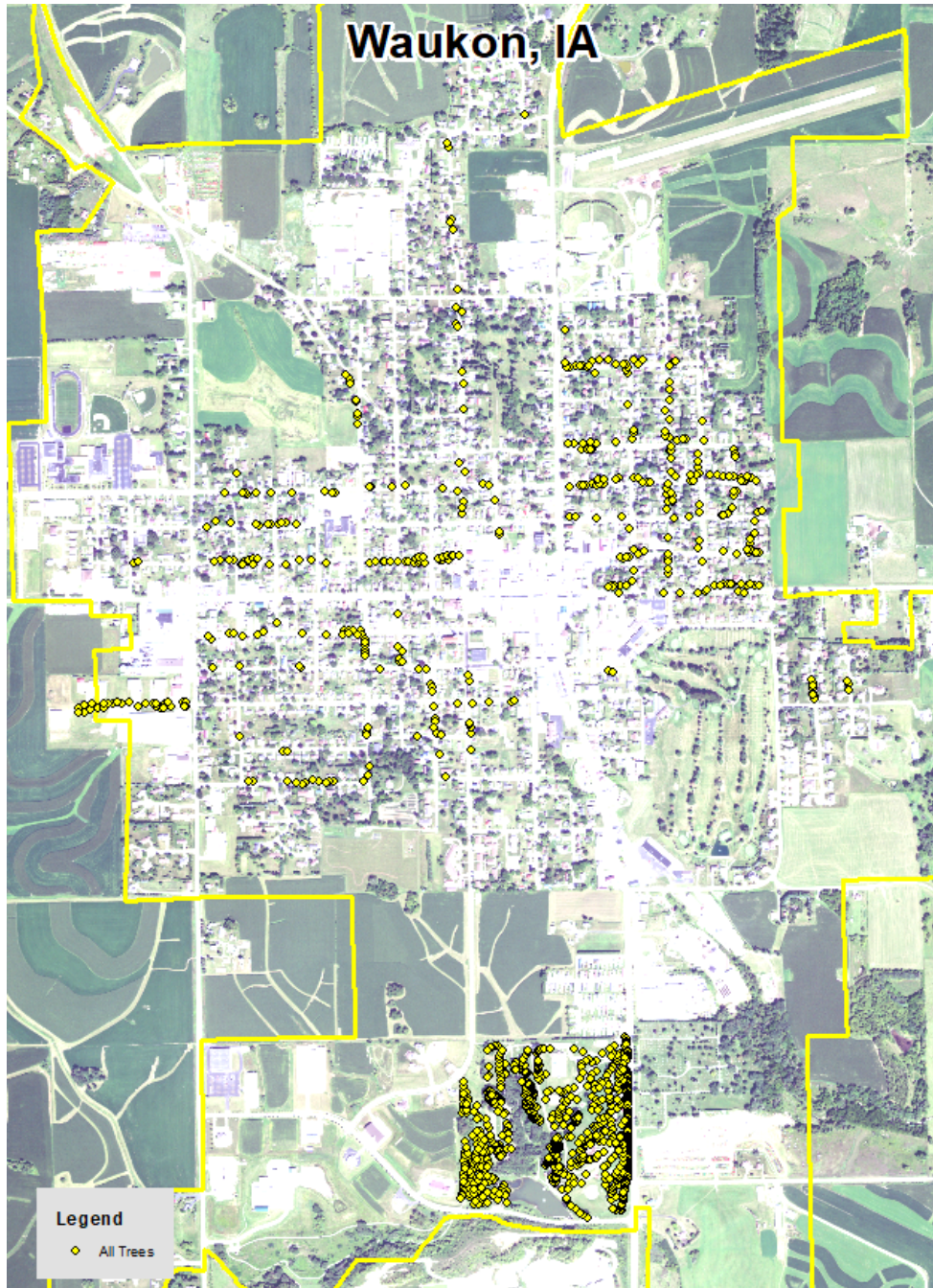


Waukon, IA



2023 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Waukon 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).

Inventory and Results

In 2022, 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 1251 trees inventoried.

- Waukon's trees provide \$137,682 of benefits annually, an average of \$110 a tree
- There are over 49 species of trees
- The top three genera are: Oak 26%, Broadleaf deciduous shrubs 13%, and Maple 11%
- 6% of trees are in need of some type of management
- 31 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 31 trees needing removal, 3 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)
- 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

Introduction

This plan was developed to assist Waukon 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 recovery from Emerald Ash Borer (EAB), an invasive pest that kills native ash trees, it is time to prepare for the increased costs of tree removal or treatment and replacement planting. With proper planning and management of the current canopy in Waukon, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2022, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

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

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

Inventory Results

The data collected for the 1251 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Waukon's trees reduce energy related costs by approximately \$39,159 annually (Appendix A, Table 1). These savings are both in Electricity (186.1 MWh) and in Natural Gas (25,546.8 Therms).

Annual Stormwater Benefits

Waukon's trees intercept about 1,861,945 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$50,459 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 Waukon, it is estimated that trees remove 2,176.5 lbs of air pollution (ozone (O₃), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$5,968 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Waukon, trees sequester about 665,468 lbs of carbon a year with an associated value of \$4,991 (Appendix A, Table 5). In addition, the trees store 5,703,519 lbs of carbon, with a yearly benefit of \$42,776 (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. Waukon receives \$37,105 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STREETS analysis, Waukon's trees provide \$137,682 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 1251 trees in Waukon provide approximately \$110 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Waukon has over 49 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Species	Condition	Tree Count	Standard Error	% of Species	% of Public Trees
American basswood	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	9	(N/A)	100.00	1.07
	Total	9	(N/A)	100.00	1.07
American chestnut	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	1	(N/A)	100.00	0.12
	Total	1	(N/A)	100.00	0.12
Amur maple	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	2	(N/A)	100.00	0.24
	Total	2	(N/A)	100.00	0.24
Apple	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	43	(N/A)	100.00	5.11
	Total	43	(N/A)	100.00	5.11
Ash	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	1	(N/A)	20.00	0.12
	Fair	1	(N/A)	20.00	0.12
	Good	3	(N/A)	60.00	0.36
	Total	5	(N/A)	100.00	0.59
Austrian pine	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00

	Fair	0	(N/A)	0.00	0.00
	Good	8	(N/A)	100.00	0.95
	Total	8	(N/A)	100.00	0.95
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Black cherry	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	2	(N/A)	100.00	0.24
	Total	2	(N/A)	100.00	0.24
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Black spruce	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	1	(N/A)	7.14	0.12
	Fair	0	(N/A)	0.00	0.00
	Good	13	(N/A)	92.86	1.55
	Total	14	(N/A)	100.00	1.66
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Blue spruce	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	1	(N/A)	5.88	0.12
	Fair	0	(N/A)	0.00	0.00
	Good	16	(N/A)	94.12	1.90
	Total	17	(N/A)	100.00	2.02
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Boxelder	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	1	(N/A)	100.00	0.12
	Total	1	(N/A)	100.00	0.12
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Broadleaf Deciduous Large	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	7	(N/A)	100.00	0.83
	Total	7	(N/A)	100.00	0.83

Broadleaf Deciduous Medium	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	1	(N/A)	100.00	0.12
	Total	1	(N/A)	100.00	0.12
Broadleaf Deciduous Small	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	156	(N/A)	100.00	18.55
	Total	156	(N/A)	100.00	18.55
Buckthorn	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	2	(N/A)	100.00	0.24
	Total	2	(N/A)	100.00	0.24
Bur oak	Dead or Dying	8	(N/A)	4.42	0.95
	Poor	0	(N/A)	0.00	0.00
	Fair	34	(N/A)	18.78	4.04
	Good	139	(N/A)	76.80	16.53
	Total	181	(N/A)	100.00	21.52
Conifer Evergreen Large	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	1	(N/A)	14.29	0.12
	Fair	0	(N/A)	0.00	0.00
	Good	6	(N/A)	85.71	0.71
	Total	7	(N/A)	100.00	0.83
Cottonwood	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	7	(N/A)	100.00	0.83

	Total	7	(N/A)	100.00	0.83
Dogwood	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	1	(N/A)	100.00	0.12
	Total	1	(N/A)	100.00	0.12
Eastern red cedar	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	33	(N/A)	100.00	3.92
	Total	33	(N/A)	100.00	3.92
Eastern white pine	Dead or Dying	2	(N/A)	3.77	0.24
	Poor	1	(N/A)	1.89	0.12
	Fair	0	(N/A)	0.00	0.00
	Good	50	(N/A)	94.34	5.95
	Total	53	(N/A)	100.00	6.30
Elm	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	4	(N/A)	100.00	0.48
	Total	4	(N/A)	100.00	0.48
Flowering dogwood	Dead or Dying	1	(N/A)	5.26	0.12
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	18	(N/A)	94.74	2.14
	Total	19	(N/A)	100.00	2.26
Ginkgo	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00

	Fair	0	(N/A)	0.00	0.00
	Good	1	(N/A)	100.00	0.12
	Total	1	(N/A)	100.00	0.12
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Honeylocust	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	8	(N/A)	100.00	0.95
	Total	8	(N/A)	100.00	0.95
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Japanese tree lilac	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	18	(N/A)	100.00	2.14
	Total	18	(N/A)	100.00	2.14
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Kentucky coffeetree	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	1	(N/A)	100.00	0.12
	Total	1	(N/A)	100.00	0.12
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Lilac	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	6	(N/A)	100.00	0.71
	Total	6	(N/A)	100.00	0.71
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Littleleaf linden	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	35	(N/A)	100.00	4.16
	Total	35	(N/A)	100.00	4.16

Mountain ash	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	5	(N/A)	100.00	0.59
	Total	5	(N/A)	100.00	0.59
Mulberry	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	1	(N/A)	100.00	0.12
	Total	1	(N/A)	100.00	0.12
Northern hackberry	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	12	(N/A)	100.00	1.43
	Total	12	(N/A)	100.00	1.43
Northern pin oak	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	2	(N/A)	100.00	0.24
	Total	2	(N/A)	100.00	0.24
Northern red oak	Dead or Dying	1	(N/A)	10.00	0.12
	Poor	0	(N/A)	0.00	0.00
	Fair	1	(N/A)	10.00	0.12
	Good	8	(N/A)	80.00	0.95
	Total	10	(N/A)	100.00	1.19
Northern white cedar	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	34	(N/A)	100.00	4.04

	Total	34	(N/A)	100.00	4.04
Norway maple	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	1	(N/A)	2.94	0.12
	Good	33	(N/A)	97.06	3.92
	Total	34	(N/A)	100.00	4.04
Norway spruce	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	3	(N/A)	100.00	0.36
	Total	3	(N/A)	100.00	0.36
Ohio buckeye	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	1	(N/A)	100.00	0.12
	Total	1	(N/A)	100.00	0.12
Pin oak	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	8	(N/A)	100.00	0.95
	Total	8	(N/A)	100.00	0.95
Quaking aspen	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	5	(N/A)	100.00	0.59
	Total	5	(N/A)	100.00	0.59
Red maple	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00

	Fair	0	(N/A)	0.00	0.00
	Good	6	(N/A)	100.00	0.71
	Total	6	(N/A)	100.00	0.71
Red pine	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	4	(N/A)	100.00	0.48
	Total	4	(N/A)	100.00	0.48
River birch	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	2	(N/A)	100.00	0.24
	Total	2	(N/A)	100.00	0.24
Scotch pine	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	1	(N/A)	12.50	0.12
	Fair	0	(N/A)	0.00	0.00
	Good	7	(N/A)	87.50	0.83
	Total	8	(N/A)	100.00	0.95
Silver maple	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	14	(N/A)	100.00	1.66
	Total	14	(N/A)	100.00	1.66
Southern magnolia	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	3	(N/A)	100.00	0.36
	Total	3	(N/A)	100.00	0.36

Sugar maple	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	2	(N/A)	6.90	0.24
	Good	27	(N/A)	93.10	3.21
	Total	29	(N/A)	100.00	3.45
Swamp white oak	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	14	(N/A)	100.00	1.66
	Total	14	(N/A)	100.00	1.66
White oak	Dead or Dying	1	(N/A)	33.33	0.12
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	2	(N/A)	66.67	0.24
	Total	3	(N/A)	100.00	0.36
Willow	Dead or Dying	0	(N/A)	0.00	0.00
	Poor	0	(N/A)	0.00	0.00
	Fair	0	(N/A)	0.00	0.00
	Good	1	(N/A)	100.00	0.12
	Total	1	(N/A)	100.00	0.12

Age Class

Most of Waukon's trees (68%) are between 6 and 18 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. Waukon's size curve is on the smaller side, indicating a younger than average 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 Waukon indicate that 93% 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, 93% of Waukon'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 2% of the population. This 2% 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	31	2%
Crown Raising	0	0%
Tree Staking	15	1%
Tree Removal	31	2%
Crown Reduction	0	0%

Canopy Cover

The total canopy with both private and public trees is 1%, acres. The canopy cover on city own properties included in the Waukon inventory includes approximately 12 acres (Appendix A, Figure 4).

Land Use and Location

The majority of Waukon's city and park trees are in planting strips in single family residential neighborhoods (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use

Single family residential	17%
Park/vacant/other	83%
Industrial/Large commercial	<1%
Small commercial	<1%
Multifamily residential	<1%

Location

Planting strip	14%
Other maintained locations	<1%
Cutout (surrounded by pavement)	<1%
Front yard	85%

Changes in Forest Structure Since plan in 2010

Since the last plan, a significant loss of canopy was observed throughout the town. Many new trees have been planted in the park.

Recommendations

Risk Management

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

Hazardous trees

Waukon has 4 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 that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 77 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 31 removals, 10 are ash trees. There are a total of 16 ash trees, and 10 of those have signs and symptoms that have been associated with EAB. In addition, there are 21 trees that are in poor health. [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)

Pruning Cycle

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

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 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 Waukon.

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. 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, as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

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 woodpecker damage.

Budget and Emerald Ash Borer Plan

Six Year Maintenance Plan

FY 2023 through 2028

Removal: as budget allows

Planting and Replacement: at a minimum ratio of 1 replacement to 1 removal

Young Tree Pruning & Maintenance: as budget allows

Visual Survey for signs and symptoms of EAB

Ash Tree Removal

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

Treatment of Ash Trees

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

EAB Quarantines

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

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

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

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

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead

and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance 151.02 (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 woodpecker damage.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used. City Code 151.06 states “If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.”

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Waukon

Annual Energy Benefits of Public Trees

2/1/2023

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Bur oak	49.9	3,791	6,713.5	6,579	10,370	(N/A)	14.9	26.5	55.75
Broadleaf Deciduous Small	1.6	124	289.3	284	408	(N/A)	13.7	1.0	2.37
Norway maple	21.5	1,631	3,027.4	2,967	4,598	(N/A)	8.6	11.7	42.97
Apple	5.2	393	833.3	817	1,210	(N/A)	5.1	3.1	18.90
Littleleaf linden	9.0	681	1,132.5	1,110	1,791	(N/A)	4.6	4.6	30.88
Eastern white pine	6.6	500	871.2	854	1,354	(N/A)	4.6	3.5	23.75
Sugar maple	14.8	1,121	1,942.5	1,904	3,025	(N/A)	4.5	7.7	54.02
Swamp white oak	5.9	451	792.3	776	1,228	(N/A)	3.5	3.1	27.90
Red maple	3.4	256	461.4	452	708	(N/A)	3.4	1.8	16.46
Silver maple	11.5	874	1,501.5	1,471	2,345	(N/A)	3.4	6.0	55.84
Northern white cedar	2.3	175	359.9	353	528	(N/A)	2.7	1.3	15.53
Eastern red cedar	3.1	233	458.1	449	682	(N/A)	2.6	1.7	20.68
American basswood	6.0	452	852.7	836	1,288	(N/A)	2.6	3.3	39.03
Northern hackberry	4.7	353	654.1	641	994	(N/A)	2.2	2.5	35.51
Lilac	1.6	125	256.9	252	377	(N/A)	1.8	1.0	17.13
Spruce	0.9	69	135.4	133	201	(N/A)	1.7	0.5	9.59
Flowering dogwood	1.3	101	216.0	212	313	(N/A)	1.5	0.8	16.45
Japanese tree lilac	1.3	101	231.0	226	327	(N/A)	1.4	0.8	18.19
Blue spruce	2.3	171	309.0	303	474	(N/A)	1.4	1.2	27.87
Northern red oak	3.3	250	440.3	432	681	(N/A)	1.4	1.7	40.07
Ash	3.7	284	499.5	490	774	(N/A)	1.3	2.0	48.36
Black spruce	1.5	114	205.0	201	315	(N/A)	1.1	0.8	22.51
Honeylocust	1.8	139	230.4	226	365	(N/A)	1.0	0.9	28.05
Black walnut	3.4	260	488.8	479	739	(N/A)	1.0	1.9	61.60
Broadleaf Deciduous Large	2.7	205	383.1	375	580	(N/A)	0.9	1.5	52.76
Norway spruce	0.9	69	118.9	117	185	(N/A)	0.7	0.5	20.58
Austrian pine	1.3	101	186.1	182	284	(N/A)	0.6	0.7	35.47
Pin oak	2.0	153	262.5	257	410	(N/A)	0.6	1.0	51.29
Scotch pine	0.9	66	111.6	109	175	(N/A)	0.6	0.4	21.93
Red pine	1.3	95	156.9	154	249	(N/A)	0.6	0.6	31.15
Cottonwood	2.8	215	384.0	376	591	(N/A)	0.6	1.5	84.42
Conifer Evergreen Large	1.1	85	147.6	145	230	(N/A)	0.6	0.6	32.87
Amur maple	0.9	67	124.3	122	189	(N/A)	0.5	0.5	31.49
Elm	0.3	25	46.9	46	71	(N/A)	0.5	0.2	11.82
Quaking aspen	0.8	57	95.2	93	150	(N/A)	0.4	0.4	30.07
Mountain ash	0.1	4	9.5	9	13	(N/A)	0.4	0.0	2.68
Willow	0.3	24	42.7	42	66	(N/A)	0.3	0.2	16.46
Ginkgo	0.4	32	55.3	54	87	(N/A)	0.2	0.2	28.86
Southern magnolia	0.3	19	38.1	37	56	(N/A)	0.2	0.1	18.82
Northern pin oak	0.1	11	23.8	23	35	(N/A)	0.2	0.1	11.52
White oak	0.6	45	85.4	84	129	(N/A)	0.2	0.3	42.96
Buckthorn	0.1	5	11.4	11	16	(N/A)	0.2	0.0	5.40
Black cherry	0.6	45	94.9	93	138	(N/A)	0.2	0.4	46.14
Ohio buckeye	0.4	31	62.6	61	92	(N/A)	0.2	0.2	30.71
River birch	0.1	6	12.4	12	18	(N/A)	0.2	0.0	8.99
Callery pear	0.2	18	29.5	29	47	(N/A)	0.1	0.1	46.78
Birch	0.2	18	29.5	29	47	(N/A)	0.1	0.1	46.78
Basswood	0.0	2	3.7	4	6	(N/A)	0.1	0.0	5.82
Hickory	0.3	20	38.1	37	57	(N/A)	0.1	0.1	57.32
Boxelder	0.2	15	23.9	23	39	(N/A)	0.1	0.1	38.63
American chestnut	0.2	18	27.0	26	44	(N/A)	0.1	0.1	44.23
Broadleaf Deciduous Medium	0.0	0	0.8	1	1	(N/A)	0.1	0.0	1.10
Dogwood	0.1	6	12.8	13	18	(N/A)	0.1	0.0	18.19
Kentucky coffeetree	0.1	7	13.7	13	21	(N/A)	0.1	0.1	20.64
Mulberry	0.1	6	12.8	13	18	(N/A)	0.1	0.0	18.19
Species	(MWh)	(\$)	Gas (Therms)	Gas (\$)	(\$)	Error	Trees	Total \$	\$/tree
Total	186.1	14,123	25,546.8	25,036	39,159	(N/A)	100.0	100.0	31.30

Table 2: Annual Stormwater Benefits

Waukon

Annual Stormwater Benefits of Public Trees

2/1/2023

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Bur oak	488,447	13,237	(N/A)	14.9	26.2	71.17
BroadleafDeciduous Small	5,027	136	(N/A)	13.7	0.3	0.79
Norway maple	167,046	4,527	(N/A)	8.6	9.0	42.31
Apple	18,551	503	(N/A)	5.1	1.0	7.86
Littleleaf linden	62,406	1,691	(N/A)	4.6	3.4	29.16
Eastern white pine	149,042	4,039	(N/A)	4.6	8.0	70.86
Sugar maple	164,959	4,470	(N/A)	4.5	8.9	79.83
Swamp white oak	36,141	979	(N/A)	3.5	1.9	22.26
Red maple	23,811	645	(N/A)	3.4	1.3	15.01
Silver maple	151,737	4,112	(N/A)	3.4	8.1	97.91
Northern white cedar	35,163	953	(N/A)	2.7	1.9	28.03
Eastern red cedar	44,710	1,212	(N/A)	2.6	2.4	36.72
American basswood	54,382	1,474	(N/A)	2.6	2.9	44.66
Northern hackberry	31,062	842	(N/A)	2.2	1.7	30.06
Lilac	5,872	159	(N/A)	1.8	0.3	7.23
Spruce	14,578	395	(N/A)	1.7	0.8	18.81
Flowering dogwood	4,728	128	(N/A)	1.5	0.3	6.74
Japanese tree lilac	4,761	129	(N/A)	1.4	0.3	7.17
Blue spruce	35,240	955	(N/A)	1.4	1.9	56.18
Northern red oak	30,134	817	(N/A)	1.4	1.6	48.04
Ash	26,003	705	(N/A)	1.3	1.4	44.04
Black spruce	20,748	562	(N/A)	1.1	1.1	40.16
Honeylocust	11,148	302	(N/A)	1.0	0.6	23.24
Black walnut	39,163	1,061	(N/A)	1.0	2.1	88.44
BroadleafDeciduous Large	33,145	898	(N/A)	0.9	1.8	81.66
Norway spruce	17,742	481	(N/A)	0.7	1.0	53.42
Austrian pine	23,397	634	(N/A)	0.6	1.3	79.26
Pin oak	17,315	469	(N/A)	0.6	0.9	58.66
Scotch pine	12,546	340	(N/A)	0.6	0.7	42.50
Red pine	24,573	666	(N/A)	0.6	1.3	83.24
Cottonwood	42,728	1,158	(N/A)	0.6	2.3	165.42
Conifer Evergreen Large	24,260	657	(N/A)	0.6	1.3	93.92
Amur maple	3,195	87	(N/A)	0.5	0.2	14.43
Elm	2,988	81	(N/A)	0.5	0.2	13.49
Quaking aspen	4,755	129	(N/A)	0.4	0.3	25.77
Mountain ash	160	4	(N/A)	0.4	0.0	0.87
Willow	1,747	47	(N/A)	0.3	0.1	11.83
Ginkgo	2,259	61	(N/A)	0.2	0.1	20.40
Southern magnolia	2,030	55	(N/A)	0.2	0.1	18.34
Northern pin oak	761	21	(N/A)	0.2	0.0	6.87
White oak	6,552	178	(N/A)	0.2	0.4	59.18
Buckthorn	206	6	(N/A)	0.2	0.0	1.86
Black cherry	3,522	95	(N/A)	0.2	0.2	31.82
Ohio buckeye	3,228	87	(N/A)	0.2	0.2	29.16
River birch	325	9	(N/A)	0.2	0.0	4.41
Callery pear	1,409	38	(N/A)	0.1	0.1	38.19
Birch	1,409	38	(N/A)	0.1	0.1	38.19
Basswood	172	5	(N/A)	0.1	0.0	4.65
Hickory	2,591	70	(N/A)	0.1	0.1	70.21

Boxelder	1,456	39 (N/A)	0.1	0.1	39.46
American chestnut	1,466	40 (N/A)	0.1	0.1	39.72
Broadleaf Deciduous Medium	12	0 (N/A)	0.1	0.0	0.33
Dogwood	264	7 (N/A)	0.1	0.0	7.17
Kentucky coffeetree	608	16 (N/A)	0.1	0.0	16.47
Mulberry	264	7 (N/A)	0.1	0.0	7.17
Citywide total	1,861,945	50,459 (N/A)	100.0	100.0	40.33

Table 3: Annual Air Quality Benefits

Waukon

Annual Air Quality Benefits of Public Trees

2/1/2023

Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total (\$)	Standard Error	% of Total Trees	Avg. \$/tree
	O ₃	NO ₂	PM ₁₀	SO ₂		NO ₂	PM ₁₀	VOC	SO ₂								
Bur oak	54.3	8.7	27.1	2.4	292	237.4	34.6	33.1	226.4	1,482	0.0	0	624.0	1,774 (N/A)	14.9	9.54	
Broadleaf Deciduous Small	0.6	0.1	0.4	0.0	3	8.4	1.2	1.1	7.4	51	0.0	0	19.2	54 (N/A)	13.7	0.32	
Norway maple	30.2	5.2	15.3	1.3	164	103.6	15.0	14.3	97.5	643	-7.4	-28	275.1	780 (N/A)	8.6	7.29	
Apple	4.0	0.7	2.1	0.2	22	25.8	3.7	3.5	23.5	158	0.0	0	63.4	180 (N/A)	5.1	2.81	
Littleleaf linden	8.5	1.5	4.5	0.4	47	42.1	6.2	5.9	40.8	264	-4.5	-17	105.3	294 (N/A)	4.6	5.07	
Eastern white pine	18.0	3.6	14.3	2.2	117	31.1	4.6	4.3	29.8	195	-87.6	-329	20.3	-17 (N/A)	4.6	-0.29	
Sugar maple	23.3	4.0	11.5	1.0	126	69.7	10.2	9.7	66.9	436	-18.3	-69	178.2	494 (N/A)	4.5	8.82	
Swamp white oak	5.4	0.9	2.9	0.2	30	28.3	4.1	3.9	27.0	176	-1.4	-5	71.4	201 (N/A)	3.5	4.57	
Red maple	5.0	0.9	2.5	0.2	27	16.0	2.3	2.2	15.2	100	-1.7	-6	42.7	121 (N/A)	3.4	2.81	
Silver maple	24.4	4.1	12.2	1.1	132	54.2	7.9	7.6	52.1	339	-13.0	-49	150.6	423 (N/A)	3.4	10.06	
Northern white cedar	3.7	0.7	3.3	0.5	25	11.4	1.6	1.5	10.5	70	-15.7	-59	17.5	36 (N/A)	2.7	1.07	
Eastern red cedar	8.9	1.8	7.1	1.1	58	15.0	2.2	2.1	13.9	92	-24.6	-92	27.4	58 (N/A)	2.6	1.77	
American basswood	6.5	1.1	3.4	0.3	36	28.8	4.2	4.0	27.0	179	-5.8	-22	69.4	192 (N/A)	2.6	5.83	
Northern hackberry	3.5	0.6	2.0	0.2	20	22.4	3.3	3.1	21.1	139	0.0	0	56.1	159 (N/A)	2.2	5.67	
Lilac	1.3	0.2	0.7	0.1	7	8.1	1.2	1.1	7.5	50	0.0	0	20.2	57 (N/A)	1.8	2.61	
Spruce	1.4	0.3	1.3	0.2	10	4.4	0.6	0.6	4.1	27	-7.3	-27	5.7	10 (N/A)	1.7	0.46	
Flowering dogwood	1.0	0.2	0.5	0.0	5	6.6	0.9	0.9	6.0	41	0.0	0	16.2	46 (N/A)	1.5	2.42	
Japanese tree lilac	0.8	0.1	0.5	0.0	5	6.8	1.0	0.9	6.0	41	0.0	0	16.2	46 (N/A)	1.4	2.55	
Blue spruce	5.6	1.1	4.5	0.7	37	10.7	1.6	1.5	10.2	67	-13.3	-50	22.6	54 (N/A)	1.4	3.15	
Northern red oak	6.2	1.1	3.0	0.3	34	15.6	2.3	2.2	14.9	97	-8.8	-33	36.7	98 (N/A)	1.4	5.76	
Ash	4.4	0.8	2.3	0.2	24	17.8	2.6	2.5	17.0	111	-1.1	-4	46.4	131 (N/A)	1.3	8.20	
Black spruce	2.7	0.5	2.3	0.3	18	7.2	1.0	1.0	6.8	45	-7.5	-28	14.4	35 (N/A)	1.1	2.46	
Honeylocust	1.8	0.3	0.9	0.1	10	8.5	1.3	1.2	8.3	54	-1.2	-4	21.3	59 (N/A)	1.0	4.56	
Black walnut	4.8	0.8	2.3	0.2	25	16.5	2.4	2.3	15.5	103	0.0	0	44.8	128 (N/A)	1.0	10.66	
Broadleaf Deciduous Large	4.3	0.7	2.0	0.2	23	13.0	1.9	1.8	12.2	81	0.0	0	36.0	103 (N/A)	0.9	9.39	
Norway spruce	2.1	0.4	1.7	0.3	14	4.3	0.6	0.6	4.1	27	-9.9	-37	4.1	3 (N/A)	0.7	0.35	
Austrian pine	4.3	0.8	3.4	0.5	28	6.4	0.9	0.9	6.0	40	-9.1	-34	14.1	33 (N/A)	0.6	4.16	
Pin oak	2.6	0.5	1.4	0.1	14	9.5	1.4	1.3	9.1	60	-5.0	-19	20.9	55 (N/A)	0.6	6.88	
Scotch pine	1.4	0.3	1.2	0.2	9	4.1	0.6	0.6	3.9	26	-5.5	-21	6.7	14 (N/A)	0.6	1.77	
Red pine	2.9	0.6	2.4	0.4	19	5.9	0.9	0.8	5.7	37	-13.6	-51	5.9	5 (N/A)	0.6	0.62	
Cottonwood	7.0	1.1	3.1	0.3	36	13.5	2.0	1.9	12.8	84	0.0	0	41.6	121 (N/A)	0.6	17.22	
Conifer Evergreen Large	2.9	0.6	2.3	0.4	19	5.3	0.8	0.7	5.1	33	-13.3	-50	4.8	2 (N/A)	0.6	0.35	
Amur maple	0.9	0.2	0.4	0.0	5	4.3	0.6	0.6	4.0	26	0.0	0	11.0	31 (N/A)	0.5	5.22	
Elm	0.3	0.0	0.1	0.0	1	1.6	0.2	0.2	1.5	10	0.0	0	4.0	11 (N/A)	0.5	1.89	
Quaking aspen	0.3	0.0	0.2	0.0	2	3.5	0.5	0.5	3.4	22	0.0	0	8.5	24 (N/A)	0.4	4.76	
Mountain ash	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.2	2	0.0	0	0.6	2 (N/A)	0.4	0.35	
Willow	0.2	0.0	0.1	0.0	1	1.5	0.2	0.2	1.4	9	-0.1	0	3.7	10 (N/A)	0.3	2.62	
Ginkgo	0.5	0.1	0.2	0.0	3	2.0	0.3	0.3	1.9	13	-0.2	-1	5.1	14 (N/A)	0.2	4.83	
Southern magnolia	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.1	8	-0.5	-2	2.4	6 (N/A)	0.2	2.10	
Northern pin oak	0.1	0.0	0.0	0.0	0	0.7	0.1	0.1	0.7	5	0.0	0	1.7	5 (N/A)	0.2	1.61	
White oak	0.8	0.1	0.4	0.0	4	2.9	0.4	0.4	2.7	18	0.0	0	7.7	22 (N/A)	0.2	7.30	
Buckthorn	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	0.0	0	0.8	2 (N/A)	0.2	0.71	
Black cherry	1.3	0.2	0.6	0.1	7	3.0	0.4	0.4	2.7	18	0.0	0	8.7	25 (N/A)	0.2	8.35	
Ohio buckeye	0.6	0.1	0.3	0.0	3	2.0	0.3	0.3	1.8	12	-0.1	-1	5.2	15 (N/A)	0.2	4.95	
River birch	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	2 (N/A)	0.2	1.21	
Callery pear	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8 (N/A)	0.1	7.92	
Birch	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8 (N/A)	0.1	7.92	
Basswood	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	
Hickory	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.3	9 (N/A)	0.1	9.34	
Boxelder	0.1	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	-0.1	0	2.3	6 (N/A)	0.1	6.37	
American chestnut	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.1	7.42	
Broadleaf Deciduous Medium	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	0.14	
Dogwood	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	0.1	2.55	
Kentucky coffeetree	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3 (N/A)	0.1	2.99	
Mulberry	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	0.1	2.55	
Citywide total	259.8	45.1	147.6	15.8	1,470	889.0	129.4	123.4	843.4	5,537	-276.9	-1,038	2,176.5	5,968 (N/A)	100.0	4.77	

Table 4: Annual Carbon Stored

Waukon

Stored CO2 Benefits of Public Trees

2/1/2023

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Bur oak	1,756,497	13,174	(N/A)	14.9	30.8	70.83
Broadleaf Deciduous	14,666	110	(N/A)	13.7	0.3	0.64
Norway maple	497,281	3,730	(N/A)	8.6	8.7	34.86
Apple	70,280	527	(N/A)	5.1	1.2	8.24
Littleleaf linden	189,138	1,419	(N/A)	4.6	3.3	24.46
Eastern white pine	225,249	1,689	(N/A)	4.6	3.9	29.64
Sugar maple	684,630	5,135	(N/A)	4.5	12.0	91.69
Swamp white oak	91,614	687	(N/A)	3.5	1.6	15.62
Red maple	58,119	436	(N/A)	3.4	1.0	10.14
Silver maple	540,375	4,053	(N/A)	3.4	9.5	96.50
Northern white cedar	35,655	267	(N/A)	2.7	0.6	7.87
Eastern red cedar	29,066	218	(N/A)	2.6	0.5	6.61
American basswood	236,664	1,775	(N/A)	2.6	4.1	53.79
Northern hackberry	46,307	347	(N/A)	2.2	0.8	12.40
Lilac	22,888	172	(N/A)	1.8	0.4	7.80
Spruce	16,838	126	(N/A)	1.7	0.3	6.01
Flowering dogwood	17,530	131	(N/A)	1.5	0.3	6.92
Japanese tree lilac	16,342	123	(N/A)	1.4	0.3	6.81
Blue spruce	45,331	340	(N/A)	1.4	0.8	20.00
Northern red oak	130,663	980	(N/A)	1.4	2.3	57.65
Ash	72,748	546	(N/A)	1.3	1.3	34.10
Black spruce	17,657	132	(N/A)	1.1	0.3	9.46
Honeylocust	22,353	168	(N/A)	1.0	0.4	12.90
Black walnut	154,130	1,156	(N/A)	1.0	2.7	96.33
Broadleaf Deciduous	136,389	1,023	(N/A)	0.9	2.4	92.99
Norway spruce	24,964	187	(N/A)	0.7	0.4	20.80
Austrian pine	39,148	294	(N/A)	0.6	0.7	36.70
Pin oak	64,732	485	(N/A)	0.6	1.1	60.69
Scotch pine	12,941	97	(N/A)	0.6	0.2	12.13
Red pine	34,642	260	(N/A)	0.6	0.6	32.48
Cottonwood	237,247	1,779	(N/A)	0.6	4.2	254.19
Conifer Evergreen La	33,669	253	(N/A)	0.6	0.6	36.07
Amur maple	13,964	105	(N/A)	0.5	0.2	17.46
Elm	8,865	66	(N/A)	0.5	0.2	11.08
Quaking aspen	10,447	78	(N/A)	0.4	0.2	15.67
Mountain ash	397	3	(N/A)	0.4	0.0	0.60
Willow	4,078	31	(N/A)	0.3	0.1	7.65
Ginkgo	6,464	48	(N/A)	0.2	0.1	16.16
Southern magnolia	1,452	11	(N/A)	0.2	0.0	3.63
Northern pin oak	1,336	10	(N/A)	0.2	0.0	3.34
White oak	24,243	182	(N/A)	0.2	0.4	60.61
Buckthorn	533	4	(N/A)	0.2	0.0	1.33
Black cherry	20,228	152	(N/A)	0.2	0.4	50.57
Ohio buckeye	9,264	69	(N/A)	0.2	0.2	23.16
River birch	437	3	(N/A)	0.2	0.0	1.64
Callery pear	3,624	27	(N/A)	0.1	0.1	27.18
Birch	3,624	27	(N/A)	0.1	0.1	27.18
Basswood	185	1	(N/A)	0.1	0.0	1.39
Hickory	8,458	63	(N/A)	0.1	0.1	63.43
Boxelder	3,624	27	(N/A)	0.1	0.1	27.18
American chestnut	3,672	28	(N/A)	0.1	0.1	27.54
Broadleaf Deciduous	17	0	(N/A)	0.1	0.0	0.13
Dogwood	908	7	(N/A)	0.1	0.0	6.81
Kentucky coffeetree	1,035	8	(N/A)	0.1	0.0	7.76
Mulberry	908	7	(N/A)	0.1	0.0	6.81
Citywide total	5,703,519	42,776	(N/A)	100.0	100.0	34.19

Table 5: Annual Carbon Sequestered

Waukon

Annual CO Benefits of Public Trees

2/1/2023

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
Bur oak	116,488	874	-8,431	-496	-67	83,783	628	191,344	1,435 (N/A)	14.9	28.8	7.72
Broadleaf Deciduous Smal	3,089	23	-77	-50	-1	2,743	21	5,706	43 (N/A)	13.7	0.9	0.25
Norway maple	37,030	278	-2,399	-210	-20	36,047	270	70,469	529 (N/A)	8.6	10.6	4.94
Apple	7,860	59	-338	-74	-3	8,688	65	16,135	121 (N/A)	5.1	2.4	1.89
Littleleaf linden	24,573	184	-911	-96	-8	15,059	113	38,626	290 (N/A)	4.6	5.8	4.99
Eastern white pine	6,813	51	-1,081	-132	-9	11,047	83	16,646	125 (N/A)	4.6	2.5	2.19
Sugar maple	33,657	252	-3,291	-160	-26	24,780	186	54,986	412 (N/A)	4.5	8.3	7.36
Swamp white oak	10,496	79	-451	-56	-4	9,974	75	19,963	150 (N/A)	3.5	3.0	3.40
Red maple	7,369	55	-279	-39	-2	5,648	42	12,699	95 (N/A)	3.4	1.9	2.21
Silver maple	43,517	326	-2,595	-122	-20	19,309	145	60,108	451 (N/A)	3.4	9.0	10.73
Northern white cedar	1,733	13	-171	-49	-2	3,874	29	5,387	40 (N/A)	2.7	0.8	1.19
Eastern red cedar	625	5	-140	-56	-1	5,160	39	5,589	42 (N/A)	2.6	0.8	1.27
American basswood	15,445	116	-1,136	-69	-9	9,993	75	24,234	182 (N/A)	2.6	3.6	5.51
Northern hackberry	4,401	33	-223	-41	-2	7,807	59	11,943	90 (N/A)	2.2	1.8	3.20
Lilac	2,501	19	-110	-24	-1	2,765	21	5,133	38 (N/A)	1.8	0.8	1.75
Spruce	952	7	-81	-20	-1	1,519	11	2,370	18 (N/A)	1.7	0.4	0.85
Flowering dogwood	2,033	15	-84	-20	-1	2,230	17	4,158	31 (N/A)	1.5	0.6	1.64
Japanese tree lilac	2,050	15	-78	-21	-1	2,235	17	4,185	31 (N/A)	1.4	0.6	1.74
Blue spruce	2,009	15	-218	-43	-2	3,780	28	5,528	41 (N/A)	1.4	0.8	2.44
Northern red oak	4,139	31	-627	-40	-5	5,519	41	8,991	67 (N/A)	1.4	1.4	3.97
Ash	6,349	48	-349	-34	-3	6,281	47	12,247	92 (N/A)	1.3	1.8	5.74
Black spruce	1,235	9	-85	-27	-1	2,526	19	3,649	27 (N/A)	1.1	0.5	1.95
Honeylocust	3,451	26	-109	-15	-1	3,068	23	6,395	48 (N/A)	1.0	1.0	3.69
Black walnut	8,507	64	-740	-37	-6	5,750	43	13,480	101 (N/A)	1.0	2.0	8.43
Broadleaf Deciduous Larg	6,965	52	-655	-29	-5	4,529	34	10,810	81 (N/A)	0.9	1.6	7.37
Norway spruce	1,071	8	-120	-17	-1	1,517	11	2,452	18 (N/A)	0.7	0.4	2.04
Austrian pine	1,508	11	-188	-28	-2	2,239	17	3,532	26 (N/A)	0.6	0.5	3.31
Pin oak	6,784	51	-311	-19	-2	3,384	25	9,837	74 (N/A)	0.6	1.5	9.22
Scotch pine	876	7	-62	-15	-1	1,460	11	2,259	17 (N/A)	0.6	0.3	2.12
Red pine	1,486	11	-166	-22	-1	2,110	16	3,408	26 (N/A)	0.6	0.5	3.20
Cottonwood	5,644	42	-1,139	-32	-9	4,744	36	9,217	69 (N/A)	0.6	1.4	9.87
Conifer Evergreen Large	1,190	9	-162	-21	-1	1,889	14	2,895	22 (N/A)	0.6	0.4	3.10
Amur maple	1,298	10	-67	-10	-1	1,482	11	2,703	20 (N/A)	0.5	0.4	3.38
Elm	816	6	-43	-4	0	552	4	1,321	10 (N/A)	0.5	0.2	1.65
Quaking aspen	1,517	11	-50	-7	0	1,262	9	2,721	20 (N/A)	0.4	0.4	4.08
Mountain ash	102	1	-2	-2	0	91	1	189	1 (N/A)	0.4	0.0	0.28
Willow	583	4	-21	-3	0	531	4	1,089	8 (N/A)	0.3	0.2	2.04
Ginkgo	417	3	-31	-6	0	715	5	1,096	8 (N/A)	0.2	0.2	2.74
Southern magnolia	169	1	-7	-4	0	422	3	581	4 (N/A)	0.2	0.1	1.45
Northern pin oak	325	2	-7	-2	0	248	2	563	4 (N/A)	0.2	0.1	1.41
White oak	1,519	11	-116	-6	-1	998	7	2,394	18 (N/A)	0.2	0.4	5.99
Buckthorn	114	1	-3	-2	0	112	1	221	2 (N/A)	0.2	0.0	0.55
Black cherry	478	4	-97	-10	-1	1,004	8	1,376	10 (N/A)	0.2	0.2	3.44
Ohio buckeye	789	6	-45	-4	0	680	5	1,420	11 (N/A)	0.2	0.2	3.55
River birch	191	1	-3	-1	0	129	1	316	2 (N/A)	0.2	0.0	1.18
Callery pear	386	3	-17	-2	0	395	3	762	6 (N/A)	0.1	0.1	5.71
Birch	386	3	-17	-2	0	395	3	762	6 (N/A)	0.1	0.1	5.71
Basswood	74	1	-1	-1	0	49	0	121	1 (N/A)	0.1	0.0	0.91
Hickory	660	5	-41	-3	0	441	3	1,058	8 (N/A)	0.1	0.2	7.93
Boxelder	418	3	-17	-2	0	336	3	735	6 (N/A)	0.1	0.1	5.51
American chestnut	445	3	-18	-2	0	393	3	819	6 (N/A)	0.1	0.1	6.14
Broadleaf Deciduous Medi	5	0	0	0	0	7	0	12	0 (N/A)	0.1	0.0	0.09
Dogwood	114	1	-4	-1	0	124	1	232	2 (N/A)	0.1	0.0	1.74
Kentucky coffeetree	209	2	-5	-1	0	159	1	361	3 (N/A)	0.1	0.1	2.71
Mulberry	114	1	-4	-1	0	124	1	232	2 (N/A)	0.1	0.0	1.74
Citywide total	382,977	2,872	-27,425	-2,191	-222	312,107	2,341	665,468	4,991 (N/A)	100.0	100.0	3.99

Table 6: Annual Social and Aesthetic Benefits

Waukon

Annual Aesthetic/Other Benefits of Public Trees

2/1/2023

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Bur oak	10,096	(N/A)	14.9	27.2	54.28
Broadleaf/Deciduous Small	106	(N/A)	13.7	0.3	0.62
Norway maple	3,669	(N/A)	8.6	9.9	34.29
Apple	443	(N/A)	5.1	1.2	6.91
Littleleaf linden	2,672	(N/A)	4.6	7.2	46.07
Eastern white pine	1,051	(N/A)	4.6	2.8	18.44
Sugar maple	3,456	(N/A)	4.5	9.3	61.72
Swamp white oak	1,126	(N/A)	3.5	3.0	25.59
Red maple	984	(N/A)	3.4	2.7	22.89
Silver maple	3,595	(N/A)	3.4	9.7	85.59
Northern white cedar	505	(N/A)	2.7	1.4	14.85
Eastern red cedar	270	(N/A)	2.6	0.7	8.18
American basswood	1,201	(N/A)	2.6	3.2	36.40
Northern hackberry	804	(N/A)	2.2	2.2	28.71
Lilac	141	(N/A)	1.8	0.4	6.39
Spruce	208	(N/A)	1.7	0.6	9.90
Flowering dogwood	114	(N/A)	1.5	0.3	6.00
Japanese tree lilac	115	(N/A)	1.4	0.3	6.40
Blue spruce	308	(N/A)	1.4	0.8	18.12
Northern red oak	320	(N/A)	1.4	0.9	18.81
Ash	629	(N/A)	1.3	1.7	39.32
Black spruce	311	(N/A)	1.1	0.8	22.25
Honeylocust	725	(N/A)	1.0	2.0	55.79
Black walnut	695	(N/A)	1.0	1.9	57.95
Broadleaf/Deciduous Large	542	(N/A)	0.9	1.5	49.23
Norway spruce	171	(N/A)	0.7	0.5	18.97
Austrian pine	102	(N/A)	0.6	0.3	12.81
Pin oak	576	(N/A)	0.6	1.6	71.96
Scotch pine	202	(N/A)	0.6	0.5	25.22
Red pine	234	(N/A)	0.6	0.6	29.29
Cottonwood	385	(N/A)	0.6	1.0	55.03
Conifer Evergreen Large	226	(N/A)	0.6	0.6	32.30
Amur maple	75	(N/A)	0.5	0.2	12.46
Elm	103	(N/A)	0.5	0.3	17.16
Quaking aspen	177	(N/A)	0.4	0.5	35.48
Mountain ash	4	(N/A)	0.4	0.0	0.84
Willow	68	(N/A)	0.3	0.2	16.92
Ginkgo	36	(N/A)	0.2	0.1	12.10
Southern magnolia	66	(N/A)	0.2	0.2	21.93
Northern pin oak	42	(N/A)	0.2	0.1	13.95
White oak	129	(N/A)	0.2	0.3	42.85
Buckthorn	6	(N/A)	0.2	0.0	2.06
Black cherry	29	(N/A)	0.2	0.1	9.60
Ohio buckeye	82	(N/A)	0.2	0.2	27.39
River birch	26	(N/A)	0.2	0.1	12.89
Callery pear	39	(N/A)	0.1	0.1	39.16
Birch	39	(N/A)	0.1	0.1	39.16
Basswood	15	(N/A)	0.1	0.0	14.73

Hickory	58 (N/A)	0.1	0.2	57.69
Boxelder	39 (N/A)	0.1	0.1	39.36
American chestnut	46 (N/A)	0.1	0.1	45.86
Broadleaf Deciduous Medium	3 (N/A)	0.1	0.0	2.74
Dogwood	6 (N/A)	0.1	0.0	6.40
Kentucky coffeetree	29 (N/A)	0.1	0.1	28.56
Mulberry	6 (N/A)	0.1	0.0	6.40
Citywide total	37,105 (N/A)	100.0	100.0	29.66

Table 7: Summary of Benefits in Dollars

Waukon

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

2/1/2023

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Bur oak	10,370	1,435	1,774	13,237	10,096	36,912	(N/A)	26.8
Broadleaf Deciduous Sm	408	43	54	136	106	747	(N/A)	0.5
Norway maple	4,598	529	780	4,527	3,669	14,102	(N/A)	10.2
Apple	1,210	121	180	503	443	2,456	(N/A)	1.8
Littleleaf linden	1,791	290	294	1,691	2,672	6,739	(N/A)	4.9
Eastern white pine	1,354	125	-17	4,039	1,051	6,552	(N/A)	4.8
Sugar maple	3,025	412	494	4,470	3,456	11,858	(N/A)	8.6
Swamp white oak	1,228	150	201	979	1,126	3,684	(N/A)	2.7
Red maple	708	95	121	645	984	2,553	(N/A)	1.9
Silver maple	2,345	451	423	4,112	3,595	10,925	(N/A)	7.9
Northern white cedar	528	40	36	953	505	2,063	(N/A)	1.5
Eastern red cedar	682	42	58	1,212	270	2,264	(N/A)	1.6
American basswood	1,288	182	192	1,474	1,201	4,337	(N/A)	3.1
Northern hackberry	994	90	159	842	804	2,888	(N/A)	2.1
Lilac	377	38	57	159	141	773	(N/A)	0.6
Spruce	201	18	10	395	208	832	(N/A)	0.6
Flowering dogwood	313	31	46	128	114	632	(N/A)	0.5
Japanese tree lilac	327	31	46	129	115	649	(N/A)	0.5
Blue spruce	474	41	54	955	308	1,832	(N/A)	1.3
Northern red oak	681	67	98	817	320	1,983	(N/A)	1.4
Ash	774	92	131	705	629	2,331	(N/A)	1.7
Black spruce	315	27	35	562	311	1,251	(N/A)	0.9
Honeylocust	365	48	59	302	725	1,499	(N/A)	1.1
Black walnut	739	101	128	1,061	695	2,725	(N/A)	2.0
Broadleaf Deciduous La	580	81	103	898	542	2,204	(N/A)	1.6
Norway spruce	185	18	3	481	171	858	(N/A)	0.6
Austrian pine	284	26	33	634	102	1,080	(N/A)	0.8
Pin oak	410	74	55	469	576	1,584	(N/A)	1.2
Scotch pine	175	17	14	340	202	748	(N/A)	0.5
Red pine	249	26	5	666	234	1,180	(N/A)	0.9
Cottonwood	591	69	121	1,158	385	2,324	(N/A)	1.7
Conifer Evergreen Large	230	22	2	657	226	1,138	(N/A)	0.8
Amur maple	189	20	31	87	75	402	(N/A)	0.3
Elm	71	10	11	81	103	276	(N/A)	0.2
Quaking aspen	150	20	24	129	177	501	(N/A)	0.4
Mountain ash	13	1	2	4	4	25	(N/A)	0.0
Willow	66	8	10	47	68	200	(N/A)	0.1
Ginkgo	87	8	14	61	36	207	(N/A)	0.2
Southern magnolia	56	4	6	55	66	188	(N/A)	0.1
Northern pin oak	35	4	5	21	42	106	(N/A)	0.1
White oak	129	18	22	178	129	475	(N/A)	0.3
Buckthorn	16	2	2	6	6	32	(N/A)	0.0
Black cherry	138	10	25	95	29	298	(N/A)	0.2
Ohio buckeye	92	11	15	87	82	287	(N/A)	0.2
River birch	18	2	2	9	26	57	(N/A)	0.0
Callery pear	47	6	8	38	39	138	(N/A)	0.1
Birch	47	6	8	38	39	138	(N/A)	0.1
Basswood	6	1	1	5	15	27	(N/A)	0.0

Hickory	57	8	9	70	58	202 (N/A)	0.1
Boxelder	39	6	6	39	39	129 (N/A)	0.1
American chestnut	44	6	7	40	46	143 (N/A)	0.1
Broadleaf Deciduous M	1	0	0	0	3	4 (N/A)	0.0
Dogwood	18	2	3	7	6	36 (N/A)	0.0
Kentucky coffeetree	21	3	3	16	29	71 (N/A)	0.1
Mulberry	18	2	3	7	6	36 (N/A)	0.0
Citywide Total	39,159	4,991	5,968	50,459	37,105	137,682 (N/A)	100.0

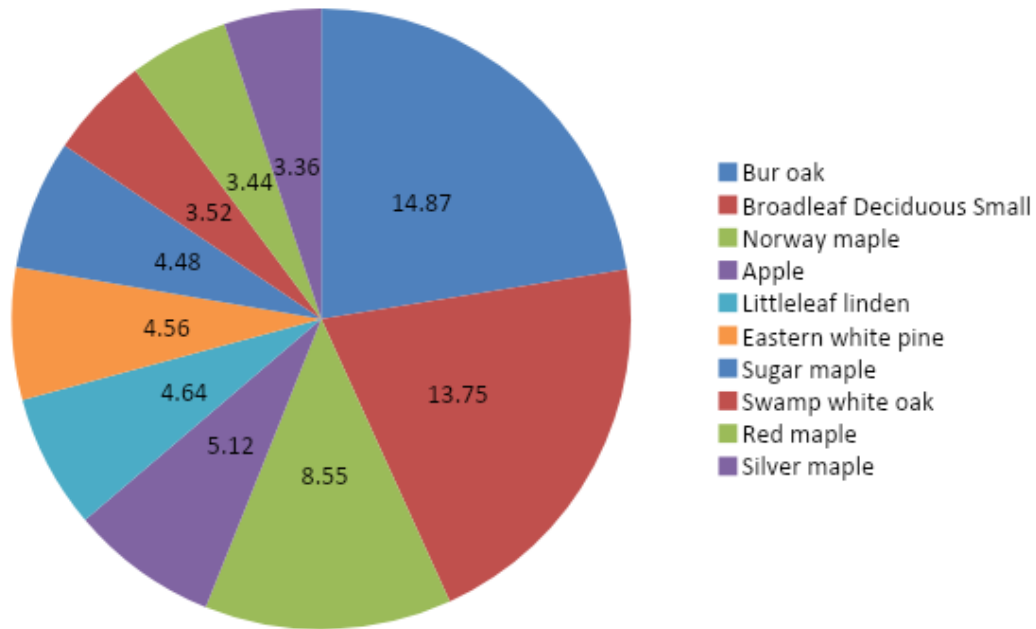


Figure 1: Species Distribution

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

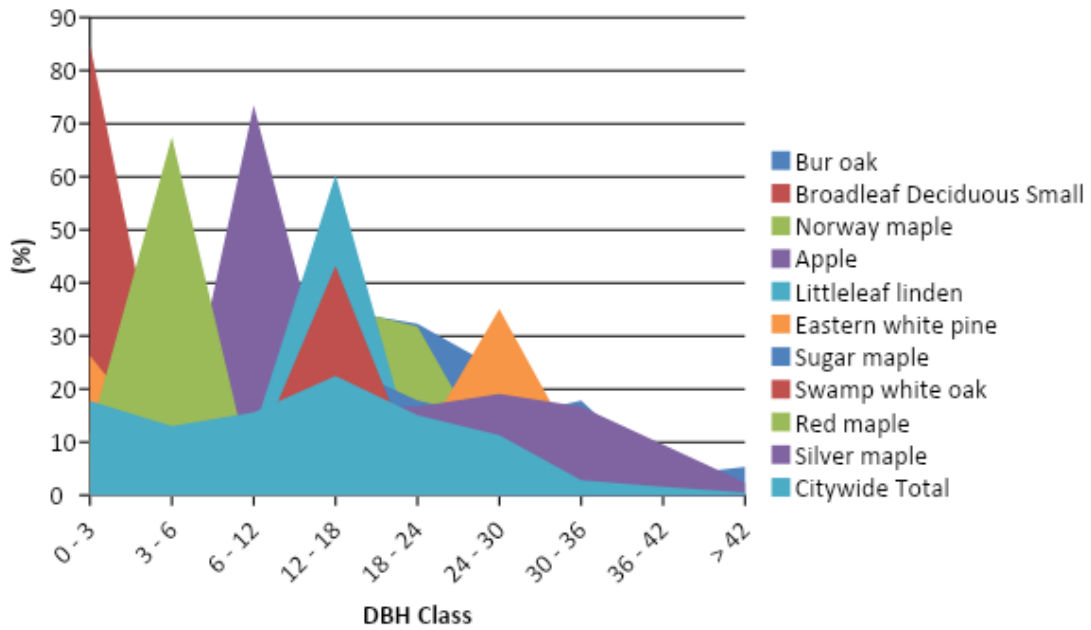


Figure 2: Relative Age Class



Figure 3: Foliage Condition

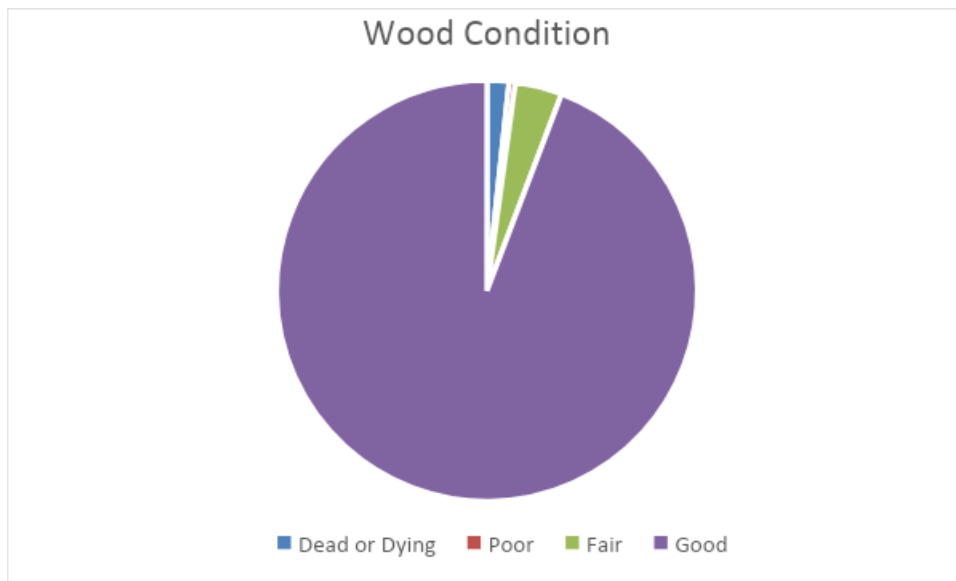


Figure 4: Wood Condition

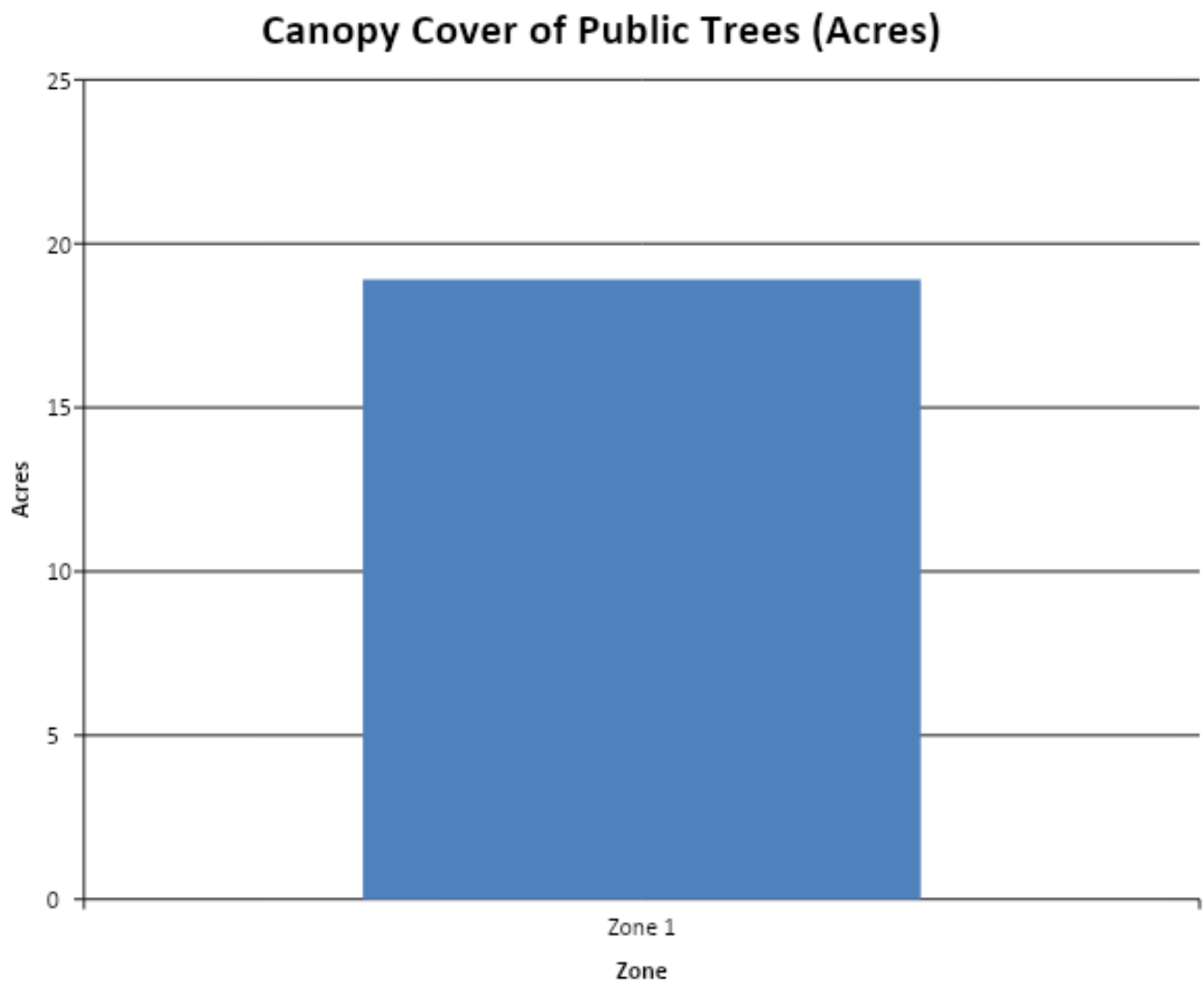


Figure 5: Canopy Cover in Acres

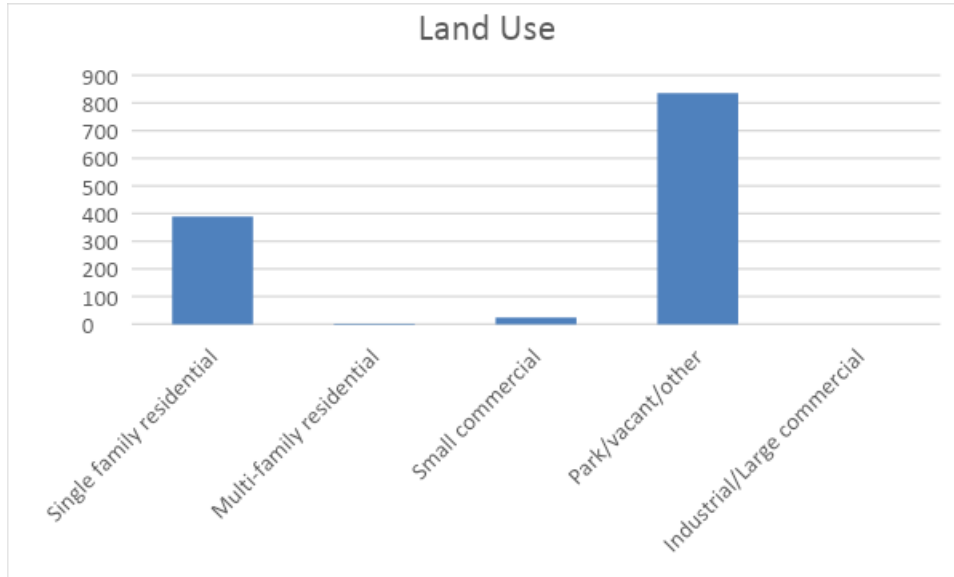


Figure 6: Land Use of city/park trees

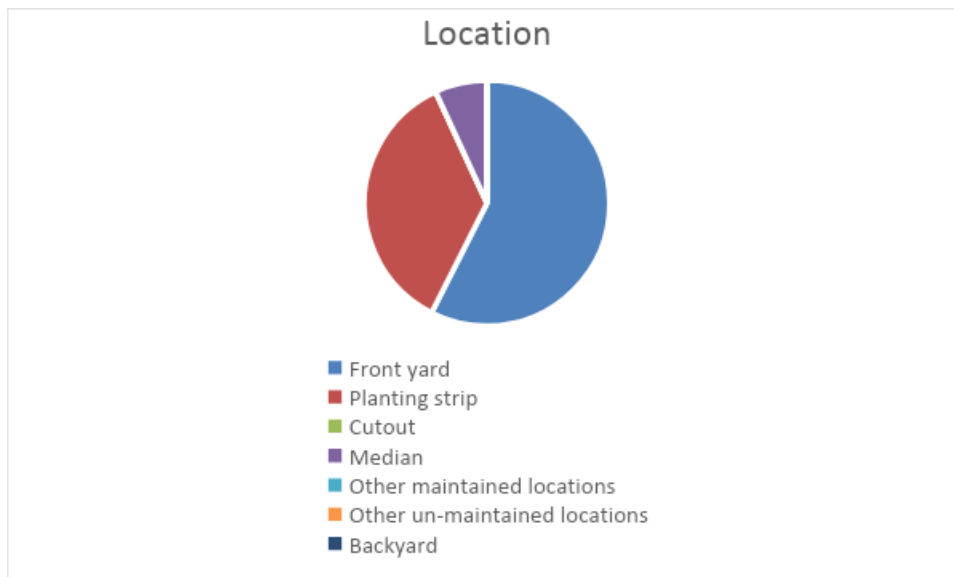


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

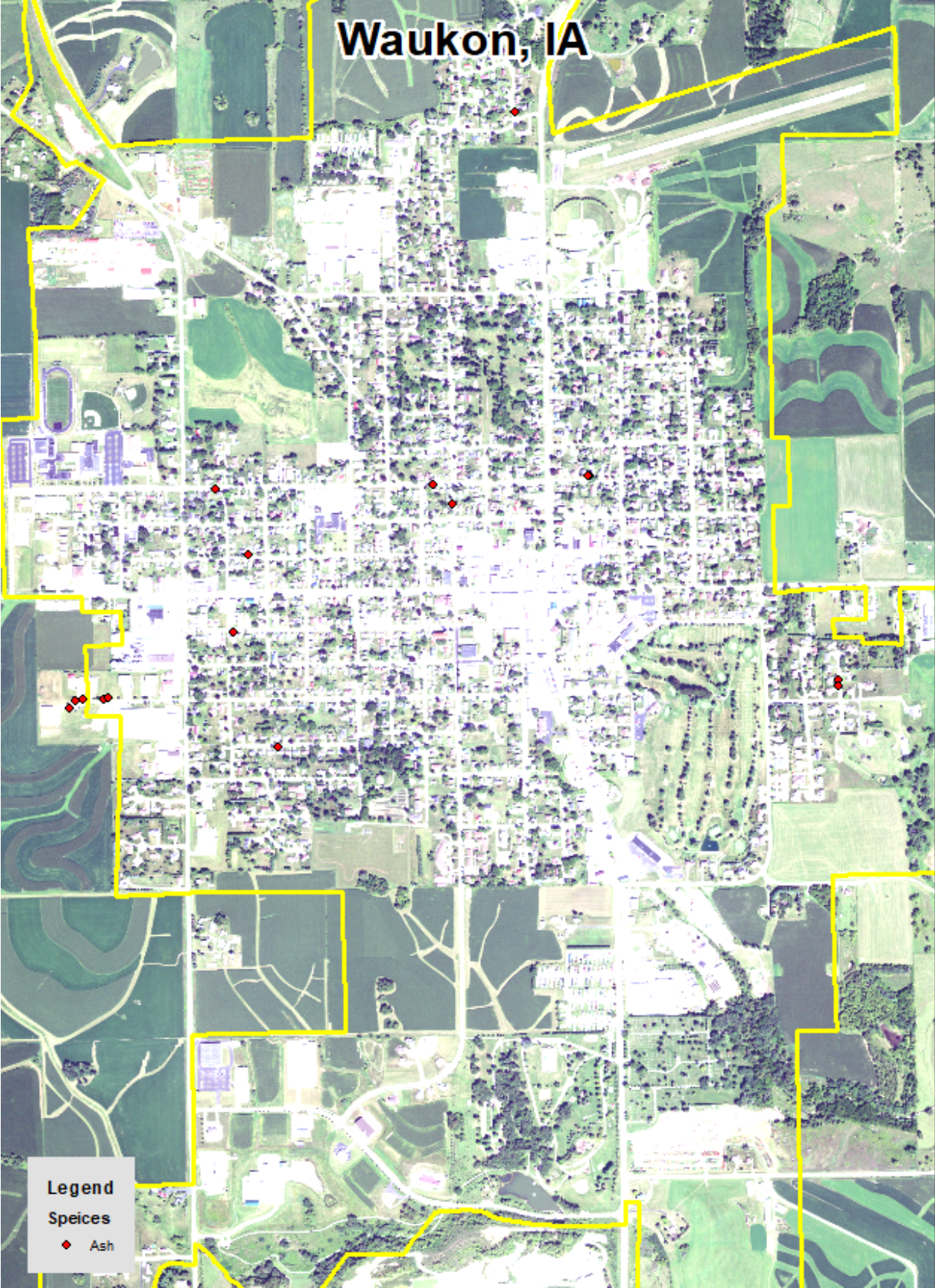


Figure 1: Location of Ash Trees

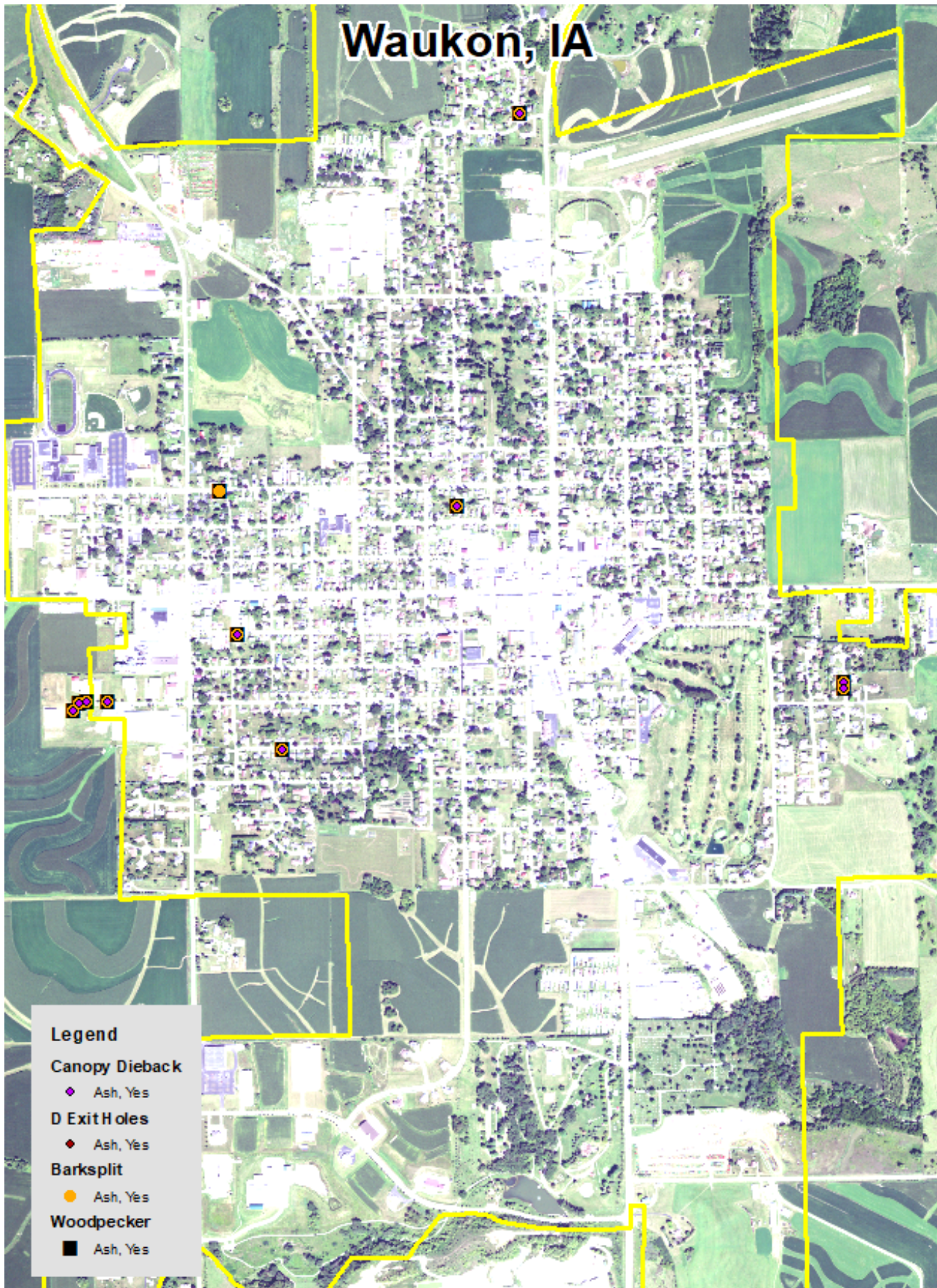


Figure 2: Location of EAB symptoms

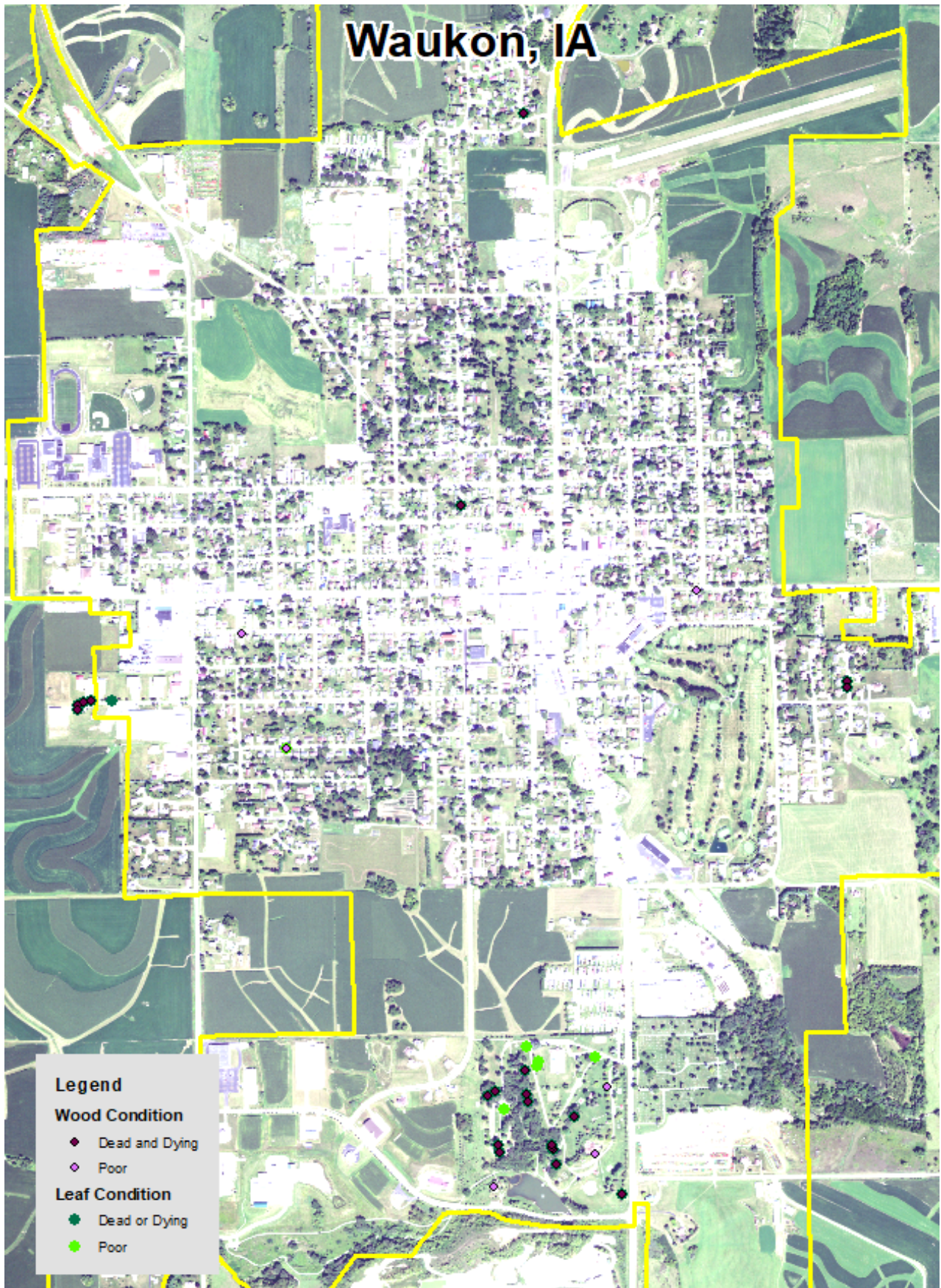


Figure 3: Location of Poor Condition Trees

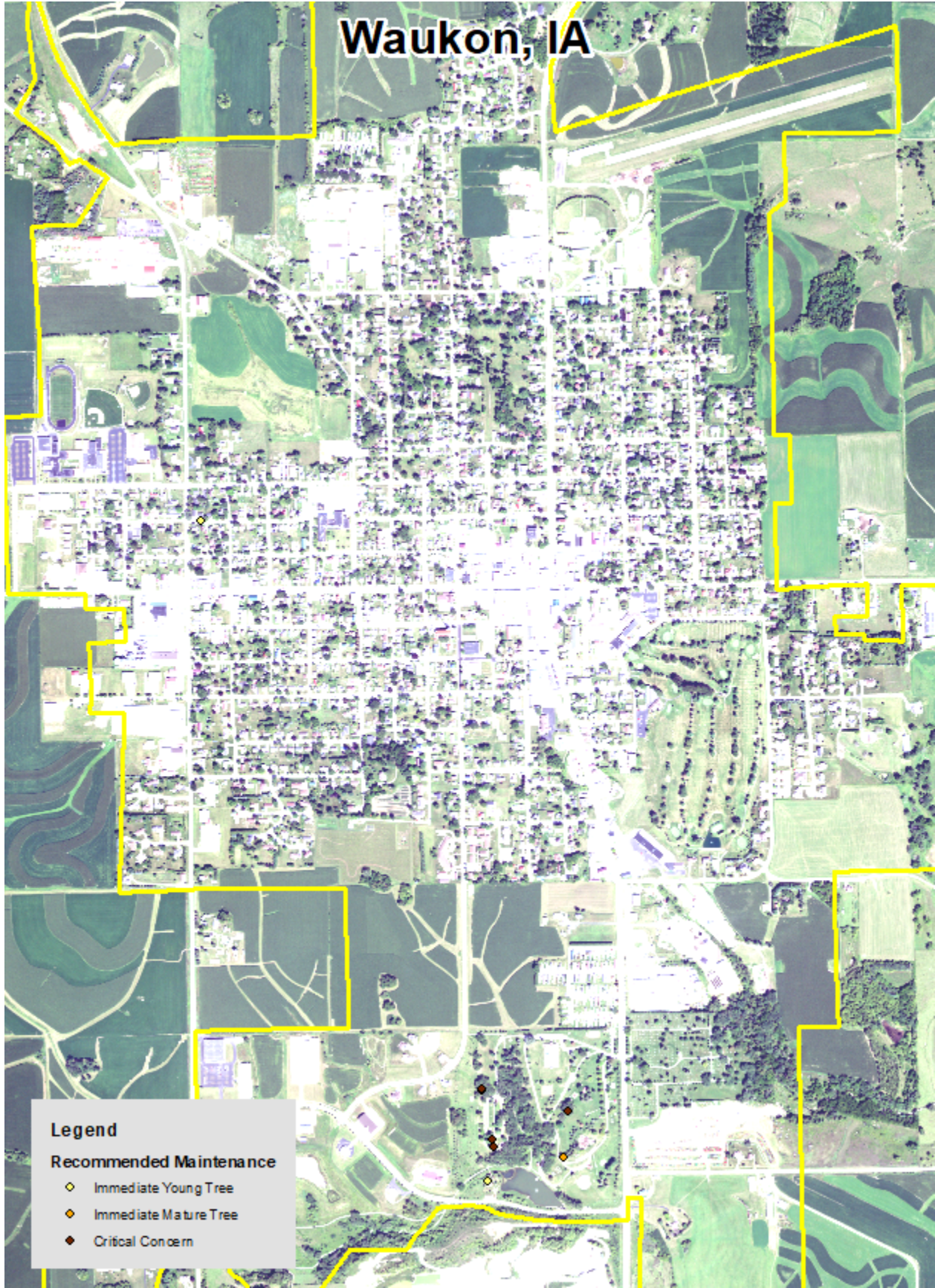


Figure 4: Location of Trees with Recommended Maintenance

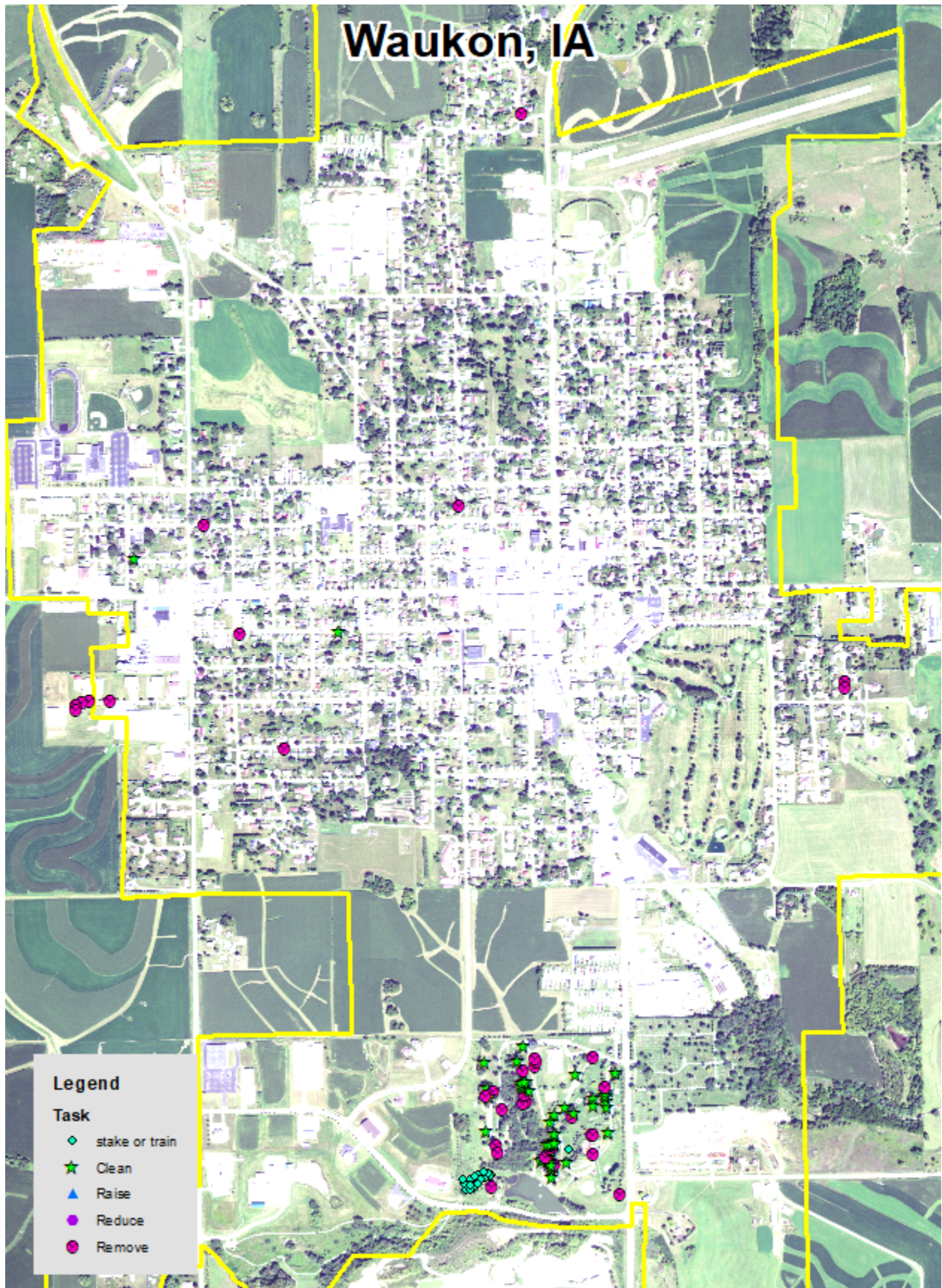


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Waukon Tree Ordinances

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

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

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