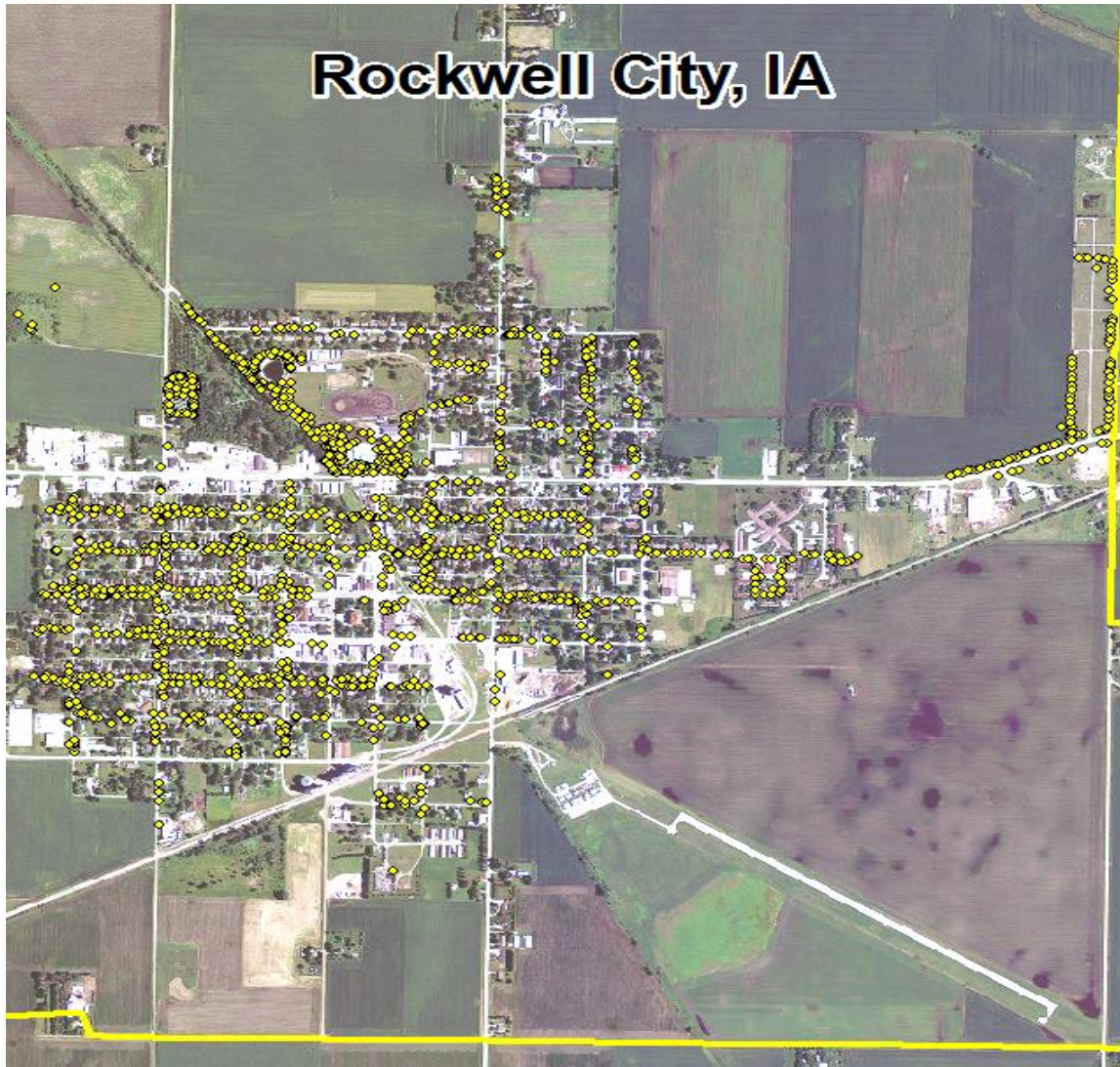


# Rockwell City, IA



2016 Urban Forest Management Plan  
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# Executive Summary

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## 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

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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

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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

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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 (O<sub>3</sub>), particulate matter less than 10 microns (PM<sub>10</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), and sulfur dioxide (SO<sub>2</sub>)) 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

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### **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](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<br>(MWh) | Electricity<br>(\$) | Total Natural<br>Gas (Therms) | Natural<br>Gas (\$) | Total<br>(\$) | Standard<br>Error | % of Total<br>Trees | % of<br>Total \$ | Avg.<br>\$/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**

| <b>Annual Stormwater Benefits of Public Trees</b> |                                   |                |                |                  |               |              |
|---|-----------------------------------|----------------|----------------|------------------|---------------|--------------|
| 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       |
| <b>Citywide total</b>                             | <b>4,072,458</b>                  | <b>110,364</b> | <b>(N/A)</b>   | <b>100.0</b>     | <b>100.0</b>  | <b>68.00</b> |

**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 <sub>3</sub>  | NO <sub>2</sub> | PM <sub>10</sub> | SO <sub>2</sub> |                   | NO <sub>2</sub> | PM <sub>10</sub> | VOC   | SO <sub>2</sub> |        |                    |                     |                     |              |                           |                  |              |
| 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 I               | 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 CO<sub>2</sub> 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 Larg  | 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**

| <b>Annual Aesthetic/Other Benefits of Public Trees</b> |            |                |                  |               |              |
|--|------------|----------------|------------------|---------------|--------------|
| 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        |
| Comifer 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 <sub>2</sub> | 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 La  | 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

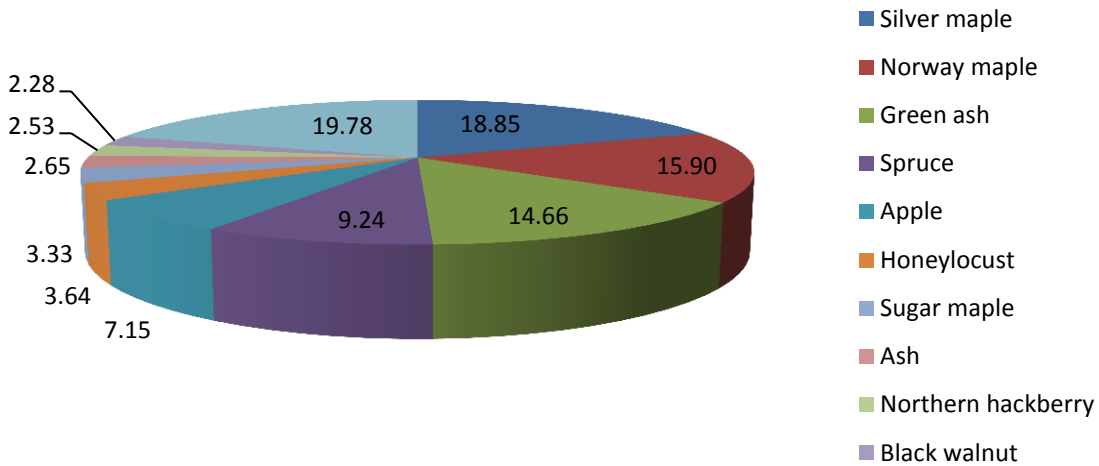


Figure 1: Species Distribution (%)

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

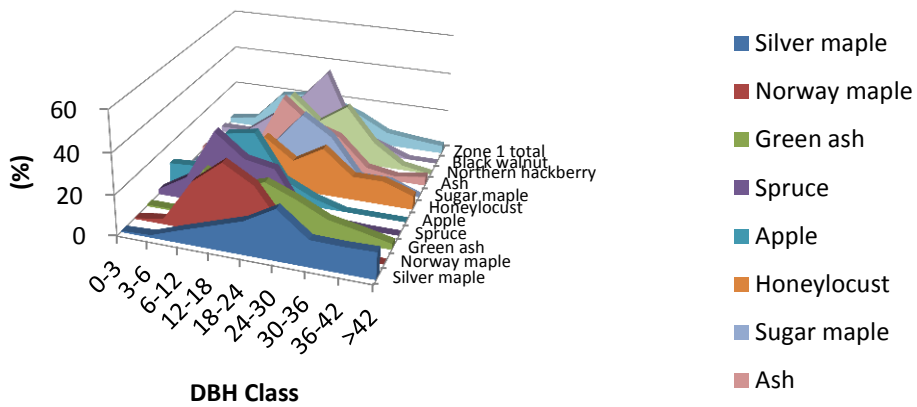
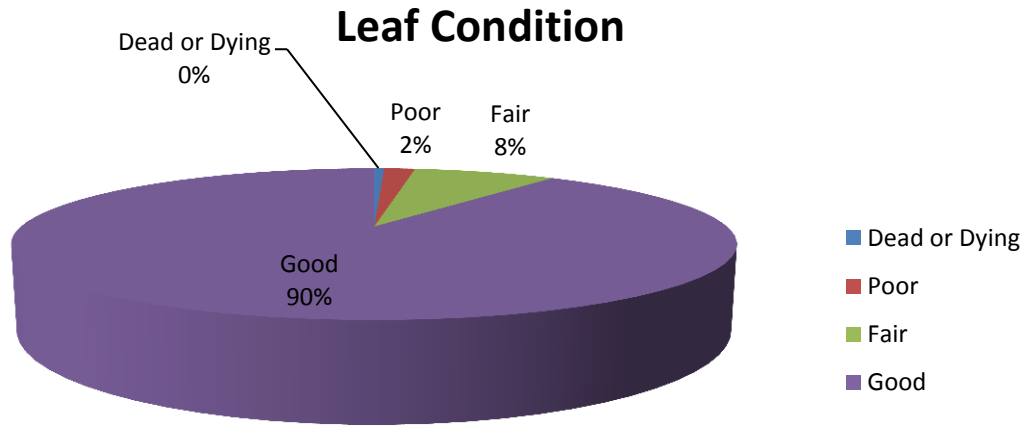
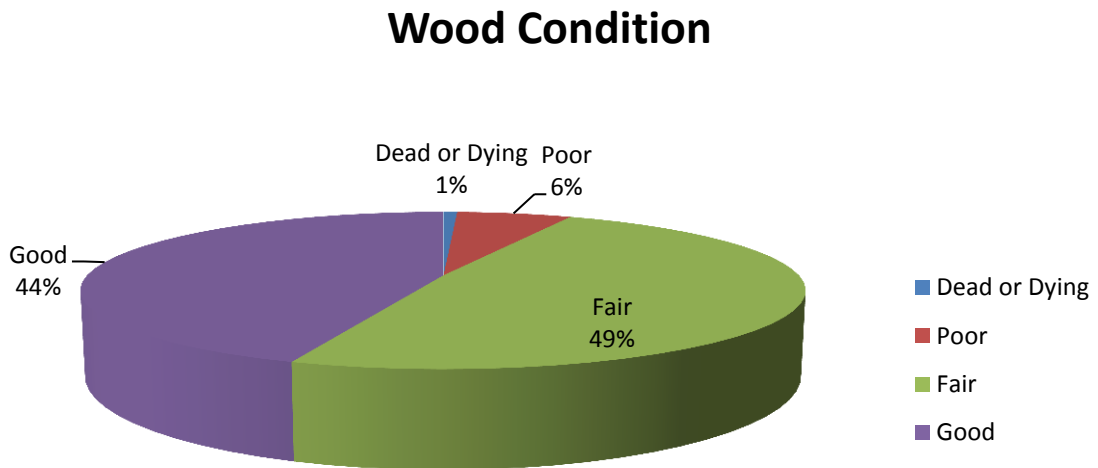


Figure 2: Relative Age Class (%)



**Figure 3: Foliage Condition**



**Figure 4: Wood Condition**

## Canopy Cover

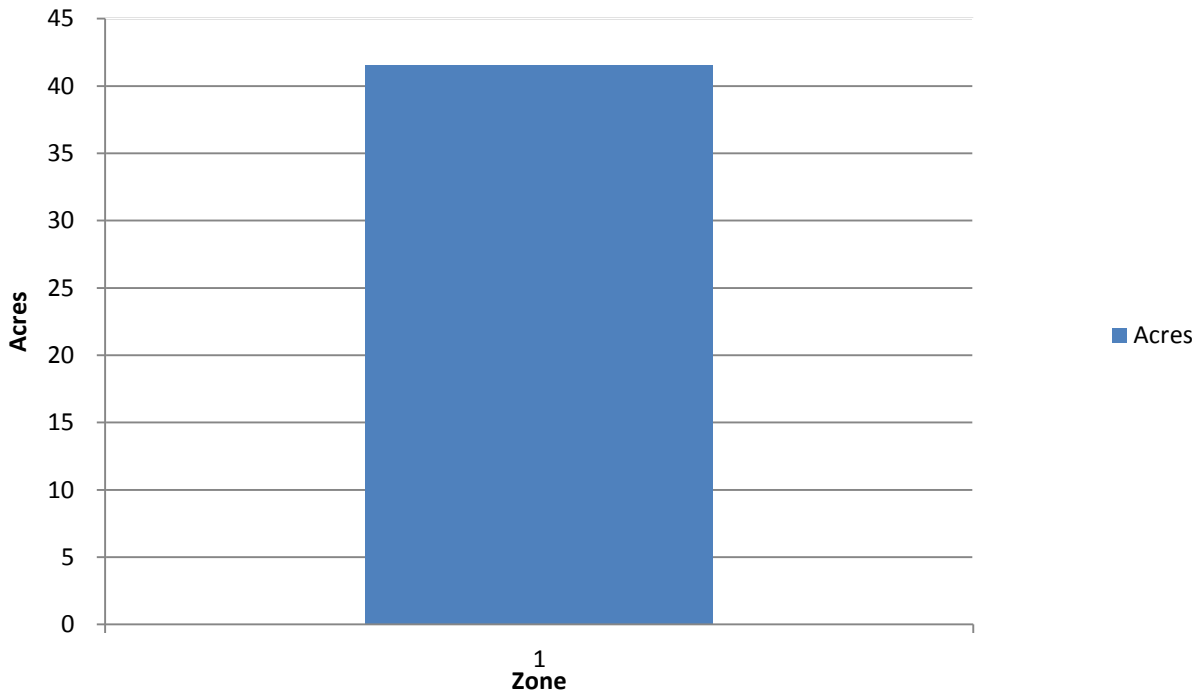


Figure 5: Canopy Cover in Acres

## Land use Public Trees by Zone (%)

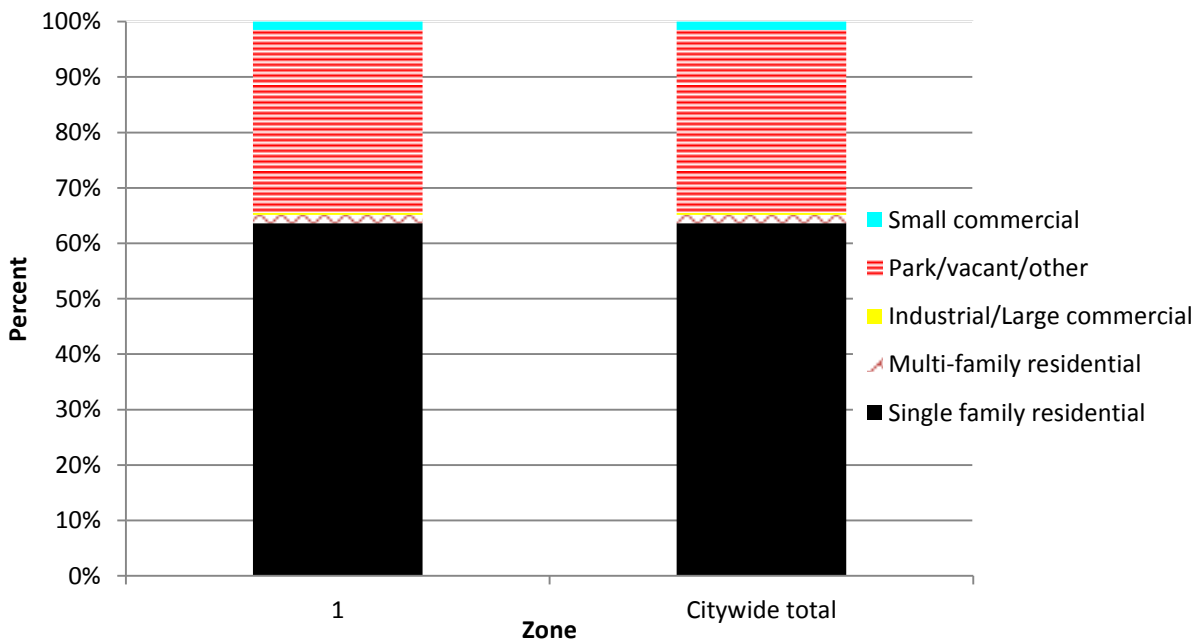


Figure 6: Land Use of city/park trees

## Location Public Trees by Zone (%)

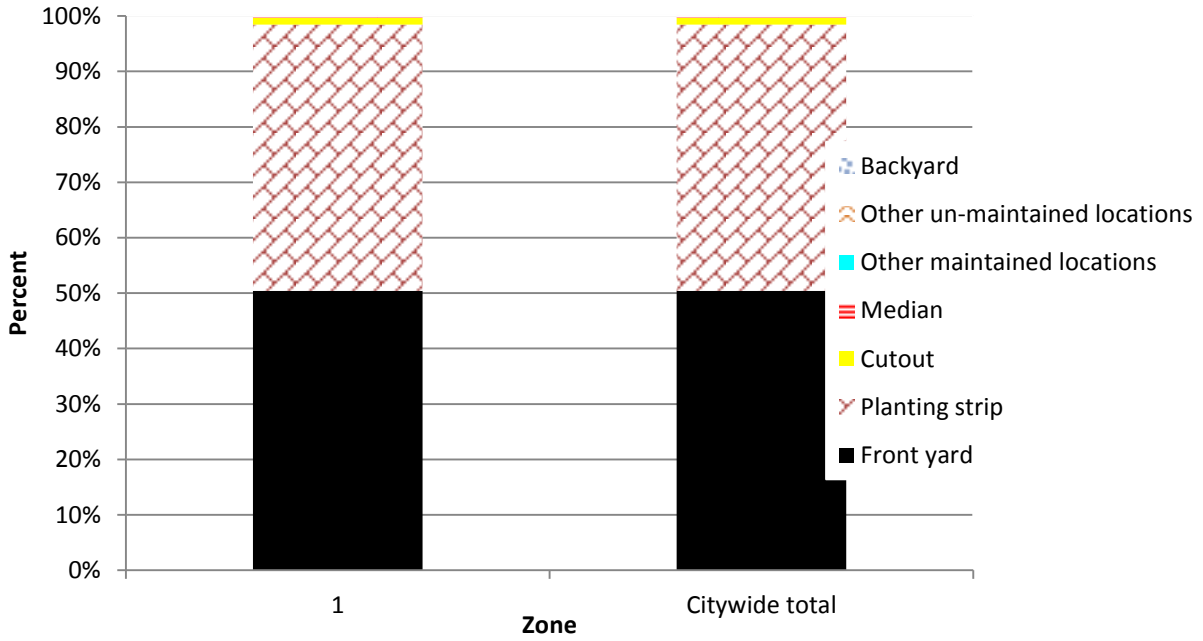


Figure 7: Location of city/park trees



## Appendix B: ArcGIS Mapping

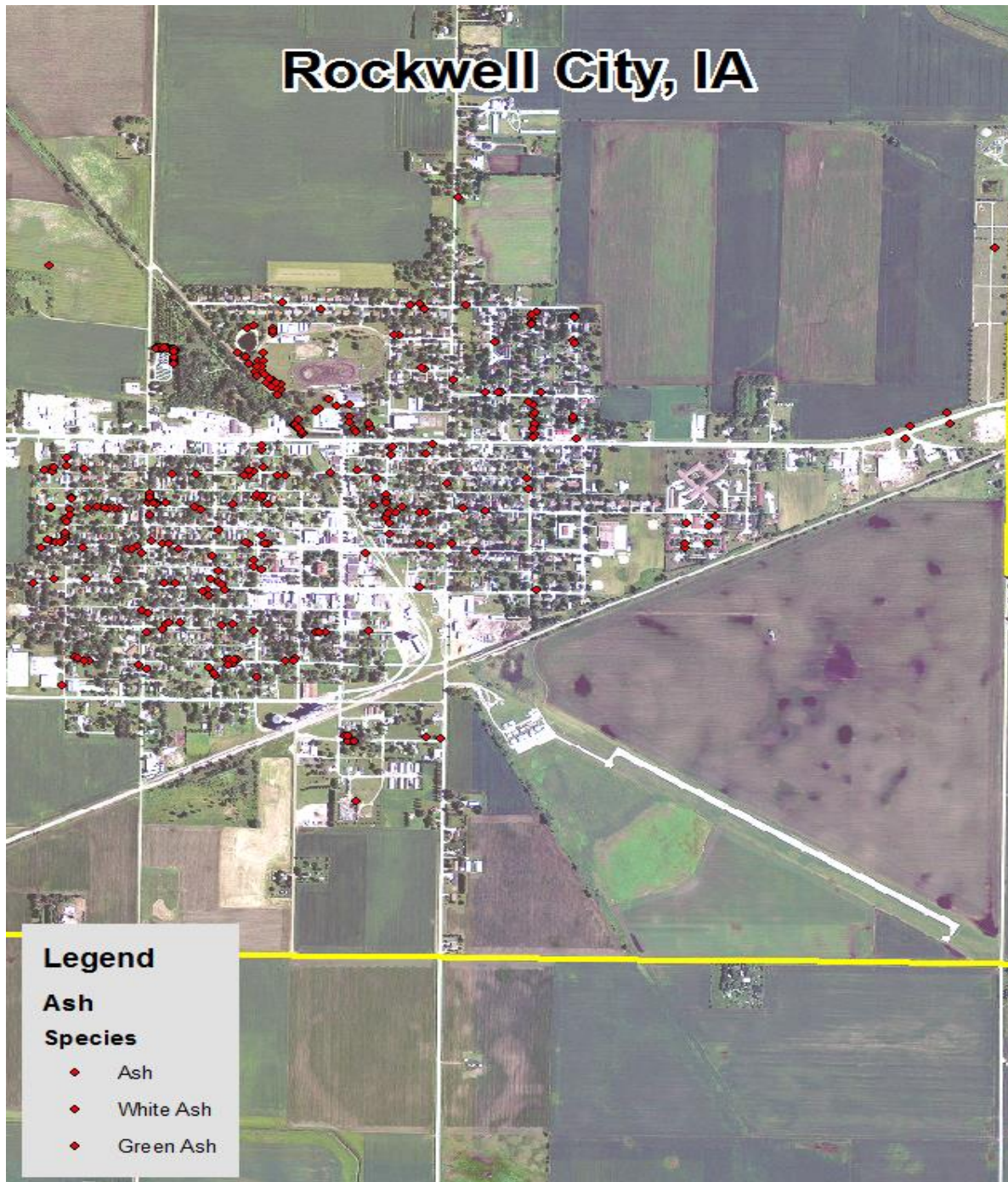


Figure 1: Location of Ash Trees

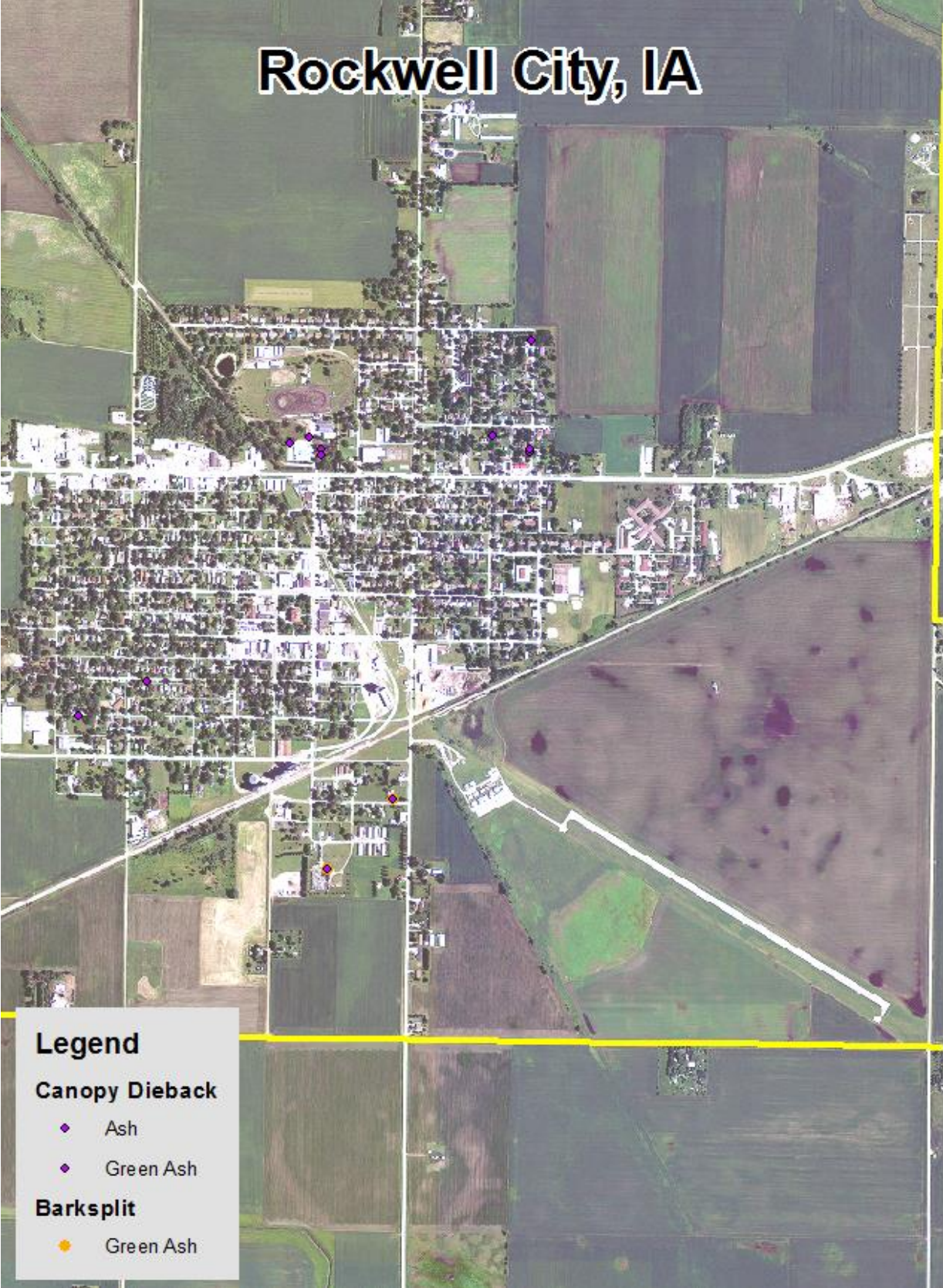


Figure 2: Location of EAB symptoms

# Rockwell City, IA

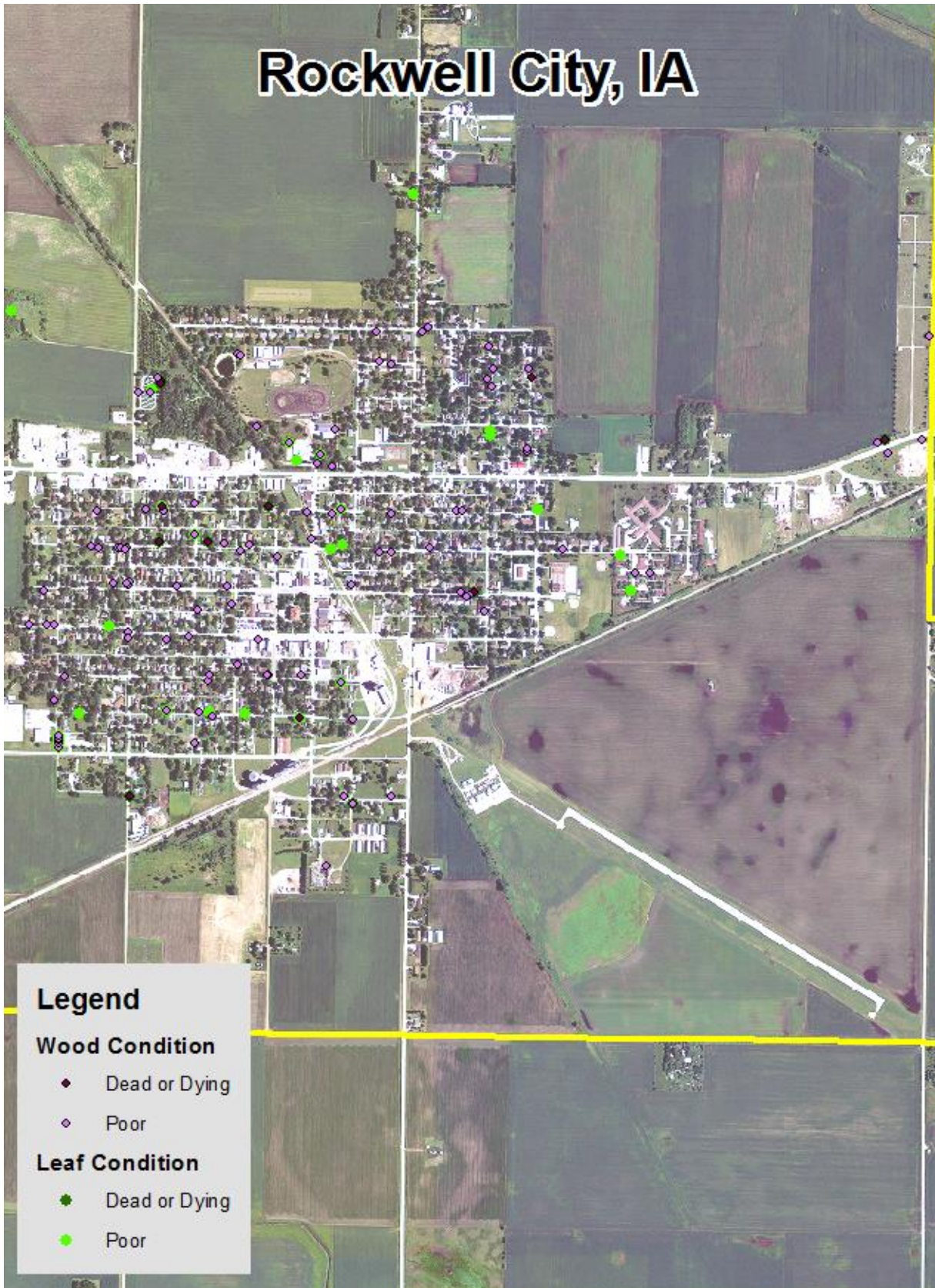


Figure 3: Location of Poor Condition Trees

# Rockwell City, IA

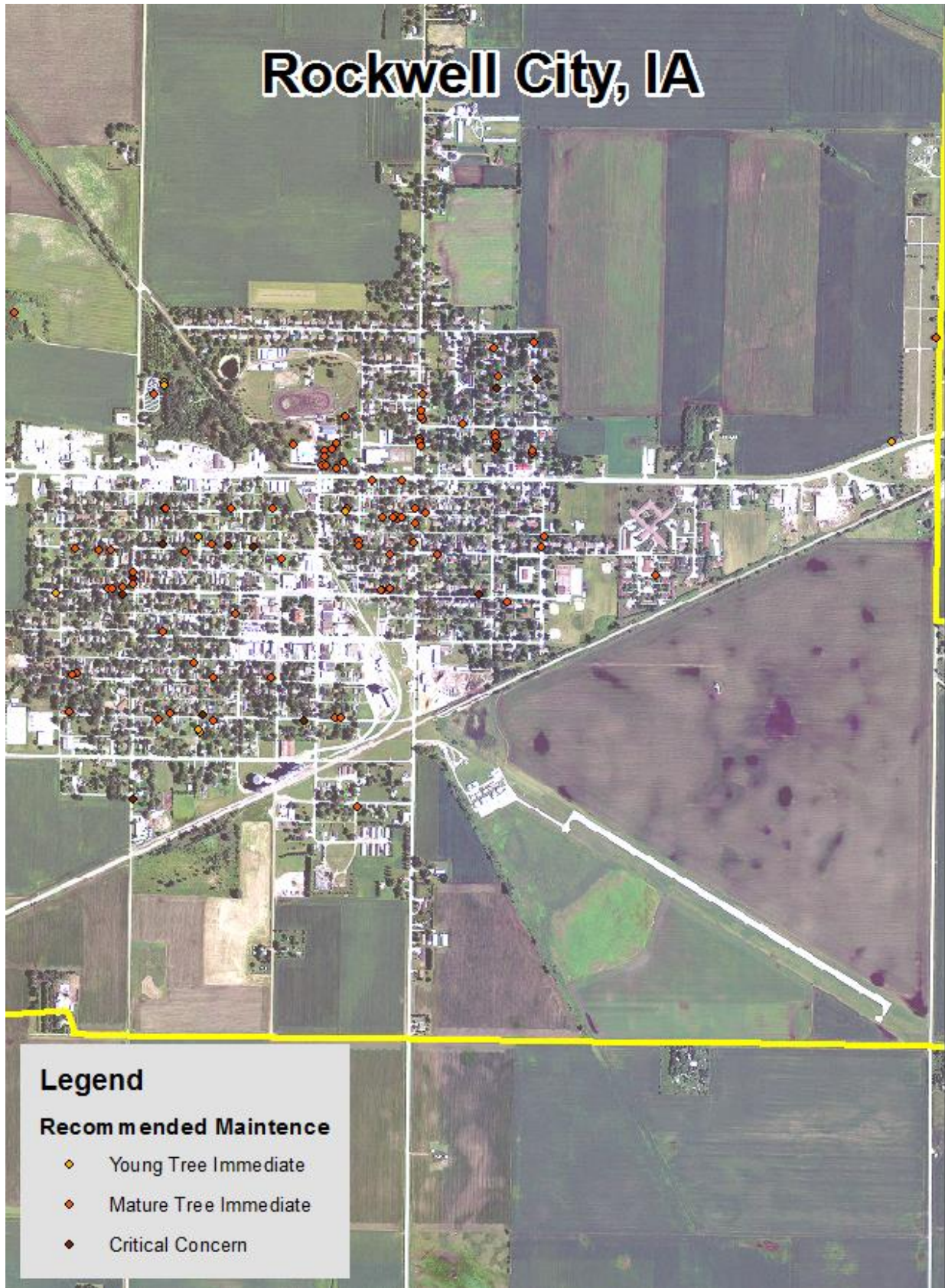


Figure 4: Location of Trees with Recommended Maintenance

# Rockwell City, IA

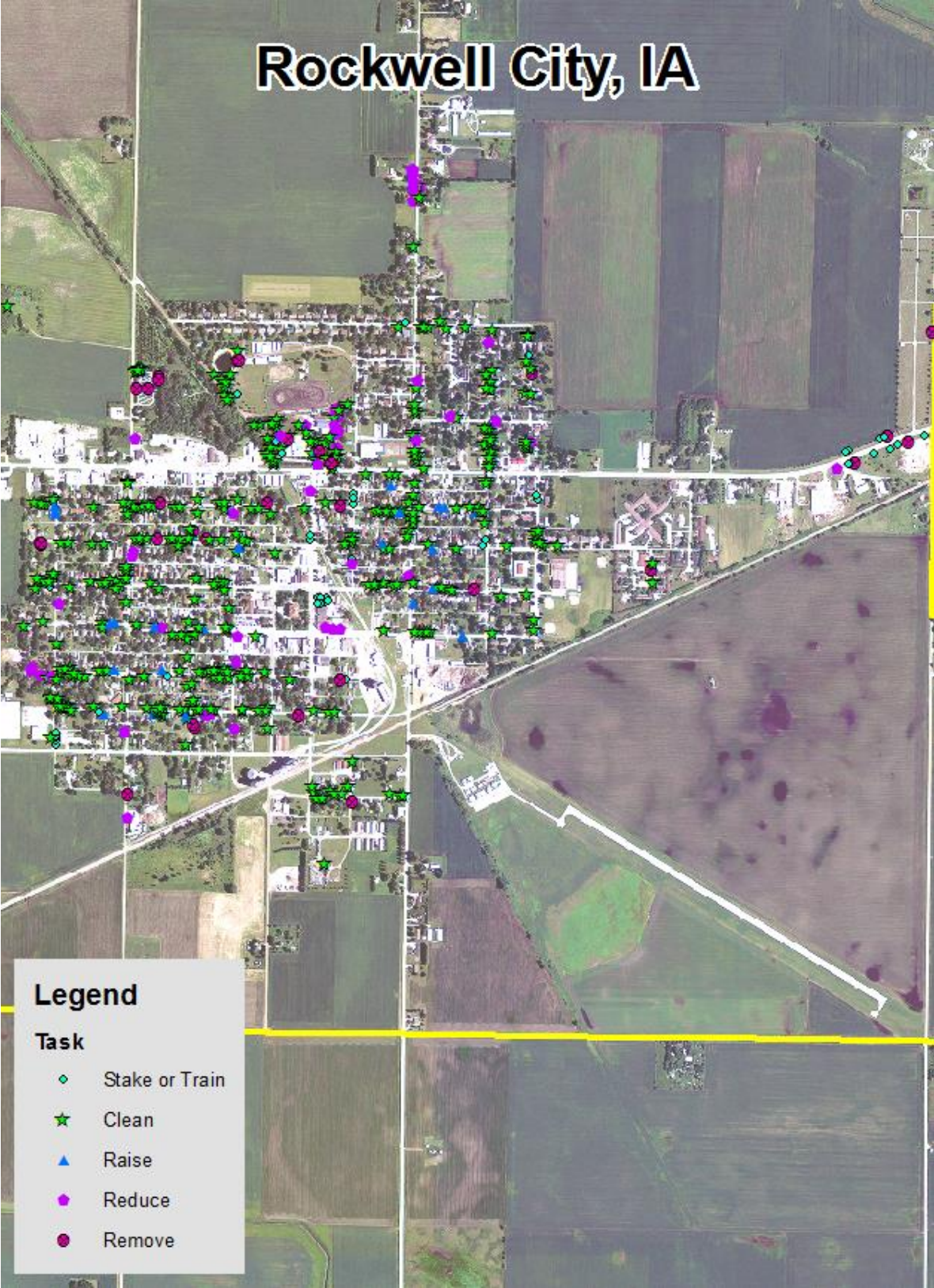


Figure 5: Maintenance Tasks \*City ownership of the trees recommended for removal should be verified prior to any removal\*

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

**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.



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