# Urban Forest Management Plan
# For Ellsworth, IA

Prepared by the Iowa DNR
Bureau of Forestry
2014

# Table of Contents

# Executive Summary

**Overview**

This plan was developed to assist the City of Ellsworth with managing its urban forest, including budgeting and planning for the future. Trees can provide a multitude of benefits to the community, and sound management of this resource is critical to fully reaping these rewards. Proactive management is especially important at this time considering the serious threats posed by pests such as the Emerald Ash Borer (EAB), Bur Oak Blight, Gypsy Moth, and others. The ultimate goal of management should be to diversify the community's forest, both in terms of species diversity and age diversity, so that any catastrophic storms or pest outbreaks may be mitigated over time.

**Inventory and Results**

In June 2014, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete survey of municipally-owned street trees within the perceived right-of-way. Below are some key findings of the 139 trees inventoried.

- Ellsworth's trees provide $25,525 of benefits annually, at an average of $184 a tree
- There are at least 24 different species of trees in Ellsworth
- The top three genus are: Ash 44%, Maple, 25%, and Black Walnut 12%
- 9% of Ellsworth's tree population is in poor health or is already dead or dying; the other 91% of trees are rated as either "fair" or "good"
- 22% of trees are in need of some type of maintenance or are recommended for removal due to poor health:
    - 23 trees need trimming to clean dead branches and improve crown health
    - 8 trees are recommended for routine removal and replacement due to overall poor health or because they're dead or dying

**Recommendations**

The core recommendations are detailed in the *Recommendations* section. Some key ones include:

- Address the 31 trees recommended for trimming or removal according to their priority level: 7 are in need of immediate attention while the rest should be dealt with sometime in the next 6 years *City ownership of the trees recommended for removal should be verified prior to any removal*
- Begin regularly monitoring ash trees for potential signs or symptoms associated with EAB
- Begin replacing trees in poor health and planting new ones with a diverse mix of species (other than maples & ash) that will buffer against major pests

# Introduction

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

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

# Inventory

In June 2014, a tree inventory was conducted that included 100% of the city owned trees along Ellsworth streets. 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 ArcGIS software as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

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

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms of EAB were reviewed for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

# Inventory Results

The data collected for the 139 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. Ellsworth's trees reduce energy related costs by approximately $7,665 annually (Appendix A, Table 1). These savings are both in Electricity (35.6 MWh) and in Natural Gas (5,067 Therms).

### Annual Stormwater Benefits

Ellsworth's trees intercept about 388,808 gallons of rainfall or snowmelt a year (Appendix A, Table 2). This interception provides $10,537 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 Ellsworth, it is estimated that trees remove 488 lbs of air pollution (ozone ($O_3$), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide ($NO_2$), and sulfur dioxide ($SO_2$)) per year with a net value of $1,389 (Appendix A, Table 3).

### Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Ellsworth, trees sequester about 56,725 lbs of carbon a year with an associated value of $425/yr (Appendix A, Table 5). In addition, the trees store 1.4 million lbs of carbon, with a yearly benefit of $10,743 (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. Ellsworth receives $5,113 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, Ellsworth's trees provide $25,525 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 139 trees in Ellsworth provide approximately $184 annually (Appendix A, Table 7).

## ***Forest Structure***

**Species Distribution**

Ellsworth has at least 24 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

| | | |
|---|---|---|
| Ash | 61 | 44% |
| Maples | 35 | 25% |
| Walnut | 16 | 12% |
| All others | < 5 ea. | < 3% ea. |

**Size Class**

Most of Ellsworth's trees (65%) are over 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). Less than 6% of the population are 6" diameter or smaller. This indicates an imbalance in the city's tree population and suggests that as the larger, older trees decline and are removed, there is a lack of younger trees being planted to replace them. Having too many large trees and too few young ones increases the risk for catastrophic storm damage and a long "lag period" following major damage.

**Condition: Wood and Foliage Health**

Both wood condition and leaf condition are useful indicators of the overall health of the urban forest. The survey results for Ellsworth indicate that 9% of the trees are in poor health or are considered dead or dying. The remaining 91% are considered either fair or in good health. (Appendix A, Figures 3 & 4 and Appendix B, Figure 3).

The 9% of trees classified as poor, dead, or dying represent opportunity costs to the city where time and space are being sacrificed. Trees in poor health should be promptly removed and replaced with new, healthy trees to diversify and improve the overall health and resiliency of Ellsworth's urban tree population.

**Management Needs**

Specific management needs of the street trees are outlined below (Appendix B, Figures 4 & 5). Crown cleaning removes dead, diseased, and broken limbs. Staking/training is for recently planted young trees that need to be staked, pruned, or shaped for proper architecture to prevent problems later on. Crown reduction is removing individual limbs to avoid interference with structures or utility wires. Removals indicate trees that are either hazardous or unhealthy and should be removed & replaced with a new tree.

| | |
|---|---|
| Crown Cleaning | 23 trees (17 routine, 6 immediate) |
| Tree Removal | 8 trees (7 routine, 1 immediate) |
| Tree Staking/Training | 0 |
| Crown Reduction | 0 |

# Recommendations

**Risk Management**

Hazardous trees and branches 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 immediately.

Hazardous trees & branches: Critical concerns and Immediate needs

Ellsworth has 7 trees that need immediate attention: 1 "critical concern" tree which has hazardous branches that need trimming and 6 trees which need "immediate" removal. Refer to the maps in Figures 4 and 5 of Appendix B to view the locations of these trees.

Routine maintenance trees

After dealing with the critical concern and immediate need trees, there are 24 trees needing "routine" maintenance which is defined as within the next six years (Appendix B, Figures 4 & 5). Of this number, 17 need trimming and 7 are recommended for removal & replacement with something new.

After addressing the trees mentioned above, any remaining trees that are listed in "poor" health (either wood or foliage) should be targeted for replacement as time and resources allow.

**Routine Pruning**

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. It is generally recommended that all trees be inspected for pruning needs every five to ten years. This would equate to pruning roughly 20 trees per year in Ellsworth.

**Planting**

Theoretically, the city should be planting (and removing) about 1-2 trees per year in order to sustain the tree population at its current number and to achieve equality in the age distribution. This assumes the typical lifespan of a tree in Ellsworth to be 80-140 years; if the trees are not living that long, or if the residents which to *increase* the current population, then the annual goal would be higher (5-10 trees/yr). 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 Ellsworth.

It is important to plant a diverse mix of differing species in the urban forest to maintain canopy health, since most insects and diseases target a single genus of trees (e.g., ash, maple, oak). Current diversity recommendations advise that a single genus not make up more than 20% of the urban forest and a single species (e.g. 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 the genus Ash and Maple, at 44% and 25% respectively (Appendix A, Figure 1). Ashes and Maples should not be planted until this percentage can be lowered. Other species to avoid for

various reasons include: cottonwood, poplar, boxelder, Chinese elm, evergreens, or willow, and any others identified in the city tree code.

A list containing generally acceptable and recommended trees for planting in Iowa is provided with this plan. Ensure each individual planting is tailored for the environmental conditions, available space, and other factors.

**Ash Tree Monitoring**

Due to the threat of EAB, it is important to continuously check the health of ash trees. At the time of the survey, no ash trees exhibited signs/symptoms of EAB (canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage). It is recommended that all ash trees should be routinely monitored as time allows for these symptoms.

# Proposed Work Schedule & Estimated Costs

EAB could potentially kill all 61 ash trees in Ellsworth within 4 years of its arrival, with tree removal costs likely to exceed $43,000. By budgeting for routine maintenance, replacement, and removals now, the city can be proactive and preventative rather than reactive when this pest arrives.

The following is a proposed 5-year work plan that would address the highest priority issues at this time. Estimated costs are based on $700/tree average for removal, $25/tree average for trimming*, and $150/tree average for planting. *Individual homeowners are presumed to be responsible for light trimming and staking/training of young trees in the City right-of-way. For new tree plantings & replacements, it is recommended that Ellsworth apply for grants. 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.

| Year 1 | Estimated Costs |
|---|---|
| Removals: 2 of the 8 recommended trees | $1400 |
| Planting and replacements: 2 new trees | $300 |
| Trimming: 5 of the 23 recommended trees | $125 |
| **Year 2** | |
| Removals: 2 of the 8 recommended trees | $1400 |
| Planting and replacements: 2 new trees | $300 |
| Trimming: 5 of the 23 recommended trees | $125 |
| **Year 3** | |
| Removals: 2 of the 8 recommended trees | $1400 |
| Planting and replacements: 2 new trees | $300 |

| | |
|---|---|
| Trimming: 5 of the 23 recommended trees | $125 |
| | |
| Year 4 | |
| Removals: 1 of the 8 recommended trees | $700 |
| Planting and replacements: 1 new trees | $150 |
| Trimming: 4 of the 23 recommended trees | $100 |
| | |
| Year 5 | |
| Removals: 1 of the 8 recommended trees | $700 |
| Planting and replacements: 2 new trees | $300 |
| Trimming: 4 of the 23 recommended trees | $100 |
| | |
| Annually thereafter | |
| Removals: 1-2/year avg. focusing on poor condition ash & maple | $1050 |
| Planting and replacements: 1-2/year avg. | $225 |
| Routine trimming | |
| Routine monitoring for EAB symptoms | |

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Maps and figures provided by Emma Bruemmer, Urban Forestry Coordinator. All data and information used for this report may be obtained by contacting the Iowa DNR Forestry Bureau.

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# Appendix A: i-Tree Data

**Table 1: Annual Energy Benefits**

**Ellsworth**

## Annual Energy Benefits of Public Trees by Species

1/25/2014

| Species | Total Electricity (MWh) | Electricity ($) | Total Natural Gas (Therms) | Natural Gas ($) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|
| Ash | 18.1 | 1,377 | 2,679.3 | 2,626 | 4,003 | (N/A) | 43.9 | 52.2 | 65.61 |
| Black walnut | 4.7 | 354 | 642.5 | 630 | 983 | (N/A) | 11.5 | 12.8 | 61.45 |
| Norway maple | 2.5 | 190 | 348.5 | 342 | 532 | (N/A) | 10.8 | 6.9 | 35.45 |
| Silver maple | 2.9 | 217 | 379.1 | 372 | 588 | (N/A) | 5.8 | 7.7 | 73.56 |
| Black maple | 1.1 | 80 | 130.1 | 127 | 208 | (N/A) | 2.9 | 2.7 | 51.88 |
| Red maple | 0.5 | 37 | 63.8 | 63 | 99 | (N/A) | 2.9 | 1.3 | 24.78 |
| American sycamore | 1.3 | 100 | 187.4 | 184 | 284 | (N/A) | 2.9 | 3.7 | 70.91 |
| Apple | 0.1 | 5 | 11.4 | 11 | 16 | (N/A) | 2.2 | 0.2 | 5.40 |
| American basswood | 0.6 | 44 | 84.5 | 83 | 127 | (N/A) | 2.2 | 1.7 | 42.22 |
| Siberian elm | 1.1 | 83 | 146.7 | 144 | 227 | (N/A) | 2.2 | 3.0 | 75.64 |
| Sugar maple | 0.3 | 25 | 41.8 | 41 | 66 | (N/A) | 1.4 | 0.9 | 33.17 |
| Northern hackberry | 0.8 | 61 | 114.8 | 112 | 173 | (N/A) | 1.4 | 2.3 | 86.67 |
| Spruce | 0.1 | 9 | 19.0 | 19 | 27 | (N/A) | 1.4 | 0.4 | 13.58 |
| Red pine | 0.3 | 20 | 29.3 | 29 | 48 | (N/A) | 1.4 | 0.6 | 24.14 |
| Other street trees | 1.3 | 98 | 188.7 | 185 | 283 | (N/A) | 7.2 | 3.7 | 28.34 |
| Citywide total | 35.6 | 2,699 | 5,066.9 | 4,966 | 7,665 | (N/A) | 100.0 | 100.0 | 55.14 |

**Table 2: Annual Stormwater Benefits**

**Ellsworth**

## Annual Stormwater Benefits of Public Trees by Species

1/25/2014

| Species | Total rainfall interception (Gal) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|
| Ash | 203,192 | 5,507 | (N/A) | 43.9 | 52.3 | 90.28 |
| Black walnut | 51,550 | 1,397 | (N/A) | 11.5 | 13.3 | 87.32 |
| Norway maple | 16,482 | 447 | (N/A) | 10.8 | 4.2 | 29.78 |
| Silver maple | 42,119 | 1,142 | (N/A) | 5.8 | 10.8 | 142.69 |
| Black maple | 7,678 | 208 | (N/A) | 2.9 | 2.0 | 52.02 |
| Red maple | 2,866 | 78 | (N/A) | 2.9 | 0.7 | 19.42 |
| American sycamore | 15,771 | 427 | (N/A) | 2.9 | 4.1 | 106.85 |
| Apple | 206 | 6 | (N/A) | 2.2 | 0.1 | 1.86 |
| American basswood | 7,043 | 191 | (N/A) | 2.2 | 1.8 | 63.63 |
| Siberian elm | 13,000 | 352 | (N/A) | 2.2 | 3.3 | 117.44 |
| Sugar maple | 1,914 | 52 | (N/A) | 1.4 | 0.5 | 25.93 |
| Northern hackberry | 8,603 | 233 | (N/A) | 1.4 | 2.2 | 116.58 |
| Spruce | 1,191 | 32 | (N/A) | 1.4 | 0.3 | 16.14 |
| Red pine | 3,077 | 83 | (N/A) | 1.4 | 0.8 | 41.70 |
| Other street trees | 14,117 | 383 | (N/A) | 7.2 | 3.6 | 38.26 |
| Citywide total | 388,808 | 10,537 | (N/A) | 100.0 | 100.0 | 75.81 |

**Table 3: Annual Air Quality Benefits**

**Ellsworth**

## Annual Air Quality Benefits of Public Trees by Species

1/25/2014

| Species | Deposition (lb) $O_3$ | $NO_2$ | $PM_{10}$ | $SO_2$ | Total Depos ($) | Avoided (lb) $NO_2$ | $PM_{10}$ | VOC | $SO_2$ | Total Avoided ($) | BVOC Emissions (lb) | BVOC Emissions ($) | Total (lb) | Total ($) | Standard Error | % of Total Trees | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ash | 45.6 | 7.9 | 21.9 | 2.0 | 245 | 88.5 | 12.8 | 12.1 | 82.3 | 547 | -10.3 | -39 | 262.6 | 753 | (N/A) | 43.9 | 12.34 |
| Black walnut | 6.3 | 1.0 | 3.0 | 0.3 | 33 | 22.3 | 3.2 | 3.1 | 21.1 | 139 | 0.0 | 0 | 60.3 | 172 | (N/A) | 11.5 | 10.76 |
| Norway maple | 2.6 | 0.4 | 1.4 | 0.1 | 14 | 12.0 | 1.7 | 1.7 | 11.4 | 75 | -0.7 | -3 | 30.7 | 87 | (N/A) | 10.8 | 5.77 |
| Silver maple | 7.5 | 1.3 | 3.7 | 0.3 | 40 | 13.5 | 2.0 | 1.9 | 12.9 | 84 | -3.8 | -14 | 39.2 | 110 | (N/A) | 5.8 | 13.79 |
| Black maple | 1.7 | 0.3 | 0.8 | 0.1 | 9 | 4.9 | 0.7 | 0.7 | 4.8 | 31 | -0.6 | -2 | 13.4 | 38 | (N/A) | 2.9 | 9.45 |
| Red maple | 0.5 | 0.1 | 0.2 | 0.0 | 3 | 2.3 | 0.3 | 0.3 | 2.2 | 14 | -0.2 | -1 | 5.8 | 16 | (N/A) | 2.9 | 4.04 |
| American sycamore | 2.0 | 0.3 | 0.9 | 0.1 | 10 | 6.4 | 0.9 | 0.9 | 6.0 | 39 | 0.0 | 0 | 17.4 | 50 | (N/A) | 2.9 | 12.48 |
| Apple | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.3 | 0.0 | 0.0 | 0.3 | 2 | 0.0 | 0 | 0.8 | 2 | (N/A) | 2.2 | 0.71 |
| American basswood | 1.0 | 0.2 | 0.5 | 0.0 | 6 | 2.8 | 0.4 | 0.4 | 2.6 | 17 | -0.9 | -3 | 7.1 | 20 | (N/A) | 2.2 | 6.56 |
| Siberian elm | 2.4 | 0.4 | 1.2 | 0.1 | 13 | 5.2 | 0.8 | 0.7 | 5.0 | 32 | 0.0 | 0 | 15.8 | 46 | (N/A) | 2.2 | 15.19 |
| Sugar maple | 0.2 | 0.0 | 0.1 | 0.0 | 1 | 1.6 | 0.2 | 0.2 | 1.5 | 10 | -0.1 | -1 | 3.7 | 10 | (N/A) | 1.4 | 5.10 |
| Northern hackberry | 1.4 | 0.2 | 0.7 | 0.1 | 8 | 3.9 | 0.6 | 0.5 | 3.6 | 24 | 0.0 | 0 | 11.0 | 32 | (N/A) | 1.4 | 15.88 |
| Spruce | 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) | 1.4 | 1.48 |
| Red pine | 0.3 | 0.1 | 0.3 | 0.0 | 2 | 1.2 | 0.2 | 0.2 | 1.2 | 7 | -1.1 | -4 | 2.3 | 6 | (N/A) | 1.4 | 2.82 |
| Other street trees | 2.5 | 0.4 | 1.3 | 0.1 | 14 | 6.3 | 0.9 | 0.9 | 5.9 | 39 | -1.9 | -7 | 16.4 | 46 | (N/A) | 7.2 | 4.57 |
| Citywide total | 74.1 | 12.6 | 36.1 | 3.4 | 399 | 171.7 | 24.9 | 23.7 | 161.2 | 1,065 | -19.9 | -75 | 487.7 | 1,389 | (N/A) | 100.0 | 9.99 |

**Table 4: Annual Carbon Stored**

**Ellsworth**

## Stored CO2 Benefits of Public Trees by Species

1/25/2014

| Species | Total Stored CO2 (lbs) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|
| Ash | 752,715 | 5,645 | (N/A) | 43.9 | 52.6 | 92.55 |
| Black walnut | 202,574 | 1,519 | (N/A) | 11.5 | 14.1 | 94.96 |
| Norway maple | 43,948 | 330 | (N/A) | 10.8 | 3.1 | 21.97 |
| Silver maple | 168,414 | 1,263 | (N/A) | 5.8 | 11.8 | 157.89 |
| Black maple | 18,818 | 141 | (N/A) | 2.9 | 1.3 | 35.28 |
| Red maple | 5,842 | 44 | (N/A) | 2.9 | 0.4 | 10.95 |
| American | 63,091 | 473 | (N/A) | 2.9 | 4.4 | 118.30 |
| Apple | 533 | 4 | (N/A) | 2.2 | 0.0 | 1.33 |
| American | 39,665 | 297 | (N/A) | 2.2 | 2.8 | 99.16 |
| Siberian elm | 60,252 | 452 | (N/A) | 2.2 | 4.2 | 150.63 |
| Sugar maple | 4,725 | 35 | (N/A) | 1.4 | 0.3 | 17.72 |
| Northern | 21,555 | 162 | (N/A) | 1.4 | 1.5 | 80.83 |
| Spruce | 513 | 4 | (N/A) | 1.4 | 0.0 | 1.93 |
| Red pine | 2,340 | 18 | (N/A) | 1.4 | 0.2 | 8.78 |
| Other street trees | 21,518 | 356 | (N/A) | 7.2 | 3.3 | 35.58 |
| Citywide total | 1,432,426 | 10,743 | (N/A) | 100.0 | 100.0 | 77.29 |

**Table 5: Annual Carbon Sequestered**

Ellsworth

Annual $CO_2$ Benefits of Public Trees by Species

1/25/2014

| Species | Sequestered (lb) | Sequestered ($) | Decomposition Release (lb) | Maintenance Release (lb) | Total Released ($) | Avoided (lb) | Avoided ($) | Net Total (lb) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ash | 12,728 | 95 | -3,613 | -12 | -27 | 30,426 | 228 | 39,529 | 296 | (N/A) | 43.9 | 36.1 | 4.86 |
| Black walnut | 11,347 | 85 | -972 | -3 | -7 | 7,814 | 59 | 18,186 | 136 | (N/A) | 11.5 | 16.6 | 8.52 |
| Norway maple | 4,349 | 33 | -211 | -3 | -2 | 4,204 | 32 | 8,339 | 63 | (N/A) | 10.8 | 7.6 | 4.17 |
| Silver maple | 12,400 | 93 | -808 | -2 | -6 | 4,794 | 36 | 16,384 | 123 | (N/A) | 5.8 | 15.0 | 15.36 |
| Black maple | 2,373 | 18 | -90 | -1 | -1 | 1,770 | 13 | 4,051 | 30 | (N/A) | 2.9 | 3.7 | 7.60 |
| Red maple | 817 | 6 | -28 | -1 | 0 | 809 | 6 | 1,596 | 12 | (N/A) | 2.9 | 1.5 | 2.99 |
| American sycamore | 3,427 | 26 | -303 | -1 | -2 | 2,209 | 17 | 5,333 | 40 | (N/A) | 2.9 | 4.9 | 10.00 |
| Apple | 114 | 1 | -3 | -1 | 0 | 112 | 1 | 222 | 2 | (N/A) | 2.2 | 0.2 | 0.56 |
| American basswood | 2,180 | 16 | -190 | -1 | -1 | 969 | 7 | 2,959 | 22 | (N/A) | 2.2 | 2.7 | 7.40 |
| Siberian elm | 2,107 | 16 | -289 | -1 | -2 | 1,838 | 14 | 3,655 | 27 | (N/A) | 2.2 | 3.3 | 9.14 |
| Sugar maple | 468 | 4 | -23 | 0 | 0 | 562 | 4 | 1,007 | 8 | (N/A) | 1.4 | 0.9 | 3.78 |
| Northern hackberry | 1,116 | 8 | -103 | 0 | -1 | 1,345 | 10 | 2,357 | 18 | (N/A) | 1.4 | 2.2 | 8.84 |
| Spruce | 105 | 1 | -2 | 0 | 0 | 189 | 1 | 291 | 2 | (N/A) | 1.4 | 0.3 | 1.09 |
| Red pine | 231 | 2 | -11 | 0 | 0 | 433 | 3 | 652 | 5 | (N/A) | 1.4 | 0.6 | 2.45 |
| Other street trees | 2,963 | 22 | -228 | -2 | -2 | 2,176 | 16 | 4,909 | 37 | (N/A) | 7.2 | 4.5 | 3.68 |
| Citywide total | 56,725 | 425 | -6,876 | -27 | -52 | 59,648 | 447 | 109,471 | 821 | (N/A) | 100.0 | 100.0 | 5.91 |

**Table 6: Annual Social and Aesthetic Benefits**

Ellsworth

Annual Aesthetic/Other Benefits of Public Trees by Species

1/25/2014

| Species | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|
| Ash | 1,145 | (N/A) | 43.9 | 22.4 | 18.78 |
| Black walnut | 925 | (N/A) | 11.5 | 18.1 | 57.79 |
| Norway maple | 463 | (N/A) | 10.8 | 9.1 | 30.86 |
| Silver maple | 930 | (N/A) | 5.8 | 18.2 | 116.28 |
| Black maple | 307 | (N/A) | 2.9 | 6.0 | 76.69 |
| Red maple | 126 | (N/A) | 2.9 | 2.5 | 31.40 |
| American sycamore | 262 | (N/A) | 2.9 | 5.1 | 65.59 |
| Apple | 6 | (N/A) | 2.2 | 0.1 | 2.06 |
| American basswood | 146 | (N/A) | 2.2 | 2.9 | 48.53 |
| Siberian elm | 140 | (N/A) | 2.2 | 2.7 | 46.66 |
| Sugar maple | 61 | (N/A) | 1.4 | 1.2 | 30.43 |
| Northern hackberry | 136 | (N/A) | 1.4 | 2.7 | 68.11 |
| Spruce | 31 | (N/A) | 1.4 | 0.6 | 15.42 |
| Red pine | 65 | (N/A) | 1.4 | 1.3 | 32.32 |
| Other street trees | 371 | (N/A) | 7.2 | 7.3 | 37.06 |
| Citywide total | 5,113 | (N/A) | 100.0 | 100.0 | 36.78 |

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

| Average Annual Benefits of Public Trees by Species | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Species | Energy | CO2 | Air Quality | Stormwater | Aesthetic/Other | Total ($) | Standard Error | % of Total $ |
| Ash | 4,002 | 296 | 753 | 5,507 | 1,145 | $11,703.85 | (±0) | 45.85 |
| Black walnut | 983 | 136 | 172 | 1,397 | 925 | $3,613.47 | (±0) | 14.16 |
| Norway maple | 532 | 63 | 87 | 447 | 463 | $1,590.46 | (±0) | 6.23 |
| Silver maple | 588 | 123 | 110 | 1,142 | 930 | $2,893.41 | (±0) | 11.34 |
| Black maple | 208 | 30 | 38 | 208 | 307 | $790.55 | (±0) | 3.10 |
| Red maple | 99 | 12 | 16 | 78 | 126 | $330.54 | (±0) | 1.29 |
| American sycamore | 284 | 40 | 50 | 427 | 262 | $1,063.33 | (±0) | 4.17 |
| Apple | 16 | 2 | 2 | 6 | 6 | $31.76 | (±0) | 0.12 |
| American basswood | 127 | 22 | 20 | 191 | 146 | $505.01 | (±0) | 1.98 |
| Siberian elm | 227 | 27 | 46 | 352 | 140 | $792.19 | (±0) | 3.10 |
| Sugar maple | 66 | 8 | 10 | 52 | 61 | $196.79 | (±0) | 0.77 |
| Northern hackberry | 173 | 18 | 32 | 233 | 136 | $592.17 | (±0) | 2.32 |
| Spruce | 27 | 2 | 3 | 32 | 31 | $95.42 | (±0) | 0.37 |
| Red pine | 48 | 5 | 6 | 83 | 65 | $206.83 | (±0) | 0.81 |
| Other street trees | 283 | 37 | 46 | 383 | 371 | $1,119.09 | (±0) | 4.38 |
| Citywide total | 7,665 | 821 | 1,389 | 10,537 | 5,113 | $25,524.88 | (±0) | 100.00 |

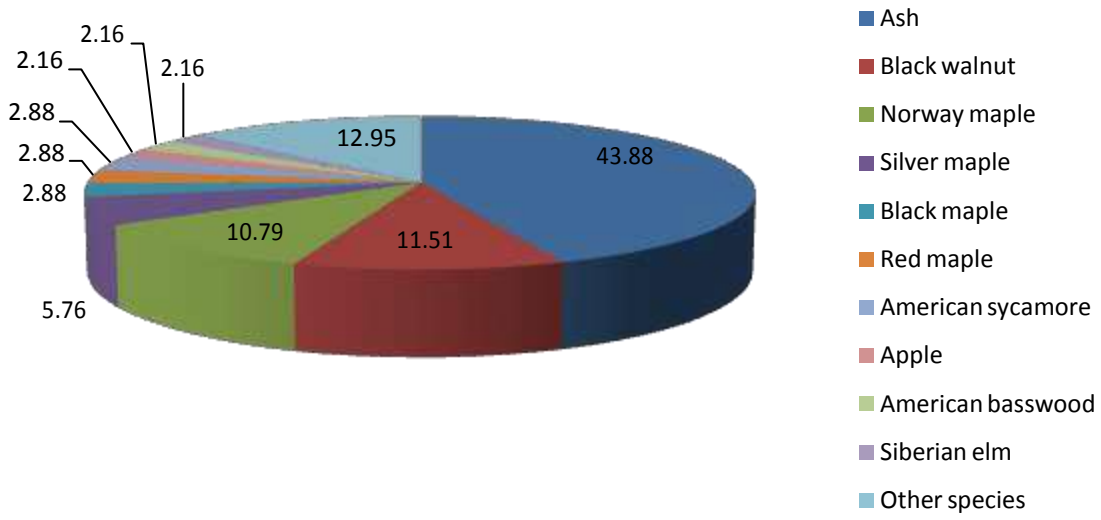


**Figure 1: Species Distribution**

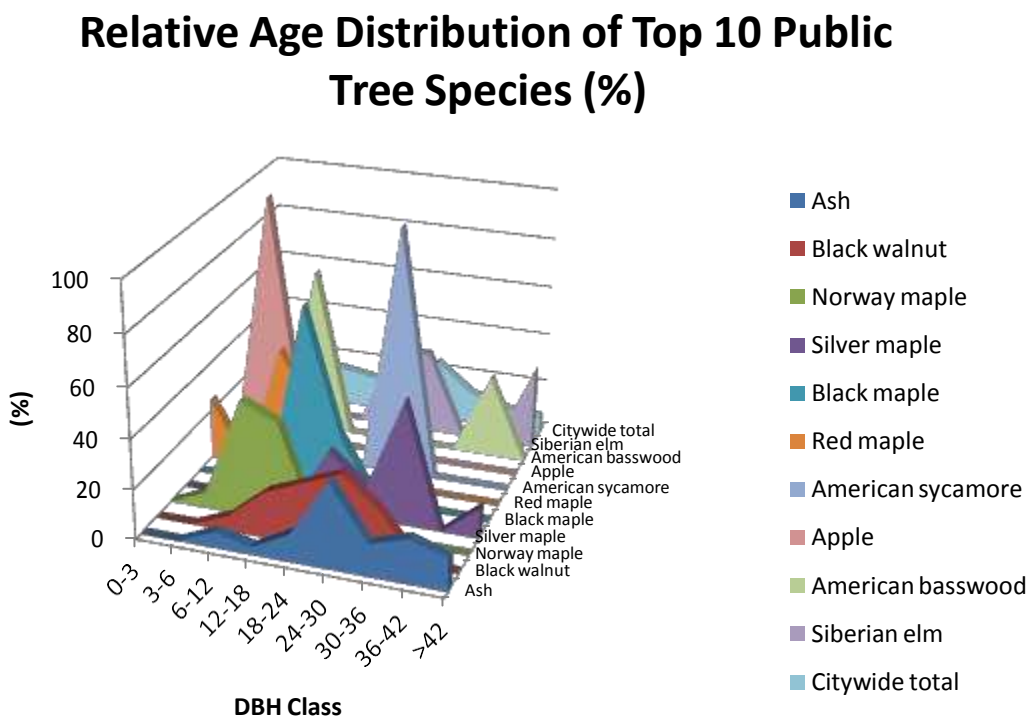


**Figure 2: Relative Age Class**

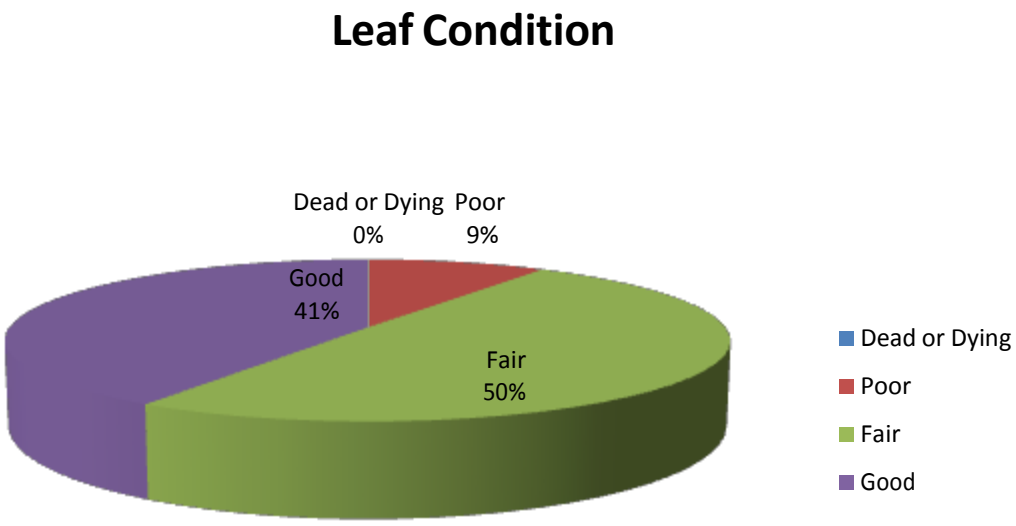


**Figure 3: Foliage Condition**

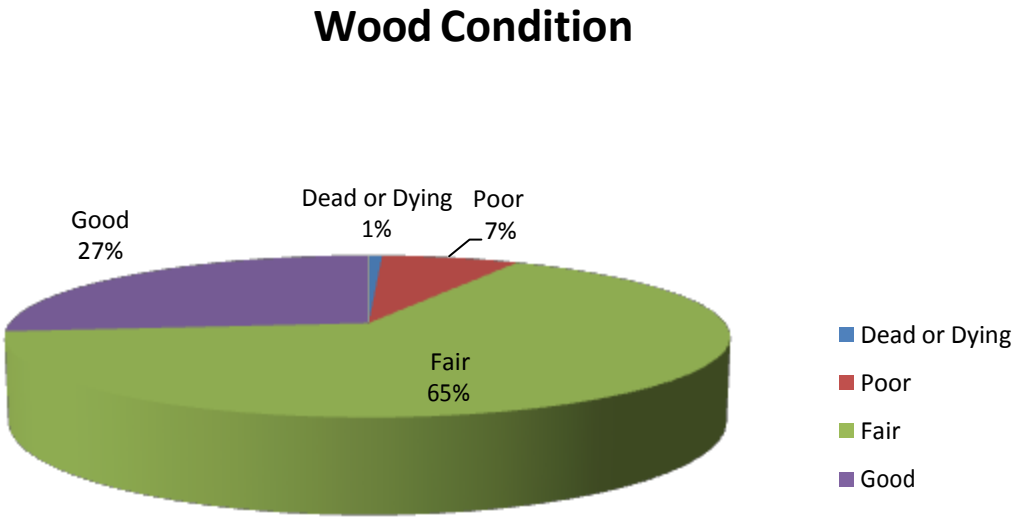


**Figure 4: Wood Condition**

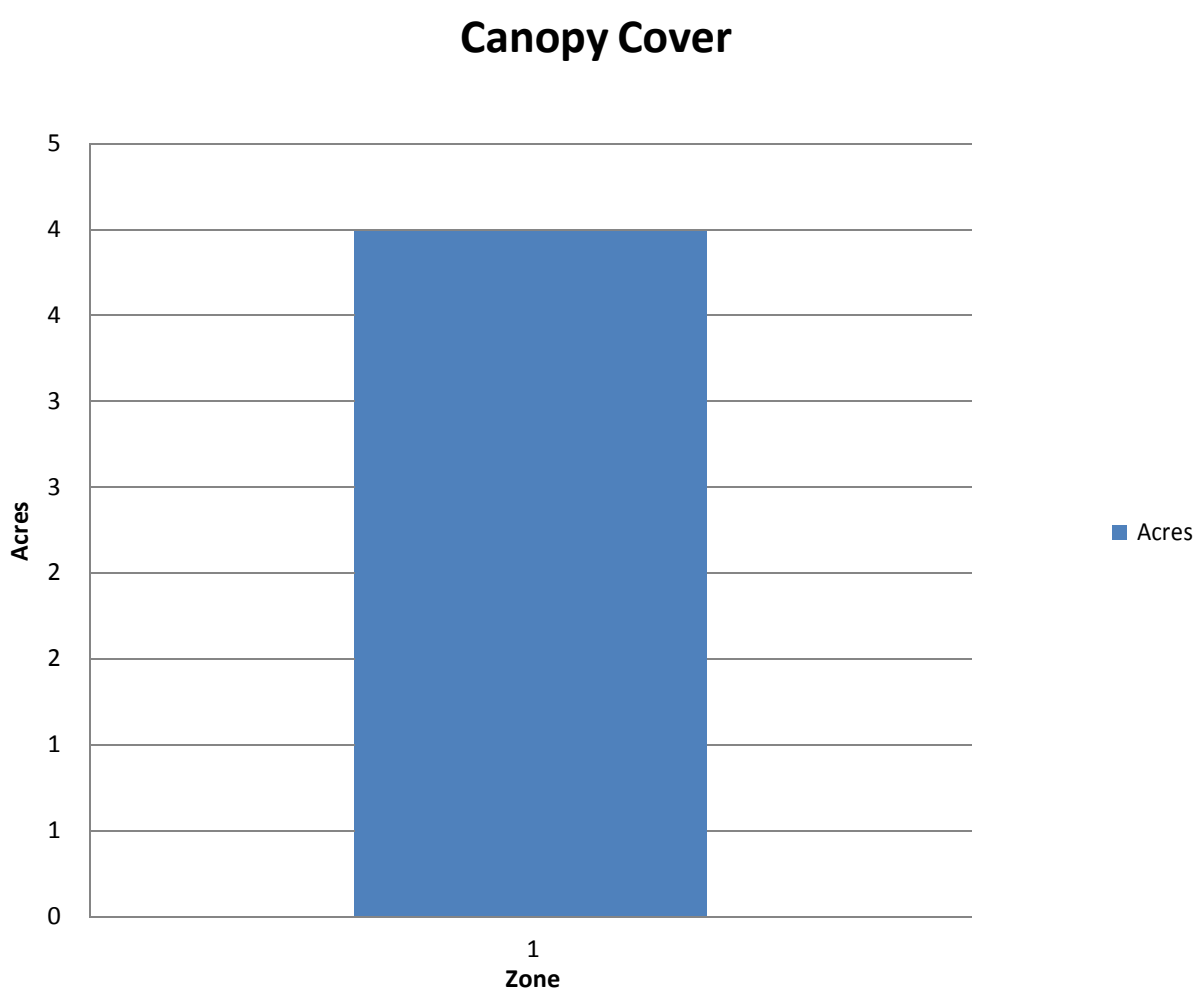


**Figure 5: Canopy Cover in Acres**

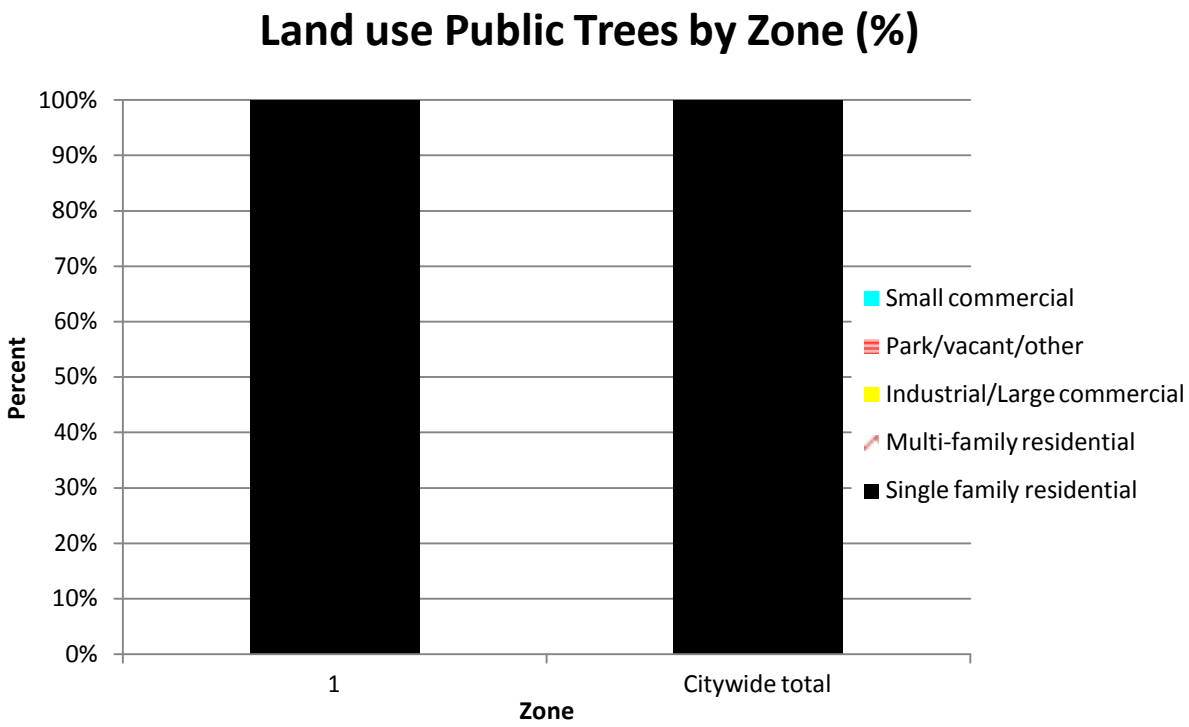


**Figure 6: Land Use of city/park trees**

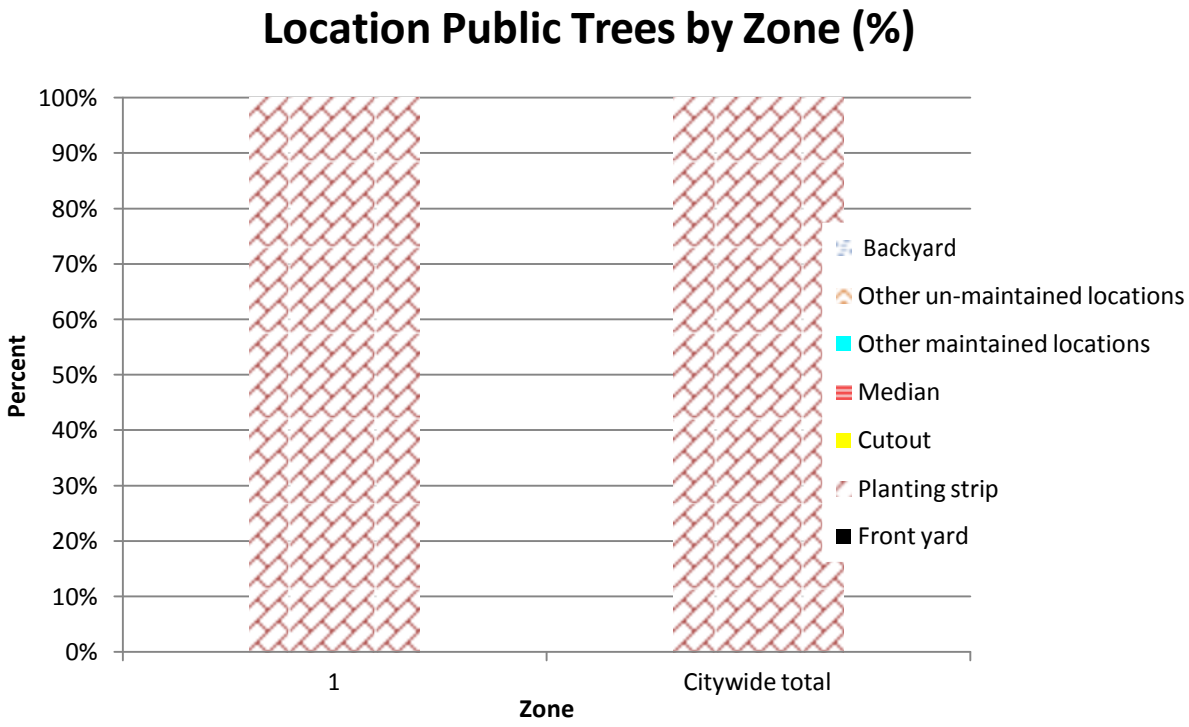


**Figure 7: Location of city/park trees**

# Appendix B: ArcGIS Mapping

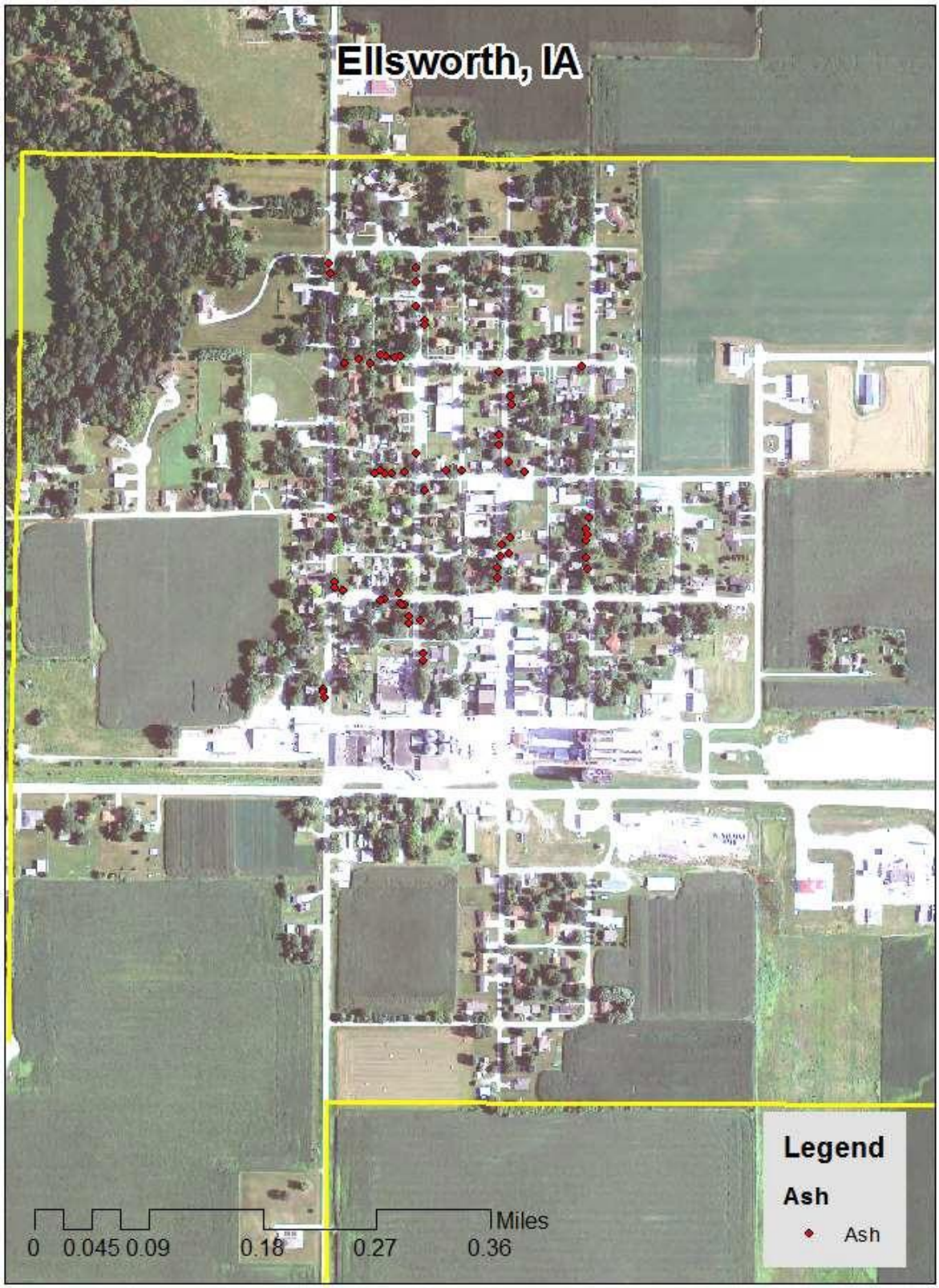


**Figure 1: Location of Ash Trees**

**NO SIGNS OR SYMPTOMS**

**Figure 2: Location of EAB symptoms**

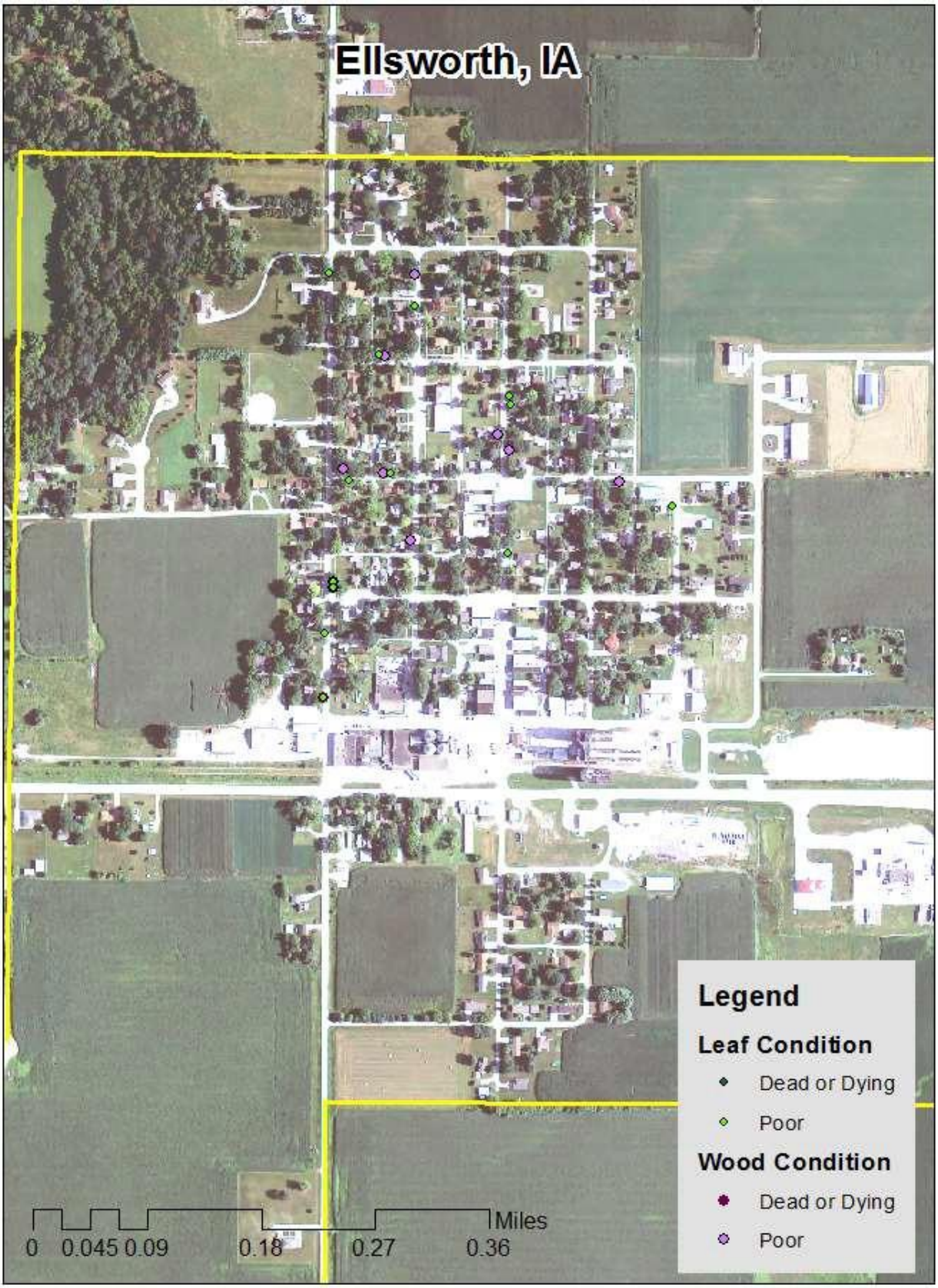


**Figure 3: Location of Poor Condition Trees**


**Figure 4: Location of Trees with Recommended Maintenance**

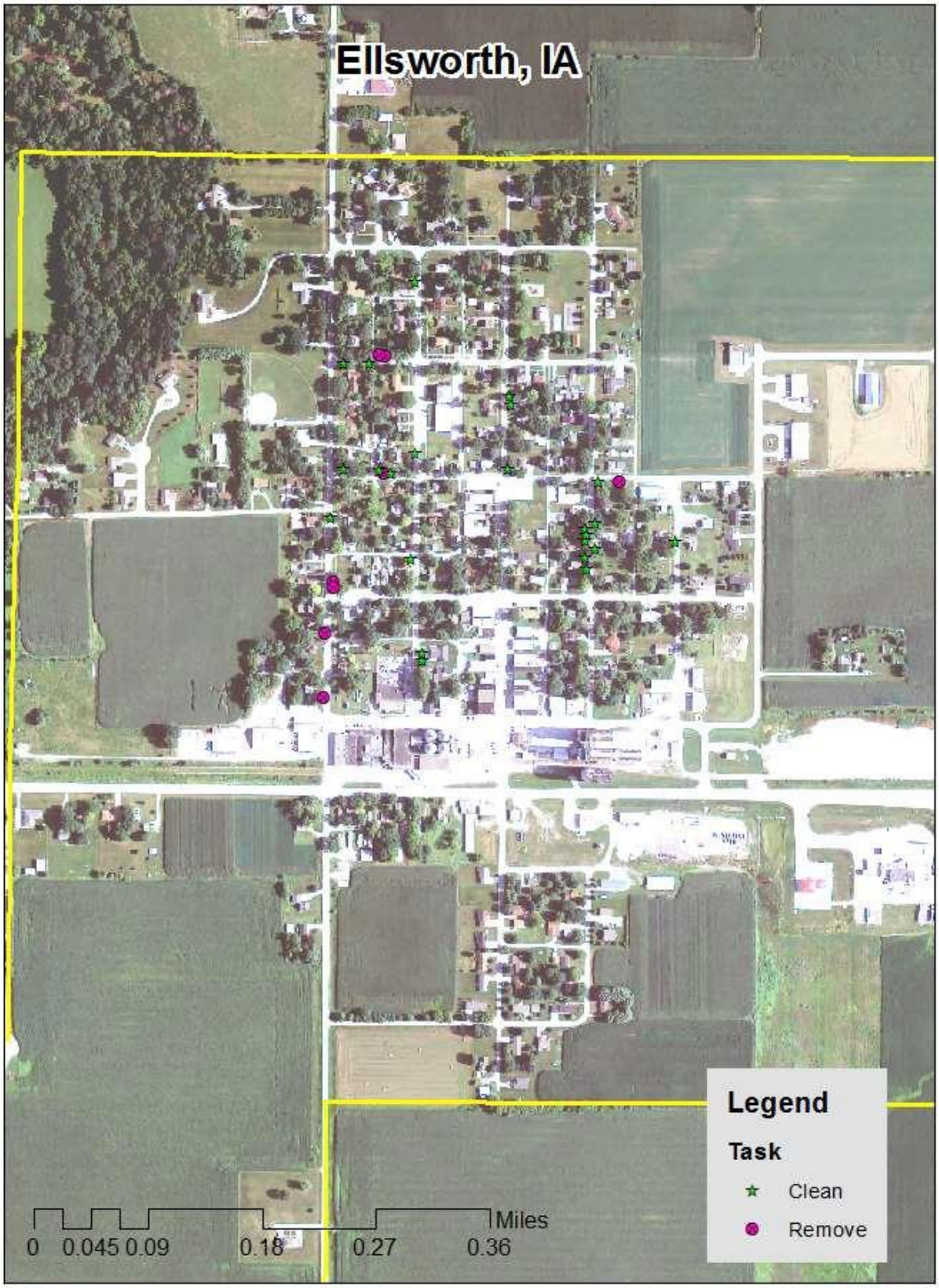


**Figure 5: Maintenance Tasks** ***City ownership of the trees recommended for removal should be verified prior to any removal***

# Appendix C: Proposed Emerald Ash Borer Plan

**Ash Tree Removal**

Ash tree removal will be prioritized with dead, dying, hazardous trees to be removed first. Next will be all ash in poor condition and displaying signs and symptoms of EAB. *City ownership of the tree recommended for removal should be verified prior to any removal*

**EAB Quarantines**

EAB is an extremely destructive plant pest and it is responsible for the death and decline of over 25 million ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:
- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

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

**Wood Disposal**

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

**Canopy Replacement**

As budget permits, all removed ash trees will be replaced. All trees will meet the guidelines in the City Code.

**Postponed Work**

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on trees other than ash will be prioritized by hazardous or emergency situations only.

**Monitoring**

It is recommended that ash trees be checked with a visual survey every year for tree death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

**Private Ash Trees**

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB.

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