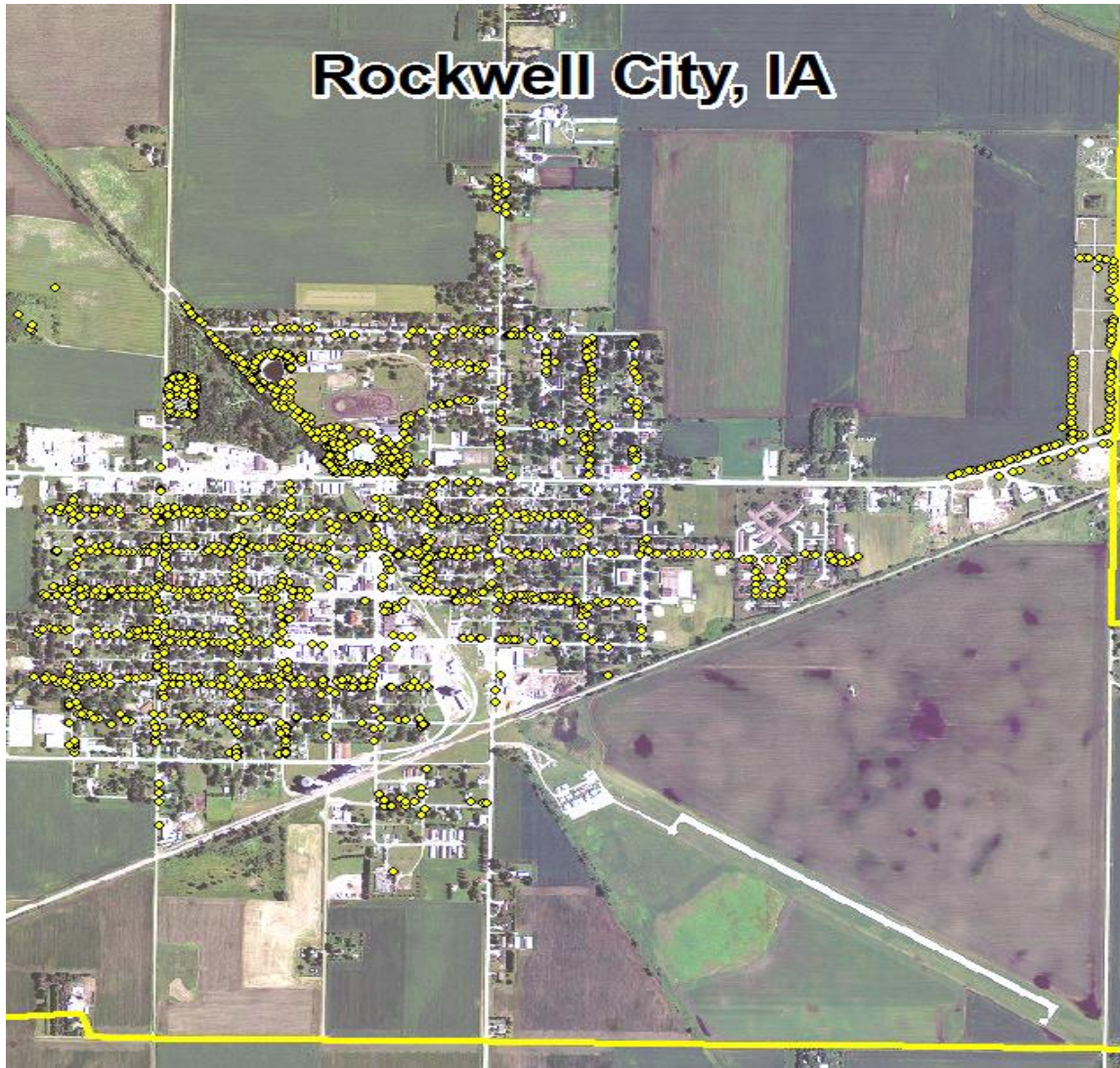


Rockwell City, IA



2016 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the city of Rockwell City 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 18% of Rockwell City's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2015, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 1,623 trees inventoried.

- Rockwell City's trees provide \$292,975 of benefits annually, an average of \$180 a tree
- There are over 40 species of trees
- The top three genera are: Maple 41%, Ash 18%, and Spruce 9%
- 33% of trees are in need of some type of management
- 32 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 32 trees needing removal, 3 trees are both greater than 24 inches in diameter at 4.5 ft. and in need of removal as soon as possible. [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)
- 12 of the 287 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, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With a budget of \$10,000 it could take 20 years to remove ash; the suggested solution is to request a budget increase to \$20,000 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2015, a tree inventory was conducted that included 100% of the city owned park and street trees. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft., recommended maintenance and 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 1,623 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Rockwell City's trees reduce energy related costs by approximately \$76,988 annually (Appendix A, Table 1). These savings are both in Electricity (366.7 MWh) and in Natural Gas (50,161.2 Therms).

Annual Stormwater Benefits

Rockwell City's trees intercept about 4,072,458 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$110,364 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 Rockwell City, it is estimated that trees remove 4,687 lbs. of air pollution (ozone (O₃), particulate matter less than 10 microns (PM₁₀), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$13,142 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Rockwell City, trees sequester about 835,367 lbs. of carbon a year with an associated value of \$6,265 (Appendix A, Table 5). In addition, the trees store 14,943,861 lbs. of carbon, with a yearly benefit of \$112,079 (Appendix A, Table 4).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Rockwell City receives \$86,216 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STRATUM analysis, Rockwell City's trees provide \$292,975 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 1,623 trees in Rockwell provide approximately \$180 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Rockwell City has over 40 tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	666	41.0%
Ash	287	17.7%
Spruce	150	9.2%
Apple	116	7.1%
Honeylocust	59	3.6%
Linden	59	3.6%
Northern Hackberry	41	2.5%
Black Walnut	37	2.3%
Oak	34	2.1%
Eastern Redcedar	27	1.7%
Elm	23	1.4%
Cottonwood	18	1.1%
American Sycamore	17	1.0%
Mulberry	10	0.6%
Birch	8	0.5%
Pine	7	0.4%
Plum	6	0.4%
Redbud	4	0.2%
Ginkgo	3	0.2%
Northern Catalpa	3	0.2%
Willow	3	0.2%
Kentucky Coffeetree	2	0.1%
Hophornbeam	2	0.1%
Japanese Tree Lilac	1	<0.1%
Eastern White Cedar	1	<0.1%
Pear	1	<0.1%
Quaking Aspen	1	<0.1%
Other Broadleaf Deciduous	18	1.1%
Other Evergreen Conifer	14	0.9%
Deciduous Conifer	5	0.3%

Age Class

Most of Rockwell City's trees (62%) are between 6 and 24 inches in diameter at 4.5 ft. (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Rockwell City's size curve is on the small-to-medium side, indicating an average-aged stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Rockwell City indicate that 90% of the trees are in good health, with only 3% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 44% of Rockwell City'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 7% of the population. This 7% 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	382	23.5%
Crown Raising	25	1.5%
Staking and Training	47	2.9%
Tree Removal	32	2.0%
Crown Reduction	54	3.3%

Canopy Cover

The canopy cover of Rockwell City is approximately 41.5 acres (Appendix A, Figure 5). According to the 2010 census, Rockwell City occupies 2,694 acres. Thus the canopy cover on city land is about 1.5%.

Land Use and Location

The majority of Rockwell City's city and park trees are in planting strips (with or without sidewalks) 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	63.6%
Park/vacant/other	33.0%
Industrial/Large commercial	0.4%
Small commercial	1.5%
Multifamily residential	1.5%

Location

Planting strip	48.1%
Other maintained locations	0.3%
Cutout (surrounded by pavement)	1.2%
Front yard	50.4%

Recommendations

Risk Management

Hazardous trees can be a significant threat to both people and property. Trees that are dead or dying, or that have large issues such as trunk cracks longer than 18 inches should be removed. Broken branches and branches that interfere with motorist's vision of pedestrians, vehicles, traffic signs and signals, etc. should be removed.

Hazardous trees

Rockwell City has 5 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 3 trees over 24 inches in diameter at 4.5 ft. (DBH) that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the removal trees are addressed, including those under 24 inches in DBH there should be follow up on the critical concern trees marked as needing maintenance. There are a total of 9 additional 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 287 ash trees, 6 are in need of removal within the next few years; another 16 trees with wood in poor health should be prioritized for removal after that. Once these trees are taken into account there are 6 remaining trees displaying signs and symptoms of EAB that should be monitored closely; attention should also be paid to the development of EAB symptoms on other ash trees. **City ownership of the trees recommended for removal should be verified prior to any removal**

Pruning Cycle

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

Planting

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

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 (41%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut (See Chapter 151, Section 151.05 in Appendix C for a list of acceptable species).

Continual Monitoring

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

PROPOSED WORK SCHEDULE AND ESTIMATED COSTS

Total \$59,770 over 6 years (\$9,962/year average)

YEAR 1

ESTIMATED COSTS

Remove 5 critical concern trees and 6 ash trees in need of non-critical removal	\$7,700
Plant 15 trees in open locations	\$2,250
Inspect ash trees for signs of Emerald Ash Borer	

YEAR 2

Remove 8 non-ash trees designated as needing non-critical removal	\$5,600
Plant 12 trees in open locations and locations from previous removals	\$1,800
Prune 1/3 of city owned trees	\$2,490
Inspect ash trees for signs of Emerald Ash Borer	

YEAR 3

Remove 11 non-ash trees designated as needing removal	\$7,700
Plant 14 trees in open locations and locations from previous removals	\$2,100
Inspect ash trees for signs of Emerald Ash Borer	

YEAR 4

Remove 2 non-ash trees designated as needing removal and 7 ash trees in poor health	\$6,300
*Or saving for ash tree treatment and/or future ash removal	
Plant 11 trees in open locations and locations from previous removals	\$1,650
Prune 1/3 of city owned trees	\$2,490
Inspect ash trees for signs of Emerald Ash Borer	

YEAR 5

Remove 11 trees (any new critical concern trees or ash in poor health)	\$7,700
*Or saving for ash tree treatment and/or future ash removal	
Plant 14 trees in open locations and locations from previous removals	\$2,100
Visual Survey for signs and symptoms of EAB	

YEAR 6

Remove 8 trees (any new critical concern trees or ash in poor health)	\$5,600
*Or saving for ash tree treatment and/or future ash removal	
Plant 12 trees in open locations and locations from previous removals	\$1,800
Prune 1/3 of city owned trees	\$2,490
Inspect ash trees for signs of Emerald Ash Borer	

Estimated costs based on average costs of \$700/tree for removal, \$150/tree for planting and maintenance, and \$15/tree for pruning.

*Reduction of ash over 6 years: Approximately 22 ash trees should be removed (approximately 8% of ash), including trees with poor wood structure and those displaying multiple symptoms of EAB. If a budget of \$10,000/year were devoted solely to the removal of ash trees and excluded such activities as removal, replanting and maintenance of other species, it would take just over 20 years to remove all of the ash trees in Rockwell City. EAB could potentially kill all ash within 4 to 15 years of its arrival. Treatment of ash would alter the cost and timeline and treatment price varies greatly by tree size and state location.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, and hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). **City ownership of the tree recommended for removal should be verified prior to any removal**

Treatment of Ash Trees

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

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:

- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

In addition, any other article, product or means of conveyance not listed above may be designated as a regulated article if a USDA inspector determines that it presents a risk of spreading EAB once a quarantine is in effect for your county.

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml.

Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions set forth in chapter 151 of the city ordinance (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on 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 151.13 states “The City has 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 diseases which constitute a potential threat to other trees within the City. The Tree Board will notify in writing the owners of such trees. Removal shall be done by said owners at their own expense within thirty (30) 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”

Proposed Budget Increase

EAB could potentially kill all ash trees in Rockwell City within 4 years of its arrival. The total cost of maintaining, removing, and replanting the city’s current population of city trees, which would include removing and replanting all of the city’s ash trees, is estimated at around \$291,000. If the current budget were increased to \$20,000 per year, this work could be accomplished in approximately 15 years. Additionally, it is recommended that Rockwell City 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 to treat a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to reduce the costs

and number of trees that need to be 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 instance, the average diameter for the ash tree population of Rockwell City is 21 inches; at \$15 per inch, it would cost an average of approximately \$315 per tree every two years, for as many years as the tree is preserved. While treatment is cheaper than removal in the short-run, it is more expensive in the long run, as it would only take 6 years of treatment per tree to exceed the cost of removal and replacement (\$945 for treatment over a six-year period, compared with \$850 for one-time removal and replacement, on average). Furthermore, treatment does not cure the tree of the devastation associated with emerald ash borer, but rather delays its onset for as long as treatment is carried out. Whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Rockwell city; therefore, it is suggested that the budget be increased to plan for this regardless of how the problem is addressed.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Rockwell City

Annual Energy Benefits of Public Trees

12/9/2015

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	99.2	7,531	13,079.6	12,818	20,349	(N/A)	18.9	26.4	66.50
Norway maple	55.5	4,213	7,861.1	7,704	11,917	(N/A)	15.9	15.5	46.19
Green ash	60.5	4,590	8,265.4	8,100	12,690	(N/A)	14.7	16.5	53.32
Spruce	13.8	1,045	1,868.1	1,831	2,875	(N/A)	9.2	3.7	19.17
Apple	13.5	1,025	2,012.5	1,972	2,997	(N/A)	7.1	3.9	25.84
Honeylocust	19.1	1,446	2,459.1	2,410	3,856	(N/A)	3.6	5.0	65.36
Sugar maple	14.0	1,059	1,888.9	1,851	2,911	(N/A)	3.3	3.8	53.90
Ash	10.7	811	1,512.0	1,482	2,293	(N/A)	2.6	3.0	53.32
Northern hackberry	13.2	1,005	1,849.9	1,813	2,818	(N/A)	2.5	3.7	68.72
Black walnut	8.7	657	1,182.2	1,159	1,815	(N/A)	2.3	2.4	49.06
American basswood	8.2	621	1,172.8	1,149	1,771	(N/A)	2.0	2.3	55.33
Eastern red cedar	2.5	188	370.4	363	551	(N/A)	1.7	0.7	20.40
Littleleaf linden	4.4	332	623.0	611	942	(N/A)	1.7	1.2	34.90
Cottonwood	7.9	602	1,059.0	1,038	1,640	(N/A)	1.1	2.1	91.11
American sycamore	3.5	264	484.0	474	738	(N/A)	1.0	1.0	43.42
Conifer Evergreen Large	2.1	156	274.3	269	425	(N/A)	0.9	0.6	30.34
Maple	1.7	132	226.7	222	354	(N/A)	0.9	0.5	25.30
Siberian elm	1.6	122	216.0	212	333	(N/A)	0.9	0.4	23.81
Red maple	1.4	108	193.7	190	298	(N/A)	0.7	0.4	27.11
Black maple	2.5	192	326.4	320	512	(N/A)	0.6	0.7	51.21
Swamp white oak	0.4	34	72.3	71	105	(N/A)	0.6	0.1	10.48
Mulberry	1.5	112	234.1	229	342	(N/A)	0.6	0.4	34.16
Northern red oak	1.7	130	238.7	234	364	(N/A)	0.6	0.5	36.36
Elm	3.2	245	424.5	416	661	(N/A)	0.6	0.9	73.49
Broadleaf Deciduous Small	0.9	69	131.9	129	198	(N/A)	0.4	0.3	28.26
Broadleaf Deciduous Large	1.3	100	176.5	173	273	(N/A)	0.4	0.4	39.01
Amur maple	1.3	95	195.6	192	287	(N/A)	0.4	0.4	41.00
Boxelder	1.2	89	163.8	161	249	(N/A)	0.4	0.3	41.52
White ash	1.5	116	210.2	206	322	(N/A)	0.4	0.4	53.71
Bur oak	0.7	53	92.2	90	143	(N/A)	0.4	0.2	23.82
Plum	0.7	50	100.7	99	149	(N/A)	0.4	0.2	24.84
Oak	0.4	34	62.9	62	95	(N/A)	0.3	0.1	19.08
Broadleaf Evergreen Large	1.1	86	141.4	139	225	(N/A)	0.3	0.3	45.01
Paper birch	0.5	34	58.1	57	91	(N/A)	0.2	0.1	22.83
Broadleaf Deciduous Medium	0.4	32	67.4	66	98	(N/A)	0.2	0.1	24.47
Eastern white pine	0.2	15	32.5	32	46	(N/A)	0.2	0.1	11.59
River birch	0.9	65	128.5	126	191	(N/A)	0.2	0.2	47.66
Eastern redbud	0.5	38	79.9	78	116	(N/A)	0.2	0.2	28.97
Ginkgo	0.5	36	64.4	63	99	(N/A)	0.2	0.1	33.04
Willow	0.8	62	116.5	114	176	(N/A)	0.2	0.2	58.77
Pin oak	0.5	38	67.6	66	104	(N/A)	0.1	0.1	51.95
Catalpa	0.5	40	76.2	75	115	(N/A)	0.1	0.1	57.32
Eastern hophornbeam	0.3	20	37.5	37	56	(N/A)	0.1	0.1	28.16
Red pine	0.1	9	19.0	19	27	(N/A)	0.1	0.0	13.58
Kentucky coffeetree	0.6	45	85.0	83	128	(N/A)	0.1	0.2	64.12
Northern pin oak	0.3	24	47.4	46	71	(N/A)	0.1	0.1	70.84
Northern white cedar	0.2	14	24.6	24	38	(N/A)	0.1	0.0	38.17
Pear	0.2	14	24.7	24	38	(N/A)	0.1	0.0	38.13
Northern catalpa	0.0	2	3.7	4	6	(N/A)	0.1	0.0	5.82
Scotch pine	0.0	2	4.0	4	6	(N/A)	0.1	0.0	5.61
Japanese tree lilac	0.0	0	0.6	1	1	(N/A)	0.1	0.0	0.87
Quaking aspen	0.4	29	53.7	53	82	(N/A)	0.1	0.1	82.02
Total	366.7	27,830	50,161.2	49,158	76,988	(N/A)	100.0	100.0	47.44

Table 2: Annual Stormwater Benefits

Rockwell City

Annual Stormwater Benefits of Public Trees						
12/9/2015						
Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	1,409,068	38,186	(N/A)	18.9	34.6	124.79
Norway maple	445,359	12,069	(N/A)	15.9	10.9	46.78
Green ash	667,101	18,078	(N/A)	14.7	16.4	75.96
Spruce	205,195	5,561	(N/A)	9.2	5.0	37.07
Apple	56,700	1,537	(N/A)	7.1	1.4	13.25
Honeylocust	201,295	5,455	(N/A)	3.6	4.9	92.46
Sugar maple	146,841	3,979	(N/A)	3.3	3.6	73.69
Ash	96,799	2,623	(N/A)	2.6	2.4	61.01
Northern hackberry	114,081	3,092	(N/A)	2.5	2.8	75.40
Black walnut	82,032	2,223	(N/A)	2.3	2.0	60.08
American basswood	85,985	2,330	(N/A)	2.0	2.1	72.82
Eastern red cedar	35,854	972	(N/A)	1.7	0.9	35.99
Littleleaf linden	42,361	1,148	(N/A)	1.7	1.0	42.52
Cottonwood	122,156	3,310	(N/A)	1.1	3.0	183.91
American sycamore	45,323	1,228	(N/A)	1.0	1.1	72.25
Conifer Evergreen Large	44,821	1,215	(N/A)	0.9	1.1	86.76
Maple	10,340	280	(N/A)	0.9	0.3	20.01
Siberian elm	13,616	369	(N/A)	0.9	0.3	26.36
Red maple	9,487	257	(N/A)	0.7	0.2	23.37
Black maple	20,113	545	(N/A)	0.6	0.5	54.51
Swamp white oak	2,295	62	(N/A)	0.6	0.1	6.22
Mulberry	7,595	206	(N/A)	0.6	0.2	20.58
Northern red oak	16,746	454	(N/A)	0.6	0.4	45.38
Elm	45,224	1,226	(N/A)	0.6	1.1	136.17
Broadleaf Deciduous Small	3,710	101	(N/A)	0.4	0.1	14.36
Broadleaf Deciduous Large	15,292	414	(N/A)	0.4	0.4	59.20
Amur maple	6,801	184	(N/A)	0.4	0.2	26.33
Boxelder	14,201	385	(N/A)	0.4	0.3	64.14
White ash	16,202	439	(N/A)	0.4	0.4	73.18
Bur oak	6,224	169	(N/A)	0.4	0.2	28.11
Plum	2,391	65	(N/A)	0.4	0.1	10.80
Oak	3,713	101	(N/A)	0.3	0.1	20.13
Broadleaf Evergreen Large	13,309	361	(N/A)	0.3	0.3	72.14
Paper birch	2,853	77	(N/A)	0.2	0.1	19.33
Broadleaf Deciduous Medium	2,344	64	(N/A)	0.2	0.1	15.88
Eastern white pine	1,999	54	(N/A)	0.2	0.0	13.55
River birch	8,701	236	(N/A)	0.2	0.2	58.95
Eastern redbud	2,681	73	(N/A)	0.2	0.1	18.17
Ginkgo	3,722	101	(N/A)	0.2	0.1	33.62
Willow	7,653	207	(N/A)	0.2	0.2	69.13
Pin oak	5,522	150	(N/A)	0.1	0.1	74.82
Catalpa	5,181	140	(N/A)	0.1	0.1	70.21
Eastern hophornbeam	931	25	(N/A)	0.1	0.0	12.62
Red pine	1,191	32	(N/A)	0.1	0.0	16.14
Kentucky coffeetree	6,534	177	(N/A)	0.1	0.2	88.53
Northern pin oak	3,764	102	(N/A)	0.1	0.1	102.01
Northern white cedar	4,605	125	(N/A)	0.1	0.1	124.79
Pear	667	18	(N/A)	0.1	0.0	18.06
Northern catalpa	172	5	(N/A)	0.1	0.0	4.65
Scotch pine	213	6	(N/A)	0.1	0.0	5.77
Japanese tree lilac	7	0	(N/A)	0.1	0.0	0.20
Quaking aspen	5,491	149	(N/A)	0.1	0.1	148.79
Citywide total	4,072,458	110,364	(N/A)	100.0	100.0	68.00

Table 3: Annual Air Quality Benefits

Rockwell City

Annual Air Quality Benefits of Public Trees

12/9/2015

Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total Standard (\$ Error)	% of Total Trees	Avg. \$/tree
	O ₃	NO ₂	PM ₁₀	SO ₂		NO ₂	PM ₁₀	VOC	SO ₂							
Silver maple	245.1	41.5	120.4	10.9	1,322	468.0	68.5	65.4	448.9	2,928	-130.3	-488	1,338.5	3,761 (N/A)	18.9	12.29
Norway maple	82.3	14.2	41.6	3.6	448	267.9	38.8	37.0	251.9	1,663	-20.1	-75	717.3	2,035 (N/A)	15.9	7.89
Green ash	85.3	13.6	40.7	3.8	454	288.6	42.0	40.1	274.1	1,798	0.0	0	788.2	2,252 (N/A)	14.7	9.46
Spruce	22.2	4.4	19.2	2.7	149	65.4	9.5	9.1	62.3	408	-83.5	-313	111.4	244 (N/A)	9.2	1.63
Apple	17.3	2.9	8.2	0.8	92	65.9	9.5	9.0	61.2	407	-0.1	0	174.7	499 (N/A)	7.1	4.30
Honeylocust	39.0	6.4	17.8	1.8	206	89.5	13.1	12.5	86.3	561	-30.2	-113	236.3	654 (N/A)	3.6	11.08
Sugar maple	18.8	3.2	9.5	0.8	102	66.4	9.7	9.2	63.2	414	-14.9	-56	166.0	460 (N/A)	3.3	8.53
Ash	19.6	3.4	9.7	0.9	106	51.6	7.5	7.1	48.5	320	-4.6	-17	143.5	409 (N/A)	2.6	9.50
Northern hackberry	16.5	2.9	8.6	0.7	91	63.6	9.2	8.8	60.0	396	0.0	0	170.5	486 (N/A)	2.5	11.86
Black walnut	8.7	1.4	4.4	0.4	47	41.3	6.0	5.7	39.2	257	0.0	0	107.1	304 (N/A)	2.3	8.22
American basswood	11.3	1.9	5.6	0.5	61	39.6	5.7	5.5	37.1	246	-9.8	-37	97.6	270 (N/A)	2.0	8.45
Eastern red cedar	7.0	1.4	5.6	0.9	45	12.1	1.7	1.7	11.2	74	-19.7	-74	21.7	46 (N/A)	1.7	1.71
Littleleaf linden	7.0	1.2	3.5	0.3	38	21.1	3.1	2.9	19.8	131	-3.4	-13	55.5	156 (N/A)	1.7	5.78
Cottonwood	22.2	3.6	9.8	1.0	116	37.6	5.5	5.2	35.9	235	0.0	0	120.9	351 (N/A)	1.1	19.49
American sycamore	6.2	1.0	2.9	0.3	33	16.7	2.4	2.3	15.7	104	0.0	0	47.4	136 (N/A)	1.0	8.01
Conifer Evergreen Large	5.4	1.1	4.3	0.7	35	9.7	1.4	1.4	9.3	61	-24.8	-93	8.3	3 (N/A)	0.9	0.19
Maple	1.8	0.3	0.9	0.1	10	8.2	1.2	1.1	7.9	51	-0.7	-3	20.8	58 (N/A)	0.9	4.17
Siberian elm	1.6	0.3	0.9	0.1	9	7.6	1.1	1.1	7.3	47	0.0	0	19.8	56 (N/A)	0.9	4.01
Red maple	1.8	0.3	0.9	0.1	10	6.8	1.0	0.9	6.5	42	-0.7	-2	17.6	50 (N/A)	0.7	4.51
Black maple	4.7	0.8	2.2	0.2	25	11.9	1.7	1.7	11.5	75	-1.6	-6	33.1	94 (N/A)	0.6	9.36
Swamp white oak	0.2	0.0	0.1	0.0	1	2.2	0.3	0.3	2.0	14	-0.1	0	5.2	15 (N/A)	0.6	1.46
Mulberry	2.6	0.4	1.2	0.1	14	7.3	1.0	1.0	6.7	45	0.0	0	20.3	58 (N/A)	0.6	5.85
Northern red oak	3.5	0.6	1.7	0.2	19	8.2	1.2	1.1	7.7	51	-5.0	-19	19.2	51 (N/A)	0.6	5.10
Elm	7.7	1.2	3.4	0.3	40	15.3	2.2	2.1	14.7	96	0.0	0	47.0	136 (N/A)	0.6	15.08
Broadleaf Deciduous Small	1.1	0.2	0.5	0.1	6	4.4	0.6	0.6	4.1	27	0.0	0	11.6	33 (N/A)	0.4	4.74
Broadleaf Deciduous Large	2.5	0.4	1.1	0.1	13	6.3	0.9	0.9	6.0	39	0.0	0	18.1	52 (N/A)	0.4	7.43
Amur maple	2.4	0.4	1.1	0.1	13	6.2	0.9	0.8	5.7	38	0.0	0	17.6	51 (N/A)	0.4	7.26
Boxelder	2.0	0.3	0.9	0.1	10	5.6	0.8	0.8	5.3	35	-0.7	-3	15.1	43 (N/A)	0.4	7.12
White ash	2.1	0.3	1.0	0.1	11	7.3	1.1	1.0	6.9	46	0.0	0	19.8	57 (N/A)	0.4	9.43
Bur oak	0.6	0.1	0.3	0.0	3	3.3	0.5	0.5	3.1	21	0.0	0	8.4	24 (N/A)	0.4	3.99
Plum	0.6	0.1	0.3	0.0	3	3.3	0.5	0.4	3.0	20	0.0	0	8.2	23 (N/A)	0.4	3.88
Oak	0.3	0.0	0.2	0.0	2	2.1	0.3	0.3	2.0	13	0.0	0	5.3	15 (N/A)	0.3	2.99
Broadleaf Evergreen Large	1.3	0.3	1.2	0.2	9	5.3	0.8	0.7	5.1	33	-5.7	-21	9.2	21 (N/A)	0.3	4.21
Paper birch	0.2	0.0	0.1	0.0	1	2.1	0.3	0.3	2.1	13	0.0	0	5.1	14 (N/A)	0.2	3.57
Broadleaf Deciduous Medium	0.2	0.0	0.2	0.0	1	2.1	0.3	0.3	1.9	13	-0.1	0	4.9	14 (N/A)	0.2	3.47
Eastern white pine	0.2	0.0	0.2	0.0	1	1.0	0.1	0.1	0.9	6	-0.6	-2	1.9	5 (N/A)	0.2	1.25
River birch	1.8	0.3	0.9	0.1	10	4.2	0.6	0.6	3.9	26	-0.4	-2	11.9	34 (N/A)	0.2	8.52
Eastern redbud	0.9	0.2	0.4	0.0	5	2.5	0.4	0.3	2.2	15	0.0	0	6.9	20 (N/A)	0.2	4.99
Ginkgo	1.1	0.2	0.5	0.0	6	2.3	0.3	0.3	2.1	14	-0.3	-1	6.6	19 (N/A)	0.2	6.22
Willow	1.6	0.3	0.8	0.1	8	4.0	0.6	0.5	3.7	25	-0.4	-1	11.1	32 (N/A)	0.2	10.55
Pin oak	1.0	0.2	0.5	0.0	5	2.4	0.3	0.3	2.2	15	-1.8	-7	5.2	13 (N/A)	0.1	6.63
Catalpa	0.5	0.1	0.3	0.0	3	2.5	0.4	0.4	2.4	16	0.0	0	6.6	19 (N/A)	0.1	9.34
Eastern hophornbeam	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.2	9 (N/A)	0.1	4.55
Red pine	0.1	0.0	0.1	0.0	1	0.6	0.1	0.1	0.5	3	-0.3	-1	1.1	3 (N/A)	0.1	1.48
Kentucky coffeetree	0.8	0.1	0.4	0.0	4	2.9	0.4	0.4	2.7	18	0.0	0	7.6	22 (N/A)	0.1	10.91
Northern pin oak	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
Northern white cedar	0.6	0.1	0.4	0.1	4	0.9	0.1	0.1	0.8	5	-2.9	-11	0.3	-2 (N/A)	0.1	-1.58
Pear	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7 (N/A)	0.1	6.56
Northern catalpa	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	0.87
Scotch pine	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	-0.1	0	0.2	1 (N/A)	0.1	0.56
Japanese tree lilac	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
Quaking aspen	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16 (N/A)	0.1	15.71
Citywide total	661.5	112.0	335.5	32.4	3,603	1,749.3	254.8	242.9	1,661.2	10,899	-362.7	-1,360	4,686.8	13,142 (N/A)	100.0	8.10

Table 4: Annual Carbon Stored

Rockwell City

Stored CO2 Benefits of Public Trees

12/9/2015

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	5,738,657	43,040	(N/A)	18.9	38.4	140.65
Norway maple	1,360,834	10,206	(N/A)	15.9	9.1	39.56
Green ash	2,827,442	21,206	(N/A)	14.7	18.9	89.10
Spruce	187,880	1,409	(N/A)	9.2	1.3	9.39
Apple	271,034	2,033	(N/A)	7.1	1.8	17.52
Honeylocust	500,800	3,756	(N/A)	3.6	3.4	63.66
Sugar maple	537,756	4,033	(N/A)	3.3	3.6	74.69
Ash	322,994	2,422	(N/A)	2.6	2.2	56.34
Northern hackberry	240,438	1,803	(N/A)	2.5	1.6	43.98
Black walnut	280,259	2,102	(N/A)	2.3	1.9	56.81
American basswood	416,576	3,124	(N/A)	2.0	2.8	97.64
Eastern red cedar	22,922	172	(N/A)	1.7	0.2	6.37
Littleleaf linden	150,384	1,128	(N/A)	1.7	1.0	41.77
Cottonwood	766,286	5,747	(N/A)	1.1	5.1	319.29
American sycamore	203,938	1,530	(N/A)	1.0	1.4	89.97
Conifer Evergreen La	63,121	473	(N/A)	0.9	0.4	33.81
Maple	21,370	160	(N/A)	0.9	0.1	11.45
Siberian elm	40,616	305	(N/A)	0.9	0.3	21.76
Red maple	21,151	159	(N/A)	0.7	0.1	14.42
Black maple	51,003	383	(N/A)	0.6	0.3	38.25
Swamp white oak	4,025	30	(N/A)	0.6	0.0	3.02
Mulberry	40,382	303	(N/A)	0.6	0.3	30.29
Northern red oak	75,191	564	(N/A)	0.6	0.5	56.39
Elm	264,061	1,980	(N/A)	0.6	1.8	220.05
Broadleaf Deciduous	17,684	133	(N/A)	0.4	0.1	18.95
Broadleaf Deciduous	83,921	629	(N/A)	0.4	0.6	89.92
Amur maple	37,659	282	(N/A)	0.4	0.3	40.35
Boxelder	71,297	535	(N/A)	0.4	0.5	89.12
White ash	43,215	324	(N/A)	0.4	0.3	54.02
Bur oak	20,689	155	(N/A)	0.4	0.1	25.86
Plum	9,706	73	(N/A)	0.4	0.1	12.13
Oak	10,049	75	(N/A)	0.3	0.1	15.07
Broadleaf Evergreen l	20,028	150	(N/A)	0.3	0.1	30.04
Paper birch	5,926	44	(N/A)	0.2	0.0	11.11
Broadleaf Deciduous	4,403	33	(N/A)	0.2	0.0	8.26
Eastern white pine	808	6	(N/A)	0.2	0.0	1.52
River birch	30,762	231	(N/A)	0.2	0.2	57.68
Eastern redbud	14,571	109	(N/A)	0.2	0.1	27.32
Ginkgo	15,605	117	(N/A)	0.2	0.1	39.01
Willow	25,850	194	(N/A)	0.2	0.2	64.62
Pin oak	25,976	195	(N/A)	0.1	0.2	97.41
Catalpa	16,915	127	(N/A)	0.1	0.1	63.43
Eastern hophornbeam	3,945	30	(N/A)	0.1	0.0	14.79
Red pine	513	4	(N/A)	0.1	0.0	1.93
Kentucky coffeetree	24,230	182	(N/A)	0.1	0.2	90.86
Northern pin oak	14,280	107	(N/A)	0.1	0.1	107.10
Northern white cedar	7,490	56	(N/A)	0.1	0.1	56.18
Pear	3,037	23	(N/A)	0.1	0.0	22.78
Northern catalpa	185	1	(N/A)	0.1	0.0	1.39
Scotch pine	38	0	(N/A)	0.1	0.0	0.29
Japanese tree lilac	14	0	(N/A)	0.1	0.0	0.10
Quaking aspen	25,943	195	(N/A)	0.1	0.2	194.57
Citywide total	14,943,861	112,079	(N/A)	100.0	100.0	69.06

Table 5: Annual Carbon Sequestered

Rockwell City

Annual CO₂ Benefits of Public Trees

12/9/2015

Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Avoided (lb)	Avoided (\$)	Net Total (lb)	Total Standard (\$ Error)	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	418,316	3,137	-27,548	-1,101	-8	0	0	389,667	2,923 (N/A)	18.9	46.6	9.55
Norway maple	89,282	670	-6,537	-550	-4	0	0	82,195	616 (N/A)	15.9	9.8	2.39
Green ash	137,077	1,028	-13,572	-642	-5	0	0	122,863	921 (N/A)	14.7	14.7	3.87
Spruce	14,232	107	-902	-250	-2	0	0	13,080	98 (N/A)	9.2	1.6	0.65
Apple	20,973	157	-1,301	-178	-1	0	0	19,494	146 (N/A)	7.1	2.3	1.26
Honeylocust	36,947	277	-2,404	-145	-1	0	0	34,398	258 (N/A)	3.6	4.1	4.37
Sugar maple	29,967	225	-2,583	-149	-1	0	0	27,236	204 (N/A)	3.3	3.3	3.78
Ash	14,222	107	-1,551	-110	-1	0	0	12,560	94 (N/A)	2.6	1.5	2.19
Northern hackberry	15,368	115	-1,154	-118	-1	0	0	14,095	106 (N/A)	2.5	1.7	2.58
Black walnut	20,371	153	-1,345	-88	-1	0	0	18,938	142 (N/A)	2.3	2.3	3.84
American basswood	24,966	187	-2,000	-94	-1	0	0	22,872	172 (N/A)	2.0	2.7	5.36
Eastern red cedar	678	5	-110	-46	0	0	0	522	4 (N/A)	1.7	0.1	0.15
Littleleaf linden	11,140	84	-724	-56	0	0	0	10,360	78 (N/A)	1.7	1.2	2.88
Cottonwood	13,228	99	-3,678	-93	-1	0	0	9,457	71 (N/A)	1.1	1.1	3.94
American sycamore	8,415	63	-979	-40	0	0	0	7,397	55 (N/A)	1.0	0.9	3.26
Conifer Evergreen Large	1,635	12	-303	-43	0	0	0	1,289	10 (N/A)	0.9	0.2	0.69
Maple	2,972	22	-103	-16	0	0	0	2,853	21 (N/A)	0.9	0.3	1.53
Siberian elm	2,902	22	-198	-19	0	0	0	2,685	20 (N/A)	0.9	0.3	1.44
Red maple	2,796	21	-102	-14	0	0	0	2,681	20 (N/A)	0.7	0.3	1.83
Black maple	4,428	33	-245	-22	0	0	0	4,161	31 (N/A)	0.6	0.5	3.12
Swamp white oak	980	7	-22	-6	0	0	0	953	7 (N/A)	0.6	0.1	0.71
Mulberry	1,202	9	-194	-23	0	0	0	984	7 (N/A)	0.6	0.1	0.74
Northern red oak	1,808	14	-361	-22	0	0	0	1,425	11 (N/A)	0.6	0.2	1.07
Elm	5,753	43	-1,267	-36	0	0	0	4,449	33 (N/A)	0.6	0.5	3.71
Broadleaf Deciduous Smal	1,039	8	-85	-12	0	0	0	943	7 (N/A)	0.4	0.1	1.01
Broadleaf Deciduous Large	2,449	18	-403	-15	0	0	0	2,031	15 (N/A)	0.4	0.2	2.18
Amur maple	1,338	10	-181	-19	0	0	0	1,139	9 (N/A)	0.4	0.1	1.22
Boxelder	4,840	36	-342	-16	0	0	0	4,481	34 (N/A)	0.4	0.5	5.60
White ash	4,214	32	-207	-14	0	0	0	3,993	30 (N/A)	0.4	0.5	4.99
Bur oak	1,590	12	-99	-8	0	0	0	1,483	11 (N/A)	0.4	0.2	1.85
Plum	991	7	-47	-9	0	0	0	936	7 (N/A)	0.4	0.1	1.17
Oak	1,091	8	-48	-6	0	0	0	1,037	8 (N/A)	0.3	0.1	1.56
Broadleaf Evergreen Large	2,107	16	-96	-10	0	0	0	2,001	15 (N/A)	0.3	0.2	3.00
Paper birch	937	7	-28	-5	0	0	0	904	7 (N/A)	0.2	0.1	1.69
Broadleaf Deciduous Medi	896	7	-21	-5	0	0	0	870	7 (N/A)	0.2	0.1	1.63
Eastern white pine	176	1	-4	-4	0	0	0	168	1 (N/A)	0.2	0.0	0.31
River birch	1,188	9	-148	-9	0	0	0	1,031	8 (N/A)	0.2	0.1	1.93
Eastern redbud	152	1	-70	-9	0	0	0	73	1 (N/A)	0.2	0.0	0.14
Ginkgo	640	5	-75	-7	0	0	0	558	4 (N/A)	0.2	0.1	1.40
Willow	856	6	-124	-9	0	0	0	723	5 (N/A)	0.2	0.1	1.81
Pin oak	2,359	18	-125	-5	0	0	0	2,229	17 (N/A)	0.1	0.3	8.36
Catalpa	1,319	10	-81	-5	0	0	0	1,233	9 (N/A)	0.1	0.1	4.62
Eastern hophornbeam	382	3	-19	-3	0	0	0	359	3 (N/A)	0.1	0.0	1.35
Red pine	105	1	-2	-2	0	0	0	100	1 (N/A)	0.1	0.0	0.38
Kentucky coffeetree	1,517	11	-116	-6	0	0	0	1,394	10 (N/A)	0.1	0.2	5.23
Northern pin oak	0	0	-69	-4	0	0	0	-73	-1 (N/A)	0.1	0.0	-0.55
Northern white cedar	0	0	-36	-4	0	0	0	-40	0 (N/A)	0.1	0.0	-0.30
Pear	268	2	-15	-2	0	0	0	251	2 (N/A)	0.1	0.0	1.88
Northern catalpa	74	1	-1	-1	0	0	0	73	1 (N/A)	0.1	0.0	0.55
Scotch pine	18	0	0	-1	0	0	0	17	0 (N/A)	0.1	0.0	0.13
Japanese tree lilac	9	0	0	0	0	0	0	8	0 (N/A)	0.1	0.0	0.06
Quaking aspen	960	7	-125	-4	0	0	0	831	6 (N/A)	0.1	0.1	6.23
Citywide total	911,172	6,834	-71,750	-4,055	-30	0	0	835,367	6,265 (N/A)	100.0	100.0	3.86

Table 6: Annual Social and Aesthetic Benefits

Rockwell City

Annual Aesthetic/Other Benefits of Public Trees					
12/9/2015					
Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	32,360	(N/A)	18.9	37.5	105.75
Norway maple	8,856	(N/A)	15.9	10.3	34.32
Green ash	11,721	(N/A)	14.7	13.6	49.25
Spruce	3,842	(N/A)	9.2	4.5	25.62
Apple	1,214	(N/A)	7.1	1.4	10.47
Honeylocust	8,831	(N/A)	3.6	10.2	149.68
Sugar maple	3,186	(N/A)	3.3	3.7	59.01
Ash	1,364	(N/A)	2.6	1.6	31.72
Northern hackberry	2,185	(N/A)	2.5	2.5	53.30
Black walnut	1,836	(N/A)	2.3	2.1	49.63
American basswood	1,826	(N/A)	2.0	2.1	57.07
Eastern red cedar	286	(N/A)	1.7	0.3	10.59
Littleleaf linden	1,208	(N/A)	1.7	1.4	44.76
Cottonwood	858	(N/A)	1.1	1.0	47.64
American sycamore	683	(N/A)	1.0	0.8	40.16
Conifer Evergreen Large	342	(N/A)	0.9	0.4	24.46
Maple	450	(N/A)	0.9	0.5	32.14
Siberian elm	324	(N/A)	0.9	0.4	23.17
Red maple	405	(N/A)	0.7	0.5	36.79
Black maple	577	(N/A)	0.6	0.7	57.74
Swamp white oak	128	(N/A)	0.6	0.1	12.83
Mulberry	70	(N/A)	0.6	0.1	6.99
Northern red oak	146	(N/A)	0.6	0.2	14.61
Elm	419	(N/A)	0.6	0.5	46.56
Broadleaf Deciduous Small	59	(N/A)	0.4	0.1	8.47
Broadleaf Deciduous Large	213	(N/A)	0.4	0.2	30.50
Amur maple	79	(N/A)	0.4	0.1	11.36
Boxelder	320	(N/A)	0.4	0.4	53.39
White ash	497	(N/A)	0.4	0.6	82.88
Bur oak	165	(N/A)	0.4	0.2	27.54
Plum	57	(N/A)	0.4	0.1	9.43
Oak	130	(N/A)	0.3	0.2	26.09
Broadleaf Evergreen Large	470	(N/A)	0.3	0.5	94.09
Paper birch	118	(N/A)	0.2	0.1	29.43
Broadleaf Deciduous Medium	105	(N/A)	0.2	0.1	26.22
Eastern white pine	53	(N/A)	0.2	0.1	13.27
River birch	115	(N/A)	0.2	0.1	28.84
Eastern redbud	8	(N/A)	0.2	0.0	2.12
Ginkgo	46	(N/A)	0.2	0.1	15.42
Willow	82	(N/A)	0.2	0.1	27.40
Pin oak	180	(N/A)	0.1	0.2	90.08
Catalpa	115	(N/A)	0.1	0.1	57.69
Eastern hophornbeam	22	(N/A)	0.1	0.0	10.94
Red pine	31	(N/A)	0.1	0.0	15.42
Kentucky coffeetree	123	(N/A)	0.1	0.1	61.64
Northern pin oak	0	(N/A)	0.1	0.0	0.00
Northern white cedar	0	(N/A)	0.1	0.0	0.00
Pear	15	(N/A)	0.1	0.0	15.48
Northern catalpa	15	(N/A)	0.1	0.0	14.73
Scotch pine	7	(N/A)	0.1	0.0	6.83
Japanese tree lilac	0	(N/A)	0.1	0.0	0.03
Quaking aspen	67	(N/A)	0.1	0.1	66.60
Citywide total	86,216	(N/A)	100.0	100.0	53.12

Table 7: Summary of Benefits in Dollars

Rockwell City

Total Annual Benefits of Public Trees by Species (\$)

12/9/2015

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Silver maple	20,349	2,923	3,761	38,186	32,360	97,579	(N/A)	33.3
Norway maple	11,917	616	2,035	12,069	8,856	35,494	(N/A)	12.1
Green ash	12,690	921	2,252	18,078	11,721	45,663	(N/A)	15.6
Spruce	2,875	98	244	5,561	3,842	12,621	(N/A)	4.3
Apple	2,997	146	499	1,537	1,214	6,393	(N/A)	2.2
Honeylocust	3,856	258	654	5,455	8,831	19,054	(N/A)	6.5
Sugar maple	2,911	204	460	3,979	3,186	10,741	(N/A)	3.7
Ash	2,293	94	409	2,623	1,364	6,783	(N/A)	2.3
Northern hackberry	2,818	106	486	3,092	2,185	8,687	(N/A)	3.0
Black walnut	1,815	142	304	2,223	1,836	6,321	(N/A)	2.2
American basswood	1,771	172	270	2,330	1,826	6,369	(N/A)	2.2
Eastern red cedar	551	4	46	972	286	1,858	(N/A)	0.6
Littleleaf linden	942	78	156	1,148	1,208	3,533	(N/A)	1.2
Cottonwood	1,640	71	351	3,310	858	6,230	(N/A)	2.1
American sycamore	738	55	136	1,228	683	2,841	(N/A)	1.0
Conifer Evergreen Large	425	10	3	1,215	342	1,994	(N/A)	0.7
Maple	354	21	58	280	450	1,164	(N/A)	0.4
Siberian elm	333	20	56	369	324	1,103	(N/A)	0.4
Red maple	298	20	50	257	405	1,030	(N/A)	0.4
Black maple	512	31	94	545	577	1,759	(N/A)	0.6
Swamp white oak	105	7	15	62	128	317	(N/A)	0.1
Mulberry	342	7	58	206	70	683	(N/A)	0.2
Northern red oak	364	11	51	454	146	1,025	(N/A)	0.3
Elm	661	33	136	1,226	419	2,475	(N/A)	0.8
Broadleaf Deciduous Sm	198	7	33	101	59	398	(N/A)	0.1
Broadleaf Deciduous La	273	15	52	414	213	968	(N/A)	0.3
Amur maple	287	9	51	184	79	610	(N/A)	0.2
Boxelder	249	34	43	385	320	1,031	(N/A)	0.4
White ash	322	30	57	439	497	1,345	(N/A)	0.5
Bur oak	143	11	24	169	165	512	(N/A)	0.2
Plum	149	7	23	65	57	301	(N/A)	0.1
Oak	95	8	15	101	130	349	(N/A)	0.1
Broadleaf Evergreen Lar	225	15	21	361	470	1,092	(N/A)	0.4
Paper birch	91	7	14	77	118	307	(N/A)	0.1
Broadleaf Deciduous M	98	7	14	64	105	287	(N/A)	0.1
Eastern white pine	46	1	5	54	53	160	(N/A)	0.1
River birch	191	8	34	236	115	584	(N/A)	0.2
Eastern redbud	116	1	20	73	8	217	(N/A)	0.1
Ginkgo	99	4	19	101	46	269	(N/A)	0.1
Willow	176	5	32	207	82	503	(N/A)	0.2
Pin oak	104	17	13	150	180	464	(N/A)	0.2
Catalpa	115	9	19	140	115	398	(N/A)	0.1
Eastern hophornbeam	56	3	9	25	22	115	(N/A)	0.0
Red pine	27	1	3	32	31	94	(N/A)	0.0
Kentucky coffeetree	128	10	22	177	123	461	(N/A)	0.2
Northern pin oak	71	-1	14	102	0	186	(N/A)	0.1
Northern white cedar	38	0	-2	125	0	161	(N/A)	0.1
Pear	38	2	7	18	15	80	(N/A)	0.0
Northern catalpa	6	1	1	5	15	27	(N/A)	0.0
Scotch pine	6	0	1	6	7	19	(N/A)	0.0
Japanese tree lilac	1	0	0	0	0	1	(N/A)	0.0
Quaking aspen	82	6	16	149	67	319	(N/A)	0.1
Citywide Total	76,988	6,265	13,142	110,364	86,216	292,975	(N/A)	100.0

Species Distribution

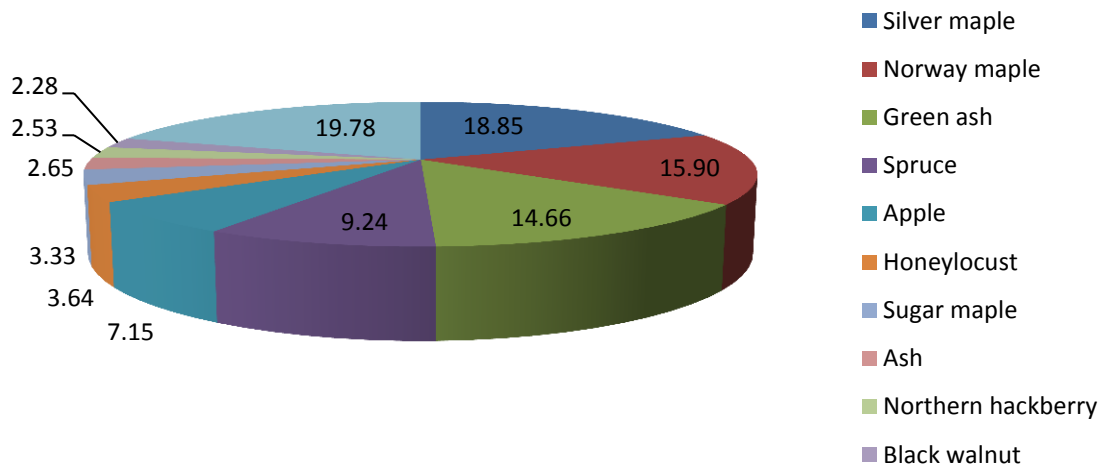


Figure 1: Species Distribution (%)

Relative Age Distribution of Top 10 Public Tree Species for Zone 1 (%)

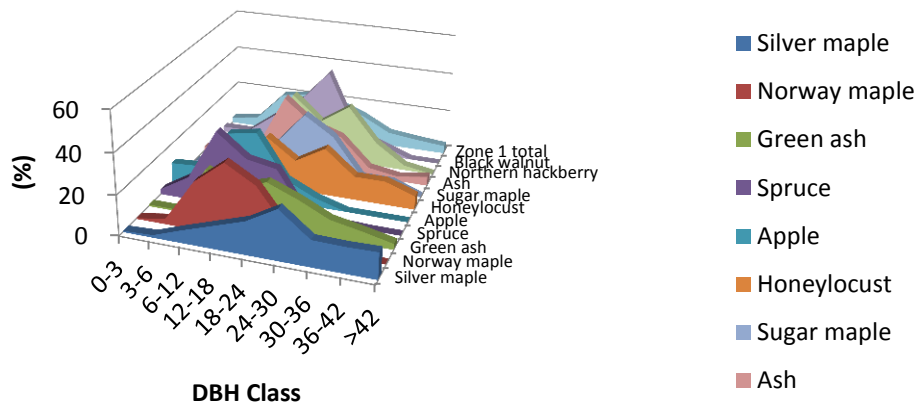


Figure 2: Relative Age Class (%)

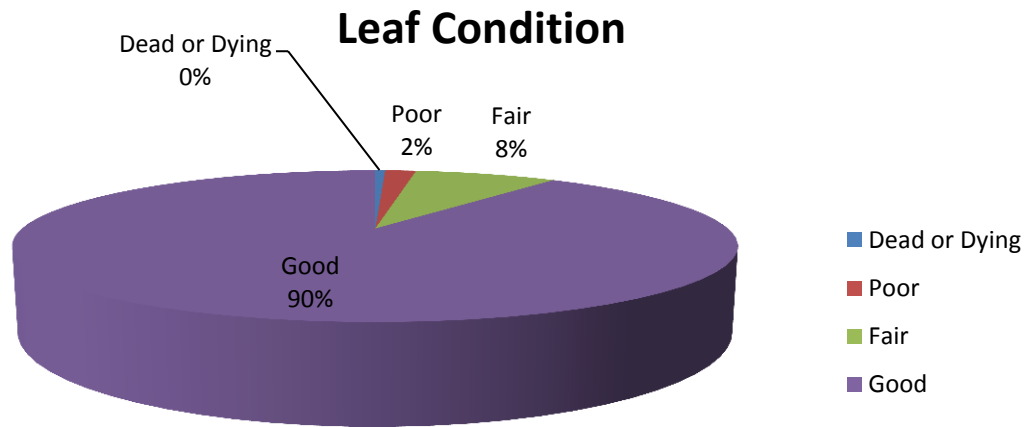


Figure 3: Foliage Condition

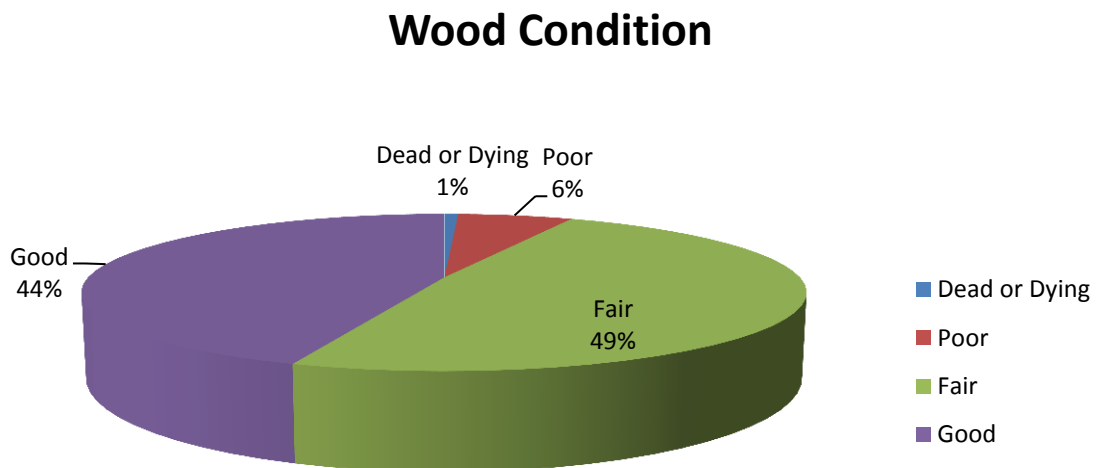


Figure 4: Wood Condition

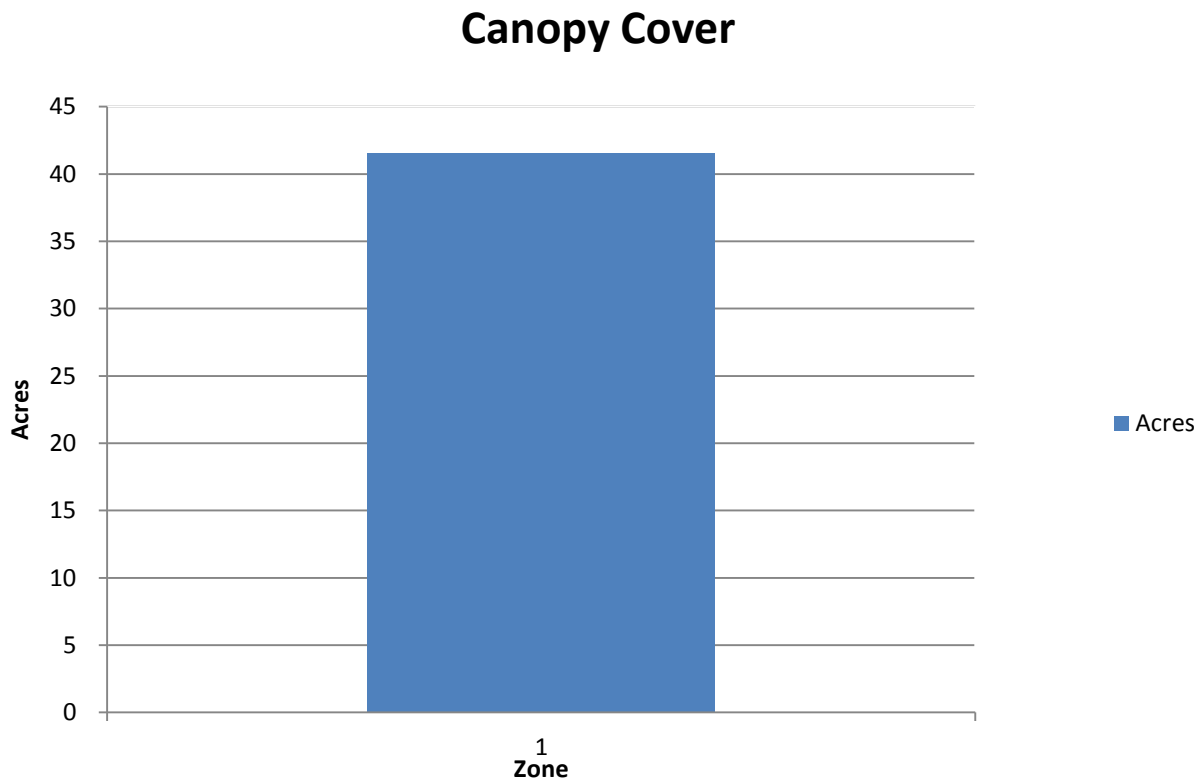


Figure 5: Canopy Cover in Acres

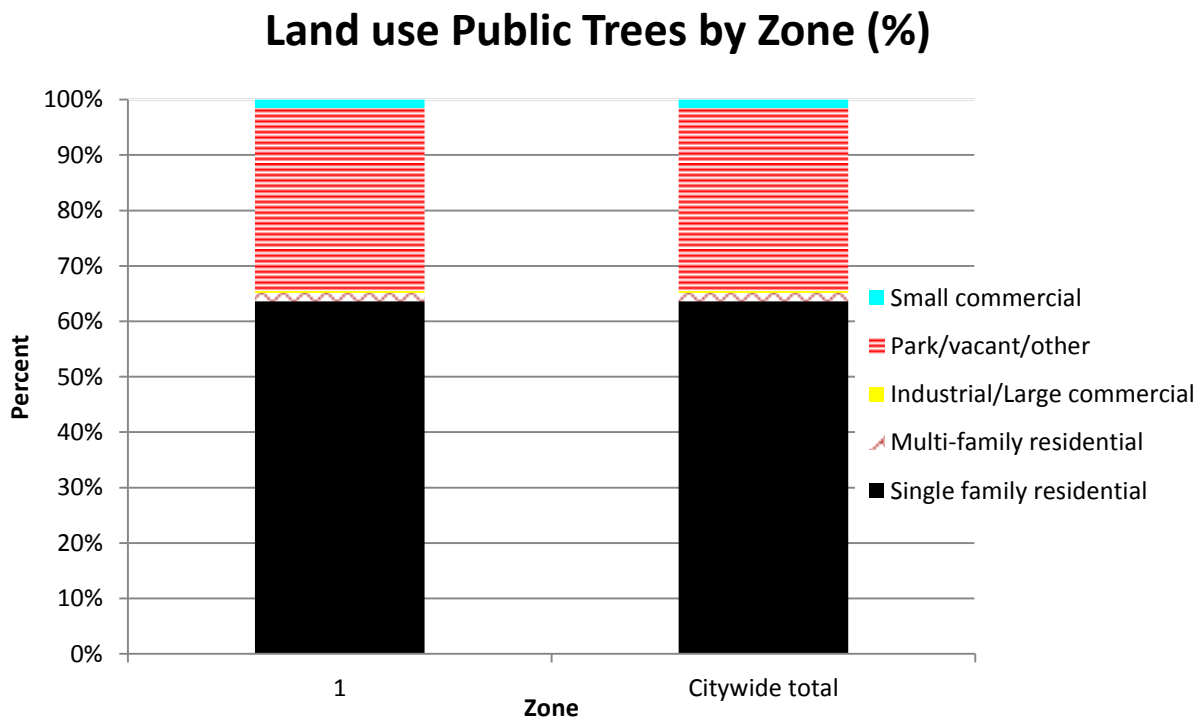


Figure 6: Land Use of city/park trees

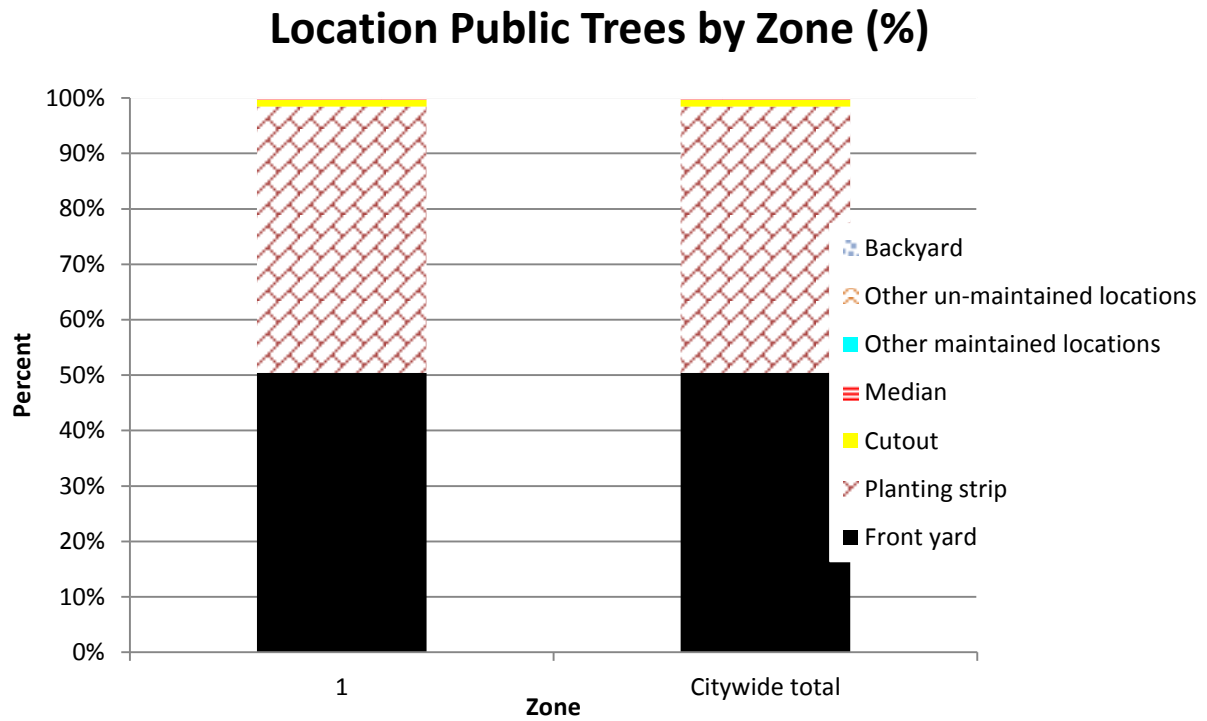


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

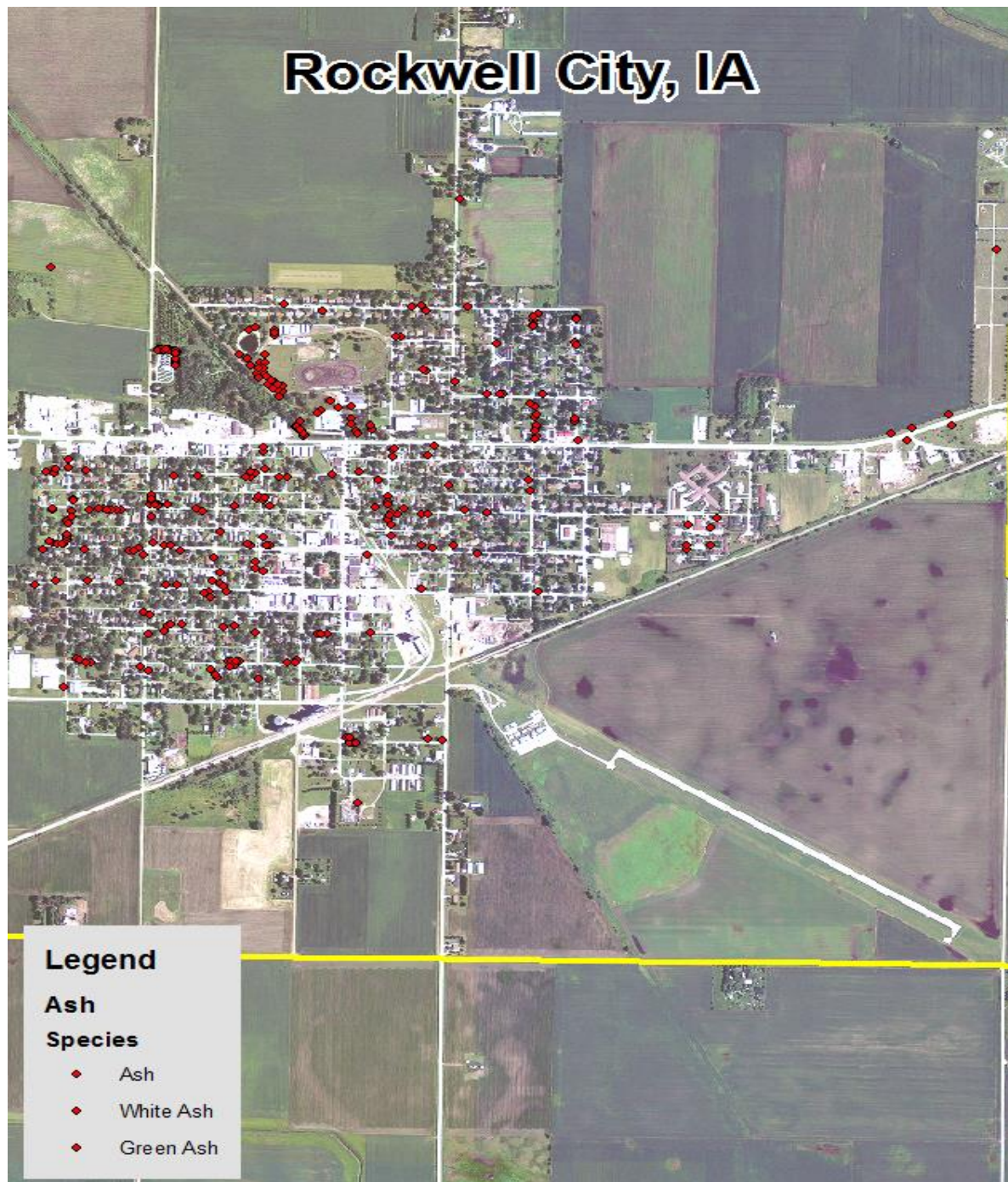


Figure 1: Location of Ash Trees

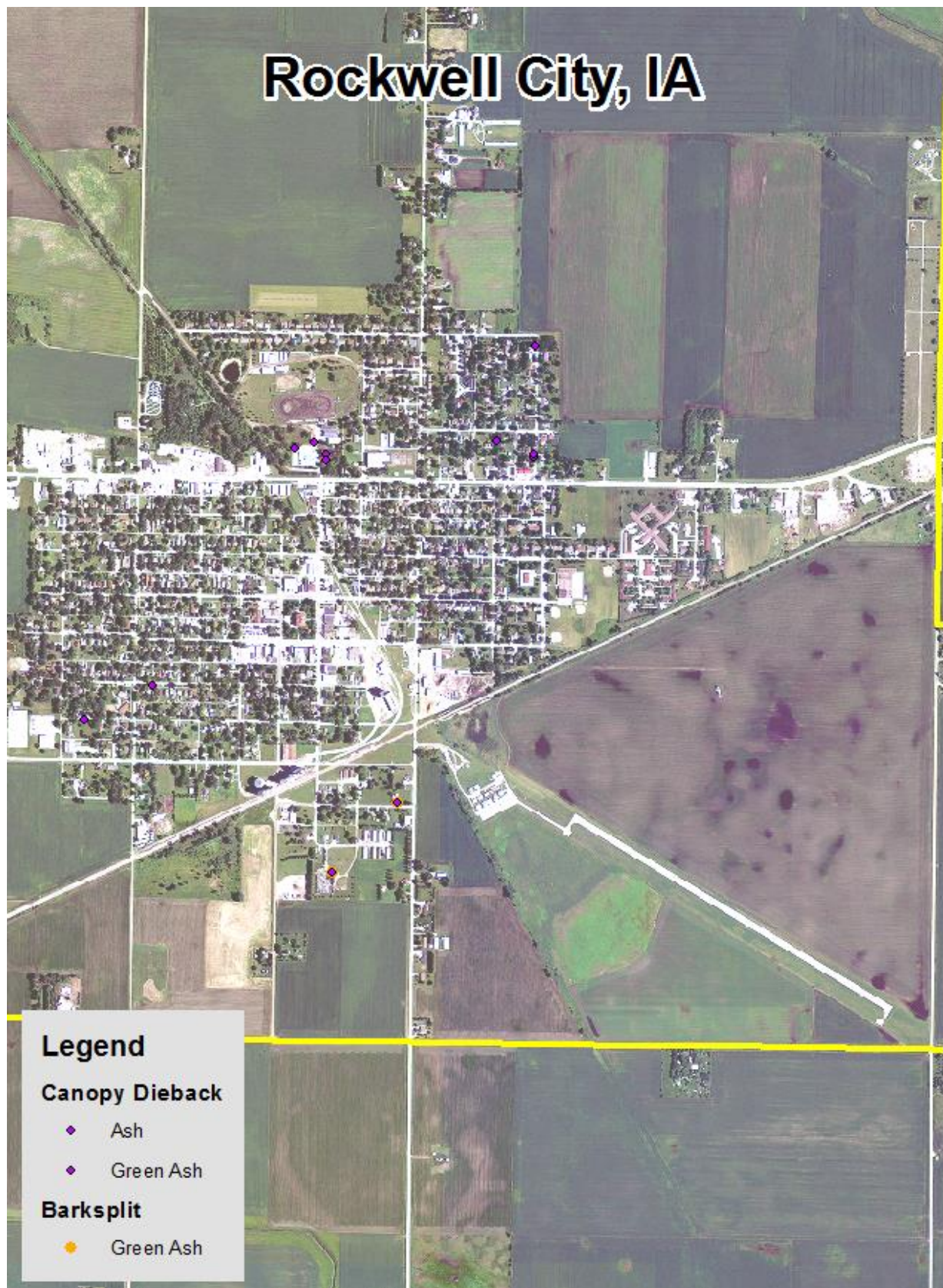


Figure 2: Location of EAB symptoms

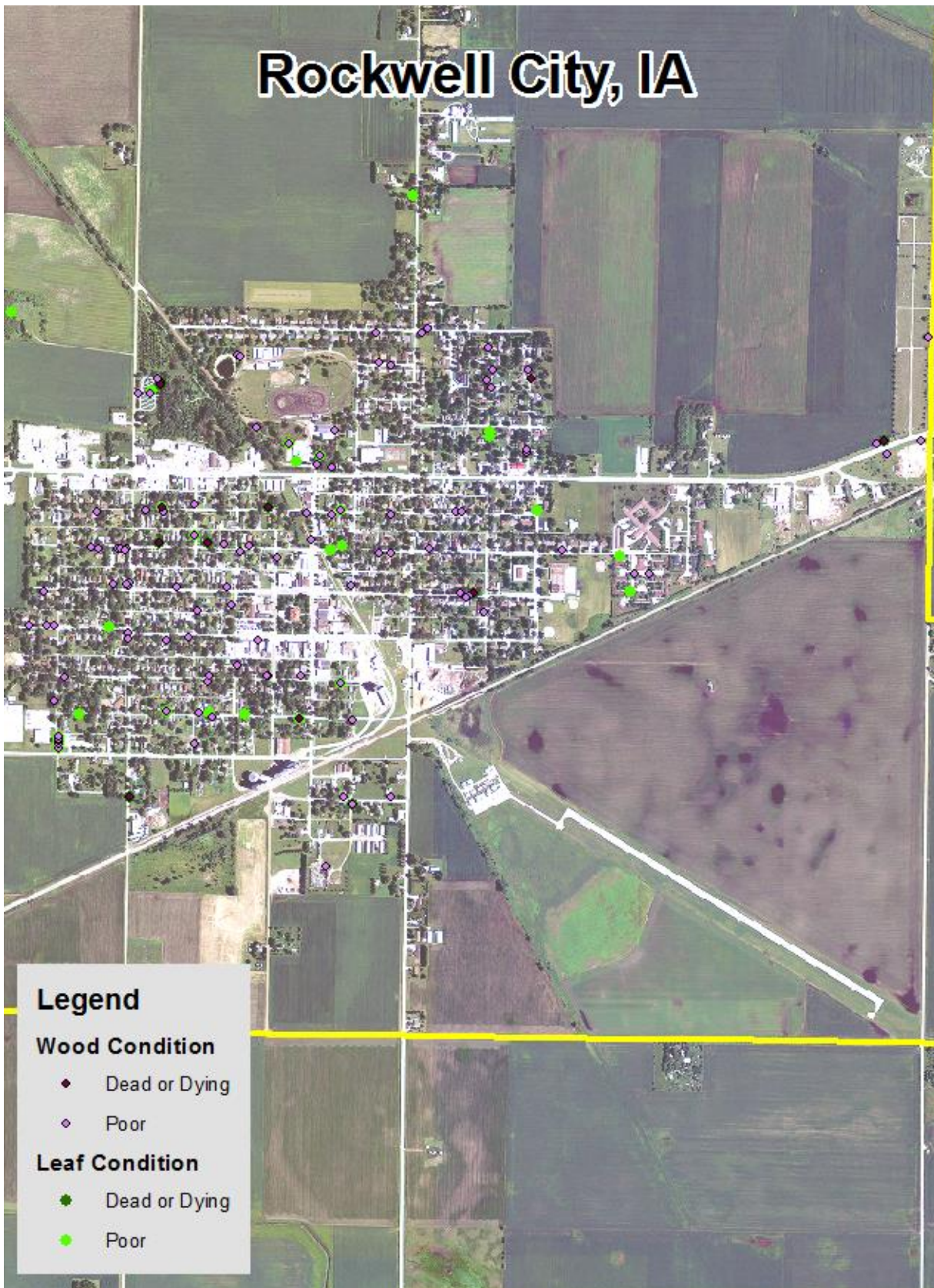


Figure 3: Location of Poor Condition Trees

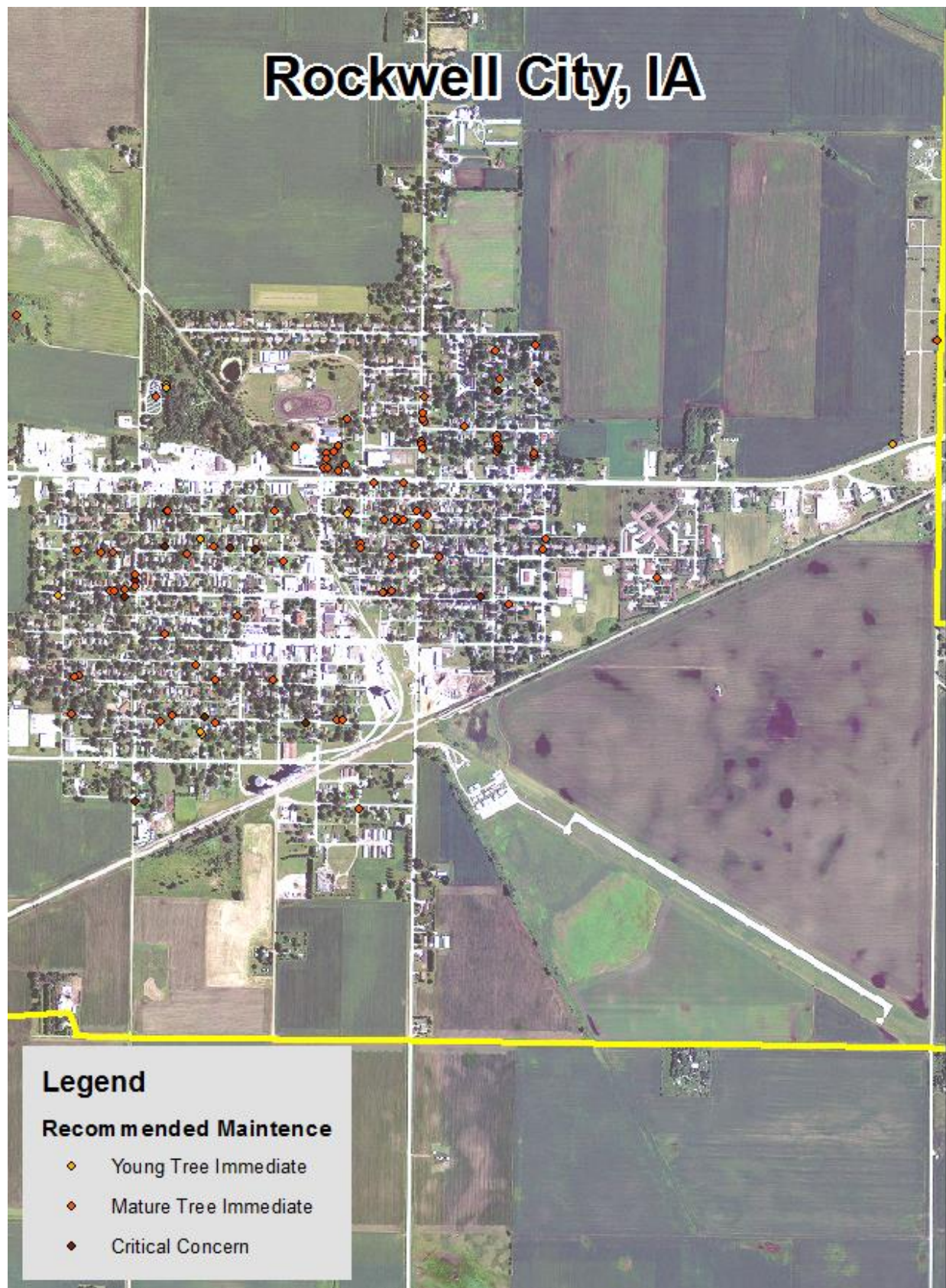


Figure 4: Location of Trees with Recommended Maintenance

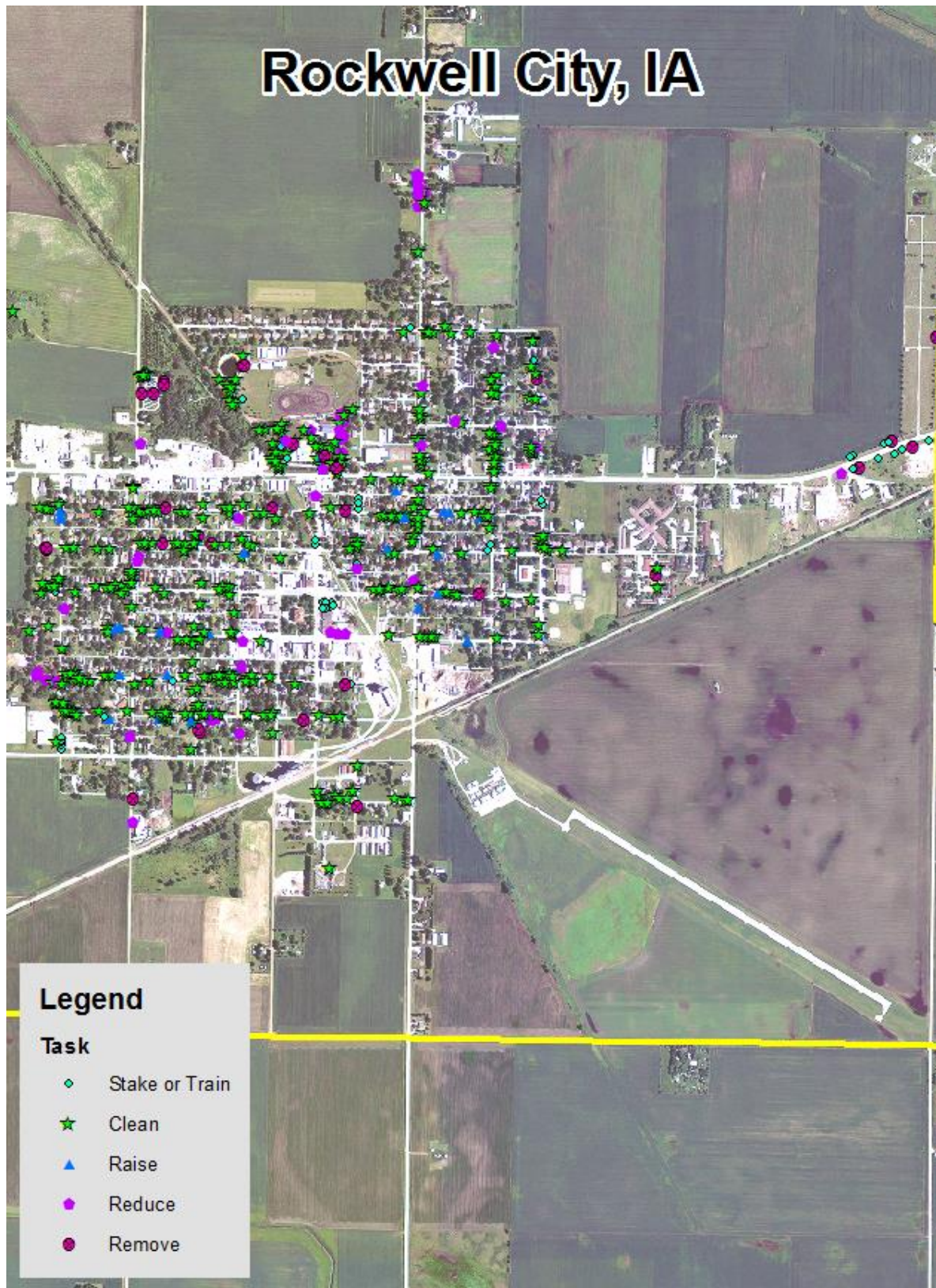


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Rockwell City Tree Ordinances

CHAPTER 151

TREES

151.01 Purpose	151.09 Utilities
151.02 Definitions	151.10 Public Tree Care
151.03 Planting Restrictions	151.11 Tree Topping
151.04 Removal of Trees Prohibited	151.12 Duty to Trim Trees
151.05 Street Tree Species to be Planted	151.13 Removal of Dead or Diseased Trees
151.06 Spacing	151.14 Removal of Stumps
151.07 Distance from Curb and Sidewalk	151.15 Arborists Insurance Required
151.08 Distance from Street Corners and Fire Hydrants	

151.01 PURPOSE. The purpose of this chapter is to beautify and preserve the appearance of the City.

151.02 DEFINITIONS. For use in this chapter, the following definitions are given.

1. "Park trees" are trees, shrubs, bushes and all other woody vegetation in public parks and other areas owned by the City to which the public has free access as a park.
2. "Street trees" are trees, shrubs, bushes and all other woody vegetation on land owned by the City and lying between property lines on either side of all streets, avenues or ways within the City.

151.03 PLANTING RESTRICTIONS. No tree shall be planted in any street, avenue or highway between the outer line of the sidewalk and the curb where the curb line is established, or where the curb line is not established, on a line ten (10) feet from the property line, unless in conformity with the provisions of this chapter.

151.04 REMOVAL OF TREES PROHIBITED. It is unlawful for any person to remove any tree from public grounds without written permission from the Tree Board.

151.05 STREET TREE SPECIES TO BE PLANTED. The following list constitutes the official street tree species for the City. No species other than those included in this list shall be planted as street trees without written permission of the City Tree Board.

SMALL TREES	MEDIUM TREES	LARGE TREES
Flowering Crab Washington Hawthorne Bradford Pear Purpleleaf Plum Redbud European Mt. Ash Saucer Magnolia Amur Maple	Green Ash Hackberry Thornless Honey Locust American Linden or Basswood Red Maple Norway Maple River Birch Littleleaf Linden Catalpa Pin Oak American Beech White Birch	Kentucky Coffeetree Silver Maple Sugar Maple Bur Oak London Plantree Sycamore Dawn Redwood Red Oak Tulip Tree Scarlet Oak

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151.06 SPACING. The spacing of street trees will be in accordance with the three species size classes, and no trees may be planted closer together than the following: small trees, 30 feet; medium trees, 40 feet; and large trees, 50 feet; except in special plantings designed or approved by a landscape architect or approved by the City Tree Board.

151.07 DISTANCE FROM CURB AND SIDEWALK. The distance trees may be planted from curbs or curb lines and sidewalks will be in accordance with the tree species size classes 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.

151.08 DISTANCE FROM STREET CORNERS AND FIRE HYDRANTS. 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 ten (10) feet from any fire hydrant.

151.09 UTILITIES. No street trees other than those species listed as small trees may be planted under or within ten (10) lateral feet of any overhead utility wire, or over or within five (5) lateral feet of any underground utility line, water line or sewer line.

151.10 PUBLIC TREE CARE. The City has 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 City Tree Board may remove or cause or order to be removed any tree or part thereof which is in an unsafe condition or which by reason of its nature is injurious to sewers, electric power lines, gas lines, water lines or other public improvements, or is affected with any injurious fungus, insect or other pest; provided, however, such removal shall be conducted in accordance with tree removal policies of the tree plan. This section does not prohibit the planting of street trees by adjacent property owners providing that the selection and location of said trees is in accordance with this chapter.

151.11 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 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 Tree Board.

151.12 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on public or private property trimmed so that all branches will be at least eight (8) feet above the sidewalks and fifteen (15) feet above the surface of streets. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax. Except as allowed in this section, it is unlawful for any property owner to trim or cut any tree in a street or public place.

(Code of Iowa, Sec. 364.12[2c, d & e])

151.13 REMOVAL OF DEAD OR DISEASED TREES. The City has 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 diseases which constitute a potential threat to other trees within the City. The Tree Board will notify in writing the owners of such trees. Removal shall be done by said owners at their own expense within thirty (30) 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.

151.14 REMOVAL OF STUMPS. All stumps of street 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.

151.15 ARBORISTS INSURANCE REQUIRED. It is unlawful for any person to engage in the business or occupation of pruning, treating or removing street or park trees within the City without filing evidence of possession of liability insurance in the minimum amounts of \$50,000.00 for bodily injury and \$100,000.00 for property damage indemnifying the City or any person injured or damaged resulting from the pursuit of such endeavors as herein described.

The State of Iowa is an Equal Opportunity Employer and provider of ADA services.

Federal law prohibits employment discrimination on the basis of race, color, age, religion, national origin, sex or disability. State law prohibits employment discrimination on the basis of race, color, creed, age, sex, sexual orientation, gender identity, national origin, religion, pregnancy, or disability. State law also prohibits public accommodation (such as access to services or physical facilities) discrimination on the basis of race, color, creed, religion, sex, sexual orientation, gender identity, religion, national origin, or disability. If you believe you have been discriminated against in any program, activity or facility as described above, or if you desire further information, please contact the Iowa Civil Rights Commission, 1-800-457-4416, or write to the Iowa Department of Natural Resources, Wallace State Office Bldg., 502 E. 9th St., Des Moines, IA 50319.

If you need accommodations because of disability to access the services of this Agency, please contact the Director at 515-725-8200.