

Poor tree species

After the removal of any 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, 1 is ash. There is only 1 public ash tree. In addition, there are 9 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

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 Hartford.

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 planted with good diversity (Appendix A, Figure 1). Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut. All trees planted must meet the restrictions in city ordinance.

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

Year 1

Removal: 1 tree with poor health
Planting and Replacement: 1 tree to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 1 tree with poor health
Planting and Replacement: 1 tree to be planted in open locations
Routine trimming: trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 3

Removal: 1 tree with poor health
Planting and Replacement: 1 tree to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 4

Removal: any new critical concern trees
Planting and Replacement: trees to be planted in open locations and locations from new critical concern trees
Routine trimming: trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 5

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

Year 6

Removal: any new critical concern trees
Planting and Replacement: trees to be planted in open locations and locations from new critical concern trees
Visual Survey for signs and symptoms of EAB
Routine trimming: trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

This work plan only addresses the current 3 trees with poor structure that need replaced.

Emerald Ash Borer Plan

Ash Tree Removal

No public ash trees will remain after the 1 in poor health is removed.

Treatment of Ash Trees

Chemical treatment can be effective, spreading 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 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.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Hartford

Annual Energy Benefits of Public Trees by Species

10/21/2013

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Conifer Evergreen Small	0.0	4	8.7	8	12	(N/A)	31.7	1.0	0.93
Silver maple	0.6	42	77.3	76	118	(N/A)	9.8	9.9	29.53
Northern hackberry	2.0	149	263.2	258	407	(N/A)	9.8	34.0	101.66
Norway maple	0.4	28	56.4	55	83	(N/A)	4.9	7.0	41.58
Black walnut	0.9	70	122.1	120	190	(N/A)	4.9	15.9	94.83
Mulberry	0.3	20	37.5	37	56	(N/A)	4.9	4.7	28.16
Blue spruce	0.3	19	30.4	30	49	(N/A)	4.9	4.1	24.51
Bur oak	0.5	36	54.0	53	88	(N/A)	4.9	7.4	44.23
Siberian elm	0.3	20	30.4	30	50	(N/A)	4.9	4.2	24.94
Amur maple	0.0	0	0.6	1	1	(N/A)	2.4	0.1	0.87
Red maple	0.0	0	0.7	1	1	(N/A)	2.4	0.1	1.03
Broadleaf Deciduous	0.0	0	0.6	1	1	(N/A)	2.4	0.1	0.87
Catalpa	0.1	7	13.7	13	21	(N/A)	2.4	1.7	20.64
Ash	0.0	3	6.2	6	9	(N/A)	2.4	0.8	8.99
Scotch pine	0.1	4	9.5	9	14	(N/A)	2.4	1.1	13.58
Northern red oak	0.2	15	23.3	23	38	(N/A)	2.4	3.2	37.72
Black locust	0.3	20	39.6	39	59	(N/A)	2.4	4.9	58.69
Other street trees	0.0	0	0.0	0	0	(N/A)	0.0	0.0	0.00
Citywide total	5.8	437	774.2	759	1,196	(N/A)	100.0	100.0	29.16

Table 2: Annual Stormwater Benefits

Hartford

Annual Stormwater Benefits of Public Trees by Species

10/21/2013

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Conifer Evergreen Small	318	9	(N/A)	31.7	0.5	0.66
Silver maple	8,581	233	(N/A)	9.8	13.6	58.14
Northern hackberry	23,097	626	(N/A)	9.8	36.6	156.49
Norway maple	3,065	83	(N/A)	4.9	4.9	41.53
Black walnut	14,477	392	(N/A)	4.9	22.9	196.17
Mulberry	931	25	(N/A)	4.9	1.5	12.62
Blue spruce	3,088	84	(N/A)	4.9	4.9	41.85
Bur oak	2,931	79	(N/A)	4.9	4.6	39.72
Siberian elm	1,573	43	(N/A)	4.9	2.5	21.32
Amur maple	7	0	(N/A)	2.4	0.0	0.20
Red maple	12	0	(N/A)	2.4	0.0	0.32
Broadleaf Deciduous	7	0	(N/A)	2.4	0.0	0.20
Catalpa	608	16	(N/A)	2.4	1.0	16.47
Ash	163	4	(N/A)	2.4	0.3	4.41
Scotch pine	595	16	(N/A)	2.4	0.9	16.14
Northern red oak	1,193	32	(N/A)	2.4	1.9	32.34
Black locust	2,479	67	(N/A)	2.4	3.9	67.19
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	63,126	1,711	(N/A)	100.0	100.0	41.73

Table 3: Annual Air Quality Benefits

Hartford

Annual Air Quality Benefits of Public Trees by Species

10/21/2013

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
Conifer Evergreen Small	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	-0.1	0	0.4	1	(N/A)	31.7	0.09
Silver maple	1.7	0.3	0.8	0.1	9	2.7	0.4	0.4	2.5	17	-1.0	-4	7.9	22	(N/A)	9.8	5.52
Northern hackberry	5.5	1.0	2.6	0.2	30	9.3	1.4	1.3	8.9	58	0.0	0	30.2	88	(N/A)	9.8	21.95
Norway maple	0.5	0.1	0.3	0.0	3	1.8	0.3	0.2	1.7	11	-0.1	-1	4.8	14	(N/A)	4.9	6.81
Black walnut	2.7	0.4	1.2	0.1	14	4.4	0.6	0.6	4.2	27	0.0	0	14.3	42	(N/A)	4.9	20.79
Mulberry	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.2	9	(N/A)	4.9	4.55
Blue spruce	0.4	0.1	0.3	0.0	3	1.2	0.2	0.2	1.1	7	-1.1	-4	2.4	6	(N/A)	4.9	2.89
Bur oak	0.2	0.0	0.1	0.0	1	2.1	0.3	0.3	2.1	14	0.0	0	5.3	15	(N/A)	4.9	7.42
Siberian elm	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.2	8	0.0	0	3.0	8	(N/A)	4.9	4.16
Amur 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)	2.4	0.11
Red 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)	2.4	0.13
Broadleaf Deciduous	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)	2.4	0.11
Catalpa	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)	2.4	2.99
Ash	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)	2.4	1.21
Scotch pine	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	1	(N/A)	2.4	1.48
Northern red oak	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	-0.3	-1	2.1	6	(N/A)	2.4	5.79
Black locust	0.5	0.1	0.2	0.0	3	1.3	0.2	0.2	1.2	8	-0.1	0	3.6	10	(N/A)	2.4	10.16
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	12.3	2.1	6.0	0.6	66	27.4	4.0	3.8	26.1	171	-2.9	-11	79.4	226	(N/A)	100.0	5.52

Table 4: Annual Carbon Stored

Hartford

Stored CO2 Benefits of Public Trees by Species

10/21/2013

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Conifer Evergreen	33	0	(N/A)	31.7	0.0	0.02
Silver maple	48,154	361	(N/A)	9.8	17.4	90.29
Northern	94,843	711	(N/A)	9.8	34.2	177.83
Norway maple	9,046	68	(N/A)	4.9	3.3	33.92
Black walnut	95,241	714	(N/A)	4.9	34.4	357.15
Mulberry	3,945	30	(N/A)	4.9	1.4	14.79
Blue spruce	2,236	17	(N/A)	4.9	0.8	8.39
Bur oak	7,344	55	(N/A)	4.9	2.7	27.54
Siberian elm	3,215	24	(N/A)	4.9	1.2	12.06
Amur maple	14	0	(N/A)	2.4	0.0	0.10
Red maple	17	0	(N/A)	2.4	0.0	0.13
Broadleaf	14	0	(N/A)	2.4	0.0	0.10
Catalpa	1,035	8	(N/A)	2.4	0.4	7.76
Ash	218	2	(N/A)	2.4	0.1	1.64
Scotch pine	257	2	(N/A)	2.4	0.1	1.93
Northern red oak	3,595	27	(N/A)	2.4	1.3	26.96
Black locust	7,945	60	(N/A)	2.4	2.9	59.59
Other street trees	0	0	(N/A)	0.0	0.0	0.00
Citywide total	277,151	2,079	(N/A)	100.0	100.0	50.70

Table 5: Annual Carbon Sequestered

Hartford

Annual CO_2 Benefits of Public Trees by Species

10/21/2013

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
Conifer Evergreen	8	0	0	-3	0	79	1	84	1	(N/A)	31.7	0.4	0.05
Silver maple	2,968	22	-231	-1	-2	935	7	3,672	28	(N/A)	9.8	19.3	6.88
Northern hackberry	2,734	21	-455	-1	-3	3,286	25	5,564	42	(N/A)	9.8	29.2	10.43
Norway maple	694	5	-43	0	0	616	5	1,266	9	(N/A)	4.9	6.6	4.75
Black walnut	1,391	10	-457	0	-3	1,547	12	2,481	19	(N/A)	4.9	13.0	9.30
Mulberry	382	3	-19	0	0	433	3	795	6	(N/A)	4.9	4.2	2.98
Blue spruce	181	1	-11	0	0	426	3	596	4	(N/A)	4.9	3.1	2.23
Bur oak	891	7	-35	0	0	786	6	1,641	12	(N/A)	4.9	8.6	6.15
Siberian elm	372	3	-15	0	0	444	3	800	6	(N/A)	4.9	4.2	3.00
Amur maple	9	0	0	0	0	6	0	14	0	(N/A)	2.4	0.1	0.11
Red maple	3	0	0	0	0	7	0	9	0	(N/A)	2.4	0.1	0.07
Broadleaf Deciduous	9	0	0	0	0	6	0	14	0	(N/A)	2.4	0.1	0.11
Catalpa	209	2	-5	0	0	159	1	362	3	(N/A)	2.4	1.9	2.72
Ash	96	1	-1	0	0	65	0	159	1	(N/A)	2.4	0.8	1.19
Scotch pine	53	0	-1	0	0	94	1	146	1	(N/A)	2.4	0.8	1.09
Northern red oak	281	2	-17	0	0	329	2	592	4	(N/A)	2.4	3.1	4.44
Black locust	470	4	-38	0	0	440	3	872	7	(N/A)	2.4	4.6	6.54
Other street trees	0	0	0	0	0	0	0	0	0	(N/A)	0.0	0.0	0.00
Citywide total	10,749	81	-1,330	-8	-10	9,656	72	19,067	143	(N/A)	100.0	100.0	3.49

Table 6: Annual Social and Aesthetic Benefits

Hartford

Annual Aesthetic/Other Benefits of Public Trees by Species

10/21/2013

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Conifer Evergreen Small	56	(N/A)	31.7	5.1	4.27
Silver maple	231	(N/A)	9.8	21.3	57.77
Northern hackberry	307	(N/A)	9.8	28.3	76.83
Norway maple	69	(N/A)	4.9	6.4	34.64
Black walnut	87	(N/A)	4.9	8.0	43.45
Mulberry	22	(N/A)	4.9	2.0	10.94
Blue spruce	50	(N/A)	4.9	4.7	25.23
Bur oak	92	(N/A)	4.9	8.5	45.86
Siberian elm	46	(N/A)	4.9	4.3	23.12
Amur maple	0	(N/A)	2.4	0.0	0.03
Red maple	0	(N/A)	2.4	0.0	0.04
Broadleaf Deciduous	0	(N/A)	2.4	0.0	0.03
Catalpa	29	(N/A)	2.4	2.6	28.56
Ash	13	(N/A)	2.4	1.2	12.89
Scotch pine	15	(N/A)	2.4	1.4	15.42
Northern red oak	24	(N/A)	2.4	2.2	24.08
Black locust	43	(N/A)	2.4	4.0	43.05
Other street trees	0	(±NaN)	0.0	0.0	0.00
Citywide total	1,084	(N/A)	100.0	100.0	26.45

Table 7: Summary of Benefits in Dollars

	Energy	CO2	Air Quality	Stormwater	Aesthetic	Total	S.E.	% of Total $
Conifer Evergreen Small	12.08	0.63	1.12	8.63	55.50	$77.96	(±0)	1.79%
Silver maple	118.10	27.54	22.08	232.56	231.08	$631.37	(±0)	14.48%
Northern hackberry	406.62	41.73	87.81	625.96	307.32	$1,469.44	(±0)	33.70%
Norway maple	83.16	9.49	13.62	83.07	69.27	$258.62	(±0)	5.93%
Black walnut	189.65	18.61	41.58	392.35	86.91	$729.10	(±0)	16.72%
Mulberry	56.32	5.96	9.10	25.23	21.88	$118.50	(±0)	2.72%
Blue spruce	49.02	4.47	5.78	83.70	50.45	$193.43	(±0)	4.44%
Bur oak	88.46	12.31	14.84	79.43	91.71	$286.75	(±0)	6.58%
Siberian elm	49.87	6.00	8.33	42.64	46.24	$153.08	(±0)	3.51%
Amur maple	0.87	0.11	0.11	0.20	0.03	$1.31	(±0)	3%
Red maple	1.03	0.07	0.13	0.32	0.04	$1.58	(±0)	4%
Broadleaf Deciduous Small	0.87	0.11	0.11	0.20	0.03	$1.31	(±0)	3%
Catalpa	20.64	2.72	2.99	16.47	28.56	$71.38	(±0)	1.64%
Ash	8.99	1.19	1.21	4.41	12.89	$28.68	(±0)	.66%
Scotch pine	13.58	1.09	1.48	16.14	15.42	$47.71	(±0)	1.09%
Northern red oak	37.72	4.44	5.79	32.34	24.08	$104.37	(±0)	2.39%
Black locust	58.69	6.54	10.16	67.19	43.05	$185.62	(±0)	4.26%
Other street trees	0	0	0	0	0	$0.00	(±0)	0%
Citywide total	**1195.663818**	**143.0016632**	**226.2413635**	**1710.836548**	**1084.478271**	**$4,360.22**	**(±0)**	**100**

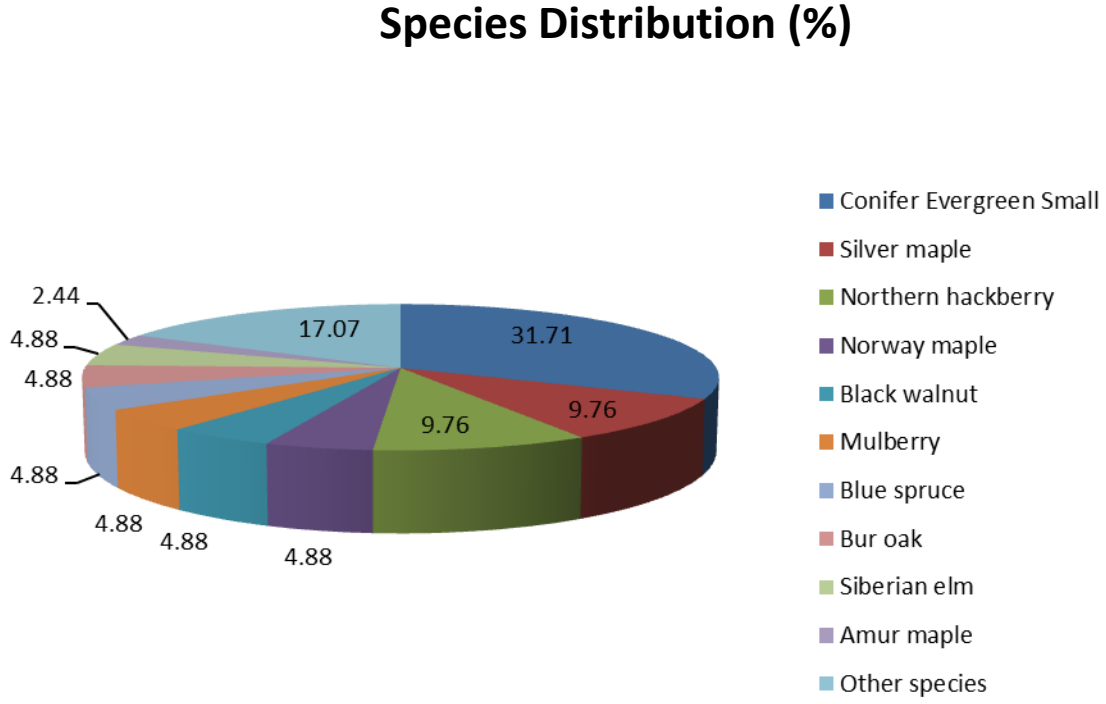

Figure 1: Species Distribution

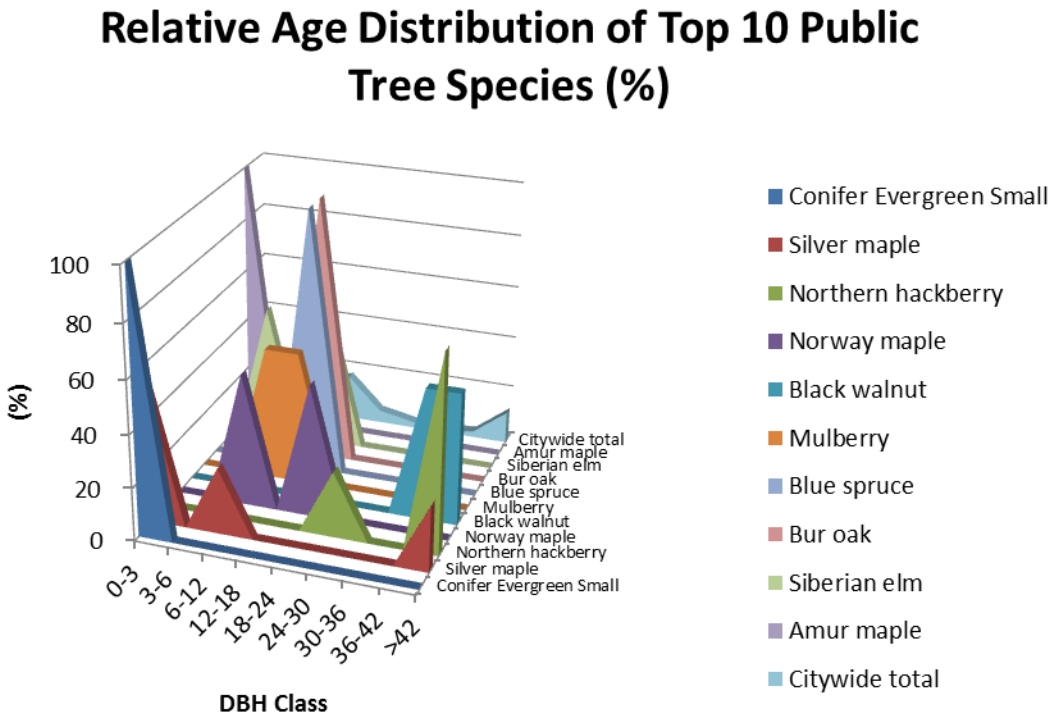

Figure 2: Relative Age Class

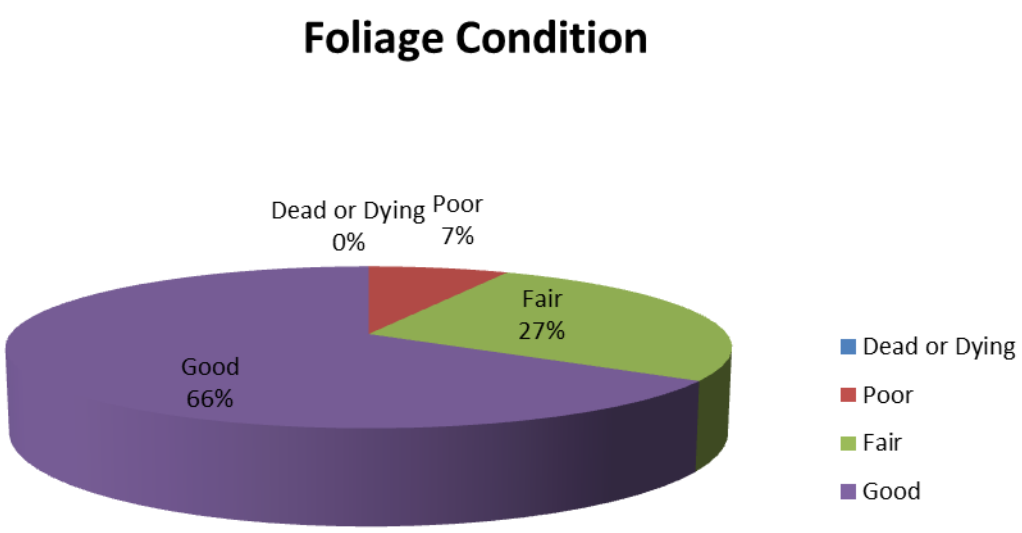

Figure 3: Foliage Condition

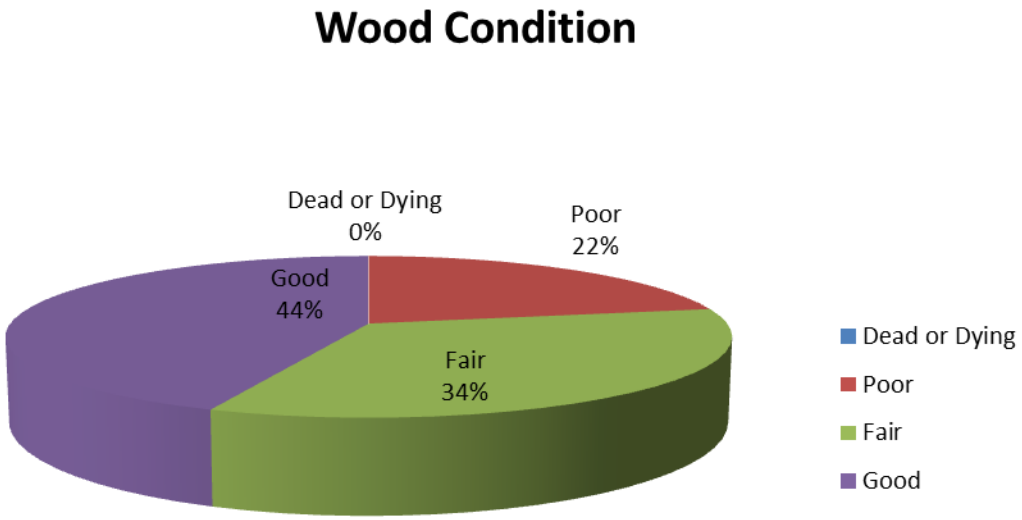

Figure 4: Wood Condition

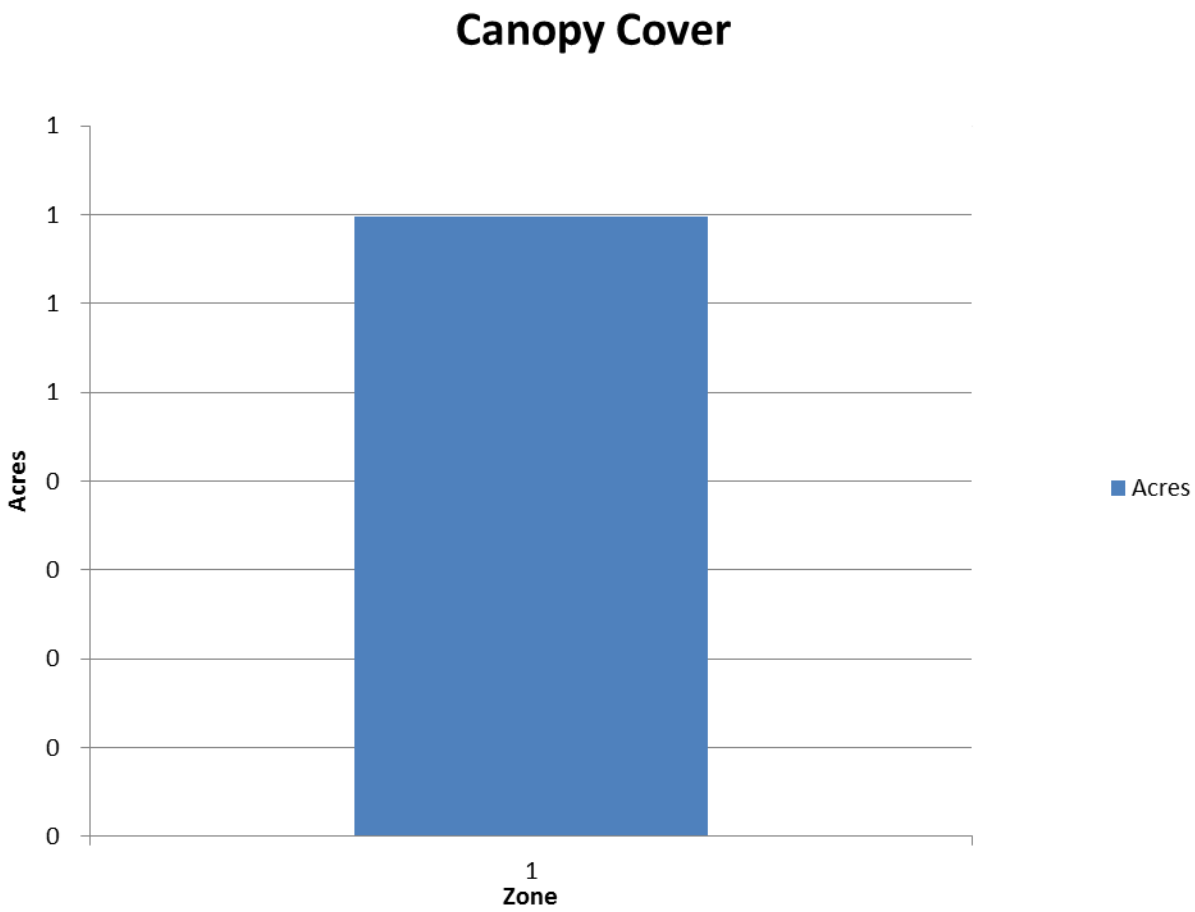

Figure 5: Canopy Cover in Acres

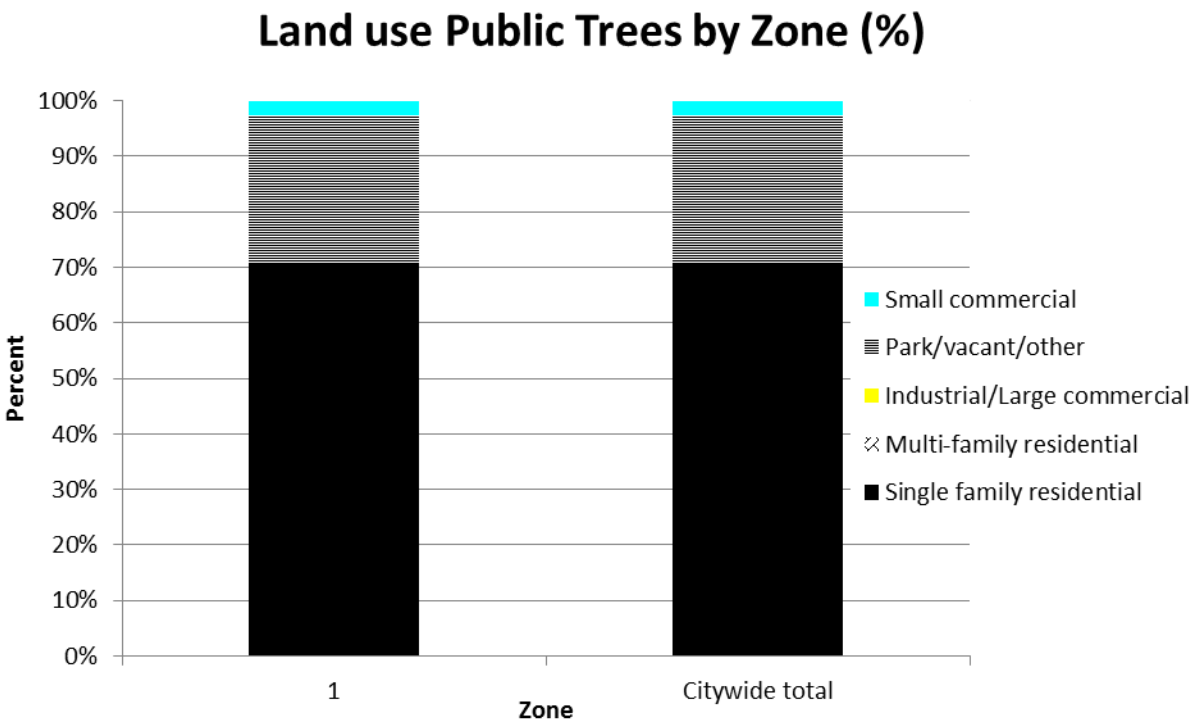

Figure 6: Land Use of city/park trees

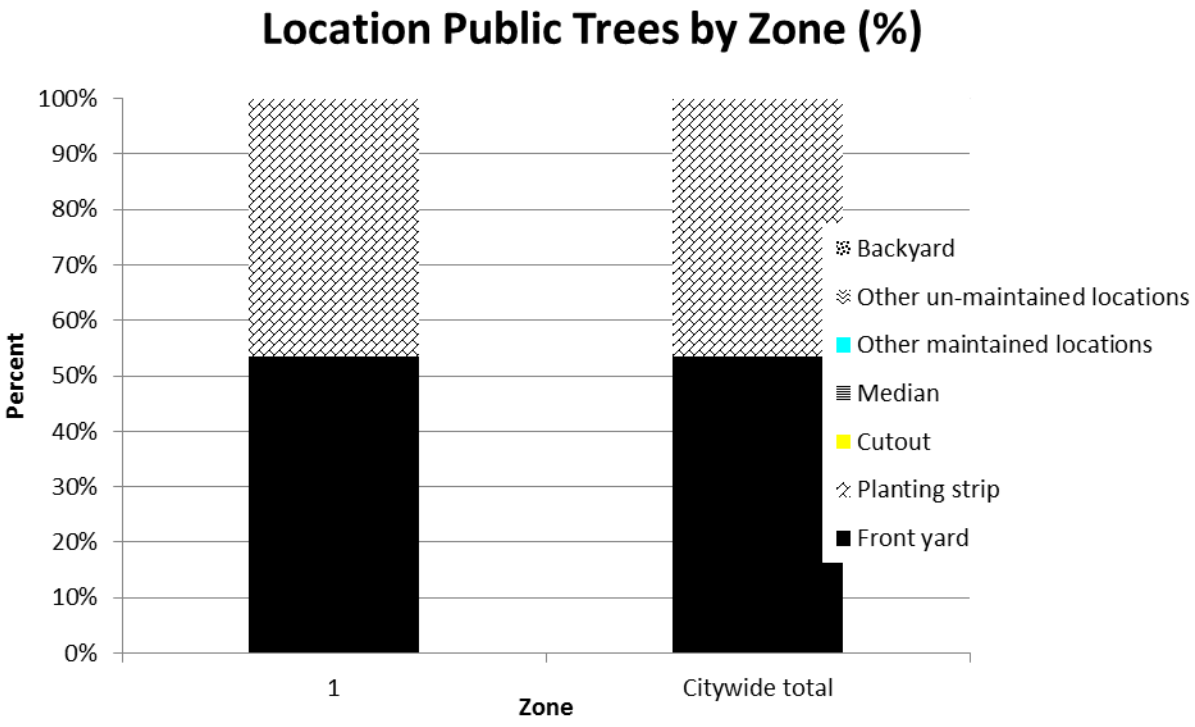

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

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

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