2012 COMMUNITY TREE MANAGEMENT PLAN

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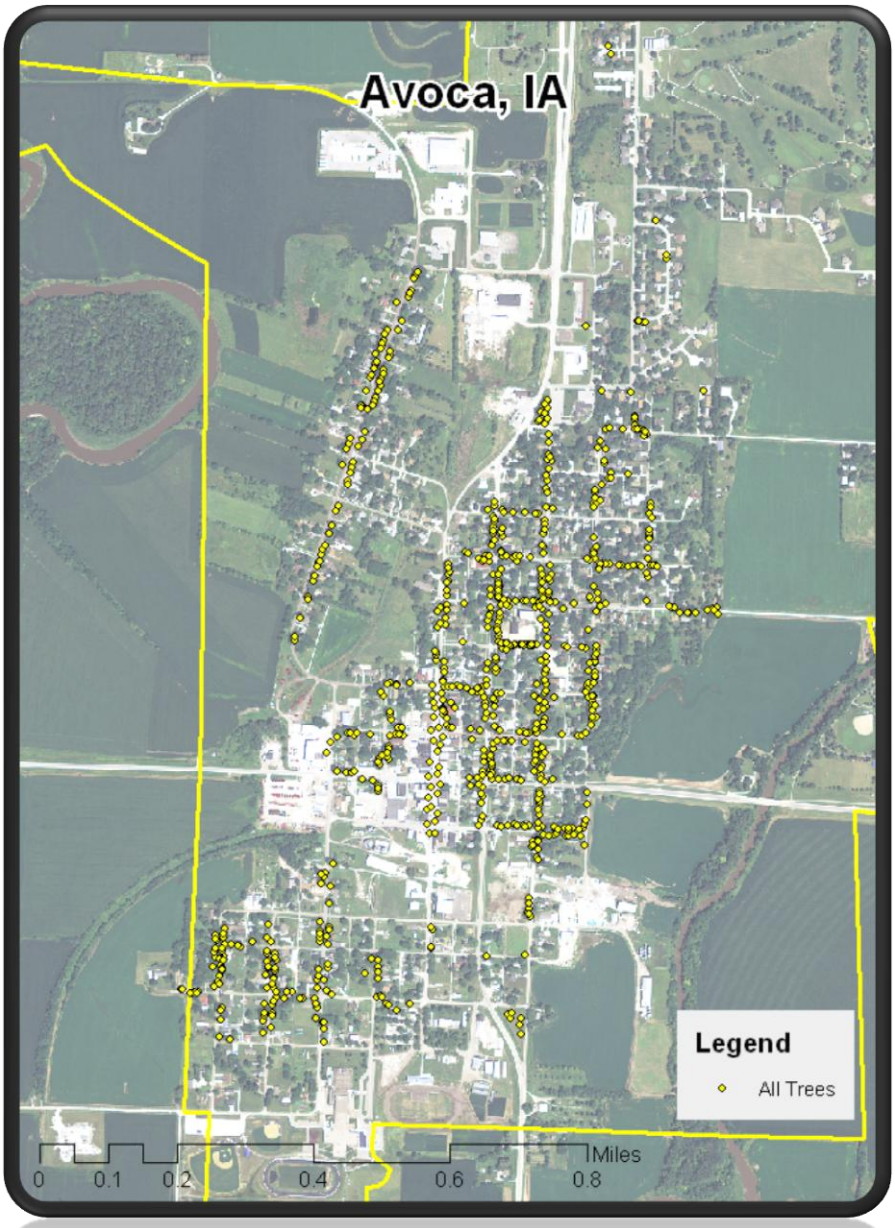

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Executive Summary

Overview

This plan was developed to assist the City of Avoca 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 6.7% of Avoca's city owned trees (ash) will die once EAB becomes established in the community. 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 2012, 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 801 trees inventoried.

- Avoca's trees provide $176,057 of benefits annually, an average of $220 a tree
- There are over 35 species of trees
- The top three genus are: Hackberry 35%, Maple 25%, and Apple 8%
- 49% of trees are in need of some type of management
- 60 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.

- 60 trees are identified for removal, 23 are critical concerns and must be removed immediately. 18 critical concern 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*
- 3 of the 56 ash trees are in need of follow up because they are displaying signs and symptoms associated with EAB – only trees with bark splits and epicormic shoots (which is 1 tree) is displayed on the map. Other conditions include: d-shaped exit holes, woodpecker damage, and crown dieback.
- 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 or Siberian elm, elm, evergreen, willow, black walnut, tree of heaven, exotic mulberry trees (white mulberry is very common), and Bradford/Callery Pear. Please also be careful not to plant the following shrubs, as they are considered invasive species: autumn olive, honeysuckles, salt cedar, rhododendron, multiflora rose, buckthorn, Japanese Barberry, Burning Bush, and Oriental bittersweet (a vine). For additional information on invasive species and native alternatives, please read my article at: http://api.ning.com/files/upDJWQuP3By62jwQaDQ*HIqC08KqOZIlyknTyIMIfSpJ1cU3EKH*F7hmZYMBaDhDCj0jivi-px1jKSL8TEKs7YPG9gU*Y9EA/CHECKYOURYARDFORFUGITIVES.pdf.
- Check ash trees with a visual survey yearly

- With the current budget it could take 3.5years to remove ash – Suggestion: request a budget increase to $6,890 annually (on top of scheduled tasks as listed in the budget/maintenance plan) and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2012, a tree inventory was conducted that included 100% of the city owned trees on both streets and street median 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 of EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory_Results

The data collected for the 801 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. Findings

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Avoca's trees reduce energy related costs by approximately $47,940 annually (Appendix A, Table 1). These savings are both in Electricity (225.3 MWh) and in Natural Gas (31,470.2 Therms).

Annual Stormwater Benefits

Avoca's trees intercept about 2,563,272 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $69,469 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 mater (ozone). In Avoca, it is estimated that trees remove 3,045 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 $8,674 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Avoca, trees sequester about 454,489 lbs of carbon a year with an associated value of $3,409 (Appendix A, Table 4). In addition, the trees store 8,981,795 lbs of carbon, with a yearly benefit of $67,363 (Appendix A, Table 5).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Avoca receives $44,055 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, Avoca's trees provide $176,057 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 801 trees in Avoca provide approximately $220 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Avoca has over 35 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Hackberry	281	35%
Maple	201	25%
Apple	63	8%
Ash	56	7%
Honeylocust	31	4%
Oak	30	4%
Spruce	25	3%
Linden	19	2%
Sycamore	18	2%
Walnut	13	2%
Pear	10	1%
Elm	9	1%
Evergreen Conifer	9	1%
Unknown	7	<1%
Mulberry	4	<1%
Redbud	4	<1%
Kentucky coffee tree	3	<1%
Broadleaf Deciduous	2	<1%
Cherry	2	<1%
Birch	1	<1%
Juniper	1	<1%
Magnolia	1	<1%

Age Class

Most of Avoca's trees (40.8%) are between 24 and 36 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, a Bell Curve is preferred and shows the highest amount of trees around 18 inches in diameter at 4.5 ft. 33.2% of Avoca's trees are less than 18 inches in diameter at 4.5 feet (DBH), and 66.8 % of Avoca's trees are greater than 18" DBH. Avoca's size curve is on the larger side, indicating an older 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 Avoca indicate that 28% of the trees are in good health, 69% are in fair health, and only 3% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 32% of Avoca'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 9% of the population. This 9% is

an estimate of trees that need management follow up. Many of the larger hackberries in this community are suffering from some kind of decay, which on a large scale (since hackberry is the most numerous species in Avoca) brings the average wood condition down. Also, 2012 was very hot and dry, likely leading to the less than optimal foliar conditions.

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	143	18%
Crown Raising	14	2%
Tree Staking	13	2%
Tree Removal	10	1%
Crown Reduction	1	<1%

Canopy Cover

The canopy cover of Avoca is approximately 28 acres (Appendix A, Figure 4). According to the 2010 census, Avoca occupies 1,242 acres. Thus the canopy cover on city land is about 2%.

Land Use and Location

The majority of Avoca'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	86.3%
Park/vacant/other	13.5%
Industrial/Large commercial	<1%
Small commercial	<1%
Multifamily residential	0%

Location	
Planting strip	75.5%
Other maintained locations	0.7%
Cutout (surrounded by pavement)	3.4%
Front yard	20.3%

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

Avoca has 26 critical concern trees (23 of which need immediate removal). 60 total trees are identified for removal, but some are classified in less immediate threat levels (Mature tree Immediate for example). Only 58 trees are in the mature sizes, 2 removals are young trees (less than 15 feet tall). These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4) and the summary table below. **Some critical concern trees have other maintenance tasks like treating pests or cleaning – so make sure to compare maps before making decisions on removals. It is recommended to start with the large diameter critical concern trees first. There are 18 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the five year maintenance plan at the end of this section. Many trees were marked with the code Critical Concern or Mature Tree Immediate without any action recommended (see Appendix Figure 4). This is either due to observed rot or insect and disease damage that is beginning to compromise the tree and needs further inspection from an arborist (I could not tell the full extent of the damage at the time of the inventory). 22 trees were identified as having insect damage in need of follow up (mostly carpenter ants which can compromise the strength and health of affected trees). After all of the critical concern trees are addressed, there should be follow up on the trees marked as critical concern pest and immediate concern removal and/or pest that do not include trimming. There are 75 trees identified as Critical Concern or Mature tree immediate and tasked with removal or to treat a pest/disease. 23 trees, as discussed are in the Critical Concern removal category, and the remaining 52 can be addressed once the most critical 23 are dealt with. Here is a summary table of tasks by recommended maintenance:

PRIORITY TASK	# BY TASK UNDER CRITICAL CONCERN	# BY TASK UNDER MATURE TREE IMMEDIATE	# BY TASK UNDER YOUNG TREE IMMEDIATE
NONE (NEEDS FURTHER INSPECTION BY ARBORIST)		22	1
STAKE/TRAIN			1
CLEAN	1	14	
RAISE		3	
REDUCE		7	
REMOVE	23	35	2
TREAT PEST/DISEASE	2	15	1
TOTAL	26	96	5

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 60 total removals, 3 are ash trees. There are a total of 56 ash trees, and 3 of those have signs and symptoms that have been associated with EAB (only 1 of these 3 is identified for removal). In addition, there are 2 trees that are in poor health that should be removed (making 3 total). *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 Avoca.

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 Hackberry (35%) and Maple (25%) (Appendix A, Figure 1). The hackberry and maple genus 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, 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). See additional species to avoid in the beginning Recommendations section. Pin oak should be avoided in Avoca due to soil pH issues, which can set up this tree species for long-term iron deficiencies and potentially death.

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 death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). Currently only 3 ash trees exhibit EAB or poor condition symptoms.*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. Replacement trees can be estimated to cost $100/tree for budgeting purposes. 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 hackberry, 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 genus 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 151.06 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."

Budget and Maintenance Plan – next 5 years_(With no additional funding)___

YEAR	MAINTENANCE TASK	PRICE PER UNIT	SUBTOTAL	YEARLY EXPENDITURE
2013	CRTICIAL REMOVALS (ALL) CRITICAL CLEANING VISUAL SURVEY FOR EAB SIGNS AND SYMPTOMS	$500/TREE X 23 TREES 1 TREE X $200	$11,500 $200	$11,700* (will need to increase current budget to accommodate this)
2014	IMMEDIATE REMOVALS VISUAL SURVEY FOR EAB SIGNS AND SYMPTOMS	$500/TREE X 20 TREES	$10,000	$10,000
2015	REMAINING IMMEDIATE REMOVALS MATURE TREE IMMEDIATE – OTHER TASKS (RAISING, CLEANING, REDUCING, PEST TREATMENT) VISUAL SURVEY FOR EAB SIGNS AND SYMPTOMS	$500/TREE X 15 TREES 20 TREES X $75/TREE UNDER LARGE TRIMMING CONTRACT	$7,500 $1,500	$10,000
2016	REMAINING MATURE TREE IMMEDIATE – OTHER TASKS (RAISING, CLEANING, REDUCING, PEST TREATMENT) PLANT REPLACEMENT TREES + WATERING AND MAINTENANCE VISUAL SURVEY FOR EAB SIGNS AND SYMPTOMS	$75 X 64 TREES $150/TREE X 44 TREES	$3,300 $6,600	$9,900
2017	PLANT REMAINING REPLACEMENTS (72 TOTAL, WHICH IS 60 X REPLACEMENT FACTOR OF 1.2) PERFORM ROUTINE TRIMMING OF ALL MUNICIPAL TREES VISUAL SURVEY FOR EAB SIGNS AND SYMPTOMS	$150/TREE X 28 TREES 801 TREES X $6.50/TREE (UNDER CONTRACT)	$4,200 $5,200	$9,400

**NOTE – COMPLETE ASH REMOVAL HAS NOT BEEN FACTORED INTO THIS BUDGET OR WORK PLAN. AFTER THE 3 CRITICAL CONCERN ASH ARE REMOVED, 53 REMAIN. AT THE CURRENT BUDGET ALLOCATION, IT WOULD TAKE $26,500 FOR REMOVALS AND $7,950 TO REPLACE AND MAINTAIN THE LOST TREES. IN TOTAL, IF EAB AFFECTED AVOCA, THE COMMUNITY WOULD NEED AN ESTIMATED $34,450 FOR REMOVALS AND REPLACEMENTS, OR 3.5 YEARS OF BUDGET TO MAKE UP THE EXPENSE. THIS LINK CAN ALSO BE USED TO ESTIMATE EAB REMOVAL OR TREATMENT COSTS: http://extension.entm.purdue.edu/treecomputer/.

Proposed Budget Increase

EAB could potentially kill all ash trees in Avoca within 4 years of its arrival. To remove all ash trees within 5 years the budget would need to be increased to $6,890 a year. Additionally, it is recommended that Avoca 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.

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Appendix A: i-Tree Data

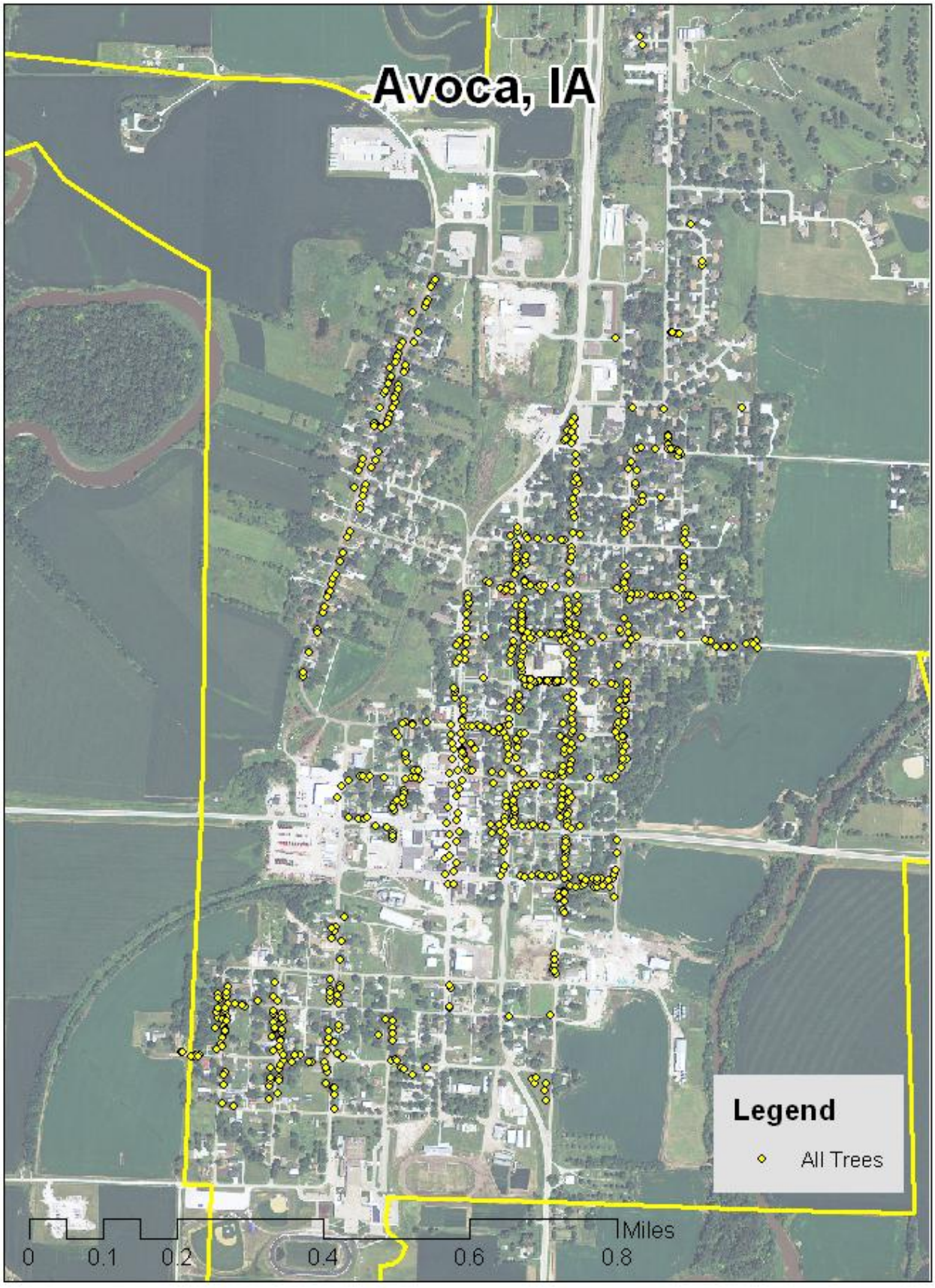
Avoca, IA
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Table 1: Annual Energy Benefits

Avoca, IA

Annual Energy Benefits of Public Trees by Species

11/10/2012

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern hackberry	106.1	8,050	15,107.7	14,806	22,856	(N/A)	34.5	47.7	82.81
Silver maple	34.3	2,602	4,522.8	4,432	7,034	(N/A)	12.4	14.7	71.05
Apple	4.0	305	654.3	641	946	(N/A)	7.9	2.0	15.02
Green ash	15.3	1,160	2,063.2	2,022	3,181	(N/A)	6.7	6.6	58.92
Norway maple	11.3	858	1,611.9	1,580	2,437	(N/A)	6.2	5.1	48.74
Honeylocust	2.4	179	314.5	308	488	(N/A)	3.9	1.0	15.73
Sugar maple	7.1	542	962.9	944	1,486	(N/A)	3.3	3.1	57.14
Northern pin oak	8.0	610	1,171.2	1,148	1,757	(N/A)	3.3	3.7	67.59
Maple	1.2	93	156.9	154	247	(N/A)	2.4	0.5	12.97
American sycamore	7.6	579	1,027.3	1,007	1,586	(N/A)	2.3	3.3	88.09
Bur oak	4.6	350	632.4	620	970	(N/A)	2.3	2.0	53.89
American basswood	5.5	420	809.2	793	1,213	(N/A)	2.3	2.5	67.38
Blue spruce	1.6	125	218.2	214	339	(N/A)	2.1	0.7	19.94
Black walnut	4.3	323	577.5	566	889	(N/A)	1.6	1.9	68.40
Northern red oak	0.8	58	112.9	111	168	(N/A)	1.5	0.4	14.04
Pear	1.4	106	199.3	195	302	(N/A)	1.3	0.6	30.16
Other street trees	9.8	740	1,328.1	1,302	2,042	(N/A)	6.4	4.3	40.03
Citywide total	225.3	17,099	31,470.2	30,841	47,940	(N/A)	100.0	100.0	59.85

Table 2: Annual Stormwater Benefits

Avoca, IA

Annual Stormwater Benefits of Public Trees by Species

11/10/2012

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern hackberry	1,114,911	30,216	(N/A)	34.5	43.5	109.48
Silver maple	516,203	13,990	(N/A)	12.4	20.1	141.31
Apple	14,301	388	(N/A)	7.9	0.6	6.15
Green ash	174,449	4,728	(N/A)	6.7	6.8	87.55
Norway maple	102,875	2,788	(N/A)	6.2	4.0	55.76
Honeylocust	28,593	775	(N/A)	3.9	1.1	25.00
Sugar maple	76,187	2,065	(N/A)	3.3	3.0	79.42
Northern pin oak	89,516	2,426	(N/A)	3.3	3.5	93.31
Maple	8,467	229	(N/A)	2.4	0.3	12.08
American sycamore	113,612	3,079	(N/A)	2.3	4.4	171.06
Bur oak	62,703	1,699	(N/A)	2.3	2.5	94.41
American basswood	66,921	1,814	(N/A)	2.3	2.6	100.76
Blue spruce	19,941	540	(N/A)	2.1	0.8	31.79
Black walnut	50,409	1,366	(N/A)	1.6	2.0	105.09
Northern red oak	4,944	134	(N/A)	1.5	0.2	11.17
Pear	5,057	137	(N/A)	1.3	0.2	13.70
Other street trees	114,185	3,095	(N/A)	6.4	4.5	60.68
Citywide total	2,563,272	69,469	(N/A)	100.0	100.0	86.73

Table 3: Annual Air Quality Benefits

Avoca, IA

Annual Air Quality Benefits of Public Trees by Species

11/10/2012

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
Northern hackberry	186.8	32.3	93.2	8.4	1,014	512.5	74.2	70.6	481.0	3,178	0.0	0	1,459.0	4,192	(N/A)	34.5	15.19
Silver maple	94.2	16.0	45.8	4.2	507	161.7	23.7	22.6	155.0	1,011	-49.4	-185	473.7	1,333	(N/A)	12.4	13.46
Apple	3.0	0.5	1.6	0.1	16	20.1	2.9	2.7	18.2	123	0.0	0	49.1	139	(N/A)	7.9	2.21
Green ash	23.2	3.7	10.9	1.0	123	72.7	10.6	10.1	69.2	453	0.0	0	201.6	577	(N/A)	6.7	10.68
Norway maple	20.8	3.6	10.3	0.9	113	54.6	7.9	7.5	51.3	339	-4.9	-18	152.0	433	(N/A)	6.2	8.66
Honeylocust	5.6	0.9	2.6	0.3	30	11.2	1.6	1.6	10.7	70	-4.6	-17	29.9	82	(N/A)	3.9	2.66
Sugar maple	9.8	1.7	5.0	0.4	53	33.9	5.0	4.7	32.3	212	-7.8	-29	85.1	236	(N/A)	3.2	9.08
Northern pin oak	20.2	3.5	9.7	0.9	108	39.1	5.6	5.4	36.4	242	-4.6	-17	116.1	333	(N/A)	3.2	12.80
Maple	1.8	0.3	0.9	0.1	10	5.7	0.8	0.8	5.5	36	-0.6	-2	15.3	43	(N/A)	2.4	2.28
American sycamore	20.0	3.2	8.8	0.9	105	36.3	5.3	5.0	34.6	226	0.0	0	114.1	331	(N/A)	2.2	18.38
Bur oak	8.9	1.4	4.1	0.4	47	22.0	3.2	3.1	20.9	137	0.0	0	64.1	184	(N/A)	2.2	10.24
American basswood	9.5	1.6	4.6	0.4	51	26.9	3.9	3.7	25.1	166	-7.9	-30	67.7	188	(N/A)	2.2	10.42
Blue spruce	2.3	0.5	2.0	0.3	15	7.8	1.1	1.1	7.5	49	-6.9	-26	15.6	38	(N/A)	2.1	2.25
Black walnut	7.0	1.1	3.3	0.3	37	20.3	3.0	2.8	19.3	127	0.0	0	57.1	164	(N/A)	1.6	12.59
Northern red oak	0.8	0.1	0.4	0.0	4	3.7	0.5	0.5	3.5	23	-1.1	-4	8.5	23	(N/A)	1.5	1.93
Pear	1.4	0.2	0.7	0.1	8	6.8	1.0	0.9	6.3	42	0.0	0	17.4	50	(N/A)	1.2	4.95
Other street trees	17.4	3.0	9.8	1.1	99	46.5	6.8	6.5	44.2	290	-15.8	-59	119.4	329	(N/A)	6.4	6.45
Citywide total	432.8	73.7	213.5	19.8	2,339	1,081.7	157.1	149.6	1,021.1	6,724	-103.5	-388	3,045.8	8,674	(N/A)	100.0	10.83

Table 4: Annual Carbon Stored

Avoca, IA

Stored CO2 Benefits of Public Trees by Species

11/10/2012

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern	2,876,434	21,573	(N/A)	34.5	32.0	78.16
Silver maple	2,237,432	16,781	(N/A)	12.4	24.9	169.50
Apple	53,075	398	(N/A)	7.9	0.6	6.32
Green ash	771,776	5,788	(N/A)	6.7	8.6	107.19
Norway maple	343,587	2,577	(N/A)	6.2	3.8	51.54
Honeylocust	73,814	554	(N/A)	3.9	0.8	17.86
Sugar maple	281,945	2,115	(N/A)	3.3	3.1	81.33
Northern pin oak	332,981	2,497	(N/A)	3.3	3.7	96.05
Maple	20,154	151	(N/A)	2.4	0.2	7.96
American	686,420	5,148	(N/A)	2.3	7.6	286.01
Bur oak	297,227	2,229	(N/A)	2.3	3.3	123.84
American	350,649	2,630	(N/A)	2.3	3.9	146.10
Blue spruce	12,338	93	(N/A)	2.1	0.1	5.44
Black walnut	232,148	1,741	(N/A)	1.6	2.6	133.93
Northern red oak	13,591	102	(N/A)	1.5	0.2	8.49
Pear	21,855	164	(N/A)	1.3	0.2	16.39
Other street trees	170,718	2,823	(N/A)	6.4	4.2	55.35
Citywide total	8,981,795	67,363	(N/A)	100.0	100.0	84.10

Table 5: Annual Carbon Sequestered

Avoca, IA

Annual CO_2 Benefits of Public Trees by Species

11/10/2012

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
Northern hackberry	142,875	1,072	-13,807	-54	-104	177,911	1,334	306,925	2,302	(N/A)	34.5	38.9	8.34
Silver maple	154,597	1,159	-10,740	-19	-81	57,494	431	201,332	1,510	(N/A)	12.4	25.5	15.25
Apple	6,168	46	-255	-12	-2	6,746	51	12,648	95	(N/A)	7.9	1.6	1.51
Green ash	33,996	255	-3,705	-11	-28	25,626	192	55,907	419	(N/A)	6.7	7.1	7.76
Norway maple	15,657	117	-1,649	-10	-12	18,951	142	32,950	247	(N/A)	6.2	4.2	4.94
Honeylocust	6,210	47	-354	-6	-3	3,962	30	9,812	74	(N/A)	3.9	1.2	2.37
Sugar maple	15,461	116	-1,353	-5	-10	11,978	90	26,081	196	(N/A)	3.3	3.3	7.52
Northern pin oak	4,958	37	-1,598	-5	-12	13,474	101	16,829	126	(N/A)	3.3	2.1	4.85
Maple	1,654	12	-97	-4	-1	2,050	15	3,604	27	(N/A)	2.4	0.5	1.42
American sycamore	13,693	103	-3,295	-4	-25	12,793	96	23,187	174	(N/A)	2.3	2.9	9.66
Bur oak	10,711	80	-1,427	-4	-11	7,741	58	17,021	128	(N/A)	2.3	2.2	7.09
American basswood	19,911	149	-1,683	-4	-13	9,277	70	27,501	206	(N/A)	2.3	3.5	11.46
Blue spruce	1,125	8	-59	-3	0	2,765	21	3,828	29	(N/A)	2.1	0.5	1.69
Black walnut	9,638	72	-1,114	-3	-8	7,144	54	15,665	117	(N/A)	1.6	2.0	9.04
Northern red oak	1,198	9	-65	-2	-1	1,278	10	2,409	18	(N/A)	1.5	0.3	1.51
Pear	2,061	15	-105	-2	-1	2,348	18	4,302	32	(N/A)	1.3	0.6	3.23
Other street trees	14,575	109	-1,807	-10	-14	16,356	123	29,114	218	(N/A)	6.4	3.7	4.28
Citywide total	454,489	3,409	-43,113	-156	-325	377,894	2,834	789,114	5,918	(N/A)	100.0	100.0	7.39

Table 6: Annual Social and Aesthetic Benefits

Avoca, IA

Annual Aesthetic/Other Benefits of Public Trees by Species

11/10/2012

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern hackberry	17,864	(N/A)	34.5	40.6	64.72
Silver maple	11,538	(N/A)	12.4	26.2	116.55
Apple	343	(N/A)	7.9	0.8	5.44
Green ash	2,802	(N/A)	6.7	6.4	51.90
Norway maple	1,511	(N/A)	6.2	3.4	30.22
Honeylocust	1,565	(N/A)	3.9	3.6	50.49
Sugar maple	1,632	(N/A)	3.3	3.7	62.78
Northern pin oak	444	(N/A)	3.3	1.0	17.07
Maple	228	(N/A)	2.4	0.5	12.00
American sycamore	917	(N/A)	2.3	2.1	50.95
Bur oak	826	(N/A)	2.3	1.9	45.86
American basswood	1,382	(N/A)	2.3	3.1	76.76
Blue spruce	396	(N/A)	2.1	0.9	23.28
Black walnut	752	(N/A)	1.6	1.7	57.81
Northern red oak	124	(N/A)	1.5	0.3	10.30
Pear	119	(N/A)	1.3	0.3	11.85
Other street trees	1,614	(N/A)	6.4	3.7	31.64
Citywide total	44,055	(N/A)	100.0	100.0	55.00

Table 7: Summary of Benefits in Dollars

Avoca, IA

Total Annual Benefits of Public Trees by Species ($)

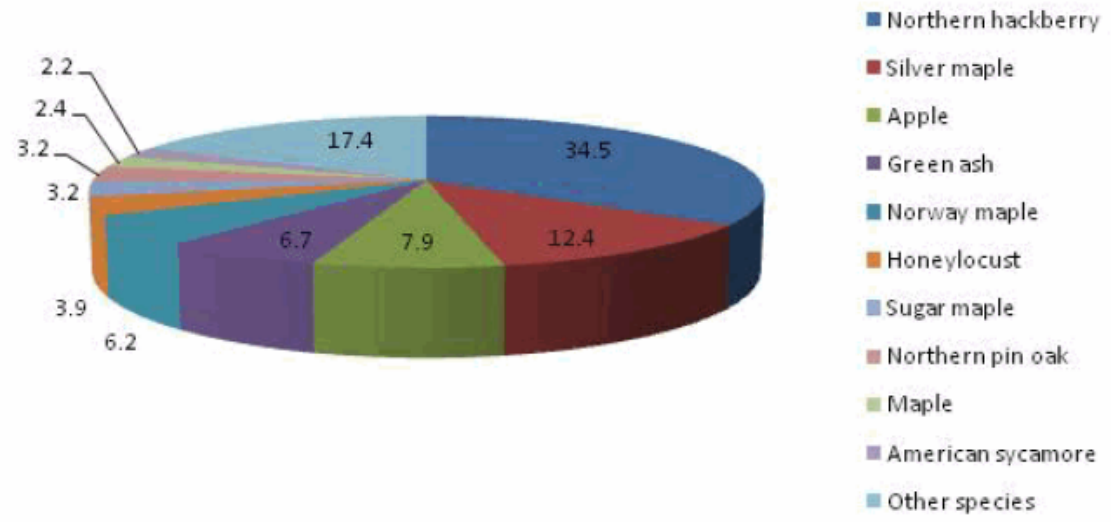
11/10/20

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Northern hackberry	22,856	2,302	4,192	30,216	17,864	77,430	(±0)	44.0
Silver maple	7,034	1,510	1,333	13,990	11,538	35,405	(±0)	20.1
Apple	946	95	139	388	343	1,911	(±0)	1.1
Green ash	3,181	419	577	4,728	2,802	11,708	(±0)	6.6
Norway maple	2,437	247	433	2,788	1,511	7,417	(±0)	4.2
Honeylocust	488	74	82	775	1,565	2,984	(±0)	1.7
Sugar maple	1,486	196	236	2,065	1,632	5,614	(±0)	3.2
Northern pin oak	1,757	126	333	2,426	444	5,086	(±0)	2.9
Maple	247	27	43	229	228	774	(±0)	0.4
American sycamore	1,586	174	331	3,079	917	6,086	(±0)	3.5
Bur oak	970	128	184	1,699	826	3,807	(±0)	2.2
American basswood	1,213	206	188	1,814	1,382	4,802	(±0)	2.7
Blue spruce	339	29	38	540	396	1,342	(±0)	0.8
Black walnut	889	117	164	1,366	752	3,288	(±0)	1.9
Northern red oak	168	18	23	134	124	467	(±0)	0.3
Pear	302	32	50	137	119	639	(±0)	0.4
Other street trees	2,042	218	329	3,095	1,614	7,297	(±0)	4.1
Citywide Total	47,940	5,918	8,674	69,469	44,055	176,057	(±0)	100.0

Avoca, IA

Species Distribution of Public Trees (%)

11/10/2012



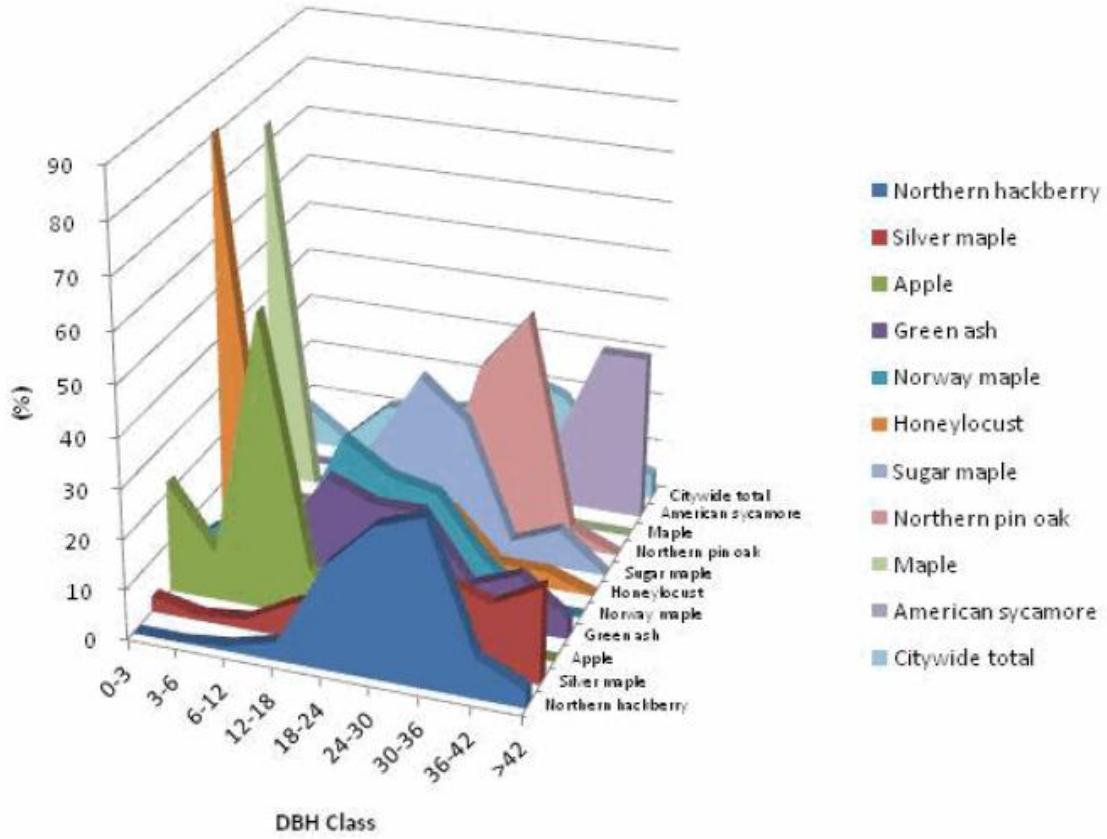
Species	Percent
Northern hackberry	34.5
Silver maple	12.4
Apple	7.9
Green ash	6.7
Norway maple	6.2
Honeylocust	3.9
Sugar maple	3.2
Northern pin oak	3.2
Maple	2.4
American sycamore	2.2
Other species	17.4
Total	100.0

Figure 1: Species Distribution

Avoca, IA

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

11/10/2012



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Northern hackberry	0.0	0.0	1.1	3.6	20.7	30.1	33.3	8.0	3.3
Silver maple	3.0	1.0	2.0	7.1	9.1	27.3	17.2	14.1	19.2
Apple	22.2	9.5	58.7	9.5	0.0	0.0	0.0	0.0	0.0
Green ash	1.9	0.0	11.1	24.1	20.4	20.4	7.4	11.1	3.7
Norway maple	4.0	10.0	8.0	28.0	22.0	20.0	8.0	0.0	0.0
Honeylocust	80.6	0.0	0.0	0.0	0.0	12.9	3.2	3.2	0.0
Sugar maple	0.0	0.0	7.7	19.2	34.6	26.9	3.8	7.7	0.0
Northern pin oak	0.0	0.0	0.0	11.5	3.8	34.6	46.2	3.8	0.0
Maple	73.7	0.0	5.3	15.8	0.0	5.3	0.0	0.0	0.0
American sycamore	0.0	0.0	0.0	0.0	0.0	22.2	11.1	33.3	33.3
Citywide total	8.6	2.1	10.6	11.9	13.5	22.1	18.7	7.6	4.9

Figure 2: Relative Age Class

Avoca, IA

Functional (Foliage) Condition of Public Trees by Species (%)

11/10/2012

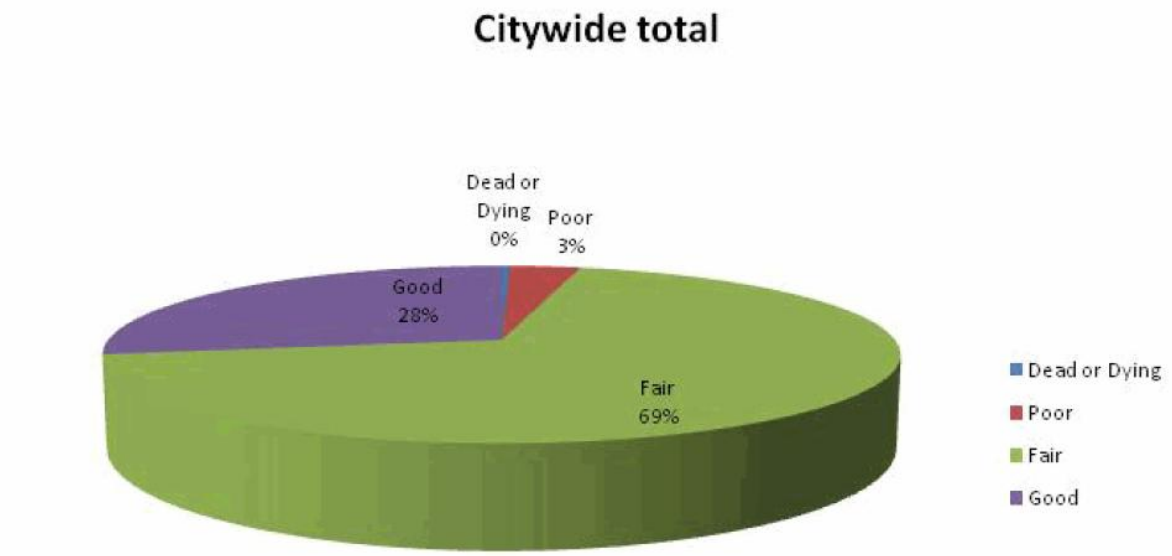


Figure 3: Foliage Condition

Avoca, IA

Structural (Woody) Condition of Public Trees by Species (%)

11/10/2012

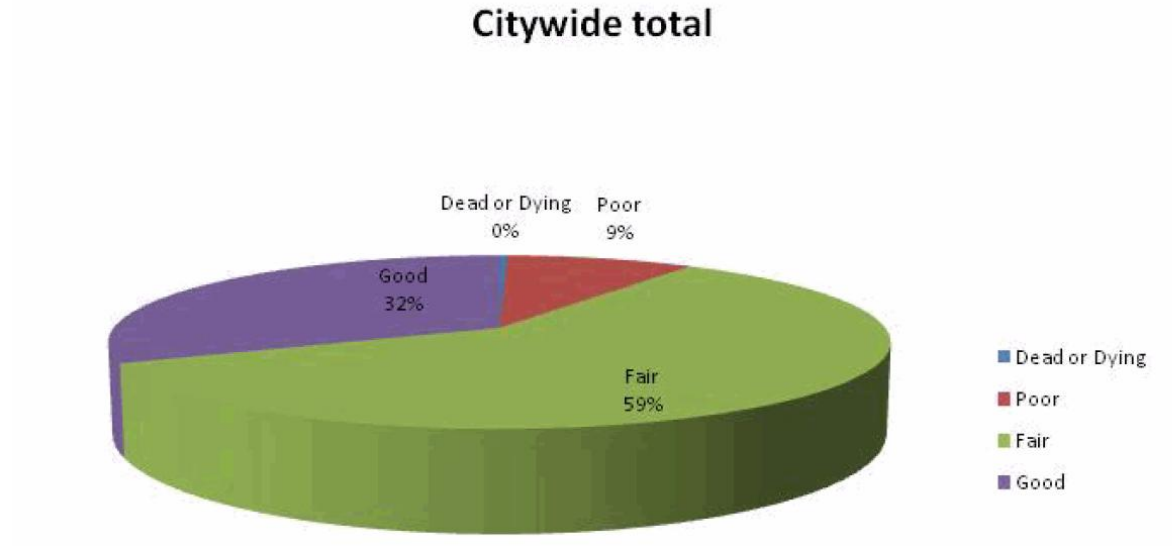
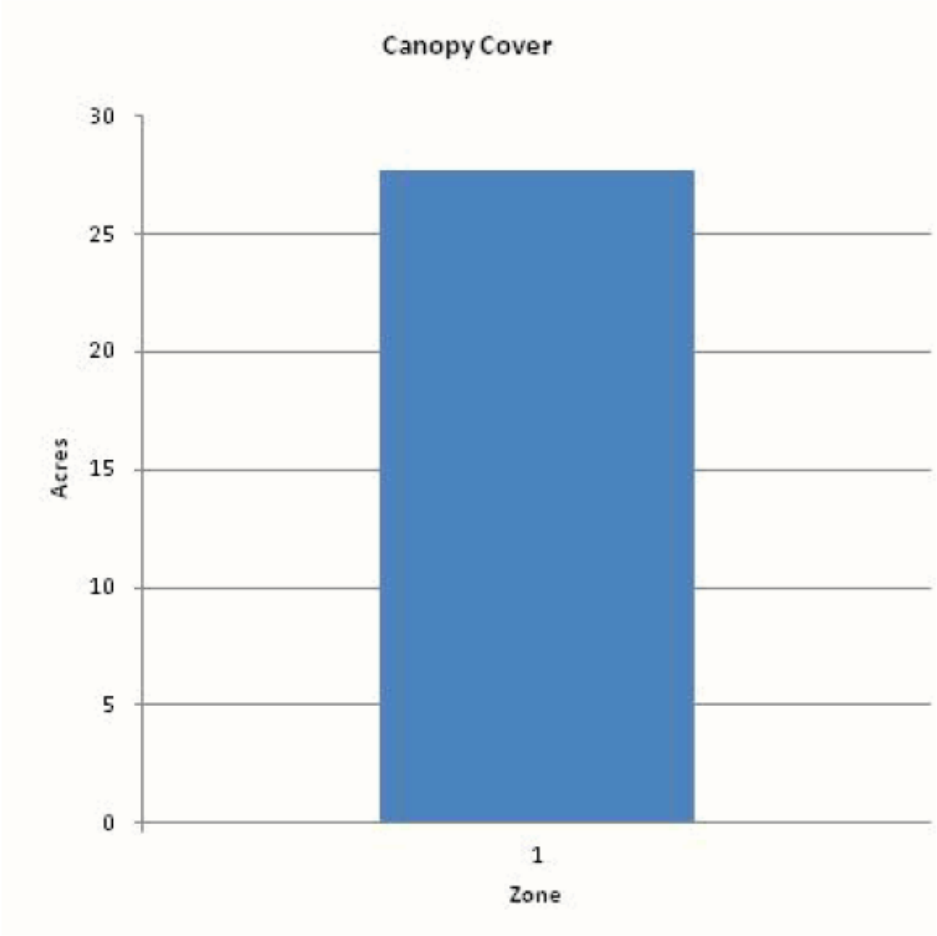


Figure 4: Wood Condition

Avoca, IA

Canopy Cover of Public Trees (Acres)

11/10/2012



Zone	Acres	% of Total Canopy Cover
1	28	100.0
Citywide total	28	100.0

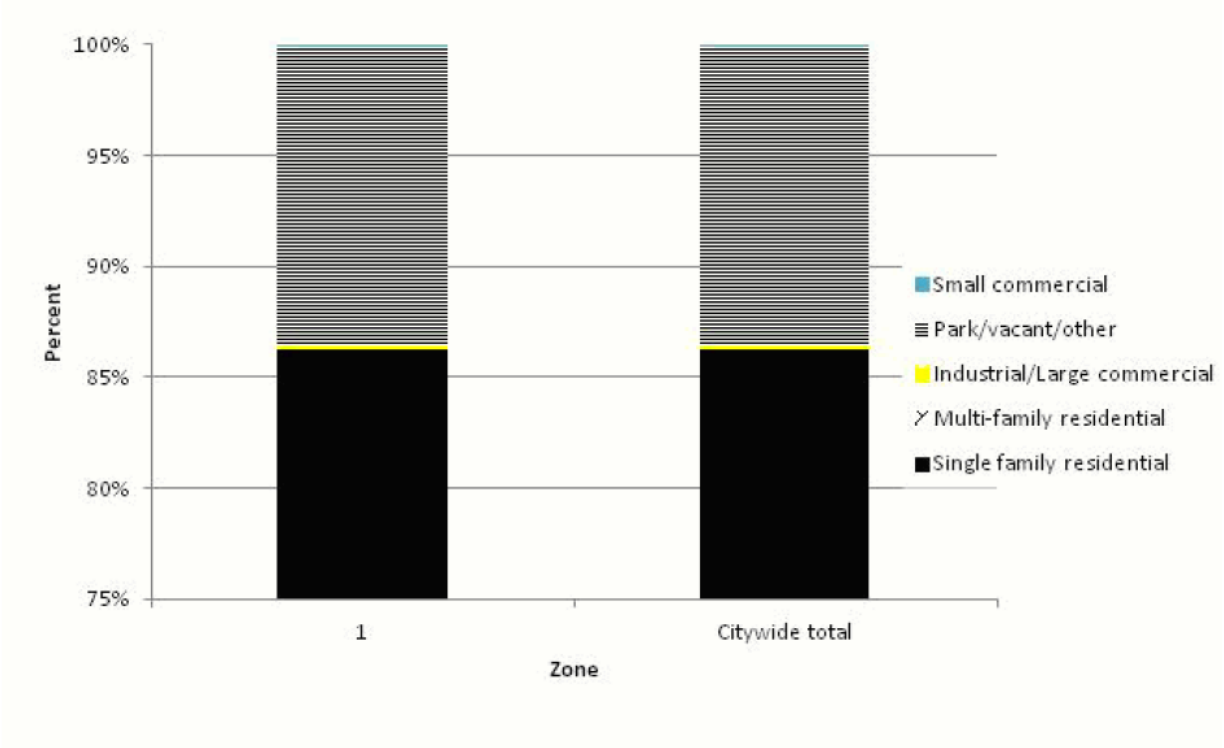
	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide	0	0	28		

Figure 5: Canopy Cover in Acres

Avoca, IA

Land Use of Public Trees by Zone (%)

11/10/2012



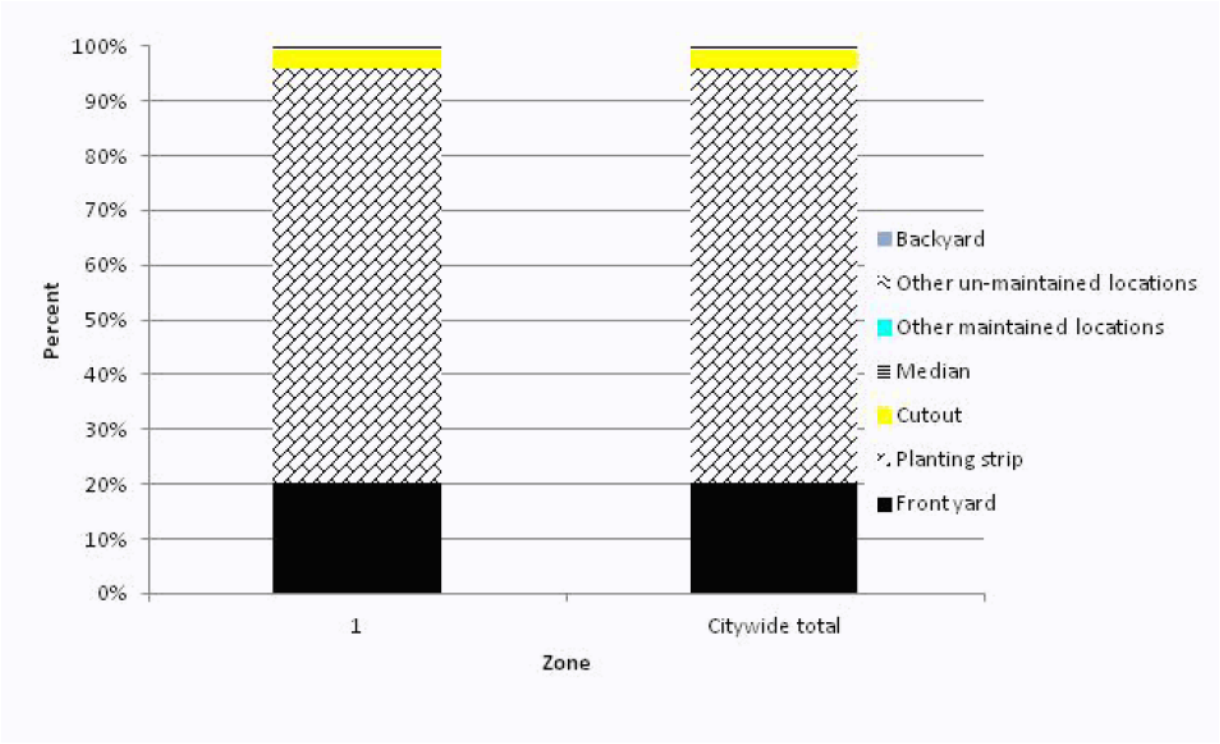
Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	86.3	0.0	0.1	13.5	0.1
Citywide total	86.3	0.0	0.1	13.5	0.1

Figure 6: Land Use of city/park trees

Avoca, IA

Location of Public Trees by Zone (%)

11/10/2012



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	20.3	75.5	3.4	0.7	0.0	0.0	0.0
Citywide total	20.3	75.5	3.4	0.7	0.0	0.0	0.0

Figure 7: Location of city/park trees

Table 8 – Recommended Maintenance Summary by Diameter Class

Avoca, IA

Recommended Maintenance for Public Trees (None)

12/11/2012

DBH Class (in)

Zone	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total
1	0	0	0	0	0	0	0	0	0	0
Citywide total	0	0	0	0	0	0	0	0	0	0

DBH Class (in)

Maintenance Type	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total	% of Total Population
None	0	0	0	0	0	0	0	0	0	0	0.00
Young tree (routine)	65	13	5	0	0	0	0	0	0	83	10.36
Young tree (immediate)	3	1	1	0	0	0	0	0	0	5	0.62
Mature tree (routine)	0	3	74	90	84	151	117	48	24	591	73.78
Mature tree (immediate)	1	0	5	5	18	20	23	11	13	96	11.99
Critical concern (public safety)	0	0	0	0	6	6	10	2	2	26	3.25
Citywide total	69	17	85	95	108	177	150	61	39	801	100.00

Table 9 – Priority Tasks by Diameter Class

Avoca, IA

Priority Task Summary for Public Trees (None)

11/10/2012

DBH Class (in)

Zone	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total
1	51	15	64	51	45	87	47	30	19	409
Citywide total	51	15	64	51	45	87	47	30	19	409

DBH Class (in)

Maintenance Type	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total	% of Total Population
None	51	15	64	51	45	87	47	30	19	409	51.06
Stake/Train	4	1	9	0	0	1	0	0	0	15	1.87
Clean	10	1	5	37	35	61	66	20	9	244	30.46
Raise	0	0	2	4	9	13	9	3	4	44	5.49
Reduce	0	0	0	0	1	2	3	1	1	8	1.00
Remove	2	0	0	2	14	10	22	5	5	60	7.49
Treat pest/disease	2	0	5	1	4	3	3	2	1	21	2.62
Citywide total	69	17	85	95	108	177	150	61	39	801	100.00

Appendix B: ArcGIS Mapping

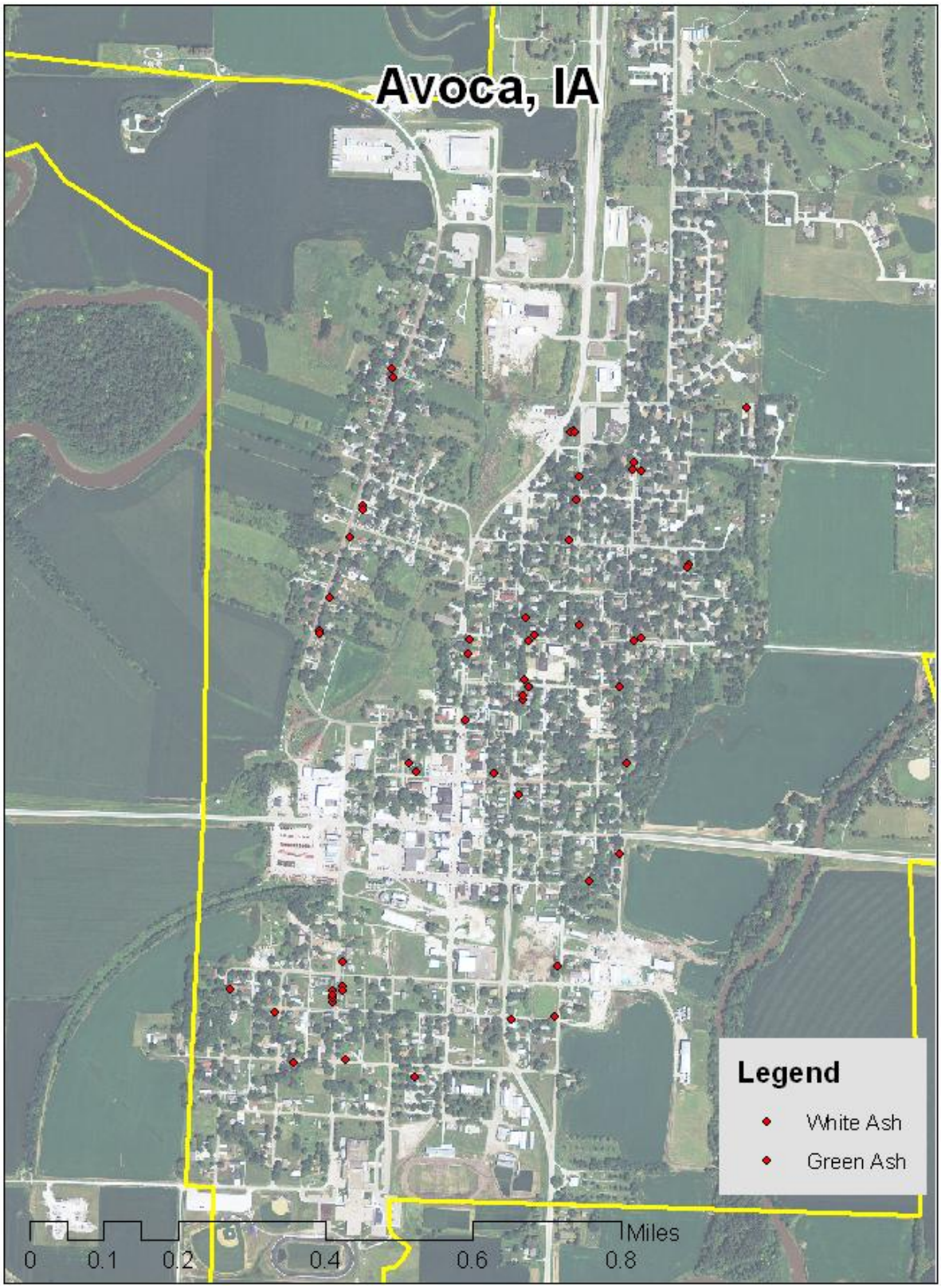


Figure 1: Location of Ash Trees

Figure 2: Location of EAB symptoms

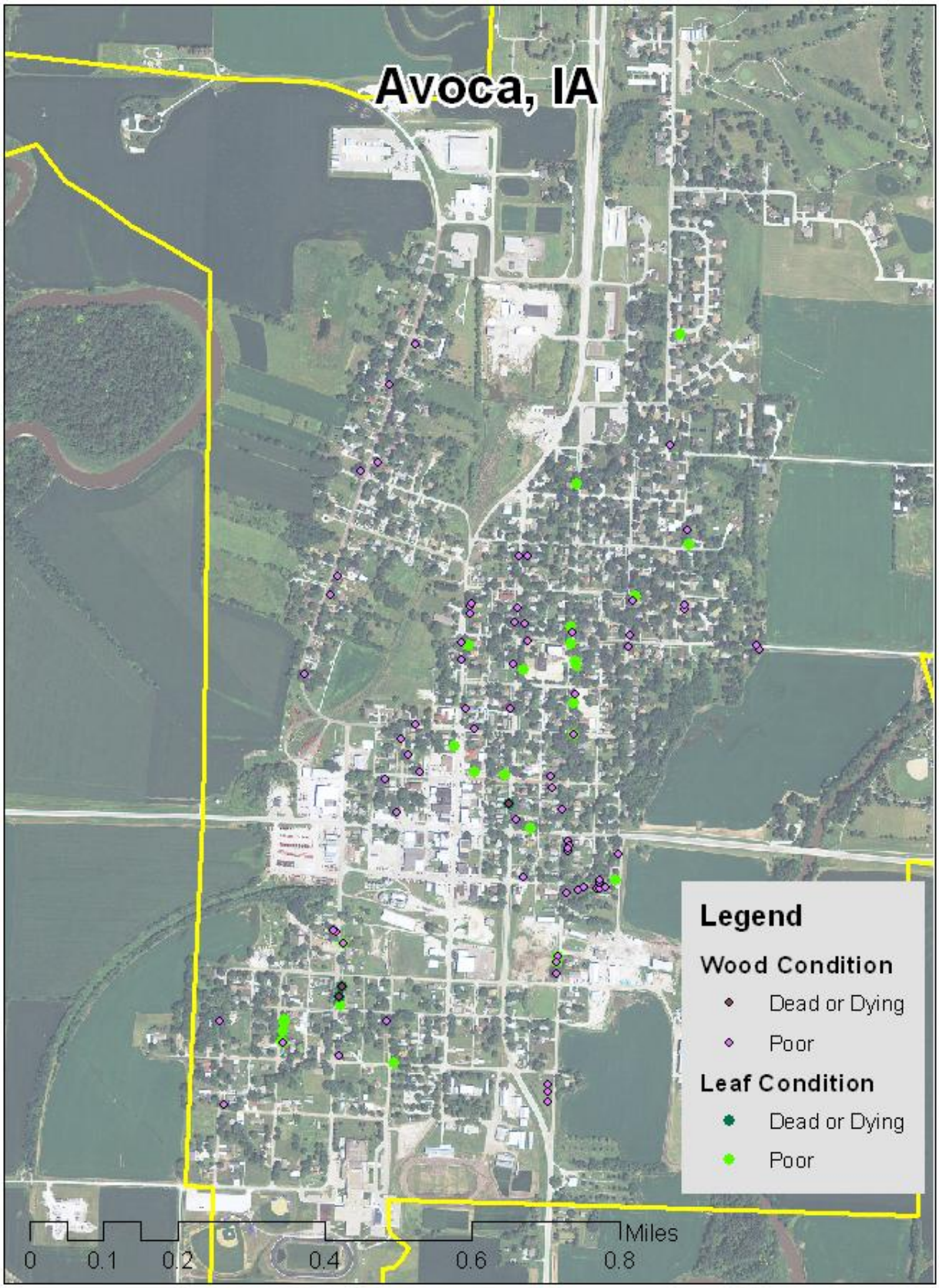


Figure 3: Location of Poor Condition Trees

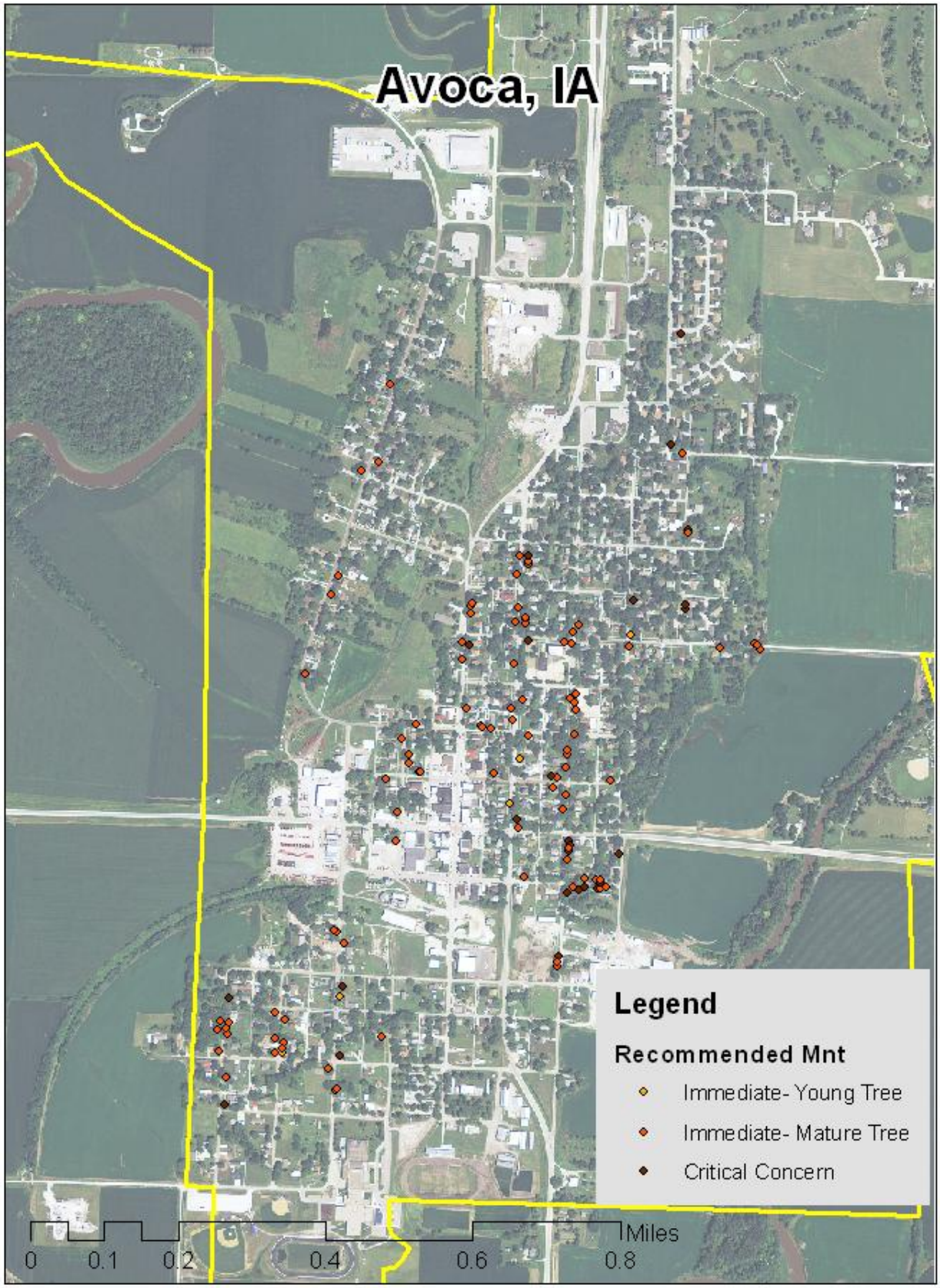


Figure 4: Location of Trees with Recommended Maintenance

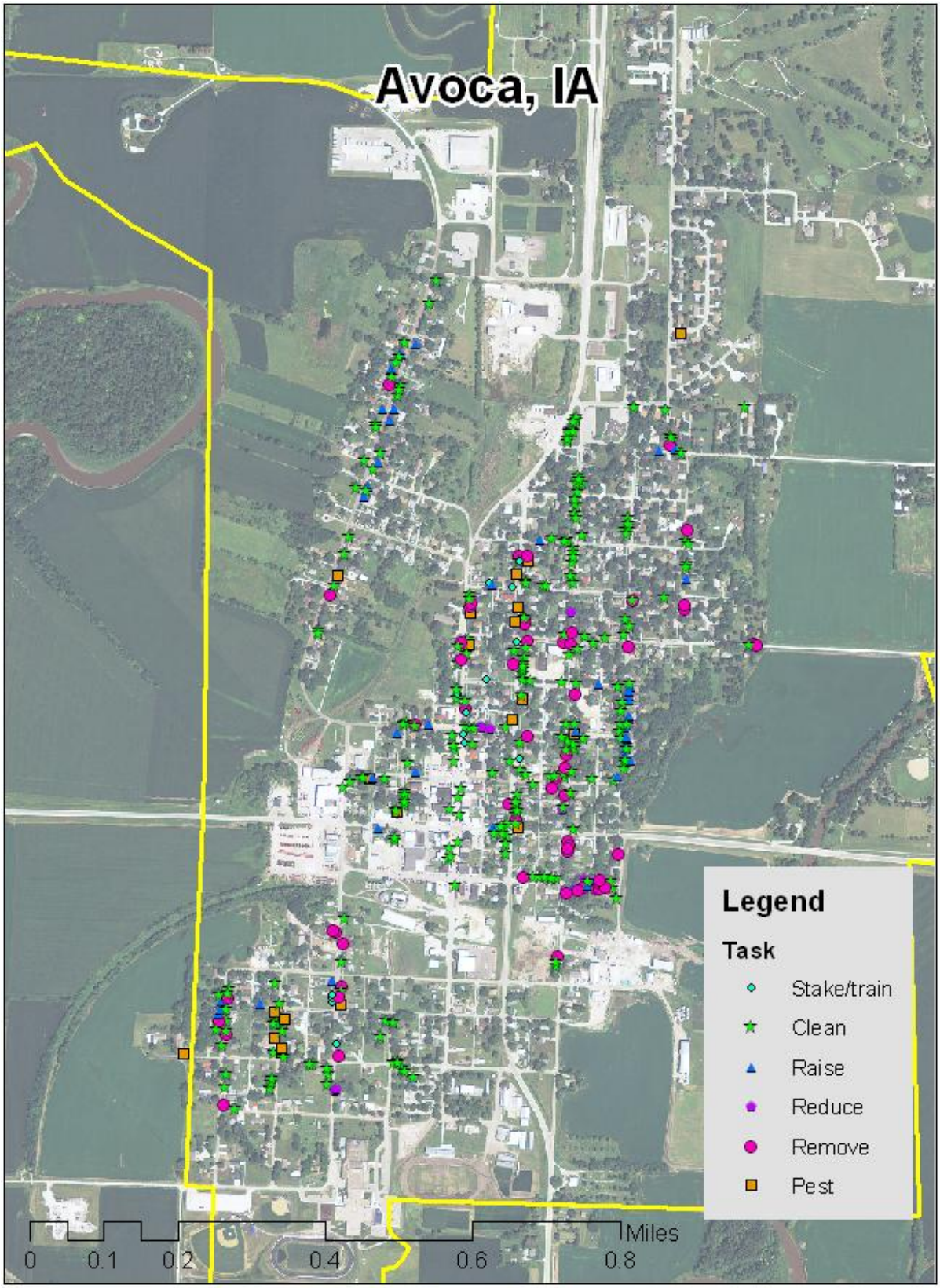


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Avoca Tree Ordinances

CHAPTER 151
TREES AND GRASS

151.01 DEFINITION. For use in this chapter, "boulevard" means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

151.02 PLANTING RESTRICTIONS. No tree shall be planted in any boulevard or street except in accordance with the following:
1. Alignment. All tress planted in any street shall be planted in the boulevard midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any boulevard which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

151.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least eighteen (18) feet above the surface of a street, twenty (20) feet above the surface of a primary highway, and eight (8) feet above the sidewalks. 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.
(Code of Iowa, Sec. 364.12[2c, d, & e])

151.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 151.03, it is unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

151.05 DISEASE CONTROL. Any dead, diseased or damaged tree or shrub which may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance.

151.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:
1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Private Property. If it is determined with reasonable certainty that any such condition exists 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.
(Code of Iowa, Sec. 364.12[3b & h])

151.07 CUTTING OR MOWING OF GRASS.
1. Duty to Cut and Mow Lawns and Lots. The owner of any property shall cut and mow all lawns and lots so that such growth shall be less than four (4) inches at all times.
2. Cutting and Mowing by City. If a property owner refuses or fails to cut and mow lawns and lots within forty-eight (48) hours after being delivered a notice from the City to perform such action, the Council may require said work to be done and the cost and expenses thereof shall be assessed to the property owner after due notice is given. The amount of such assessment shall be certified to the County Auditor as provided by law and the same shall be collected with and in the same manner as general property taxes.

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 Director Chuck Gipp at 515-281-5918.