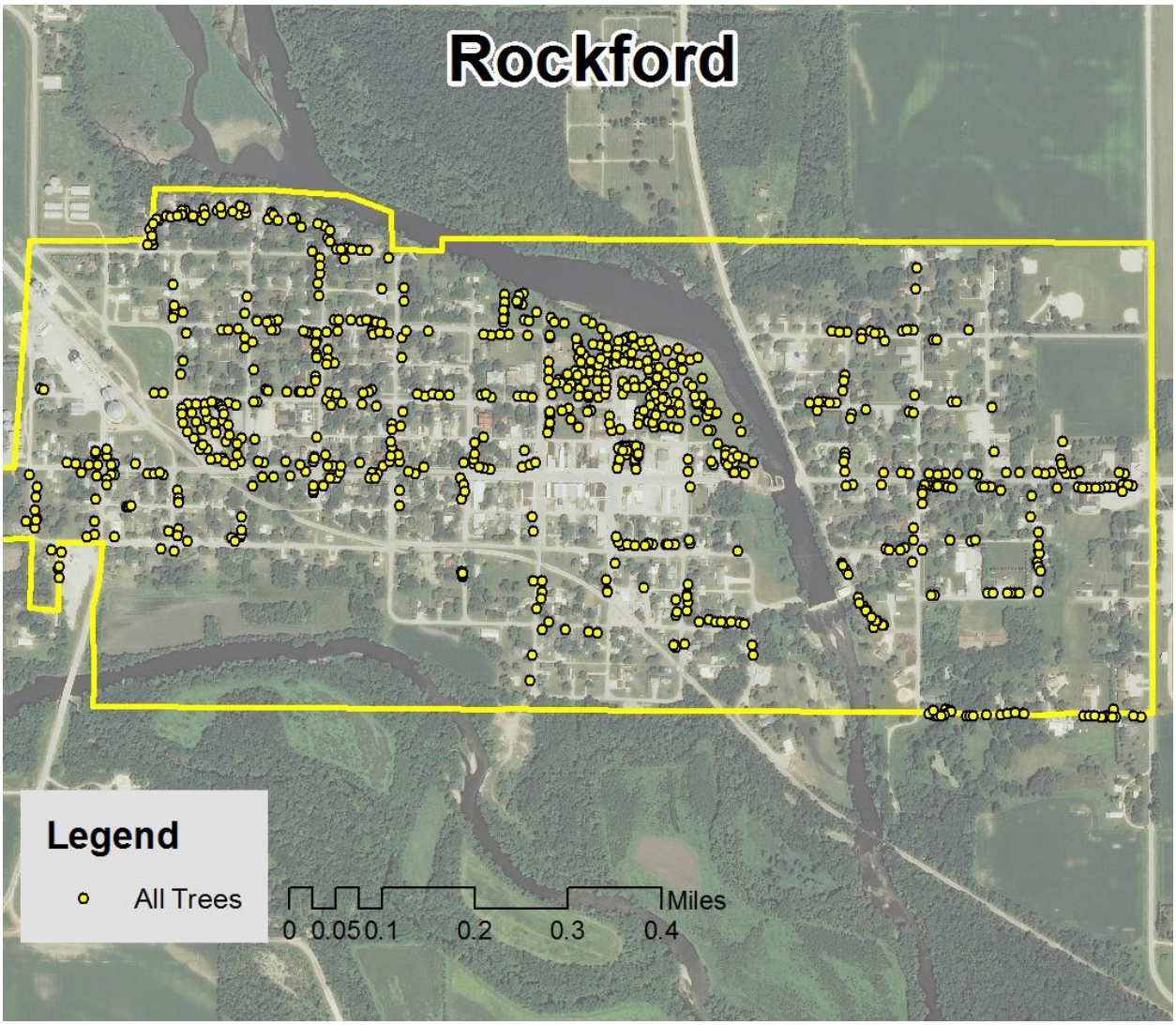
Rockford, IA



2015 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Rockford 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 19% of Rockford'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 2014, a tree inventory was conducted by Emma Hanigan, 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 772 trees inventoried.

- Rockford's trees provide $131,732 of benefits annually, an average of $170 a tree
- There are over 53 species of trees
- The top three genera are: Maple 27%, Ash 19%, and Oak 12%
- 10% of trees are in need of some type of management
- 39 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 39 trees needing removal, 22 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*
- 29 of the 145 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 do not include: ash, maple, boxelder, white poplar, tree of heaven, black locust, mulberry, mountain ash, Siberian elm, Lombardy poplar, American elm, Russian olive, pin oak, Chinese elm, Boileana poplar, silver maple, weeping birch, white birch, cottonwood, willow, catalpa, Crimson King maple or paper birch
- Check ash trees with a visual survey yearly
- With the current budget it could take 38 years to remove ash – Suggestion: request a budget increase to $21,750 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2014, a tree inventory was conducted by Emma Hanigan, 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 772 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.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Rockford's trees reduce energy related costs by approximately $35,506 annually (Appendix A, Table 1). These savings are both in Electricity (170.5 MWh) and in Natural Gas (23,028.7 Therms).

Annual Stormwater Benefits

Rockford's trees intercept about 1,902,387 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $51,555 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 Rockford, it is estimated that trees remove 2,194.4 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 $6,207 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Rockford, trees sequester about 364,779 lbs of carbon a year with an associated value of $2,736 (Appendix A, Table 4). In addition, the trees store 7,222,236 lbs of carbon, with a yearly benefit of $54,167 (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. Rockford receives $33,858 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, Rockford's trees provide $131,732 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 772 trees in Rockford provide approximately $170 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Rockford has over 53 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	211	27%
Ash	145	19%
Oak	96	12%
Hackberry	61	8%
Black Walnut	57	7%
Spruce	41	5%
Pine	34	4%
Apple/Crabapple	31	4%
Elm	27	3%
Birch	20	3%
Linden/Basswood	11	1%
Aspen/Cottonwood	8	1%
Honeylocust	4	1%
Ohio Buckeye	3	<1%
Eastern Red Cedar	3	<1%
Hickory	2	<1%
Mulberry	2	<1%
Amur Corktree	2	<1%
Cherry/Plum	2	<1%
Catalpa	1	<1%
Eastern Redbud	1	<1%
Ginkgo	1	<1%
Kentucky Coffeetree	1	<1%
Pear	1	<1%
Willow	1	<1%
Mountain Ash	1	<1%
Northern White Cedar	1	<1%
Eastern Hemlock	1	<1%
Other Small Deciduous	2	<1%
Other Large Evergreen	1	<1%

Age Class

Most of Rockford's trees are between 6 and 18 inches (40%) and 24 and 36 inches (28%) 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. Rockford's size curve indicates there are a significant number of trees spread throughout the 6-36 inch range, indicating a relatively even distribution of ages.

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 Rockford indicate that 87% of the trees are in good health, with only 2% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Additionally, 40% of Rockford'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 10% of the population. This 10% 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).

Tree Removal	39	5%
Crown Cleaning	31	4%
Crown Reduction	2	<1%
Tree Staking	1	<1%

Canopy Cover

The total canopy with both private and public trees is 27%, 110 acres. The canopy cover included in the Rockford inventory includes approximately 19 acres (Appendix A, Figure 4).

Land Use and Location

The majority of Rockford's city and park trees are in front yards 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	67%
Park/vacant/other	33%
Industrial/Large commercial	<1%

Location	
Front yard	70%
Planting strip	29%
Median	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

Rockford has 2 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 4 trees over 36 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 73 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 39 removals, 4 are ash trees. There are a total of 145 ash trees, and 29 of those have signs and symptoms that have been associated with EAB. In addition, there are 21 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.

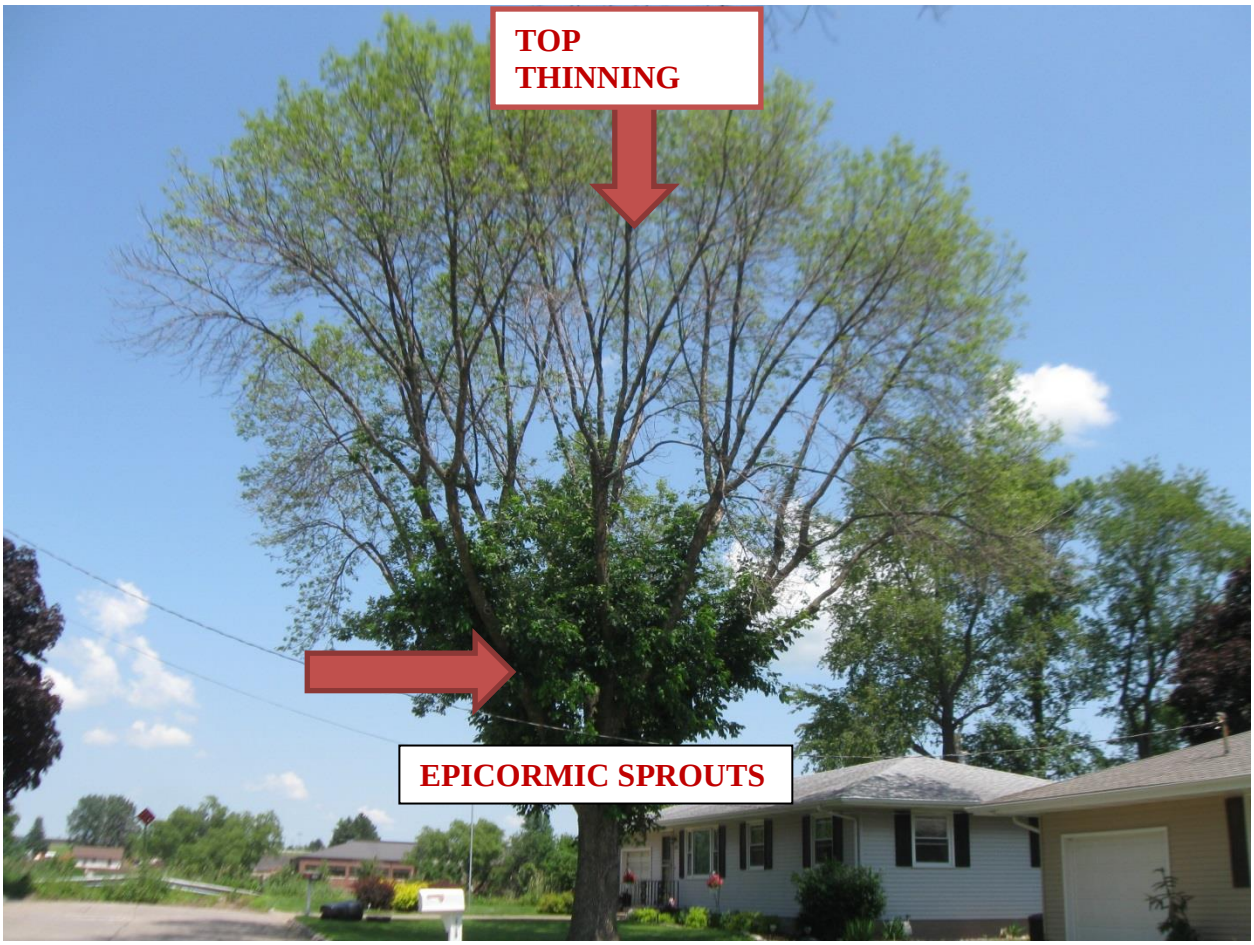
Planting

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 Rockford.

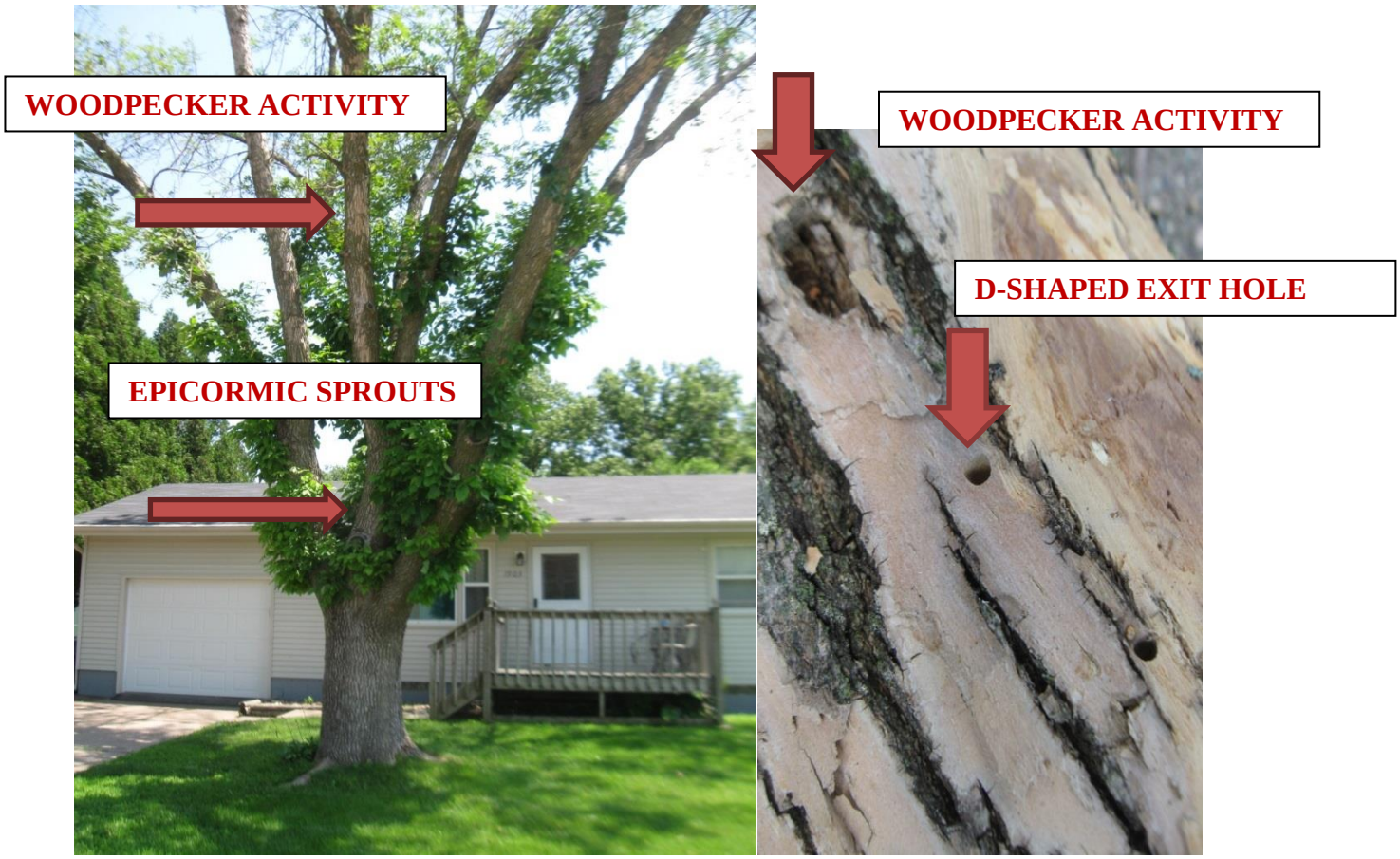
It is important to plant a diverse mix of species in the urban forest to maintain canopy health, since most insects and diseases target a genus (ash) or species (green ash) of trees. Current diversity recommendations advise that a genus (i.e. maple, oak) not make up more than 20% of the urban forest 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 (27%) (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: Boxelder, white poplar, tree of heaven, black locust, mulberry, mountain ash, Siberian elm, Lombardy poplar, American elm, Russian olive, pin oak, Chinese elm, Boileana poplar, silver maple, weeping birch, white birch, cottonwood, willow, catalpa, Crimson King maple or paper birch, as outlined in section 151.03 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.03 (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 Rockford, 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 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.

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 151.03 (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, boxelder, white poplar, tree of heaven, black locust, mulberry, mountain ash, Siberian elm, Lombardy poplar, American elm, Russian olive, pin oak, Chinese elm, Boileana poplar, silver maple, weeping birch, white birch, cottonwood, willow, catalpa, Crimson King maple or paper birch.

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 151.11 states “The City shall have the right to cause the removal of any dead or diseased trees on private property within the City when such trees constitute a hazard to life and property or harbor insects or disease which constitute a potential threat to other trees within the City. The Council shall notify in writing the owners of such trees. Removal shall be done by said owners at their own expense within sixty (60) days after the date of service of notice. In the event of failure of owners to comply with such provisions, the City shall have the authority to remove such trees and charge the cost of removal on the owner’s property tax notice.”

Six Year Maintenance Plan and Cost Estimates

Year 1 (FY 2016)

Remove 2 critical concern trees that need immediate attention	$1,800
Maintain 3 critical concern trees that need immediate attention (cleaning)	$900
Remove 18 trees (marked for removal)	$16,200
Plant and Maintain 24 trees in open locations (pursue grants)	$2,400
Ash tree treatment (if elected), 40 trees in good condition, average 12–18"	avg. $225/tree
-$15 per inch, treated every two years, see note	
Visual Survey for signs and symptoms of EAB	

Year 2 (FY 2017)

Remove 19 trees (marked for removal)	$17,100
Plant and Maintain 23 trees in open locations (pursue grants)	$2,300
Ash tree treatment (if elected)	
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)	
Visual Survey for signs and symptoms of EAB	

Year 4 (FY 2019)

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)	
Routine trimming: Contract to trim 1/3 of the city trees (~$300 per tree)	
Visual 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)	
Visual Survey for signs and symptoms of EAB	

Year 6 (FY 2021)

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)	
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 years of its arrival.
******Assuming a cost of $900 per tree for removal, the budget would need to be increased to $21,750 a year to remove all ash trees within 6 years.
*******Suggest a future (post ash removal and replacement) budget of at least $3,500 (approximate current budget). Currently, this amount would cover about 16% 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 partially dependent on receiving grant funds annually.

Proposed Budget Increase

EAB could potentially kill all ash trees in Rockford within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $21,750 a year. If the budget were increased to $10,050 a year all ash could be removed within 13 years. Additionally, it is recommended that Rockford 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 Rockford 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 Rockford. 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

Rockford

Annual Energy Benefits of Public Trees

11/25/2014

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	37.6	2,851	4,984.5	4,885	7,736	(N/A)	18.5	21.8	54.10
Bur oak	27.8	2,112	3,809.6	3,733	5,845	(N/A)	10.4	16.5	73.07
Sugar maple	19.2	1,461	2,564.3	2,513	3,974	(N/A)	9.3	11.2	55.19
Northern hackberry	16.6	1,263	2,348.2	2,301	3,565	(N/A)	7.9	10.0	58.44
Black walnut	15.4	1,170	2,065.7	2,024	3,195	(N/A)	7.4	9.0	56.05
Norway maple	12.8	975	1,810.9	1,775	2,750	(N/A)	7.3	7.7	49.10
Silver maple	14.2	1,081	1,864.3	1,827	2,908	(N/A)	6.3	8.2	59.35
Apple	1.0	76	166.0	163	238	(N/A)	4.0	0.7	7.68
Blue spruce	2.2	169	294.1	288	458	(N/A)	2.8	1.3	20.80
Maple	0.7	51	92.8	91	142	(N/A)	2.5	0.4	7.47
Spruce	1.2	90	144.0	141	231	(N/A)	2.2	0.7	13.61
Scotch pine	1.4	109	187.1	183	292	(N/A)	2.1	0.8	18.26
Eastern white pine	1.8	138	215.0	211	348	(N/A)	2.1	1.0	21.76
Birch	0.0	4	8.7	9	12	(N/A)	1.4	0.0	1.10
Siberian elm	3.1	239	403.0	395	634	(N/A)	1.4	1.8	57.63
Swamp white oak	0.0	3	7.9	8	11	(N/A)	1.3	0.0	1.10
Eastern cottonwood	2.7	204	360.7	354	558	(N/A)	0.9	1.6	79.68
American elm	0.8	64	118.0	116	179	(N/A)	0.9	0.5	25.62
American basswood	1.0	73	145.3	142	216	(N/A)	0.9	0.6	30.82
Boxelder	1.0	73	122.4	120	193	(N/A)	0.9	0.5	27.50
Elm	1.5	116	211.2	207	323	(N/A)	0.9	0.9	46.11
Red maple	0.6	42	74.3	73	115	(N/A)	0.8	0.3	19.14
River birch	0.4	29	56.8	56	84	(N/A)	0.8	0.2	14.04
Honeylocust	1.1	87	142.4	140	226	(N/A)	0.5	0.6	56.53
Northern red oak	0.3	21	40.0	39	60	(N/A)	0.5	0.2	15.06
Littleleaf linden	0.4	33	61.3	60	93	(N/A)	0.5	0.3	23.37
Eastern red cedar	0.1	11	23.8	23	34	(N/A)	0.4	0.1	11.47
Paper birch	0.5	34	64.3	63	97	(N/A)	0.4	0.3	32.46
Ohio buckeye	0.1	11	23.8	23	35	(N/A)	0.4	0.1	11.52
Austrian pine	0.3	23	42.8	42	65	(N/A)	0.3	0.2	32.56
Amur corktree	0.5	36	59.0	58	94	(N/A)	0.3	0.3	46.78
Hickory	0.5	38	65.1	64	102	(N/A)	0.3	0.3	50.77
Norway spruce	0.4	28	49.2	48	76	(N/A)	0.3	0.2	38.17
White ash	0.4	27	41.7	41	68	(N/A)	0.3	0.2	34.11
Broadleaf Deciduous Small	0.0	3	7.6	7	11	(N/A)	0.3	0.0	5.40
Mulberry	0.4	30	63.2	62	92	(N/A)	0.3	0.3	46.14
Oak	0.2	18	27.5	27	45	(N/A)	0.3	0.1	22.44
Chinese elm	0.4	32	57.4	56	88	(N/A)	0.3	0.2	43.92
Quaking aspen	0.2	18	27.0	26	44	(N/A)	0.1	0.1	44.23
Willow	0.3	24	47.4	46	71	(N/A)	0.1	0.2	70.84
Kentucky coffeetree	0.0	0	0.5	0	1	(N/A)	0.1	0.0	0.66
Amur maple	0.2	14	24.7	24	38	(N/A)	0.1	0.1	38.13
Pear	0.1	6	12.8	13	18	(N/A)	0.1	0.1	18.19
Catalpa	0.2	18	27.0	26	44	(N/A)	0.1	0.1	44.23
Northern white cedar	0.1	4	9.5	9	14	(N/A)	0.1	0.0	13.58
Eastern redbud	0.0	0	0.6	1	1	(N/A)	0.1	0.0	0.87
Conifer Evergreen Large	0.1	10	14.6	14	24	(N/A)	0.1	0.1	24.14
Plum	0.0	2	3.8	4	5	(N/A)	0.1	0.0	5.40
Eastern hemlock	0.0	0	0.7	1	1	(N/A)	0.1	0.0	0.93
Black cherry	0.1	6	12.8	13	18	(N/A)	0.1	0.1	18.19
Black maple	0.0	0	0.7	1	1	(N/A)	0.1	0.0	1.03
Ginkgo	0.1	5	9.9	10	15	(N/A)	0.1	0.0	14.72
Mountain ash	0.1	6	12.8	13	18	(N/A)	0.1	0.1	18.19

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Total	170.5	12,938	23,028.7	22,568	35,506	(N/A)	100.0	100.0	45.99

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

11/25/2014

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	388,166	10,519	(N/A)	18.5	20.4	73.56
Bur oak	388,929	10,540	(N/A)	10.4	20.4	131.75
Sugar maple	198,859	5,389	(N/A)	9.3	10.5	74.85
Northern hackberry	165,730	4,491	(N/A)	7.9	8.7	73.63
Black walnut	169,751	4,600	(N/A)	7.4	8.9	80.71
Norway maple	108,458	2,939	(N/A)	7.3	5.7	52.49
Silver maple	203,513	5,515	(N/A)	6.3	10.7	112.56
Apple	3,448	93	(N/A)	4.0	0.2	3.01
Blue spruce	30,140	817	(N/A)	2.8	1.6	37.13
Maple	3,544	96	(N/A)	2.5	0.2	5.05
Spruce	14,005	380	(N/A)	2.2	0.7	22.33
Scotch pine	17,738	481	(N/A)	2.1	0.9	30.04
Eastern white pine	22,672	614	(N/A)	2.1	1.2	38.40
Birch	134	4	(N/A)	1.4	0.0	0.33
Siberian elm	31,135	844	(N/A)	1.4	1.6	76.71
Swamp white oak	122	3	(N/A)	1.3	0.0	0.33
Eastern cottonwood	38,307	1,038	(N/A)	0.9	2.0	148.30
American elm	9,548	259	(N/A)	0.9	0.5	36.96
American basswood	9,310	252	(N/A)	0.9	0.5	36.04
Boxelder	6,804	184	(N/A)	0.9	0.4	26.34
Elm	20,215	548	(N/A)	0.9	1.1	78.26
Red maple	3,141	85	(N/A)	0.8	0.2	14.19
River birch	3,976	108	(N/A)	0.8	0.2	17.96
Honeylocust	7,576	205	(N/A)	0.5	0.4	51.33
Northern red oak	3,087	84	(N/A)	0.5	0.2	20.92
Littleleaf linden	2,641	72	(N/A)	0.5	0.1	17.90
Eastern red cedar	1,978	54	(N/A)	0.4	0.1	17.86
Paper birch	4,722	128	(N/A)	0.4	0.2	42.66
Ohio buckeye	761	21	(N/A)	0.4	0.0	6.87
Austrian pine	5,237	142	(N/A)	0.3	0.3	70.96
Amur corktree	2,818	76	(N/A)	0.3	0.1	38.19
Hickory	4,056	110	(N/A)	0.3	0.2	54.96
Norway spruce	9,209	250	(N/A)	0.3	0.5	124.79
White ash	2,276	62	(N/A)	0.3	0.1	30.84
Broadleaf Deciduous Small	137	4	(N/A)	0.3	0.0	1.86
Mulberry	2,348	64	(N/A)	0.3	0.1	31.82
Oak	1,483	40	(N/A)	0.3	0.1	20.10
Chinese elm	5,662	153	(N/A)	0.3	0.3	76.72
Quaking aspen	1,466	40	(N/A)	0.1	0.1	39.72
Willow	3,764	102	(N/A)	0.1	0.2	102.01
Kentucky coffeetree	18	0	(N/A)	0.1	0.0	0.48
Amur maple	667	18	(N/A)	0.1	0.0	18.06
Pear	264	7	(N/A)	0.1	0.0	7.17
Catalpa	1,466	40	(N/A)	0.1	0.1	39.72
Northern white cedar	596	16	(N/A)	0.1	0.0	16.14
Eastern redbud	7	0	(N/A)	0.1	0.0	0.20
Conifer Evergreen Large	1,539	42	(N/A)	0.1	0.1	41.70
Plum	69	2	(N/A)	0.1	0.0	1.86
Eastern hemlock	49	1	(N/A)	0.1	0.0	1.32
Black cherry	264	7	(N/A)	0.1	0.0	7.17
Black maple	12	0	(N/A)	0.1	0.0	0.32
Ginkgo	301	8	(N/A)	0.1	0.0	8.17
Mountain ash	264	7	(N/A)	0.1	0.0	7.17
Citywide total	1,902,387	51,555	(N/A)	100.0	100.0	66.78

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

11/25/2014

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	47.2	7.6	22.9	2.1	252	178.0	26.0	24.8	170.3	1,112	0.0	0	478.8	1,364 (N/A)	18.5	9.54
Bur oak	57.8	9.2	26.1	2.6	303	132.9	19.3	18.4	126.1	828	0.0	0	392.4	1,131 (N/A)	10.4	14.13
Sugar maple	25.4	4.3	12.9	1.1	138	91.1	13.3	12.7	87.2	569	-20.1	-75	227.9	632 (N/A)	9.3	8.78
Northern hackberry	26.5	4.6	13.4	1.2	144	80.2	11.6	11.1	75.5	498	0.0	0	224.1	643 (N/A)	7.9	10.53
Black walnut	21.2	3.4	10.1	0.9	113	73.2	10.7	10.2	69.9	457	0.0	0	199.6	570 (N/A)	7.4	10.00
Norway maple	21.0	3.6	10.5	0.9	114	61.9	9.0	8.5	58.3	384	-5.0	-19	168.7	479 (N/A)	7.3	8.56
Silver maple	34.6	5.9	17.0	1.5	186	67.0	9.8	9.4	64.4	420	-17.9	-67	191.7	539 (N/A)	6.3	11.00
Apple	0.6	0.1	0.4	0.0	4	5.0	0.7	0.7	4.5	31	0.0	0	12.0	34 (N/A)	4.0	1.10
Blue spruce	4.2	0.8	3.5	0.5	28	10.5	1.5	1.5	10.1	66	-10.9	-41	21.7	52 (N/A)	2.8	2.39
Maple	0.5	0.1	0.3	0.0	3	3.2	0.5	0.4	3.0	20	-0.2	-1	7.9	22 (N/A)	2.5	1.16
Spruce	1.5	0.3	1.3	0.2	10	5.5	0.8	0.8	5.4	35	-4.9	-18	10.8	26 (N/A)	2.2	1.55
Scotch pine	1.8	0.4	1.7	0.2	13	6.7	1.0	0.9	6.5	42	-6.3	-24	13.0	31 (N/A)	2.1	1.95
Eastern white pine	2.5	0.5	2.1	0.3	17	8.3	1.2	1.2	8.2	53	-8.3	-31	16.1	38 (N/A)	2.1	2.39
Birch	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	2 (N/A)	1.4	0.14
Siberian elm	5.1	0.9	2.5	0.2	28	14.8	2.2	2.1	14.3	93	0.0	0	42.0	120 (N/A)	1.4	10.94
Swamp white oak	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1 (N/A)	1.3	0.14
Eastern cottonwood	6.2	1.0	2.8	0.3	32	12.8	1.9	1.8	12.2	80	0.0	0	38.8	112 (N/A)	0.9	16.00
American elm	1.1	0.2	0.6	0.0	6	4.0	0.6	0.6	3.8	25	0.0	0	10.8	31 (N/A)	0.9	4.41
American basswood	1.1	0.2	0.6	0.0	6	4.7	0.7	0.6	4.4	29	-1.0	-4	11.4	32 (N/A)	0.9	4.51
Boxelder	0.6	0.1	0.3	0.0	3	4.5	0.7	0.6	4.3	28	-0.3	-1	10.8	30 (N/A)	0.9	4.32
Elm	2.8	0.5	1.3	0.1	15	7.3	1.1	1.0	6.9	45	0.0	0	21.0	60 (N/A)	0.9	8.62
Red maple	0.5	0.1	0.3	0.0	3	2.6	0.4	0.4	2.5	16	-0.2	-1	6.6	18 (N/A)	0.8	3.07
River birch	0.9	0.2	0.4	0.0	5	1.8	0.3	0.3	1.7	11	-0.2	-1	5.4	15 (N/A)	0.8	2.56
Honeylocust	1.3	0.2	0.6	0.1	7	5.3	0.8	0.7	5.2	33	-0.8	-3	13.4	37 (N/A)	0.5	9.33
Northern red oak	0.7	0.1	0.3	0.0	4	1.3	0.2	0.2	1.3	8	-1.0	-4	3.1	8 (N/A)	0.5	2.07
Littleleaf linden	0.3	0.0	0.2	0.0	2	2.1	0.3	0.3	2.0	13	-0.2	-1	5.0	14 (N/A)	0.5	3.52
Eastern red cedar	0.2	0.0	0.2	0.0	1	0.7	0.1	0.1	0.7	4	-1.0	-4	1.0	2 (N/A)	0.4	0.62
Paper birch	0.5	0.1	0.3	0.0	3	2.2	0.3	0.3	2.1	14	0.0	0	5.7	16 (N/A)	0.4	5.45
Ohio buckeye	0.1	0.0	0.0	0.0	0	0.7	0.1	0.1	0.7	5	0.0	0	1.7	5 (N/A)	0.4	1.61
Austrian pine	0.9	0.2	0.7	0.1	6	1.5	0.2	0.2	1.4	9	-2.0	-8	3.1	7 (N/A)	0.3	3.63
Amur corktree	0.4	0.1	0.2	0.0	2	2.2	0.3	0.3	2.1	14	-0.1	0	5.6	16 (N/A)	0.3	7.92
Hickory	0.4	0.1	0.2	0.0	2	2.3	0.3	0.3	2.3	15	0.0	0	5.9	17 (N/A)	0.3	8.38
Norway spruce	1.1	0.2	0.9	0.1	7	1.8	0.3	0.2	1.7	11	-5.7	-21	0.6	-3 (N/A)	0.3	-1.58
White ash	0.1	0.0	0.1	0.0	1	1.7	0.2	0.2	1.6	10	0.0	0	4.0	11 (N/A)	0.3	5.61
Broadleaf Deciduous Small	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1 (N/A)	0.3	0.71
Mulberry	0.9	0.1	0.4	0.0	5	2.0	0.3	0.3	1.8	12	0.0	0	5.8	17 (N/A)	0.3	8.35
Oak	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.7	8 (N/A)	0.3	3.75
Chinese elm	0.8	0.1	0.4	0.0	4	2.0	0.3	0.3	1.9	12	0.0	0	5.8	17 (N/A)	0.3	8.29
Quaking aspen	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.1	7.42
Willow	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14 (N/A)	0.1	13.58
Kentucky coffeetree	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)	0.1	0.08
Amur maple	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)	0.1	6.56
Pear	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	0.1	2.55
Catalpa	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.1	7.42
Northern white cedar	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)	0.1	1.48
Eastern redbud	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)	0.1	0.11
Conifer Evergreen Large	0.2	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.5	-2	1.2	3 (N/A)	0.1	2.82
Plum	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1 (N/A)	0.1	0.71
Eastern hemlock	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)	0.1	0.05
Black cherry	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	0.1	2.55
Black 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)	0.1	0.13
Ginkgo	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	0.0	0	0.8	2 (N/A)	0.1	2.12
Mountain ash	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	0.1	2.55
Citywide total	272.4	45.4	136.2	13.1	1,475	811.0	118.3	112.8	772.4	5,059	-87.2	-327	2,194.4	6,207 (N/A)	100.0	8.04

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

11/25/2014

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	1,557,025	11,678	(N/A)	18.5	21.6	81.66
Bur oak	1,920,597	14,404	(N/A)	10.4	26.6	180.06
Sugar maple	725,160	5,439	(N/A)	9.3	10.0	75.54
Northern hackberry	407,733	3,058	(N/A)	7.9	5.6	50.13
Black walnut	692,623	5,195	(N/A)	7.4	9.6	91.13
Norway maple	347,566	2,607	(N/A)	7.3	4.8	46.55
Silver maple	773,961	5,805	(N/A)	6.3	10.7	118.46
Apple	12,154	91	(N/A)	4.0	0.2	2.94
Blue spruce	29,751	223	(N/A)	2.8	0.4	10.14
Maple	6,901	52	(N/A)	2.5	0.1	2.72
Spruce	9,928	74	(N/A)	2.2	0.1	4.38
Scotch pine	13,151	99	(N/A)	2.1	0.2	6.16
Eastern white pine	17,901	134	(N/A)	2.1	0.2	8.39
Birch	185	1	(N/A)	1.4	0.0	0.13
Siberian elm	126,658	950	(N/A)	1.4	1.8	86.36
Swamp white oak	168	1	(N/A)	1.3	0.0	0.13
Eastern cottonwood	208,975	1,567	(N/A)	0.9	2.9	223.90
American elm	25,453	191	(N/A)	0.9	0.4	27.27
American basswood	39,932	299	(N/A)	0.9	0.6	42.78
Boxelder	14,393	108	(N/A)	0.9	0.2	15.42
Elm	94,434	708	(N/A)	0.9	1.3	101.18
Red maple	6,279	47	(N/A)	0.8	0.1	7.85
River birch	14,566	109	(N/A)	0.8	0.2	18.21
Honeylocust	15,854	119	(N/A)	0.5	0.2	29.73
Northern red oak	15,277	115	(N/A)	0.5	0.2	28.64
Littleleaf linden	6,669	50	(N/A)	0.5	0.1	12.50
Eastern red cedar	831	6	(N/A)	0.4	0.0	2.08
Paper birch	16,993	127	(N/A)	0.4	0.2	42.48
Ohio buckeye	1,336	10	(N/A)	0.4	0.0	3.34
Austrian pine	7,555	57	(N/A)	0.3	0.1	28.33
Amur corktree	7,248	54	(N/A)	0.3	0.1	27.18
Hickory	12,130	91	(N/A)	0.3	0.2	45.49
Norway spruce	14,981	112	(N/A)	0.3	0.2	56.18
White ash	4,706	35	(N/A)	0.3	0.1	17.65
Broadleaf Deciduous	356	3	(N/A)	0.3	0.0	1.33
Mulberry	13,485	101	(N/A)	0.3	0.2	50.57
Oak	3,684	28	(N/A)	0.3	0.1	13.81
Chinese elm	26,129	196	(N/A)	0.3	0.4	97.98
Quaking aspen	3,672	28	(N/A)	0.1	0.1	27.54
Willow	14,280	107	(N/A)	0.1	0.2	107.10
Kentucky coffeetree	12	0	(N/A)	0.1	0.0	0.09
Amur maple	3,037	23	(N/A)	0.1	0.0	22.78
Pear	908	7	(N/A)	0.1	0.0	6.81
Catalpa	3,672	28	(N/A)	0.1	0.1	27.54
Northern white cedar	257	2	(N/A)	0.1	0.0	1.93
Eastern redbud	14	0	(N/A)	0.1	0.0	0.10
Conifer Evergreen La	1,170	9	(N/A)	0.1	0.0	8.78
Plum	178	1	(N/A)	0.1	0.0	1.33
Eastern hemlock	2	0	(N/A)	0.1	0.0	0.02
Black cherry	908	7	(N/A)	0.1	0.0	6.81
Black maple	17	0	(N/A)	0.1	0.0	0.13
Ginkgo	474	4	(N/A)	0.1	0.0	3.56
Mountain ash	908	7	(N/A)	0.1	0.0	6.81
Citywide total	7,222,236	54,167	(N/A)	100.0	100.0	70.16

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees

11/25/2014

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	84,183	631	-7,474	-381	-59	63,011	473	139,339	1,045	(N/A)	18.5	22.7	7.31
Bur oak	63,481	476	-9,219	-309	-71	46,672	350	100,625	755	(N/A)	10.4	16.4	9.43
Sugar maple	40,619	305	-3,481	-201	-28	32,277	242	69,214	519	(N/A)	9.3	11.3	7.21
Northern hackberry	21,000	157	-1,958	-160	-16	27,919	209	46,801	351	(N/A)	7.9	7.6	5.75
Black walnut	35,918	269	-3,325	-160	-26	25,867	194	58,302	437	(N/A)	7.4	9.5	7.67
Norway maple	20,056	150	-1,668	-126	-13	21,543	162	39,805	299	(N/A)	7.3	6.5	5.33
Silver maple	58,275	437	-3,718	-158	-29	23,892	179	78,292	587	(N/A)	6.3	12.7	11.98
Apple	1,592	12	-59	-18	-1	1,670	13	3,185	24	(N/A)	4.0	0.5	0.77
Blue spruce	1,613	12	-143	-39	-1	3,743	28	5,174	39	(N/A)	2.8	0.8	1.76
Maple	1,002	8	-34	-9	0	1,125	8	2,085	16	(N/A)	2.5	0.3	0.82
Spruce	1,069	8	-48	-20	-1	1,995	15	2,996	22	(N/A)	2.2	0.5	1.32
Scotch pine	1,348	10	-63	-25	-1	2,404	18	3,664	27	(N/A)	2.1	0.6	1.72
Eastern white pine	1,683	13	-86	-29	-1	3,039	23	4,607	35	(N/A)	2.1	0.8	2.16
Birch	60	0	-1	-2	0	79	1	135	1	(N/A)	1.4	0.0	0.09
Siberian elm	5,592	42	-608	-32	-5	5,281	40	10,232	77	(N/A)	1.4	1.7	6.98
Swamp white oak	54	0	-1	-2	0	72	1	123	1	(N/A)	1.3	0.0	0.09
Eastern cottonwood	5,374	40	-1,003	-30	-8	4,513	34	8,855	66	(N/A)	0.9	1.4	9.49
American elm	1,049	8	-122	-9	-1	1,408	11	2,325	17	(N/A)	0.9	0.4	2.49
American basswood	2,607	20	-192	-12	-2	1,621	12	4,025	30	(N/A)	0.9	0.7	4.31
Boxelder	1,854	14	-70	-10	-1	1,604	12	3,378	25	(N/A)	0.9	0.6	3.62
Elm	3,532	26	-453	-18	-4	2,559	19	5,620	42	(N/A)	0.9	0.9	6.02
Red maple	894	7	-30	-6	0	930	7	1,788	13	(N/A)	0.8	0.3	2.23
River birch	487	4	-71	-5	-1	632	5	1,044	8	(N/A)	0.8	0.2	1.30
Honeylocust	2,359	18	-76	-9	-1	1,913	14	4,187	31	(N/A)	0.5	0.7	7.85
Northern red oak	15	0	-73	-4	-1	465	3	402	3	(N/A)	0.5	0.1	0.75
Littleleaf linden	1,184	9	-32	-5	0	738	6	1,884	14	(N/A)	0.5	0.3	3.53
Eastern red cedar	120	1	-4	-4	0	246	2	358	3	(N/A)	0.4	0.1	0.89
Paper birch	1,140	9	-82	-5	-1	760	6	1,813	14	(N/A)	0.4	0.3	4.53
Ohio buckeye	325	2	-7	-2	0	248	2	563	4	(N/A)	0.4	0.1	1.41
Austrian pine	147	1	-36	-6	0	512	4	617	5	(N/A)	0.3	0.1	2.31
Amur corktree	772	6	-35	-4	0	790	6	1,523	11	(N/A)	0.3	0.2	5.71
Hickory	1,105	8	-58	-5	0	834	6	1,876	14	(N/A)	0.3	0.3	7.04
Norway spruce	256	2	-72	-8	-1	622	5	798	6	(N/A)	0.3	0.1	2.99
White ash	676	5	-23	-3	0	604	5	1,254	9	(N/A)	0.3	0.2	4.70
Broadleaf Deciduous Sn	76	1	-2	-1	0	74	1	147	1	(N/A)	0.3	0.0	0.55
Mulberry	0	0	-65	-7	-1	670	5	598	4	(N/A)	0.3	0.1	2.24
Oak	448	3	-18	-2	0	397	3	825	6	(N/A)	0.3	0.1	3.09
Chinese elm	1,034	8	-125	-5	-1	699	5	1,602	12	(N/A)	0.3	0.3	6.01
Quaking aspen	445	3	-18	-2	0	393	3	819	6	(N/A)	0.1	0.1	6.14
Willow	0	0	-69	-4	-1	539	4	466	3	(N/A)	0.1	0.1	3.49
Kentucky coffeetree	3	0	0	0	0	4	0	7	0	(N/A)	0.1	0.0	0.05
Amur maple	268	2	-15	-2	0	308	2	560	4	(N/A)	0.1	0.1	4.20
Pear	114	1	-4	-1	0	124	1	232	2	(N/A)	0.1	0.0	1.74
Catalpa	445	3	-18	-2	0	393	3	819	6	(N/A)	0.1	0.1	6.14
Northern white cedar	53	0	-1	-1	0	94	1	145	1	(N/A)	0.1	0.0	1.08
Eastern redbud	9	0	0	0	0	6	0	14	0	(N/A)	0.1	0.0	0.10
Conifer Evergreen Large	116	1	-6	-2	0	216	2	324	2	(N/A)	0.1	0.1	2.43
Plum	38	0	-1	-1	0	37	0	74	1	(N/A)	0.1	0.0	0.55
Eastern hemlock	4	0	0	0	0	6	0	9	0	(N/A)	0.1	0.0	0.07
Black cherry	114	1	-4	-1	0	124	1	232	2	(N/A)	0.1	0.0	1.74
Black maple	3	0	0	0	0	7	0	9	0	(N/A)	0.1	0.0	0.07
Ginkgo	58	0	-2	-1	0	111	1	165	1	(N/A)	0.1	0.0	1.24
Mountain ash	114	1	-4	-1	0	124	1	232	2	(N/A)	0.1	0.0	1.74
Citywide total	364,779	2,736	-34,676	-1,849	-274	285,916	2,144	614,169	4,606	(N/A)	100.0	100.0	5.97

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

11/25/2014

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	7,269	(N/A)	18.5	21.5	50.83
Bur oak	4,561	(N/A)	10.4	13.5	57.01
Sugar maple	4,310	(N/A)	9.3	12.7	59.86
Northern hackberry	2,823	(N/A)	7.9	8.3	46.29
Black walnut	2,988	(N/A)	7.4	8.8	52.42
Norway maple	1,960	(N/A)	7.3	5.8	34.99
Silver maple	4,652	(N/A)	6.3	13.7	94.94
Apple	82	(N/A)	4.0	0.2	2.64
Blue spruce	417	(N/A)	2.8	1.2	18.95
Maple	155	(N/A)	2.5	0.5	8.16
Spruce	331	(N/A)	2.2	1.0	19.46
Scotch pine	379	(N/A)	2.1	1.1	23.72
Eastern white pine	471	(N/A)	2.1	1.4	29.47
Birch	30	(N/A)	1.4	0.1	2.74
Siberian elm	424	(N/A)	1.4	1.3	38.56
Swamp white oak	27	(N/A)	1.3	0.1	2.74
Eastern cottonwood	381	(N/A)	0.9	1.1	54.37
American elm	156	(N/A)	0.9	0.5	22.32
American basswood	208	(N/A)	0.9	0.6	29.71
Boxelder	218	(N/A)	0.9	0.6	31.21
Elm	292	(N/A)	0.9	0.9	41.71
Red maple	140	(N/A)	0.8	0.4	23.36
River birch	55	(N/A)	0.8	0.2	9.21
Honeylocust	503	(N/A)	0.5	1.5	125.68
Northern red oak	5	(N/A)	0.5	0.0	1.15
Littleleaf linden	149	(N/A)	0.5	0.4	37.17
Eastern red cedar	64	(N/A)	0.4	0.2	21.34
Paper birch	109	(N/A)	0.4	0.3	36.29
Ohio buckeye	42	(N/A)	0.4	0.1	13.95
Austrian pine	20	(N/A)	0.3	0.1	9.99
Amur corktree	78	(N/A)	0.3	0.2	39.16
Hickory	104	(N/A)	0.3	0.3	51.77
Norway spruce	26	(N/A)	0.3	0.1	13.13
White ash	97	(N/A)	0.3	0.3	48.58
Broadleaf Deciduous Small	4	(N/A)	0.3	0.0	2.06
Mulberry	0	(N/A)	0.3	0.0	0.00
Oak	51	(N/A)	0.3	0.2	25.56
Chinese elm	81	(N/A)	0.3	0.2	40.67
Quaking aspen	46	(N/A)	0.1	0.1	45.86
Willow	0	(N/A)	0.1	0.0	0.00
Kentucky coffeetree	5	(N/A)	0.1	0.0	5.26
Amur maple	15	(N/A)	0.1	0.0	15.48
Pear	6	(N/A)	0.1	0.0	6.40
Catalpa	46	(N/A)	0.1	0.1	45.86
Northern white cedar	15	(N/A)	0.1	0.0	15.42
Eastern redbud	0	(N/A)	0.1	0.0	0.03
Conifer Evergreen Large	32	(N/A)	0.1	0.1	32.32
Plum	2	(N/A)	0.1	0.0	2.06
Eastern hemlock	6	(N/A)	0.1	0.0	5.76
Black cherry	6	(N/A)	0.1	0.0	6.40
Black maple	0	(N/A)	0.1	0.0	0.04
Ginkgo	7	(N/A)	0.1	0.0	6.77
Mountain ash	6	(N/A)	0.1	0.0	6.40
Citywide total	33,858	(N/A)	100.0	100.0	43.86

Table 7: Summary of Benefits in Dollars

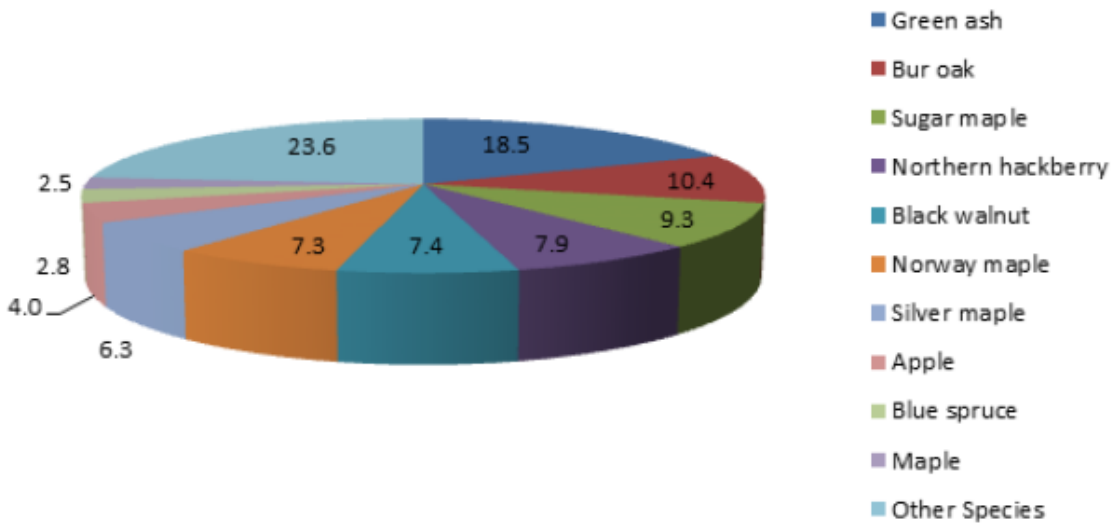
Total Annual Benefits of Public Trees by Species ($)

11/25/201

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Green ash	7,736	1,045	1,364	10,519	7,269	27,933	(N/A)	21.2
Bur oak	5,845	755	1,131	10,540	4,561	22,832	(N/A)	17.3
Sugar maple	3,974	519	632	5,389	4,310	14,824	(N/A)	11.3
Northern hackberry	3,565	351	643	4,491	2,823	11,873	(N/A)	9.0
Black walnut	3,195	437	570	4,600	2,988	11,790	(N/A)	8.9
Norway maple	2,750	299	479	2,939	1,960	8,426	(N/A)	6.4
Silver maple	2,908	587	539	5,515	4,652	14,202	(N/A)	10.8
Apple	238	24	34	93	82	472	(N/A)	0.4
Blue spruce	458	39	52	817	417	1,783	(N/A)	1.4
Maple	142	16	22	96	155	431	(N/A)	0.3
Spruce	231	22	26	380	331	991	(N/A)	0.8
Scotch pine	292	27	31	481	379	1,211	(N/A)	0.9
Eastern white pine	348	35	38	614	471	1,507	(N/A)	1.1
Birch	12	1	2	4	30	48	(N/A)	0.0
Siberian elm	634	77	120	844	424	2,099	(N/A)	1.6
Swamp white oak	11	1	1	3	27	44	(N/A)	0.0
Eastern cottonwood	558	66	112	1,038	381	2,155	(N/A)	1.6
American elm	179	17	31	259	156	643	(N/A)	0.5
American basswood	216	30	32	252	208	738	(N/A)	0.6
Boxelder	193	25	30	184	218	651	(N/A)	0.5
Elm	323	42	60	548	292	1,265	(N/A)	1.0
Red maple	115	13	18	85	140	372	(N/A)	0.3
River birch	84	8	15	108	55	270	(N/A)	0.2
Honeylocust	226	31	37	205	503	1,003	(N/A)	0.8
Northern red oak	60	3	8	84	5	160	(N/A)	0.1
Littleleaf linden	93	14	14	72	149	342	(N/A)	0.3
Eastern red cedar	34	3	2	54	64	157	(N/A)	0.1
Paper birch	97	14	16	128	109	364	(N/A)	0.3
Ohio buckeye	35	4	5	21	42	106	(N/A)	0.1
Austrian pine	65	5	7	142	20	239	(N/A)	0.2
Amur corktree	94	11	16	76	78	276	(N/A)	0.2
Hickory	102	14	17	110	104	346	(N/A)	0.3
Norway spruce	76	6	-3	250	26	355	(N/A)	0.3
White ash	68	9	11	62	97	248	(N/A)	0.2
Broadleaf Deciduous Sm	11	1	1	4	4	21	(N/A)	0.0
Mulberry	92	4	17	64	0	177	(N/A)	0.1
Oak	45	6	8	40	51	150	(N/A)	0.1
Chinese elm	88	12	17	153	81	351	(N/A)	0.3
Quaking aspen	44	6	7	40	46	143	(N/A)	0.1
Willow	71	3	14	102	0	190	(N/A)	0.1
Kentucky coffeetree	1	0	0	0	5	7	(N/A)	0.0
Amur maple	38	4	7	18	15	82	(N/A)	0.1
Pear	18	2	3	7	6	36	(N/A)	0.0
Catalpa	44	6	7	40	46	143	(N/A)	0.1
Northern white cedar	14	1	1	16	15	48	(N/A)	0.0
Eastern redbud	1	0	0	0	0	1	(N/A)	0.0
Conifer Evergreen Large	24	2	3	42	32	103	(N/A)	0.1
Plum	5	1	1	2	2	11	(N/A)	0.0
Eastern hemlock	1	0	0	1	6	8	(N/A)	0.0
Black cherry	18	2	3	7	6	36	(N/A)	0.0
Black maple	1	0	0	0	0	2	(N/A)	0.0
Ginkgo	15	1	2	8	7	33	(N/A)	0.0
Mountain ash	18	2	3	7	6	36	(N/A)	0.0
Citywide Total	35,506	4,606	6,207	51,555	33,858	131,732	(N/A)	100.0

Species Distribution of Public Trees

11/25/2014

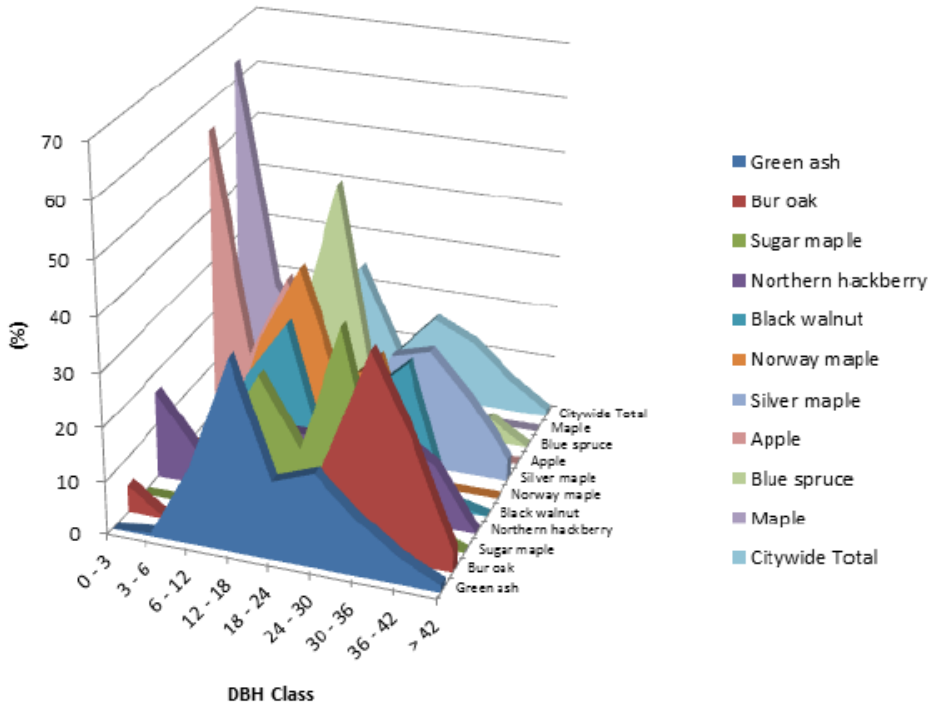


Species	Percent
Green ash	18.5
Bur oak	10.4
Sugar maple	9.3
Northern hackberry	7.9
Black walnut	7.4
Norway maple	7.3
Silver maple	6.3
Apple	4.0
Blue spruce	2.8
Maple	2.5
Other Species	23.6
Total	100.0

Figure 1: Species Distribution

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

11/25/2014



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Green ash	0.00	0.70	14.69	35.66	14.69	17.48	10.49	4.90	1.40
Bur oak	5.00	0.00	3.75	6.25	3.75	17.50	37.50	22.50	3.75
Sugar maple	0.00	0.00	12.50	26.39	13.89	37.50	6.94	2.78	0.00
Northern hackberry	16.39	6.56	6.56	13.11	13.11	16.39	16.39	11.48	0.00
Black walnut	0.00	0.00	19.30	29.82	3.51	19.30	26.32	1.75	0.00
Norway maple	0.00	0.00	23.21	37.50	16.07	23.21	0.00	0.00	0.00
Silver maple	0.00	8.16	14.29	10.20	6.12	20.41	22.45	14.29	4.08
Apple	54.84	12.90	29.03	3.23	0.00	0.00	0.00	0.00	0.00
Blue spruce	9.09	9.09	18.18	45.45	4.55	9.09	0.00	4.55	0.00
Maple	63.16	21.05	10.53	5.26	0.00	0.00	0.00	0.00	0.00
Citywide Total	12.05	4.40	15.41	24.22	8.16	15.93	12.44	6.22	1.17

Figure 2: Relative Age Class

Table 8: Foliage Condition

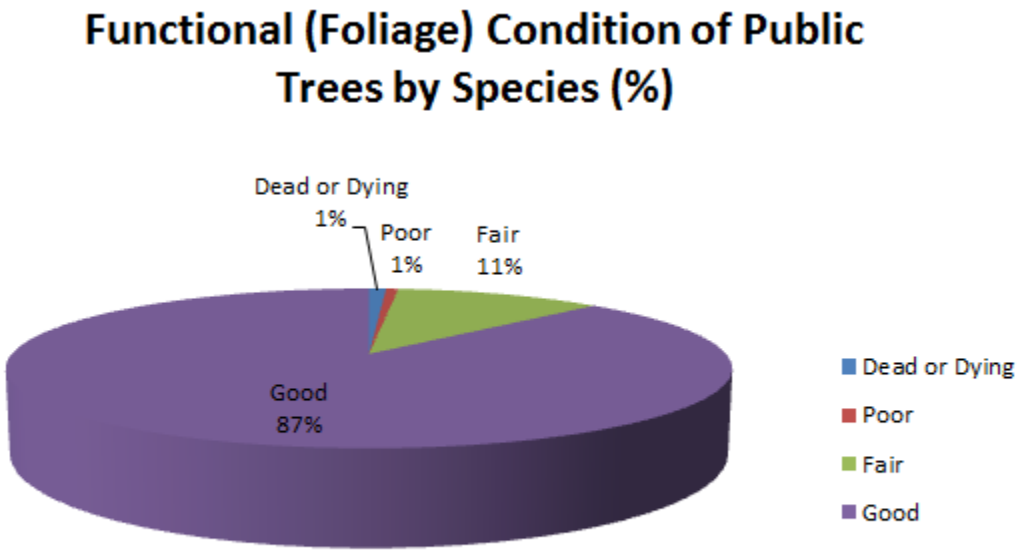
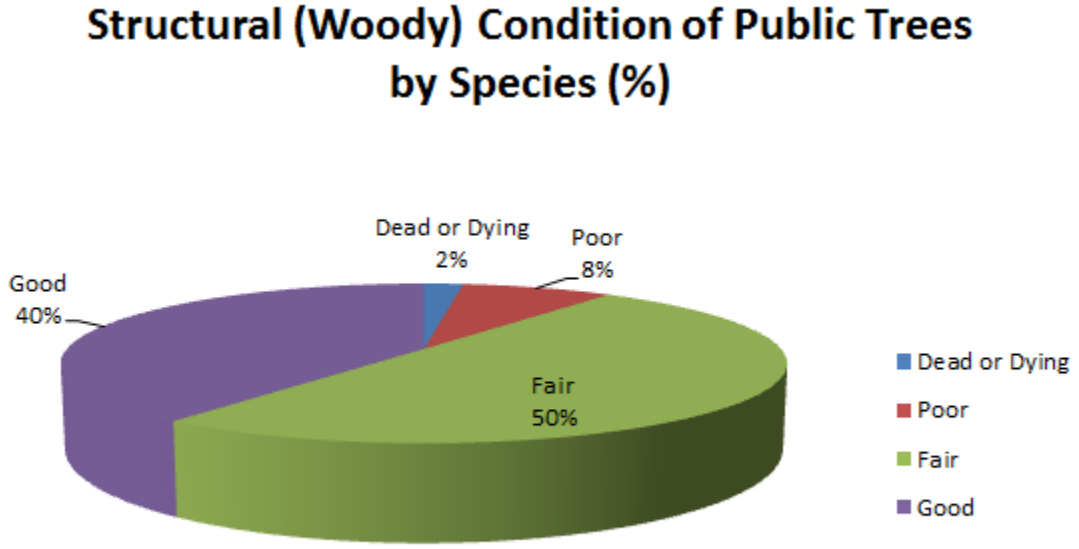
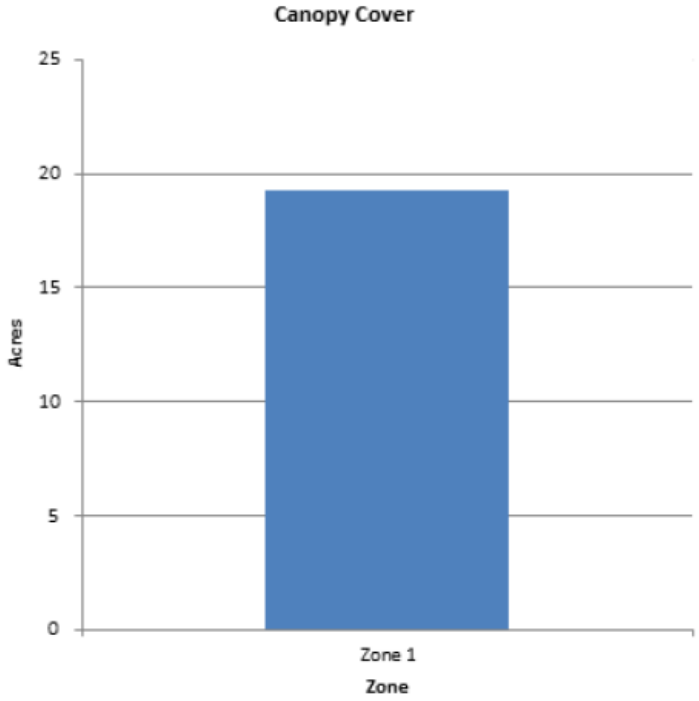


Table 9: Wood Condition



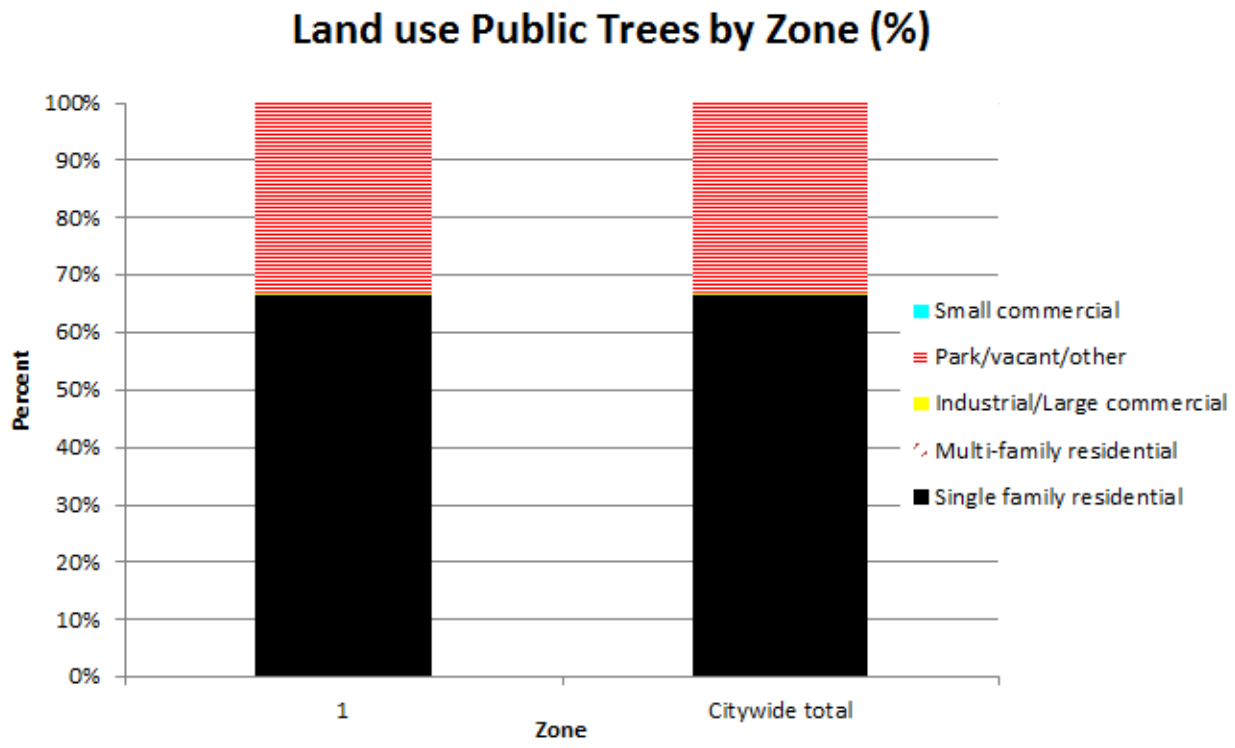
Canopy Cover of Public Trees (Acres)

11/25/2014



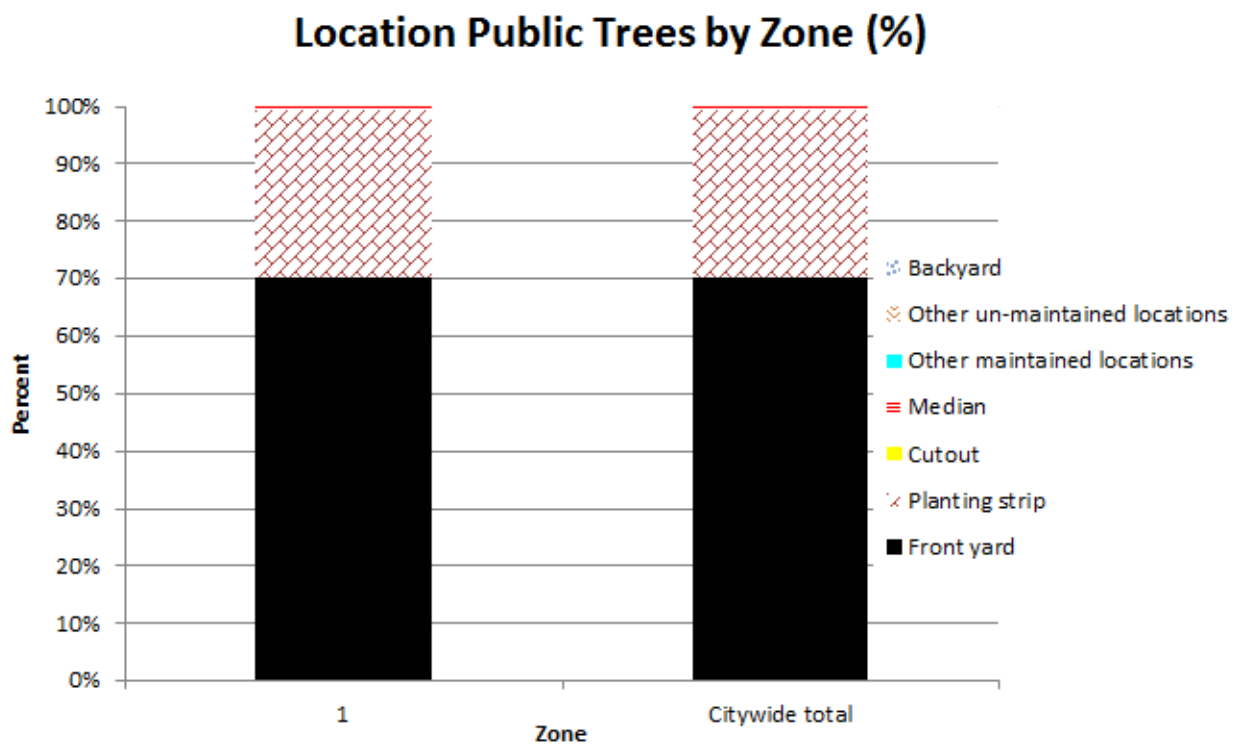
Zone	Acres	% of Total Canopy Cover
Zone 1	19	100.0
Citywide total	19	100.0

Figure 3: Canopy Cover in Acres



Zone	Single family residential	Multi-family residential	Industrial/Large commercial	Park/vacant/other	Small commercial
1	66.58	0.00	0.13	33.29	0.00
Citywide total	66.58	0.00	0.13	33.29	0.00

Figure 4: Land Use of city/park trees



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	70.34	28.89	0.00	0.78	0.00	0.00	0.00
Citywide total	70.34	28.89	0.00	0.78	0.00	0.00	0.00

Figure 5: Location of city/park trees

Appendix B: ArcGIS Mapping

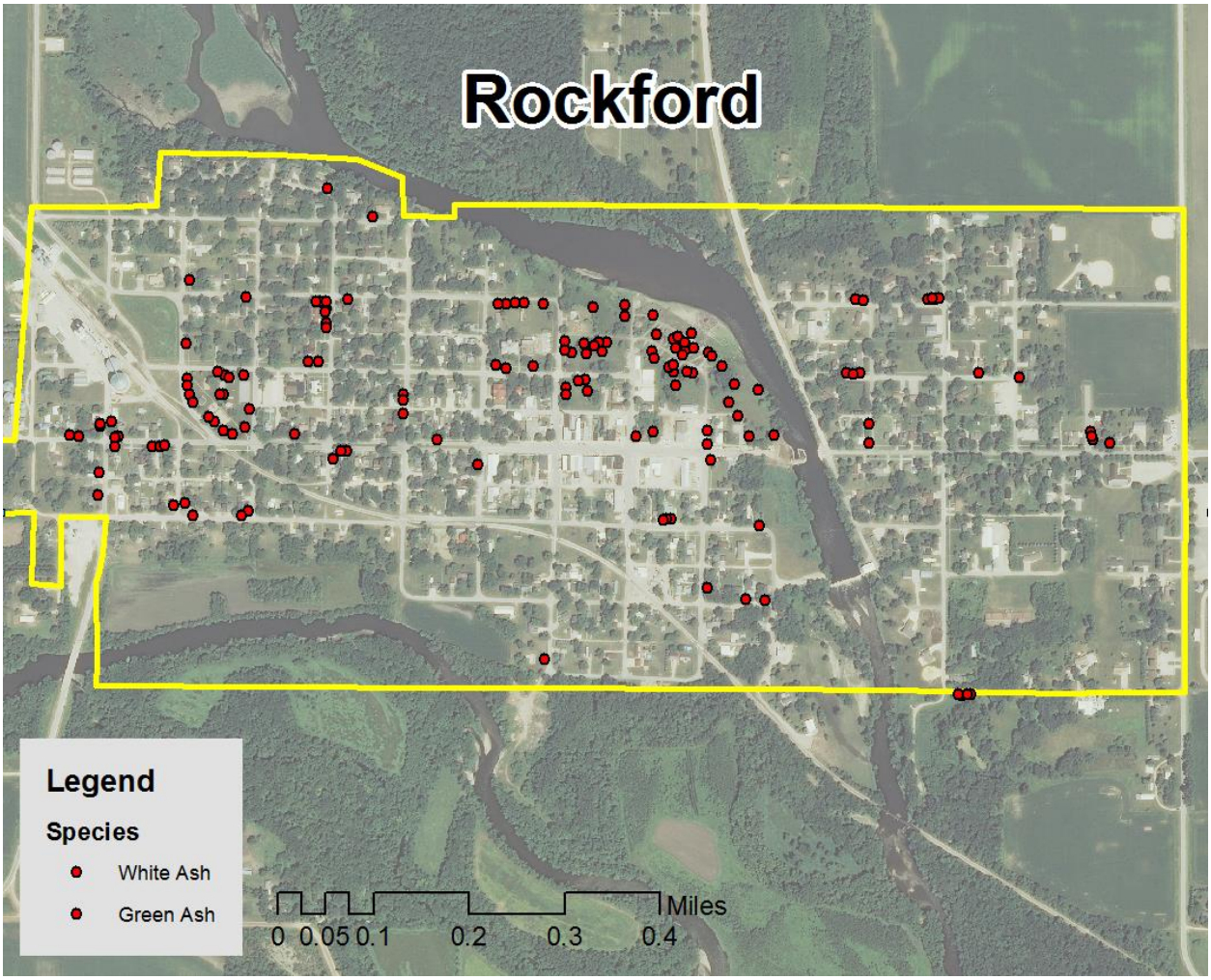


Figure 1: Location of Ash Trees

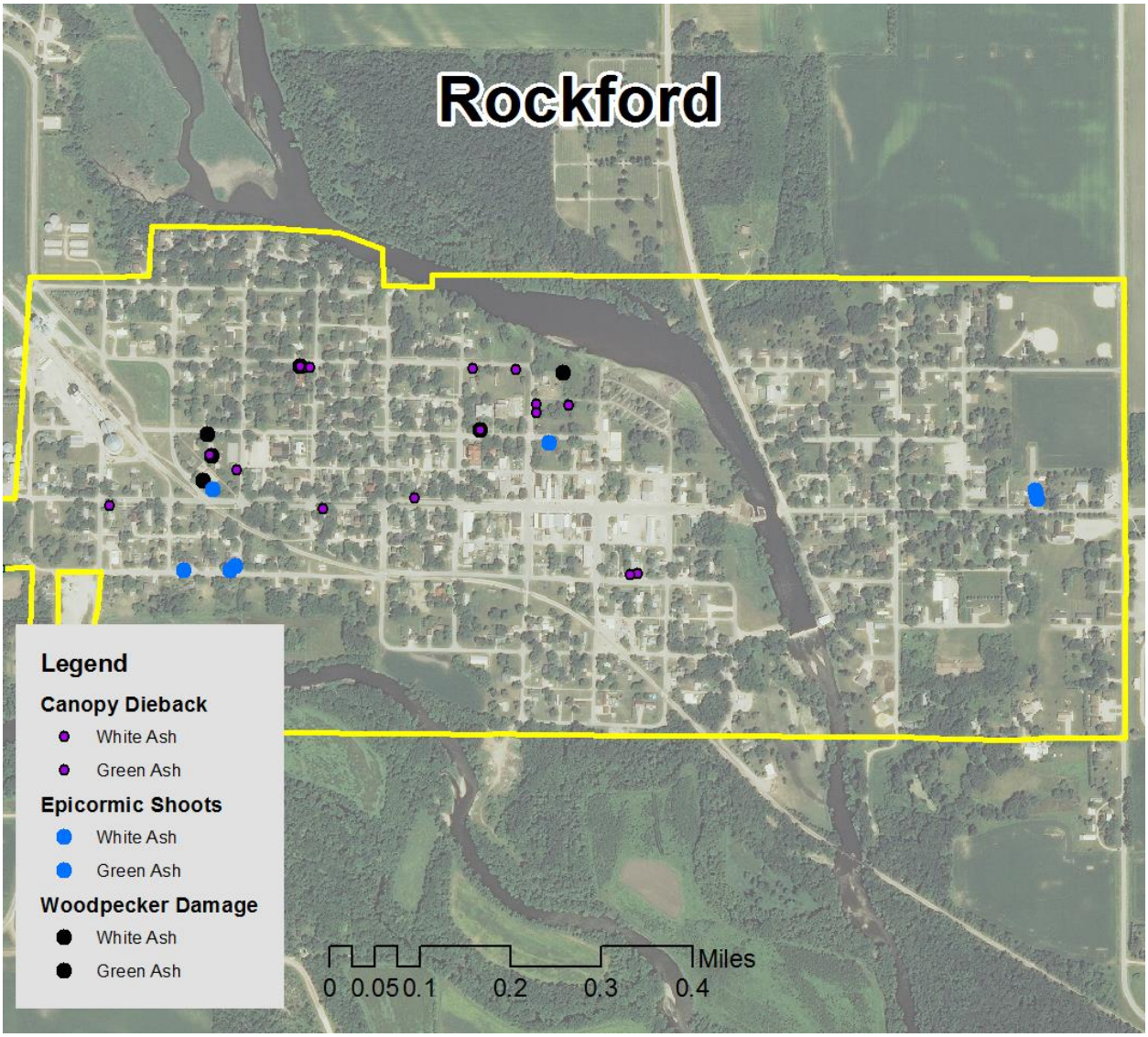


Figure 2: Location of EAB symptoms

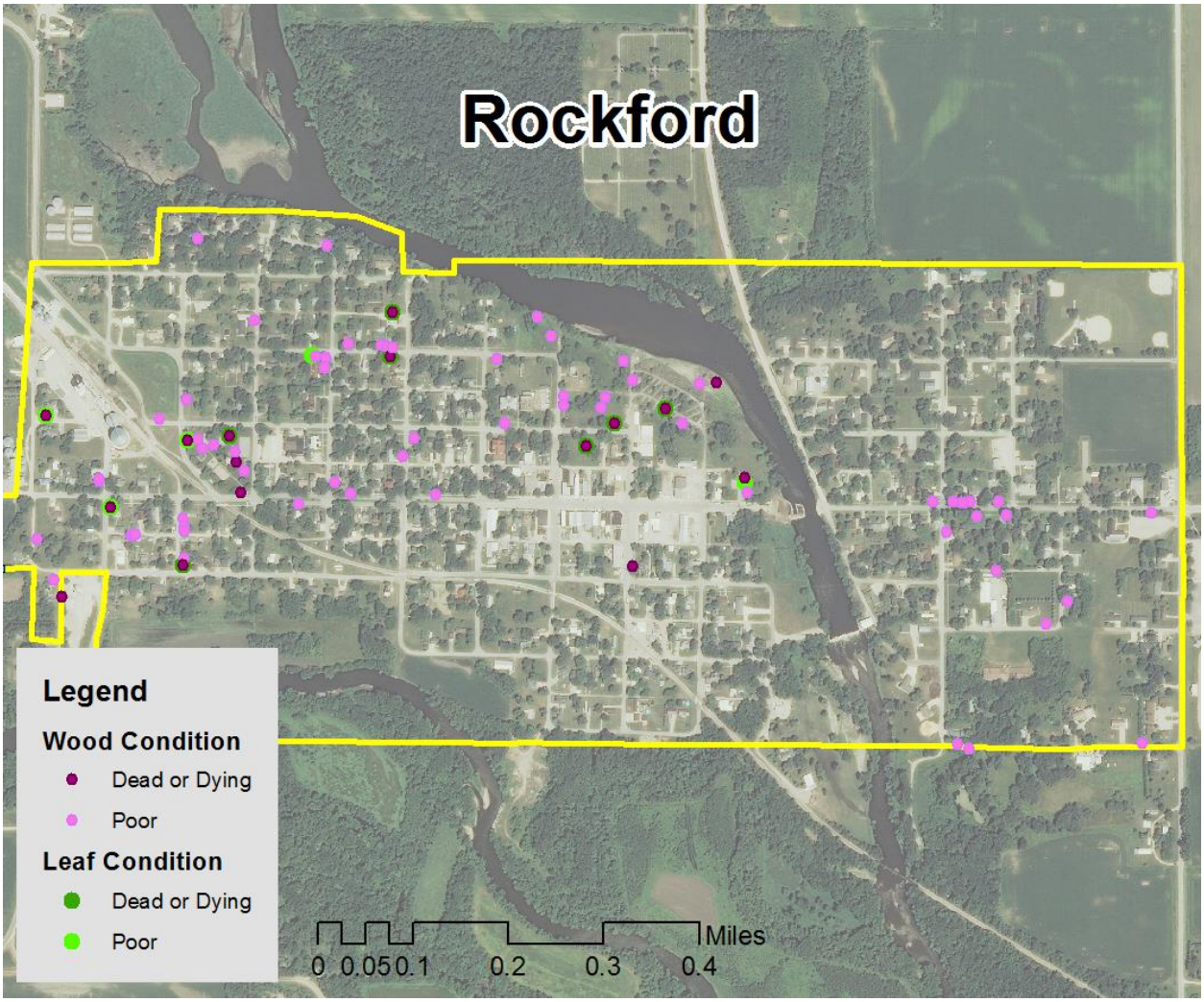


Figure 3: Location of Poor Condition Trees

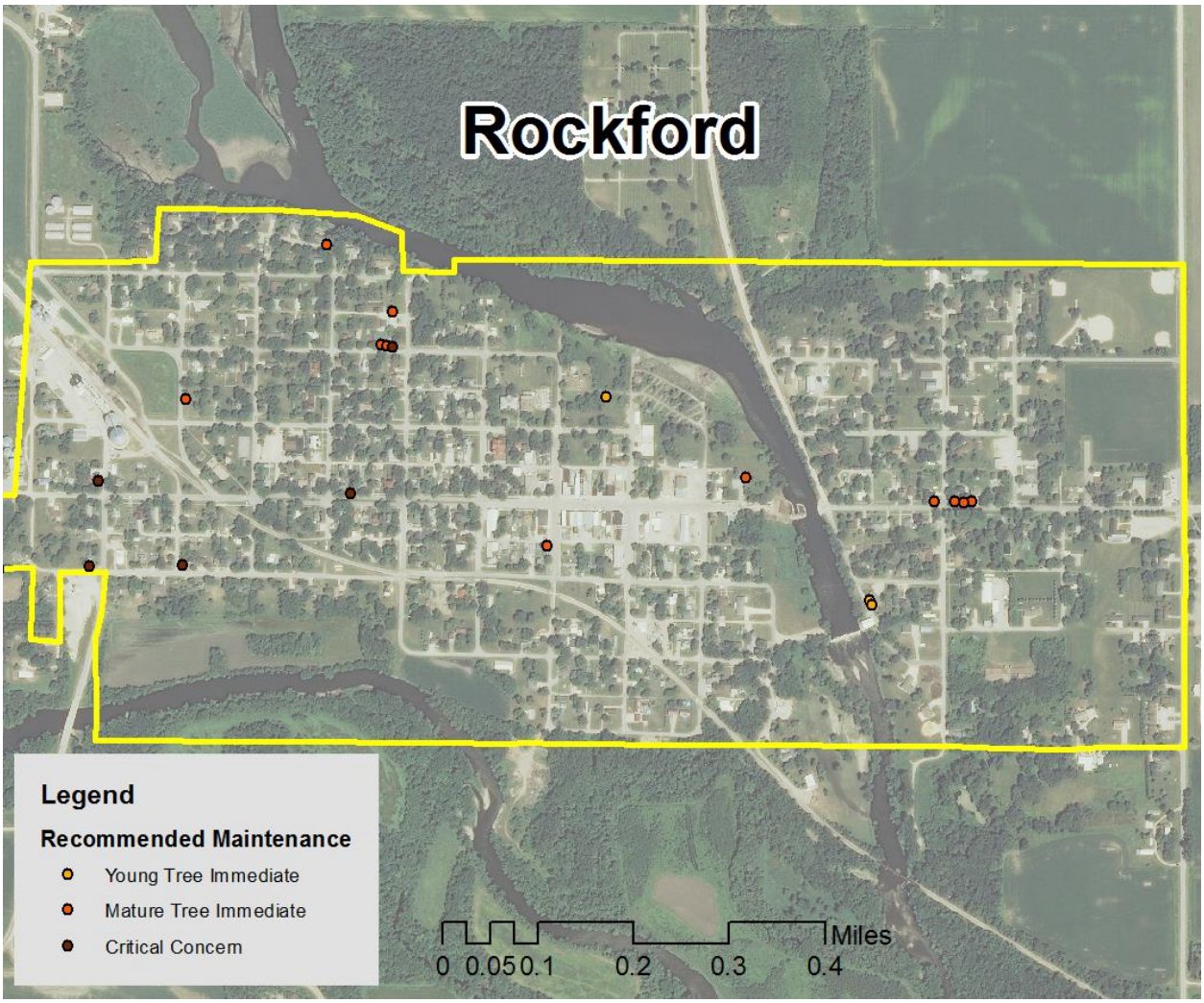


Figure 4: Location of Trees with Recommended Maintenance

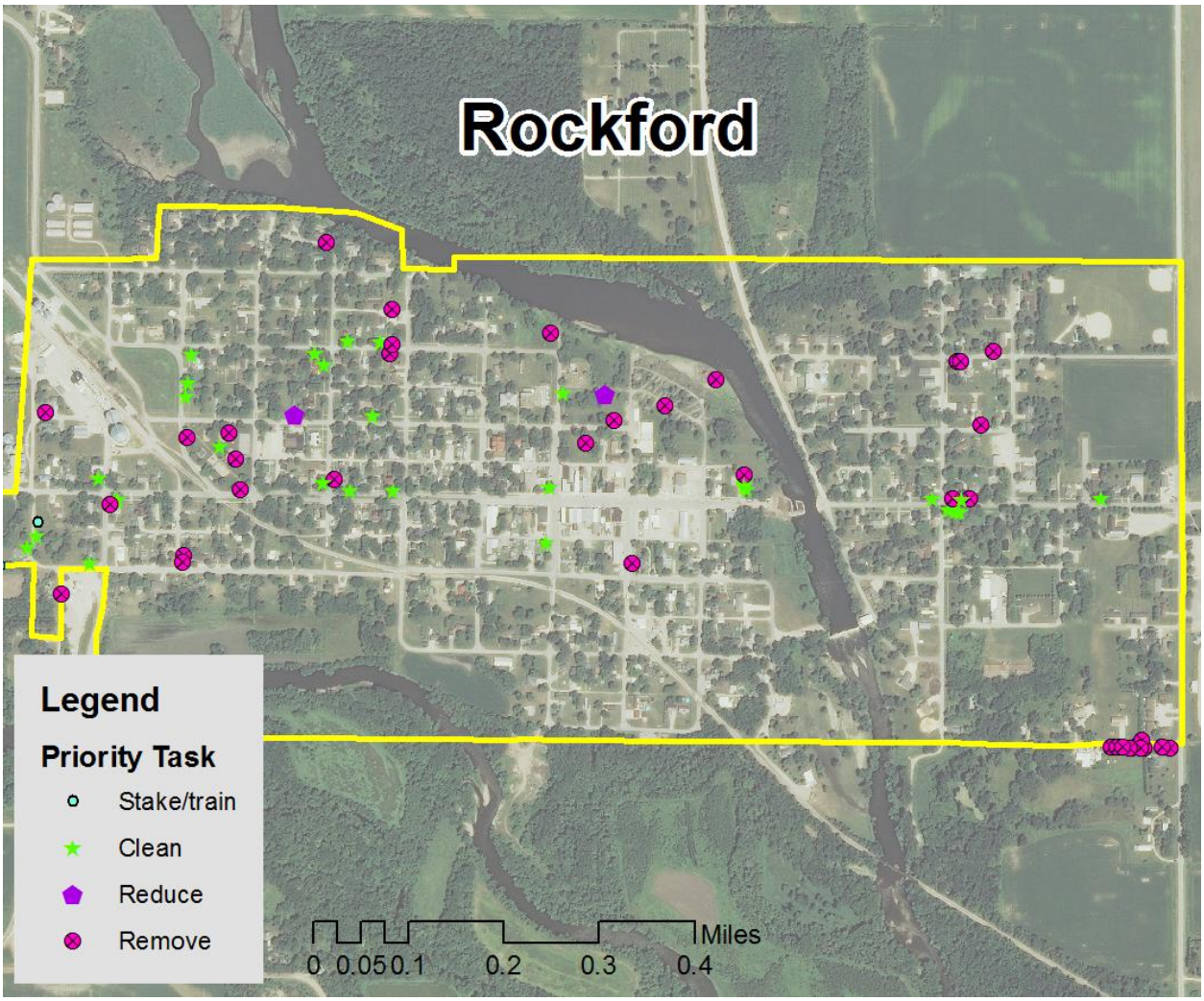


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Rockford Tree Ordinances

CHAPTER 151

TREES

151.01 Definitions
151.02 Permits for Planting Trees in the Parking
151.03 Street Tree Species
151.04 Spacing
151.05 Distance from Curb and Sidewalk
151.06 Distance from Street Corners and Fire Plugs
151.07 Utilities
151.08 Public Tree Care
151.09 Tree Topping
151.10 Pruning; Corner Clearance
151.11 Dead or Diseased Tree Removal on Private Property
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151.01 DEFINITIONS. For use in this chapter, the following definitions are given.

1. "Parking" 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.

2. "Property owner" means a personal and private property owner in the City as shown by the County Auditor's plats of the City.

3. "Public property" means any and all property located within the confines of the City and owned by the City or held in the name of the City by any of the departments, commissions or agencies within the government.

4. "Street tree" or "tree" means a tree in the public place, except where otherwise indicated. Trees located within parkings are street trees.

151.02 PERMITS FOR PLANTING TREES IN THE PARKING. A permit must be secured at the office of the Clerk before planting any tree in any parking within the corporate limits of the City. The fee for said permit shall be in an amount duly established by the Council from time to time.

151.03 STREET TREE SPECIES.

1. The following list constitutes the official tree species for the City. This does not mean it is complete or will remain unchanged; however, it provides a broad selection of trees that show promise as tough, attractive additions to the City landscape. No species other than those may be planted as street trees without written permission of the Council.

SMALL TREES	MEDIUM TREES	LARGE TREES
Flowering Plum	Little Leaf Linden	Ginkgo
Flowering Crab	Redmond Linden	White Oak
Hornbeam	Thornless Honey Locust	Red Oak
Amur Maple	Hophornbeam	Black Oak
Red Bud	Amur Corktree	Swamp White Oak
Serviceberry		Basswood
Japanese Tree Lilac		Sycamore
Pagoda Dogwood Tree		Hackberry
Thornless Cockspur Hawthorn		Green Ash (seedless)
Amur Maackia		Maples (hard)
Tatarian Maple		White Ash
Truncatum Maple		Japanese Pagoda Tree
Where: Small = mature height less than 25 feet (as a rule, must be trained to tree form) Medium = mature height 25 to 40 feet Large = mature height greater than 40 feet		

No species other than those included in this list may be planted without written permission of the Council. All trees planted within City parkings shall be a minimum of 1¼ inches in caliper or larger at the base and a minimum of four (4) feet tall or larger in height. Trees must meet the American Standard for Nursery Stock.

2. The following list contains trees that are not allowed on City parkings:

Boxelder	Lombardy Poplar	Weeping Birch
White Poplar	American Elm	White Birch
Tree of Heaven	Russian Olive	Cottonwood
Black Locust	Pin Oak	Willow
Mulberry	Chinese Elm	Catalpa
Mountain Ash	Boileana Poplar	Crimson King Maple
Siberian Elm	Silver Maple	Paper Birch

For safety consideration, no conifers or evergreens should be planted between the sidewalk and the curb of any City street.

151.04 SPACING. The spacing of street trees shall be in accordance with the tree (3) species size classes listed in Section 151.03 of this chapter, and no trees may be planted closer together than the following: Small Trees, 30 feet; Medium Trees, 40 feet; Large Trees, 50 feet, except in special plantings approved by the Council.

151.05 DISTANCE FROM CURB AND SIDEWALK. The distance trees may be planted from curbs or curb lines and sidewalks will be in accordance

with the three (3) species size classes listed in Section 151.03, and no trees may be planted closer to any curb or sidewalk than the following: Small Trees, two (2) feet; Medium Trees, three (3) feet; and Large Trees, four (4) feet. No trees shall be planted where the width of the parking is less than three (3) feet.

151.06 DISTANCE FROM STREET CORNERS AND FIRE PLUGS. No street tree shall be planted closer than twenty (20) feet from any street corner, measured from the point of nearest intersecting curbs or curb lines. No street tree shall be planted closer than six (6) feet to driveways. No street tree shall be planted closer than ten (10) feet of any fireplug.

151.07 UTILITIES. No street trees other than those species listed as Small Trees in Section 151.03 may be planted under or within twenty (20) lateral feet of any overhead utility wire, or over or within ten (10) lateral feet of any underground water line, sewer, transmission line or other utility.

151.08 PUBLIC TREE CARE. The City and the Rockford Municipal Utilities have the right to plant, prune, maintain and remove trees, plants and shrubs within the lines of all streets, alleys, avenues, lanes, squares and public grounds, as may be necessary to insure public safety or to preserve or enhance the symmetry and beauty of such public grounds. The Council may remove or cause or order to be removed any tree or shrub or part thereof which is in an unsafe condition or which by reason of its nature is injurious to sewers, gas lines, water lines or other public improvements, or is affected with any injurious fungus, insect or other pest or which obstructs view of traffic. This section does not prohibit the planting of street trees by adjacent property owners provided that the selection and location of said trees are in accordance with this chapter.

151.09 TREE TOPPING. It is unlawful as a normal practice for any person or City department to top any street tree, park tree or other tree on public property. Topping is defined as the severe cutting back of limbs to stubs larger than three (3) inches in diameter within the tree's crown to such a degree so as to remove the normal canopy and disfigure the tree. Trees severely damaged by storms or other causes, or certain trees under utility wires or other obstructions where other pruning practices are impractical, may be exempted from this section at the determination of the Council. The tree trimming and tree topping conducted by the employees of the Rockford Municipal Utilities shall be exempt from this section.

151.10 PRUNING; CORNER CLEARANCE. The owner or agent of the property abutting any public property or any street trees or tree shall prune the branches so that such branches do not obstruct the light from any street lamp or

obstruct the view of any street intersection and so that there is a clear space of eight (8) feet above the surface of the sidewalk and at least fifteen (15) feet above the surface of the street. Said owners shall remove all dead, diseased or dangerous trees or broken or decayed limbs which constitute a menace to the safety of the public. The City shall have the right to prune any trees or shrubs on private property when the same interfere with the proper spread of light along the street from a street light or interfere with visibility of any traffic control device or sign. The abutting property owner shall not be required to remove diseased trees or dead wood on the publicly owned property or right-of-way. (Exception: trees on north and south sides of Main Avenue from First Street N.W. to Second Street N.W. and First Street S.W. to Second Street S.W., also including trees on Second Street S.W. from Main Avenue to the alley.)

151.11 DEAD OR DISEASED TREE REMOVAL ON PRIVATE PROPERTY. The City shall have the right to cause the removal of any dead or diseased trees on private property within the City when such trees constitute a hazard to life and property or harbor insects or disease which constitute a potential threat to other trees within the City. The Council shall notify in writing the owners of such trees. Removal shall be done by said owners at their own expense within sixty (60) days after the date of service of notice. In the event of failure of owners to comply with such provisions, the City shall have the authority to remove such trees and charge the cost of removal on the owner's property tax notice. A tree shall be deemed entirely on private property if more than twenty-five percent (25%) of the tree trunk at a point three (3) feet above the ground level is on private property.

151.12 PROCEDURE UPON ORDER TO PRESERVE OR REMOVE. When the City shall find it necessary to order the trimming, preservation or removal of trees or plants upon private property, as authorized in Section 151.11, it shall serve a written order to correct the dangerous condition upon the owner, operator, occupant or other person responsible for its existence.

1. Method of Service. The order shall be served in one of the following ways:

A. By making person delivery of the order to the person responsible.

B. By leaving the order with some person of suitable age and discretion upon the premises.

C. By affixing a copy of the order to the door or the entrance of the premises in violation.

D. By mailing a copy of the order to the last known address of the owner of the premises, by registered mail.

E. By publishing a copy of the order in a local paper once a week for three (3) successive weeks.

2. Time for Compliance. The order required herein shall set forth a time limit for compliance, dependent upon the hazard and danger created by the violation. In cases of extreme danger to persons or public property, the City shall have the authority to require compliance immediately upon service of the order or remove the hazard at City cost without right of appeal.

3. Appeal From Order. A person to whom an order hereunder is directed shall have the right, within twenty-four (24) hours after the service of such order, to appeal to the Council, who shall review the order within thirty (30) days and file its decision thereon. Unless the order is revoked or modified, it shall remain in full force and be obeyed by the person to whom directed. No person to whom an order is directed shall fail to comply with such order within three (3) days after an appeal has been determined.

4. Failure to Comply. When a person to whom an order is directed fails to comply within the specified time, the City shall remedy the condition or contract with others for such purpose and charge the cost thereof to the person to whom the order is directed. The person remedying a condition under a contract made hereunder shall be authorized to enter premises for that purpose.

5. Special Assessment. If the cost of remedying a condition is not paid within thirty (30) days after receipt of a statement therefor from the City, such cost shall be levied against the property owner upon which said hazard exists as a special assessment. The levying of such assessment shall not affect the liability of the person to whom the order is directed to fine or imprisonment as herein provided. Such special assessment shall be certified by the City to the County Treasurer and shall thereupon become and be a lien upon such property, shall be included in the next tax bill rendered to the owner or owners thereof unless paid before, and shall be collected in the same manner as other taxes against such property.

151.13 REMOVAL OF STUMPS. All stumps of street trees and park trees shall be removed below the surface of the ground so that the top of the stump does not project above the surface of the ground.

151.14 ABUSE OR MUTILATION OF TREES. No person shall:

1. Damage, cut, carve, transplant or injure the bark of street or park trees.

2. Remove any healthy street or park tree or plant without approval of the Council.

3. Attach any rope, wire or other contrivance to any street or park tree or plant.

4. Dig in or otherwise disturb, injure or impair the root systems of street or park trees.

5. Cause or permit any wire charged with electricity to come in contact with street or park trees or plants or allow any gaseous, liquid or solid substance which is harmful to such trees or plants to come in contact with them.

151.15 VIOLATIONS. Each day that a violation of this chapter is committed or permitted to continue shall constitute a separate offense, except when under appeal.

151.16 EMERGENCIES. The City shall, by resolution, declare a state of emergency in the event of storm, disaster, tree disease or other cause and order the removal of trees, fallen limbs or debris at City cost and expense.

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If you need accommodations because of disability to access the services of this Agency, please contact the Director at 515-281-5918.