# Tama, IA



2016 Urban Forest Management Plan Prepared by Matt Brewer Bureau of Forestry, Iowa DNR





Trees inventoried in Summer 2015

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## Executive Summary\_

#### Overview

This plan was developed to assist the City of Tama 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 14% of Tama'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 by Matt Brewer, Iowa DNR, 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 1,070 trees inventoried.

- Tama's trees provide \$247,901 of benefits annually, an average of \$232 a tree
- There are over 52 species of trees
- The top three genera are: Maple 32%, Oak 16%, and Ash 14%
- 18% of trees are in need of some type of management
- 29 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 29 trees needing removal, 25 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\*
- 54 of the 150 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 that are consistent with the *Approved Street Tree List* and do not include ash or maple
- Check ash trees with a visual survey yearly
- Budget impacts from ash removal Suggestion: request a budget increase to at least \$10,500-\$22,500 a year and apply for grants to plant replacement trees

## Introduction

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

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

### Inventory

In 2015, a tree inventory was conducted by Matt Brewer, Iowa DNR, 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 1,070 city trees was entered into the USDA Forest Service program i-Tree Streets, part of the i-Tree suite. The following are results from the i-Tree Streets analysis.

## <u>Annual Benefits</u>

#### **Annual Energy Benefits**

Trees conserve energy by shading buildings and blocking winds. Tama's trees reduce energy related costs by approximately \$62,463 annually (Appendix A, Table 1). These savings are both in Electricity (297.1 MWh) and in Natural Gas (40,726.2 Therms).

#### **Annual Stormwater Benefits**

Tama's trees intercept about 3,860,921 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$104,631 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 Tama, it is estimated that trees remove 3,808.7 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 \$10,599 (Appendix A, Table 3).

#### **Annual Carbon Benefits**

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Tama, trees sequester about 738,187 lbs of carbon a year with an associated value of \$5,536 (Appendix A, Table 4). In addition, the trees store 15,212,862 lbs of carbon, with a yearly benefit of \$114,096 (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. Tama receives \$61,508 in annual social benefits from trees (Appendix A, Table 6).

#### **Financial Summary of all Benefits**

According to the USDA Forest Service i-Tree Streets analysis, Tama's trees provide \$247,901 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 1,070 trees in Tama provides approximately \$232 annually (Appendix A, Table 7).

#### Forest Structure

#### **Species Distribution**

Tama has over 52 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	344	32%
Oak	171	16%
Ash	150	14%
Spruce	65	6%
Hackberry	47	4%
Northern White Cedar	37	3%
Elm	35	3%
Apple/Crabapple	31	3%
Pine	31	3%
Eastern Red Cedar	20	2%
Hickory	17	2%
Honeylocust	14	1%
Linden/Basswood	14	1%
Aspen/Cottonwood	13	1%
Black Walnut	12	1%
Pear	12	1%
Willow	12	1%
Mulberry	6	1%
Catalpa	5	<1%
Ohio Buckeye	4	<1%
American Sycamore	4	<1%
American Chestnut	3	<1%
Ginkgo	3	<1%
Cherry/Plum	3	<1%
Mountain Ash	3	<1%
Lilac	2	<1%
Birch	1	<1%
Eastern Redbud	1	<1%
Dogwood	1	<1%
Magnolia	1	<1%
Other Small Deciduous	6	1%
Other Medium Deciduous	1	<1%
Other Large Evergreen	1	<1%

#### Age Class

Over half of Tama's trees (61%) are between 18 and 36 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that a large number of trees are in the smallest size categories (a downward slope) to prepare for natural mortality and to maintain canopy cover. Tama will have an aging tree population as this 61% matures, and should consider new plantings (currently only 6% are under 6 inches in diameter) to develop the next generation of trees.

#### **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 Tama indicate that 80% of the trees are in good health, with only 4% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Additionally, 45% of Tama'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 19% of the population. This 19% 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	146	14%
Tree Removal	29	3%
Tree Staking	7	<1%

#### Canopy Cover

The total canopy with both private and public trees is 31% (678 acres). The canopy cover included in the Tama inventory includes approximately 36 acres (Appendix A, Figure 4).

#### Land Use and Location

The majority of Tama's city and park trees are in yard settings in single family residential neighborhoods (Appendix A, Figure 6 & Appendix A, Figure 7). The following describes the land use and locations for the street and park trees.

Land Use	
Single family residential	75%
Park/vacant/other	23%
Small commercial	1%
Multifamily residential	<1%
Location	
Front yard	55%
Planting strip	45%
Other maintained locations	<1%

## **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

Tama has 15 critical concern trees, 11 of which need immediate removal and 4 that need immediate cleaning. 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 15 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. There are a total of 182 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 29 removals, 8 are ash trees. There are a total of 150 ash trees, and 54 of those have signs and symptoms that have been associated with EAB. In addition, there are 25 ash 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 at least 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 or greater number of trees helps ensure continuation of the benefits of the existing forest in Tama.

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 10% of the urban forest and a single species (i.e. silver maple, sugar maple, white oak, bur oak) not make up more than 5-10% of the total urban forest. Presently, the forest is heavily planted with maple (32%) (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. Tree species that may be planted can be found on the *Approved Street Tree List*, as outlined in section 6-2.0103 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 6-2.0103 (Appendix C).

#### **Continual Monitoring For EAB**

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 (See examples below). Once EAB arrives in Tama, it could potentially kill all ash within 4 to 10 years of its arrival.



EAB infested tree in Muscatine with top thinning and many new green epicormic sprouts



EAB infested tree in Muscatine with sprouting, wood pecker activity, and D-shaped exit holes

## 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 an 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 <u>http://extension.entm.purdue.edu/treecomputer/</u>

#### **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.

#### 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? The entire state of Iowa is under quarantine, so regulated articles may not be moved into non-quarantined states. For more information, please visit http://www.emeraldashborer.info/.

#### **Canopy Replacement**

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance 6-2.0103 (Appendix C). The new plantings will be a diverse mix, consistent with the *Approved Street Tree List*, and will not include ash or maple.

#### **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. City Code 6-2.0205 states "If the superintendent upon inspection or examination, in person or by some qualified person acting for him, shall determine with reasonable certainty that any condition as herein defined exists in or upon private premises and that the danger to other elm trees within the city is imminent, he shall immediately notify by certified mail the owner, occupant or person in charge of such property, to correct such condition within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (14) days of receipt thereof, the council may cause the nuisance to be removed and the cost assessed against the property as provided in Article 2, Chapter 2, of Title III.".

#### Six Year Maintenance Plan and Cost Estimates

#### Year 1 (FY 2016)

Remove 11 critical concern trees that need immediate attention	\$9 <i>,</i> 900
Maintain 4 critical concern trees that need immediate attention (cleaning)	\$1,200
Remove 4 trees (marked for removal)	\$3,600
Plant and Maintain 20 trees in open locations (pursue grants)	\$2,000
Ash tree treatment (if elected), 72 trees in good condition, average 24–30"	avg. \$405/tree
-\$15 per inch, treated every two years, see note	
*Or saving for future ash removal	
Viewal Courses for sizes and supertains of FAD	

Visual Survey for signs and symptoms of EAB

#### Year 2 (FY 2017)

Remove 14 trees (marked for removal)	\$12,600
Plant and Maintain 20 trees in open locations (pursue grants)	\$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Routine trimming: Contract to trim 1/3 of the city trees (~\$300 per tree)	
Visual Survey for signs and symptoms of EAB	

#### Year 3 (FY 2018)

Remove any new critical concern trees and ash in poor health	\$900/tree
Plant and Maintain 20 trees in open locations (pursue grants)	\$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Visual Survey for signs and symptoms of EAB	

#### <u>Year 4 (FY 2019)</u>

Remove any new critical concern trees and ash in poor health\$900/treePlant and Maintain 20 trees in open locations (pursue grants)\$2,000Ash tree treatment (if elected) or saving for future ash removal\$2,000Routine trimming: Contract to trim 1/3 of the city trees (~\$300 per tree)Yisual Survey for signs and symptoms of EAB

#### Year 5 (FY 2020)

Remove any new critical concern trees and ash in poor health	\$900/tree
Plant and Maintain 20 trees in open locations (pursue grants)	\$2,000
Ash tree treatment (if elected) or saving for future ash removal	
Visual Survey for signs and symptoms of EAB	

#### Year 6 (FY 2021)

Remove any new critical concern trees and ash in poor health Plant and Maintain 20 trees in open locations (pursue grants) Ash tree treatment (if elected) or saving for future ash removal Routine trimming: Contract to trim 1/3 of the city trees (~\$300 per tree) Visual Survey for signs and symptoms of EAB

\*Reduction of ash in poor health will reduce exposure to Emerald Ash Borer over time. EAB could potentially kill all ash within 4-15 years of its arrival.

\$900/tree

\$2,000

\*\*Assuming a cost of \$900 per tree for removal, the budget would need to be increased to \$22,500 a year to remove all ash trees within 6 years.

\*\*\*Suggest a future (post ash removal and replacement) budget of at least \$2 per capita (population 2,877). Currently, this amount would cover about 25% of what would be needed to remove EAB infested trees over a six year period. Suggest setting aside additional funds to prepare for the expected arrival of EAB. Planting would be at least partially dependent on receiving grant funds annually.

#### Proposed Budget Increase

EAB could potentially kill all ash trees in Tama within 4-15 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to \$22,500 a year. If the budget were increased to \$10,500 a year all ash could be removed within 13 years. Additionally, it is recommended that Tama 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.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For an example, if the average ash diameter is 20 inches and treatment costs \$15 per inch, then treating 10 trees would cost about \$3,000 (every other year treatment). This would be 10 trees selected for treatment, and Tama would still need to find \$900 per tree for removal. Alternatively, if there are 15 treatable trees, it would cost approximately \$4,500 every two years for treatment and leave five less trees for removal (for at least two more years). These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Tama. It is suggested to consider increasing the budget to plan for this.

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## Appendix A: i-Tree Data

#### Table 1: Annual Energy Benefits

#### Annual Energy Benefits of Public Trees

2/2/2016

	Total Electricity	Electricity	Total Natural	Natural	Total Standard	% of Total	% of	Avg.
Species	(MWh)	(\$)	Gas (Therms)	Gas (\$)	(\$) Error	Trees	Total \$	\$/tree
Green ash	47.2	3 586	6 569 3	6 4 3 8	10 024 (N/A)	13.4	16.0	70 10
Silver maple	47.8	3,625	6.282.7	6.157	9.782 (N/A)	12.0	15.7	76.42
Bur oak	38.7	2,934	5,333.7	5.227	8.161 (N/A)	11.4	13.1	66.89
Sugar maple	31.6	2,398	4,255,2	4.170	6.568 (N/A)	9.1	10.5	67.71
Norway maple	24.1	1.830	3,513,9	3,444	5.274 (N/A)	8.3	8.4	59.26
Northern hackberry	19.2	1.455	2.665.0	2.612	4.066 (N/A)	4.4	6.5	86.52
Spruce	6.2	471	816.3	800	1.271 (N/A)	3.7	2.0	31.78
Northern white cedar	4.7	355	605.9	594	948 (N/A)	3.5	1.5	25.63
Pin oak	10.7	815	1.428.4	1.400	2.214 (N/A)	3.0	3.5	69.20
Apple	3.0	227	452.1	443	670 (N/A)	2.9	1.1	21.62
Siberian elm	6.3	477	852.2	835	1.312 (N/A)	2.7	2.1	45.26
Eastern white pine	4.5	339	594.3	582	922 (N/A)	2.3	1.5	36.87
Blue spruce	1.8	136	254.8	250	385 (N/A)	2.3	0.6	15.41
Eastern red cedar	1.8	135	265.0	260	394 (N/A)	1.9	0.6	19.72
Hickory	4.2	322	538.5	528	849 (N/A)	1.6	1.4	49.95
Red maple	3.9	292	504.7	495	787 (N/A)	1.4	1.3	52.47
Honevlocust	4.6	350	604.3	592	942 (N/A)	1.3	1.5	67.27
Black walnut	3.6	271	504.3	494	766 (N/A)	1.1	1.2	63.79
Pear	1.5	110	220.1	216	326 (N/A)	1.1	0.5	27.17
Cottonwood	4.8	367	656.0	643	1.010 (N/A)	1.1	1.6	84.19
Willow	2.8	214	409.7	402	615 (N/A)	1.1	1.0	51.26
American basswood	3.4	255	485.8	476	731 (N/A)	1.0	1.2	66.43
Northern red oak	1.7	132	235.4	231	363 (N/A)	1.0	0.6	32.96
Maple	0.9	66	113.3	111	177 (N/A)	0.9	0.3	17.68
White ash	2.0	152	267.0	262	414 (N/A)	0.7	0.7	59.11
Mulberry	1.1	81	170.9	168	249 (N/A)	0.6	0.4	41.48
Broadleaf Deciduous Sm	all 0.3	23	52.6	52	75 (N/A)	0.6	0.1	12.42
Elm	1.9	141	249.3	244	385 (N/A)	0.6	0.6	64.14
Red pine	1.0	76	132.9	130	206 (N/A)	0.6	0.3	34.32
Catalpa	1.7	132	239.0	234	367 (N/A)	0.5	0.6	73.34
Boxelder	0.9	68	121.8	119	187 (N/A)	0.4	0.3	46.82
American sycamore	1.6	121	217.3	213	334 (N/A)	0.4	0.5	83.39
Ohio buckeye	1.3	97	189.7	186	283 (N/A)	0.4	0.5	70.84
Mountain ash	0.5	35	69.1	68	102 (N/A)	0.3	0.2	34.15
White oak	1.0	72	127.5	125	197 (N/A)	0.3	0.3	65.72
Ginkgo	0.6	45	77.4	76	121 (N/A)	0.3	0.2	40.38
Littleleaf linden	0.9	65	125.7	123	188 (N/A)	0.3	0.3	62.69
American chestnut	0.7	54	94.4	93	147 (N/A)	0.3	0.2	48.96
Plum	0.4	28	49.3	48	76 (N/A)	0.2	0.1	38.13
Oak	0.6	45	85.0	83	128 (N/A)	0.2	0.2	64.12
Lilac	0.1	6	12.8	13	18 (N/A)	0.1	0.0	18.19
Amur maple	0.2	14	24.7	24	38 (N/A)	0.1	0.1	38.13
Eastern redbud	0.1	6	12.8	13	18 (N/A)	0.1	0.0	18.19
River birch	0.3	24	47.4	46	71 (N/A)	0.1	0.1	70.84
Sweetbay	0.2	17	28.2	28	44 (N/A)	0.1	0.1	44.11
Dogwood	0.1	6	12.8	13	18 (N/A)	0.1	0.0	18.19
Black cherry	0.2	15	31.6	31	46 (N/A)	0.1	0.1	46.14
Swamp white oak	0.0	3	6.2	6	9 (N/A)	0.1	0.0	8.99
Conifer Evergreen Large	0.1	10	14.6	14	24 (N/A)	0.1	0.0	24.14
Broadleaf Deciduous Me	diu 0.3	24	47.4	46	71 (N/A)	0.1	0.1	70.84
Eastern cottonwood	0.4	29	53.7	53	82 (N/A)	0.1	0.1	82.02
Japanese tree lilac	0.0	2	3.8	4	5 (N/A)	0.1	0.0	5.40
Total	297.1	22,551	40,726.2	39,912	62,463 (N/A)	100.0	100.0	58.38

#### 2016 Urban Forest Management Plan

#### Table 2: Annual Stormwater Benefits

#### Annual Stormwater Benefits of Public Trees

2/2/2016

			o			
Spacias	Total rainfall	Total	Standard	a % of Total	% of Total	Avg.
Species Group and	merception (Gal)	(3)	ALAN	Tiees	\$	3/Lee
Green ash	599,803	16,255	(N/A)	13.4	15.5	113.67
Silver maple	752,298	20,387	(N/A)	12.0	19.5	159.28
Buroak	490,919	13,304	(N/A)	11.4	12.7	109.05
Sugar maple	411,857	11,101	(N/A)	9.1	10.7	115.07
Norway maple	252,455	6,842	(N/A)	8.3	6.5	/6.8/
Northern hackberry	210,760	5,712	(N/A)	4.4	5.5	121.52
Spruce	139,895	3,791	(N/A)	3./	5.0	94.78
Northern white cedar	92,390	2,504	(N/A)	3.2	2.4	0/.0/
Pin oak	130,028	3,524	(N/A)	3.0	3.4	110.12
Apple	12,063	327	(N/A)	2.9	0.3	10.55
Siberian elm	68,949	1,869	(N/A)	2.7	1.8	64.43
Eastern white pine	110,724	3,001	(N/A)	2.3	2.9	120.03
Blue spruce	21,746	589	(N/A)	2.3	0.6	23.57
Eastern red cedar	25,728	697	(N/A)	1.9	0.7	34.86
Hickory	37,134	1,006	(N/A)	1.6	1.0	59.20
Red maple	32,696	886	(N/A)	1.4	0.8	59.07
Honeylocust	55,692	1,509	(N/A)	1.3	1.4	107.80
Black walnut	44,332	1,201	(N/A)	1.1	1.1	100.12
Pear	5,692	154	(N/A)	1.1	0.1	12.85
Cottonwood	68,829	1,865	(N/A)	1.1	1.8	155.44
Willow	27,783	753	(N/A)	1.1	0.7	62.74
American basswood	38,852	1,053	(N/A)	1.0	1.0	95.72
Northern red oak	13,962	378	(N/A)	1.0	0.4	34.40
Maple	5,142	139	(N/A)	0.9	0.1	13.93
White ash	23,126	627	(N/A)	0.7	0.6	89.53
Mulberry	6,135	166	(N/A)	0.6	0.2	27.71
Broadleaf Deciduous Small	1,073	29	(N/A)	0.6	0.0	4.85
Elm	22,884	620	(N/A)	0.6	0.6	103.36
Red pine	22,722	616	(N/A)	0.6	0.6	102.63
Catalpa	26,067	706	(N/A)	0.5	0.7	141.28
Boxelder	9,012	244	(N/A)	0.4	0.2	61.06
American sycamore	22,163	601	(N/A)	0.4	0.6	150.15
Ohio buckeye	15,057	408	(N/A)	0.4	0.4	102.01
Mountain ash	2,105	57	(N/A)	0.3	0.1	19.02
White oak	10,899	295	(N/A)	0.3	0.3	98.45
Ginkgo	3,815	103	(N/A)	0.3	0.1	34.46
Littleleaf linden	11,232	304	(N/A)	0.3	0.3	101.46
American chestnut	7,564	205	(N/A)	0.3	0.2	68.33
Plum	1,333	36	(N/A)	0.2	0.0	18.06
Oak	6,534	177	(N/A)	0.2	0.2	88.53
Lilac	264	7	(N/A)	0.1	0.0	7.17
Amur maple	667	18	(N/A)	0.1	0.0	18.06
Eastern redbud	264	7	(N/A)	0.1	0.0	7.17
River birch	3,764	102	(N/A)	0.1	0.1	102.01
Sweetbay	2,052	56	(N/A)	0.1	0.1	55.60
Dogwood	264	7	(N/A)	0.1	0.0	7.17
Black cherry	1,174	32	(N/A)	0.1	0.0	31.82
Swamp white oak	163	4	(N/A)	0.1	0.0	4.41
Conifer Evergreen Large	1,539	42	(N/A)	0.1	0.0	41.70
Broadleaf Deciduous Medium	3,764	102	(N/A)	0.1	0.1	102.01
Eastern cottonwood	5,491	149	(N/A)	0.1	0.1	148.79
Japanese tree lilac	69	2	(N/A)	0.1	0.0	1.86
Citywide total	3,860,921	104,631	(N/A)	100.0	100.0	97.79

2016 Urban Forest Management Plan

#### Table 3: Annual Air Quality Benefits

#### Annual Air Quality Benefits of Public Trees

2/2/2016

		D	eposition	(lb)	Total		Avoid	ed (lb)		Total	BVOC	BVOC	Total	Total Standard	% of Total	A
Species	03	NO <sub>2</sub>	PM 10	SO 2	Depos.	NO <sub>2</sub>	PM 10	VOC	so <sub>2</sub>	Avoided (\$)	Emissions (lb)	Emissions (\$)	(1b)	(\$) Error	Trees	\$/tree
Green ash	82.0	13.1	37.9	3.7	433	226.5	32.0	31.4	214.1	1 409	0.0	(*)	641.6	1.842 (N/A)	13.4	12.88
Silver maple	141.6	24.0	68 3	63	760	225.1	33.0	31.5	216.0	1 408	-73 1	-2.74	672.7	1,894 (N/A)	12.0	14 80
Bur oak	67.8	10.9	31.3	3.0	358	185.0	26.9	25.6	175.2	1.151	0.0	0	525.7	1.509 (N/A)	11.4	12.37
Sugar maple	58.5	10.0	28.2	2.6	314	150.0	21.9	20.9	143.1	936	-45.2	-169	300.0	1.081 (N/A)	9.1	11 14
Norway maple	55.0	9.5	26.6	2.0	296	117.2	16.9	16.1	109.4	725	-12.6	-47	340.5	974 (N/A)	83	10.94
Northern hackberry	37.8	6.5	18.6	17	204	92.0	13.4	12.7	86.9	572	0.0	0	260.7	777 (N/A)	4.4	16.52
Sonice	17.0	3.4	13.5	2.1	110	29.3	43	41	28.1	183	-81.4	-305	209.7	-11 (N/A)	3.7	-0.29
Northern white cedar	10.9	2.2	8.8	13	72	22.0	3.2	3.1	21.2	138	-50.2	-188	20.5	21 (N/A)	3.5	0.56
Pin oak	24.1	4.2	12.2	11	132	50.8	74	71	48.6	318	-44.4	-166	111.2	283 (N/A)	3.0	8 84
Annie	3.4	0.6	1.7	0.2	152	14.7	2.1	2.0	13.6	90	0.0	0	38.2	109 (N/A)	2.0	3.51
Siberian elm	11.7	2.0	5.7	0.5	63	20.0	4.4	4.2	28.5	187	0.0	0	96.7	240 (N(A)	2.7	8 60
Eastern white nine	13.6	2.0	10.8	17	80	21.1	3.1	3.0	20.5	132	69.9	258	7.4	249 (IN/A) 37 (N/A)	2.7	1.40
Bhe spruce	2.4	0.5	2.2	0.3	16	21.1	1.2	1.2	20.5	53	-00.0	-258	17.1	42 (N/A)	2.5	1.60
Eastern red cedar	5.1	1.0	4.0	0.5	22	0.0	1.2	1.2	8.1	53	14.1	52	17.1	42 (IN/A)	1.0	1.67
Hickory	3.0	0.6	2.0	0.0	21	10.0	2.0	2.8	10.2	125	-14.1	-55	51.5	146 (N/A)	1.5	0.50
Red monte	7.0	1.4	2.0	0.2	42	19.9	2.9	2.0	19.2	125	0.0	10	51.5	146 (N/A)	1.0	0.73
Heneryleoust	11.0	1.7	5.0	0.5	T2 50	21.7	2.7	2.5	20.8	126	-2.7	-10	50.2	140 (IV/A)	1.7	11 49
Plack walnut	5.0	1.0	3.0	0.5	21	17.2	2.2	2.4	20.0	107	-0.0	-55	10.5	101 (IN/A)	1.5	11.40
Diack wallut	1.6	0.9	2.7	0.5	51	7.1	2.5	2.4	10.2	107	0.0	0	40.0	138 (IN/A)	1.1	4 27
Cattorwood	12.0	0.5	0.8	0.1	62	7.1	1.0	1.0	21.0	144	0.0	0	18.4	32 (IN/A)	1.1	4.57
Cononwood	12.0	1.9	2.5	0.5	20	23.1	3.4	5.2	21.9	144	0.0	0	/1.3	200 (N/A)	1.1	0.26
American becaused	5.9	1.0	2.9	0.5	52	15.7	2.0	1.9	12.8	101	-1.4	-2	38.9	111 (N/A)	1.1	9.20
American basswood	5.4	0.9	2.0	0.2	29	10.3	2.4	2.2	15.2	101	-4.0	-1/	40.7	113 (N/A)	1.0	10.25
Northern red oak	2.7	0.5	1.4	0.1	15	8.5	1.2	1.1	7.9	52	-3.8	-14	19.3	52 (N/A)	1.0	4.72
Maple White act	0.9	0.1	0.5	0.0	2	4.1	0.0	0.0	3.9	20	-0.3	-1	10.4	29 (N/A)	0.9	2.91
white ash	3.5	0.0	1.0	0.2	19	9.5	1.4	1.5	9.1	22	0.0	0	27.1	78 (N/A)	0.7	11.12
Mulberry	2.2	0.4	1.0	0.1	12	5.5	0.8	0.7	4.9	33	0.0	0	15.3	44 (N/A)	0.0	1.58
Broadleaf Deciduous Small	0.2	0.0	0.1	0.0	1	1.5	0.2	0.2	1.4	9	0.0	0	3.7	10 (N/A)	0.0	1.73
Eim	3.0	0.0	1.0	0.2	19	8.8	1.5	1.2	8.4	22	0.0	0	25.6	/4 (N/A)	0.0	12.29
Ked pine	2.7	0.5	2.2	0.3	18	4.7	0.7	0.7	4.5	29	-12.7	-48	3.7	0 (N/A)	0.0	-0.06
Catalpa	3.9	0.0	1.8	0.2	21	8.5	1.2	1.2	7.9	52	0.0	0	25.1	72 (N/A)	0.5	14.50
Boxelder	1.1	0.2	0.5	0.1	0	4.5	0.0	0.0	4.1	27	-0.5	-2	10.9	31 (N/A)	0.4	7.09
American sycamore	3.7	0.0	1.0	0.2	19	/.0	1.1	1.1	7.2	4/	0.0	0	23.0	00 (N/A)	0.4	10.01
Ohio buckeye	3.5	0.0	1.0	0.2	19	0.3	0.9	0.9	5.8	39	-0.8	-5	18.9	54 (N/A)	0.4	13.58
Mountain ash	0.7	0.1	0.3	0.0	4	2.2	0.3	0.3	2.1	14	0.0	0	6.1	17 (N/A)	0.3	5.82
White oak	1.4	0.2	0.7	0.1	1	4.5	0.7	0.0	4.5	28	0.0	0	12.5	30 (N/A)	0.3	7.22
Littleleeflinden	1.0	0.2	1.0	0.0	12	2.0	0.4	0.4	2.7	26	-0.5	-1	1.7	22 (IN/A)	0.5	11.22
American chestruit	2.2	0.4	1.0	0.1	12	7.2	0.0	0.0	3.9	20	-1.0	-4	11.9	34 (N/A)	0.5	0.71
Dium	0.9	0.1	0.4	0.0	2	17	0.5	0.5	17	11	0.0	0	9.2	20 (N/A)	0.5	6.56
Pium Oale	0.4	0.1	0.2	0.0	2	2.0	0.5	0.2	1.7	10	0.0	0	4.0	13 (N/A)	0.2	10.01
Udk	0.8	0.1	0.4	0.0	4	2.9	0.4	0.4	2.7	10	0.0	0	/.0	22 (N/A)	0.2	2.55
Anne monto	0.0	0.0	0.0	0.0	1	0.4	0.1	0.1	0.5	2 5	0.0	0	0.9	5 (N/A)	0.1	6.56
Amu maple	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.0	2	0.0	0	2.5	7 (IN/A)	0.1	0.50
Eastern feddud	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.5	2	0.0		0.9	5 (N/A)	0.1	2.33
Sweether	0.9	0.1	0.4	0.0	2	1.0	0.2	0.2	1.5	10	-0.2	-1	4.7	14 (N/A)	0.1	10.94
Sweetbay	0.7	0.1	0.5	0.1	4	1.0	0.1	0.1	1.0	0	0.0	0	3.7	11 (N/A)	0.1	10.84
Dogwood	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.5	2	0.0	0	0.9	5 (N/A)	0.1	2.55
Black cherry	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	0	0.0	0	2.9	δ (N/A)	0.1	8.35
Swamp white oak	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)	0.1	1.21
Conter Evergreen Large	0.2	0.0	0.1	0.0	1	0.0	0.1	0.1	0.0	4	-0.5	-2	1.2	⇒ (N/A)	0.1	2.82
Broadleaf Deciduous Medium	0.9	0.1	0.4	0.0	\$	1.0	0.2	0.2	1.5	10	-0.2	-1	4.7	14 (N/A)	0.1	15.58
Lastern cottonwood	0.8	0.1	0.4	0.0	4	1.9	0.5	0.3	1.8	12	0.0	U	5.5	10 (N/A)	0.1	15./1
Japanese uee mac	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.5	1 (N/A)	0.1	0.71
Citywide total	623.9	105.9	514.4	51.9	3,396	1,418.2	206.5	196.8	1,346.0	8,834	-434.9	-1,631	3,808.7	10,599 (N/A)	100.0	9.91

#### Table 4: Annual Carbon Stored

#### Stored CO2 Benefits of Public Trees

2/2/2016						
	Total Stored	Total	Standard	% of Total	% of	Avg.
Species	CO2 (lbs)	(\$)	Error	Trees	Total \$	\$/tree
Green ash	2,685,147	20,139	(N/A)	13.4	17.7	140.83
Silver maple	3,365,111	25,238	(N/A)	12.0	22.1	197.17
Bur oak	2,229,858	16,724	(N/A)	11.4	14.7	137.08
Sugar maple	1,693,154	12,699	(N/A)	9.1	11.1	130.91
Norway maple	908,363	6,813	(N/A)	8.3	6.0	76.55
Northern hackberry	601,282	4,510	(N/A)	4.4	4.0	95.95
Spruce	209,317	1,570	(N/A)	3.7	1.4	39.25
Northern white cedar	126,352	948	(N/A)	3.5	0.8	25.61
Pin oak	649,617	4,872	(N/A)	3.0	4.3	152.25
Apple	55,054	413	(N/A)	2.9	0.4	13.32
Siberian elm	284,232	2,132	(N/A)	2.7	1.9	73.51
Eastern white pine	179,805	1,349	(N/A)	2.3	1.2	53.94
Blue spruce	12,957	97	(N/A)	2.3	0.1	3.89
Eastern red cedar	16,583	124	(N/A)	1.9	0.1	6.22
Hickory	127,822	959	(N/A)	1.6	0.8	56.39
Red maple	85,526	641	(N/A)	1.4	0.6	42.76
Honevlocust	143,252	1.074	(N/A)	1.3	0.9	76,74
Black walnut	188,993	1.417	(N/A)	1.1	1.2	118.12
Pear	25 247	189	(N/A)	11	0.2	15.78
Cottonwood	409 818	3 074	(N/A)	11	2.7	256.14
Willow	96 758	726	(N/A)	11	0.6	60 47
American basswood	199 101	1 493	(N/A)	1.0	13	135.75
Northern red oak	53 766	403	(N/A)	10	0.4	36.66
Manle	10,635	80	(N/A)	0.9	0.1	7.98
White ash	65 454	491	(N/A)	0.7	0.4	70.13
Mulberry	34 621	260	(N/A)	0.6	0.1	43.28
Broadleaf Deciduous	3 659	200	(N/A)	0.6	0.0	4 57
Flm	121,032	908	(N/A)	0.6	0.0	151.29
Red nine	32 400	244	(N/A)	0.6	0.0	40.62
Catalna	131 438	0.96	(N/A)	0.5	0.0	107.16
Boxelder	33 705	253	(N/A)	0.5	0.9	63 37
American sycamore	123 641	027	(N/A)	0.4	0.2	231.83
Ohio buckeye	57 121	429	(N/A)	0.4	0.0	107.10
Mountain ach	10.688	420	(N/A)	0.4	0.4	26.72
White oak	15,000	340	(N/A)	0.3	0.1	113.47
Ginlego	12 700	102	(N/A)	0.3	0.5	24.40
Littleleeflinden	15,790	2.42	(N/A)	0.5	0.1	114 20
American chestruit	30,650	230	(N/A)	0.3	0.5	76.62
Phum	6 074	250	(N/A)	0.5	0.2	22.78
Oal	24,220	100	(N/A)	0.2	0.0	22.76
Uak	24,230	162	(IV/A)	0.2	0.2	50.80
Amur menle	2 0 2 7	22	(N/A)	0.1	0.0	22.70
Fastern radbud	5,057	23		0.1	0.0	22.70
Eastern redoud	14 280	107	(IN/A)	0.1	0.0	107.10
Curver birch	6 7 4 2	107	(IN/A)	0.1	0.1	50.57
Dominand	0,745	7	(IV/A)	0.1	0.0	50.57
Dogwood Die els els ensus	908	51	(IN/A)	0.1	0.0	0.81
Summer white sele	0,745	10	(IN/A)	0.1	0.0	1 4
Swamp white oak	218	2		0.1	0.0	1.04
Conner Evergreen La	1,170	107		0.1	0.0	8.78
Broadlear Deciduous	14,280	107	(IN/A)	0.1	0.1	107.10
Eastern cottonwood	20,943	195	(IN/A)	0.1	0.2	194.57
Japanese tree mac	1/8	1	(IN/A)	0.1	0.0	1.55
Citywide total	15,212,862	114,096	(N/A)	100.0	100.0	106.63

#### Table 5: Annual Carbon Sequestered

Annual CO Benefits of Public Trees

	Sequestered	Sequestered	Decomposition	Maintenance	Total	Avoided	Avoided	Net Total	Total Standard	% of Total	% of	Δυσ
Species	(lb)	(\$)	Release (1b)	Release (lb)	Released (\$)	(lb)	(\$)	(lb)	(\$) Error	Trees	Total \$	\$/tree
Green ash	114 120	856	-12 889	-511	-100	79 249	594	179 970	1 350 (N/A)	13.4	15.5	9.44
Silver maple	226 408	1 698	-16 153	-511	-125	80 114	601	289 812	2.174(N/A)	12.4	25.0	16.98
Bur oak	91.597	687	-10,704	-418	-83	64,839	486	145.315	1.090 (N/A)	11.4	12.5	8.93
Sugar maple	79 009	593	-8 127	-354	-64	52,991	397	123 518	926 (N/A)	9.1	10.6	9.55
Norway maple	25,136	189	-4.361	-269	-35	40.446	303	60,952	457 (N/A)	8.3	5.3	5.14
Northern hackberry	25 939	195	-2.886	-188	-23	32,147	241	55 011	413 (N/A)	4.4	47	8 78
Spruce	5.296	40	-1.005	-125	-8	10.414	78	14.581	109 (N/A)	3.7	1.3	2.73
Northern white cedar	3,313	25	-606	-96	-5	7.836	59	10.447	78 (N/A)	3.5	0.9	2.12
Pin oak	56,578	424	-3,118	-117	-24	18,003	135	71,346	535 (N/A)	3.0	6.2	16.72
Apple	4,558	34	-264	-41	-2	5,023	38	9,274	70 (N/A)	2.9	0.8	2.24
Siberian elm	12,332	92	-1,370	-72	-11	10,548	79	21,439	161 (N/A)	2.7	1.8	5.54
Eastern white pine	1,554	12	-863	-107	-7	7,501	56	8,085	61 (N/A)	2.3	0.7	2.43
Blue spruce	1,206	9	-62	-31	-1	2,998	22	4,111	31 (N/A)	2.3	0.4	1.23
Eastern red cedar	302	2	-80	-33	-1	2,976	22	3,166	24 (N/A)	1.9	0.3	1.19
Hickory	9,258	69	-614	-40	-5	7,105	53	15,710	118 (N/A)	1.6	1.4	6.93
Red maple	5,708	43	-411	-34	-3	6,461	48	11,725	88 (N/A)	1.4	1.0	5.86
Honeylocust	4,311	32	-688	-35	-5	7,724	58	11,312	85 (N/A)	1.3	1.0	6.06
Black walnut	8,853	66	-907	-39	-7	5,996	45	13,902	104 (N/A)	1.1	1.2	8.69
Pear	1,868	14	-121	-20	-1	2,438	18	4,165	31 (N/A)	1.1	0.4	2.60
Cottonwood	8,945	67	-1,967	-55	-15	8,119	61	15,041	113 (N/A)	1.1	1.3	9.40
Willow	2,535	19	-464	-33	-4	4,722	35	6,760	51 (N/A)	1.1	0.6	4.22
American basswood	11,491	86	-956	-39	-7	5,627	42	16,123	121 (N/A)	1.0	1.4	10.99
Northern red oak	2,240	17	-258	-21	-2	2,914	22	4,875	37 (N/A)	1.0	0.4	3.32
Maple	1,476	11	-51	-8	0	1,452	11	2,869	22 (N/A)	0.9	0.2	2.15
White ash	5,883	44	-315	-18	-2	3,361	25	8,911	67 (N/A)	0.7	0.8	9.55
Mulberry	592	4	-166	-18	-1	1,798	13	2,206	17 (N/A)	0.6	0.2	2.76
Broadleaf Deciduous Smal	473	4	-18	-5	0	508	4	958	7 (N/A)	0.6	0.1	1.20
Elm	3,712	28	-581	-20	-5	3,106	23	6,217	47 (N/A)	0.6	0.5	7.77
Red pine	1,074	8	-156	-20	-1	1,672	13	2,571	19 (N/A)	0.6	0.2	3.21
Catalpa	3,952	30	-631	-20	-5	2,927	22	6,229	47 (N/A)	0.5	0.5	9.34
Boxelder	2,845	21	-162	-11	-1	1,501	11	4,174	31 (N/A)	0.4	0.4	7.83
American sycamore	3,255	24	-593	-18	-5	2,665	20	5,309	40 (N/A)	0.4	0.5	9.95
Ohio buckeye	1,110	8	-274	-15	-2	2,154	16	2,975	22 (N/A)	0.4	0.3	5.58
Mountain ash	860	6	-51	-6	0	767	6	1,570	12 (N/A)	0.3	0.1	3.93
White oak	2,262	17	-218	-10	-2	1,595	12	3,629	27 (N/A)	0.3	0.3	9.07
Ginkgo	360	3	-66	-8	-1	1,000	7	1,285	10 (N/A)	0.3	0.1	3.21
Littleleaf linden	1,118	8	-219	-12	-2	1,433	11	2,320	17 (N/A)	0.3	0.2	5.80
American chestnut	1,614	12	-147	-7	-1	1,202	9	2,661	20 (N/A)	0.3	0.2	6.65
Plum	535	4	-29	-4	0	617	5	1,119	8 (N/A)	0.2	0.1	4.20
Oak	1,517	11	-116	-6	-1	994	7	2,388	18 (N/A)	0.2	0.2	8.95
Lilac	114	1	-4	-1	0	124	1	232	2 (N/A)	0.1	0.0	1.74
Amur maple	268	2	-15	-2	0	308	2	560	4 (N/A)	0.1	0.0	4.20
Eastern redbud	114	1	-4	-1	0	124	1	232	2 (N/A)	0.1	0.0	1.74
River birch	0	0	-69	-4	-1	539	4	466	3 (N/A)	0.1	0.0	3.49
Sweetbay	325	2	-32	-2	0	365	3	656	5 (N/A)	0.1	0.1	4.92
Dogwood	114	1	-4	-1	0	124	1	232	2 (N/A)	0.1	0.0	1.74
Black cherry	478	4	-32	-3	0	335	3	778	6 (N/A)	0.1	0.1	5.84
Swamp white oak	96	1	-2	-1	0	65	0	158	1 (N/A)	0.1	0.0	1.18
Conifer Evergreen Large	116	1	-6	-2	0	216	2	324	2 (N/A)	0.1	0.0	2.43
Broadleaf Deciduous Medi	370	3	-69	-4	-1	539	4	837	6 (N/A)	0.1	0.1	6.27
Eastern cottonwood	960	7	-125	-4	-1	650	5	1,481	11 (N/A)	0.1	0.1	11.11
Japanese tree lilac	38	0	-1	-1	0	37	0	74	1 (N/A)	0.1	0.0	0.55
Citywide total	738,187	5,536	-73,031	-3,467	-574	498,372	3,738	1,160,062	8,700 (N/A)	100.0	100.0	8.13

Annual Aesthetic/Other Benefits of Public Trees										
		Standard	% of Total	% of Total	Avg.					
Species	Total (\$)	Error	Trees	\$	\$/tree					
Green ash	8,626	(N/A)	13.4	14.0	60.32					
Silver maple	16,377	(N/A)	12.0	26.6	127.94					
Bur oak	6,963	(N/A)	11.4	11.3	57.07					
Sugar maple	7,865	(N/A)	9.1	12.8	81.08					
Norway maple	2,323	(N/A)	8.3	3.8	26.11					
Northern hackberry	3,159	(N/A)	4.4	5.1	67.22					
Spruce	866	(N/A)	3.7	1.4	21.66					
Northern white cedar	734	(N/A)	3.5	1.2	19.83					
Pin oak	4,193	(N/A)	3.0	6.8	131.04					
Apple	262	(N/A)	2.9	0.4	8.45					
Siberian elm	961	(N/A)	2.7	1.6	33.14					
Eastern white pine	164	(N/A)	2.3	0.3	6.58					
Blue spruce	484	(N/A)	2.3	0.8	19.35					
Eastern red cedar	144	(N/A)	1.9	0.2	7.20					
Hickory	845	(N/A)	1.6	1.4	49.68					
Red maple	730	(N/A)	1.4	1.2	48.66					
Honeylocust	1,035	(N/A)	1.3	1.7	73.96					
Black walnut	692	(N/A)	1.1	1.1	57.67					
Pear	107	(N/A)	1.1	0.2	8.90					
Cottonwood	621	(N/A)	1.1	1.0	51.75					
Willow	251	(N/A)	1.1	0.4	20.92					
American basswood	808	(N/A)	1.0	1.3	73.42					
Northern red oak	196	(N/A)	1.0	0.3	17.79					
Maple	221	(N/A)	0.9	0.4	22.15					
White ash	628	(N/A)	0.7	1.0	89.71					
Mulberry	35	(N/A)	0.6	0.1	5.87					
Broadleaf Deciduous Small	26	(N/A)	0.6	0.0	4.28					
Elm	294	(N/A)	0.6	0.5	48.98					
Red pine	194	(N/A)	0.6	0.3	32.29					
Catalpa	278	(N/A)	0.5	0.5	55.69					
Boxelder	208	(N/A)	0.4	0.3	52.01					
American sycamore	227	(N/A)	0.4	0.4	56.84					
Ohio buckeye	94	(N/A)	0.4	0.2	23.60					
Mountain ash	51	(N/A)	0.3	0.1	16.89					
White oak	178	(N/A)	0.3	0.3	59.35					
Gmkgo	30	(N/A)	0.3	0.0	9.85					
Littlelear linden	100	(N/A)	0.3	0.2	50.54					
American chestnut	141	(N/A)	0.3	0.2	47.00					
Plum	31	(N/A)	0.2	0.1	15.48					
Uak	123	(N/A)	0.2	0.2	01.04					
Lilac	0	(N/A)	0.1	0.0	6.40					
Amur maple	15	(N/A)	0.1	0.0	15.48					
Eastern redbud	0	(N/A)	0.1	0.0	6.40					
River birch	0	(N/A)	0.1	0.0	0.00					
Sweetbay	27	(N/A)	0.1	0.0	27.26					
Dogwood	6	(IN/A)	0.1	0.0	6.40					
Black cherry	29	(N/A)	0.1	0.0	28.80					
Swamp white oak	13	(N/A)	0.1	0.0	12.89					
Conifer Evergreen Large	32	(N/A)	0.1	0.1	32.32					
Broadleaf Deciduous Medium	31	(N/A)	0.1	0.1	31.46					
Eastern cottonwood	67	(N/A)	0.1	0.1	66.60					
Japanese tree lilac	2	(N/A)	0.1	0.0	2.06					
Citywide total	61,508	(N/A)	100.0	100.0	57.48					

## Table 6: Annual Social and Aesthetic Benefits

#### 2016 Urban Forest Management Plan

Total Annual B	enefits o	of Publi	c Trees by	Species (S	\$)			
2/2/2016								
Species	Energy	co <sub>2</sub>	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Green ash	10,024	1,350	1,842	16,255	8,626	38,096	(N/A)	15.4
Silver maple	9,782	2,174	1,894	20,387	16,377	50,614	(N/A)	20.4
Bur oak	8,161	1,090	1,509	13,304	6,963	31,027	(N/A)	12.5
Sugar maple	6,568	926	1,081	11,161	7,865	27,602	(N/A)	11.1
Norway maple	5,274	457	974	6,842	2,323	15,870	(N/A)	6.4
Northern hackberry	4,066	413	777	5,712	3,159	14,126	(N/A)	5.7
Spruce	1,271	109	-11	3,791	866	6,026	(N/A)	2.4
Northern white cedar	948	78	21	2,504	734	4,285	(N/A)	1.7
Pin oak	2,214	535	283	3,524	4,193	10,749	(N/A)	4.3
Apple	670	70	109	327	262	1,438	(N/A)	0.6
Siberian elm	1,312	161	249	1,869	961	4,552	(N/A)	1.8
Eastern white pine	922	61	-37	3,001	164	4,110	(N/A)	1.7
Blue spruce	385	31	42	589	484	1,531	(N/A)	0.6
Eastern red cedar	394	24	33	697	144	1,293	(N/A)	0.5
Hickory	849	118	146	1,006	845	2,964	(N/A)	1.2
Red maple	787	88	146	886	730	2,637	(N/A)	1.1
Honeylocust	942	85	161	1,509	1,035	3,732	(N/A)	1.5
Black walnut	766	104	138	1,201	692	2,901	(N/A)	1.2
Pear	326	31	52	154	107	671	(N/A)	0.3
Cottonwood	1,010	113	206	1,865	621	3,816	(N/A)	1.5
Willow	615	51	111	753	251	1,781	(N/A)	0.7
American basswood	731	121	113	1,053	808	2,825	(N/A)	1.1
Northern red oak	363	37	52	378	196	1,025	(N/A)	0.4
Maple	177	22	29	139	221	588	(N/A)	0.2
White ash	414	67	78	627	628	1,813	(N/A)	0.7
Mulberry	249	17	44	166	35	511	(N/A)	0.2
Broadleaf Deciduous Sn	75	7	10	29	26	147	(N/A)	0.1
Elm	385	47	74	620	294	1,419	(N/A)	0.6
Red pine	206	19	0	616	194	1,034	(N/A)	0.4
Catalpa	367	47	72	706	278	1,471	(N/A)	0.6
Boxelder	187	31	31	244	208	702	(N/A)	0.3
American sycamore	334	40	66	601	227	1,268	(N/A)	0.5
Ohio buckeye	283	22	54	408	94	862	(N/A)	0.3
Mountain ash	102	12	17	57	51	239	(N/A)	0.1
White oak	197	27	36	295	178	733	(N/A)	0.3
Ginkgo	121	10	22	103	30	285	(N/A)	0.1
Littleleaf linden	188	17	34	304	106	649	(N/A)	0.3
American chestnut	147	20	26	205	141	539	(N/A)	0.2
Plum	76	8	13	36	31	165	(N/A)	0.1
Oak	128	18	22	177	123	468	(N/A)	0.2
Lilac	18	2	3	7	6	36	(N/A)	0.0
Amur maple	38	4	7	18	15	82	(N/A)	0.0
Eastern redbud	18	2	3	7	6	36	(N/A)	0.0
River birch	71	3	14	102	0	190	(N/A)	0.1
Sweetbay	44	5	11	56	27	143	(N/A)	0.1
Dogwood	18	2	3	7	6	36	(N/A)	0.0
Black cherry	46	6	8	32	29	121	(N/A)	0.0
Swamp white oak	9	1	1	4	13	29	(N/A)	0.0
Conifer Evergreen Large	24	2	3	42	32	103	(N/A)	0.0
Broadleaf Deciduous Me	71	6	14	102	31	224	(N/A)	0.1
Eastern cottonwood	82	11	16	149	67	324	(N/A)	0.1
Japanese tree lilac	5	1	1	2	2	11	(N/A)	0.0
Citywide Total	62,463	8,700	10,599	104,631	61,508	247,901	(N/A)	100.0

#### Table 7: Summary of Benefits in Dollars

## Species Distribution of Public Trees

2/2/2016



Snecies	Percent
species	Ittent
Green ash	13.4
Silver maple	12.0
Bur oak	11.4
Sugar maple	9.1
Norway maple	8.3
Northern hackberry	4.4
Spruce	3.7
Northern white cedar	3.5
Pin oak	3.0
Apple	2.9
Other Species	28.4
Total	100.0

#### Figure 1: Species Distribution

- Green ash
- Silver maple
- Bur oak
- Sugar map le
- Norway maple
- Northern hackberry
- Spruce
- Northern white cedar
- Pin oak
- Apple
- Other Species

## Relative Age Distribution of Top 10 Public Tree Species for All Zones (%)

2/2/2016



DDH Class	D	BH	C	la	s	s
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				DBH class	(in)				
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Green ash	1.40	0.00	2.80	6.29	14.69	36.36	29.37	6.99	2.10
Silver maple	0.78	0.00	2.34	3.91	4.69	15.63	37.50	11.72	23.44
Bur oak	4.92	0.82	2.46	9.84	11.48	33.61	24.59	9.84	2.46
Sugar maple	1.03	0.00	4.12	8.25	8.25	25.77	45.36	7.22	0.00
Norway maple	2.25	1.12	8.99	14.61	13.48	38.20	20.22	1.12	0.00
Northern hackberry	0.00	0.00	0.00	12.77	4.26	21.28	38.30	14.89	8.51
Spruce	5.00	2.50	2.50	12.50	17.50	32.50	25.00	2.50	0.00
Northern white cedar	0.00	21.62	2.70	27.03	13.51	10.81	10.81	2.70	10.81
Pin oak	3.13	3.13	3.13	6.25	9.38	18.75	37.50	18.75	0.00
Apple	6.45	25.81	32.26	25.81	6.45	3.23	0.00	0.00	0.00
Citywide Total	2.62	3.83	8.41	11.68	10.47	24.77	25.89	7.10	5.23

Figure 2: Relative Age Class

## **Citywide total**



Figure 3: Foliage Condition

## **Citywide total**



#### Figure 4: Wood Condition

## **Canopy Cover of Public Trees (Acres)**

2/2/2016



Zone	Acres	% of Total Canopy Cover
Zone 1	36	100.0
Citywide total	36	100.0

Figure 5: Canopy Cover in Acres



## Land use Public Trees by Zone (%)

	Single	Multi-			
	family	family	Industrial/Large	Park/vacant	Small
Zone	residential	residential	commercial	/other	commercial
1	75.14	0.75	0.00	22.90	1.21
Citywide total	75.14	0.75	0.00	22.90	1.21

Figure 6: Land Use of city/park trees



	Front	Planting			Other maintained	Other un- maintained	
Zone	yard	strip	Cutout	Median	locations	locations	Backyard
1	54.95	44.95	0.00	0.09	0.00	0.00	0.00
Citywide total	54.95	44.95	0.00	0.09	0.00	0.00	0.00

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: Tama Tree Ordinances

#### TITLE VI - COMMUNITY DEVELOPMENT AND ENVIRONMENT CHAPTER 2 - TREES

#### ARTICLE 1 GENERAL PROVISIONS

6-2.0101 PURPOSE. The purpose of this ordinance is to enhance the appearance of the City and to promote the public health, safety and well being by regulating the planting, care and removal of trees, shrubs and bushes.

6-2.0102 DEFINITIONS. For use in this Chapter, the following terms are defined:

 "Parking": shall mean 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

6-2.0103 PLANTING RESTRICTIONS. No tree, shrub bush or other woody vegetation shall be planted in or upon the parking except in accordance with the following:

- 1. The owner of the adjacent real estate shall have made application for a permit on a form provided by the City Clerk and paid such fee as the City Council may from time to time fix and establish by resolution.
- 2. As a condition of the issuance of said permit the owner of the adjacent real estate and such other persons as the City may require shall agree in writing at their expense, to trim and maintain said trees, shrubs, bushes or woody vegetation and to remove the same as the City may require or deem necessary with said agreement to be a perpetual covenant running with said abutting real estate, binding upon successive owners thereof and with the same to be filed of record in the office of the Tama County Recorder.

Title VI, Page 13

- 3. Any tree, shrub, bush or other woody vegetation shall be of such type and planted in such a manner and in such locations as the City may prescribe.
- 4. The issuance or denial of a permit shall be in the sole discretion of the City of Tama.

6-2.0104 DUTY TO TRIM TREES. The owner or agent of the abutting real estate shall keep trees, shrubs, bushes or woody vegetation on or overhanging the streets or sidewalks trimmed so as not to obstruct traffic and visibility and so that all branches will be at least fifteen (15) feet above the surface of the street and at least eight (8) feet above the surface of the sidewalks.

6-2.0105 REMOVAL OF DEAD OR DISEASED TREES. The City may in its discretion, require the removal, at the owners expense, of dead or diseased trees on private property.

6-2.0106 PUBLIC TREE CARE. The City may, in its discretion, plant, prune, maintain, trim, remove or cause to be removed, any tree, shrub, bush or other woody vegetation in or upon the parking as it deems necessary to maintain the public safety, health and well-being and/or preserve or enhance the symmetry and beauty of the parking in particular and the City in general.

6-2.0107 It shall be unlawful for any person to cut or trim any tree situated in or upon the parking unless the City's prior consent is obtained and unless said work is done under the supervision of the City.

6-2.0108 Failure of any property owner to perform any duty or obligation imposed upon them by this Article shall be deemed a violation of the City Code and in, addition to all other remedies available to it, the City may, in its discretion, and in the manner proscribed by Section 364.12(3)(b)of the Code of Iowa, perform the required action and assess the costs against the property for collection in the same manner as a property tax.

Title VI, Page 14

There being present the following Council members: \_\_\_\_\_\_ and Bearden, Metz, McAdoo, Hill, Smith \_\_\_\_\_\_ and the following Council members absent: \_\_\_\_\_\_\_. It was moved by \_\_\_\_\_\_ and seconded by McAdoo \_\_\_\_\_\_ that the following Resolution be adopted:

RESOLUTION NO. 11-00

BE IT RESOLVED by the Council of the City of Tama, Iowa:

1. In accordance with Section 6-2.0103 of the City Code of Tama, Iowa, the following species of trees may be planted in the parking subject to compliance with all other provisions of the City Code:

a. Large trees:

Black Maple Norway Maple Red Maple Sugar Maple Freeman Maple River Birch (single stem only) Hackberry White Ash Gingko (male form only) Thornless Honeylocust Kentucky Coffeetree Cucumbertree Magnolia Sycamore Black Cherry White Oak Swamp White Oak Red Oak Shingle Oak Bur Oak Chinkapin Oak English Oak Black Oak Basswood Little Leaf Linden Redmond Linden

b. Small trees:

Amur Maple Tatarian Maple Ruby Red Horsechestnut Serviceberry European Hornbeam American Hornbeam Eastern Redbud Yellowwood

#### 2016 Urban Forest Management Plan

2

Pagoda Dogwood Thornless Cockspur Hawthorn Washington Hawthorn Winter King Hawthorn Hophornbeam Amur Corktree Amur Cherry Mayday Tree Japanese Pagoda Tree Japanese Tree Lilac

 In accordance with Section 6-2.0103 of the City Code of Tama, Iowa, every application for a planting permit shall be accompanied by a permit fee in the amount of \$25.00.

A roll call was taken and the following Council members voted "aye": McAdoo, Hill, Smith, Bearden, Metz \_\_\_\_\_\_ and the following council members voted "nay": \_\_\_\_\_\_ That the vote being called and the results thereof tabulated, the Mayor declared the resolution duly adopted.

Dated this <u>5th</u> day of <u>June</u>, 2000.

CITY OF TAMA, IOWA

Richard Gibson, Mayor

ATTEST :

7

under welch

Judy Welch, City Clerk

(SEAL)

## TITLE VI - COMMUNITY DEVELOPMENT AND ENVIRONMENT CHAPTER 2 - TREES

#### ARTICLE 2 DUTCH ELM DISEASE CONTROL

6-2.0201 TREES SUBJECT TO REMOVAL. The council having determined that the health of the elm trees within the city is threatened by a fatal disease known as the Dutch Elm Disease hereby declares the following shall be removed:

1. Living or Standing Trees. Any living or standing elm tree or part thereof infected with the Dutch Elm Disease fungus or which harbors any of the elm bark beetles, that is scolytus multistriatus (eichb.) or hylurgopinus rufipes (marsh.).

2. Dead Trees. Any dead elm tree or part thereof including logs, branches, stumps, firewood or other elm material from which the bark has not been removed and burned or sprayed with an effective elm bark beetle destroying insecticide.

6-2.0202 DUTY TO REMOVE. No person, firm or corporation shall permit any tree or material as defined in Section 1 of this article to remain on the premises owned, controlled or occupied by him within the city.

6-2.0203 INSPECTION. The superintendent shall inspect or cause to be inspected all premises and places within the city to determine whether any condition as defined in Section 1 of this article exists thereon, and shall also inspect or cause to be inspected any elm trees reported or suspected to be infected with the Dutch Elm Disease or any elm bark bearing material reported or suspected to be infected with the elm bark beetles.

6-2.0204 REMOVAL FROM CITY PROPERTY. If the superintendent upon inspection or examination, in person or by some qualified person acting for him, shall determine that any condition as herein defined exists in or upon any public street, alley, park or in any public place, including the strip between the

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curb and the lot line of private property, within the city and that the danger of other elm trees within the city is imminent, he shall immediately cause it to be removed and burned or otherwise correct the same in such manner as to destroy or prevent as fully as possible the spread of Dutch Elm Disease or the insect pests or vectors known to carry such disease fungus.

6-2.0205 REMOVAL FROM PRIVATE PROPERTY. If the superintendent upon inspection or examination, in person or by some qualified person acting for him, shall determine with reasonable certainty that any condition as herein defined exists in or upon private premises and that the danger to other elm trees within the city is imminent, he shall immediately notify by certified mail the owner, occupant or person in charge of such property, to correct such condition within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (14) days of receipt thereof, the council may cause the nuisance to be removed and the cost assessed against the property as provided in Article 2, Chapter 2, of Title III.

If the superintendent is unable to determine with reasonable certainty whether or not a tree in or upon private premises is infected with Dutch Elm Disease, he is authorized to remove or cut specimens from said tree, and obtain a diagnosis of such specimens.

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#### 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. 9<sup>th</sup> 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.