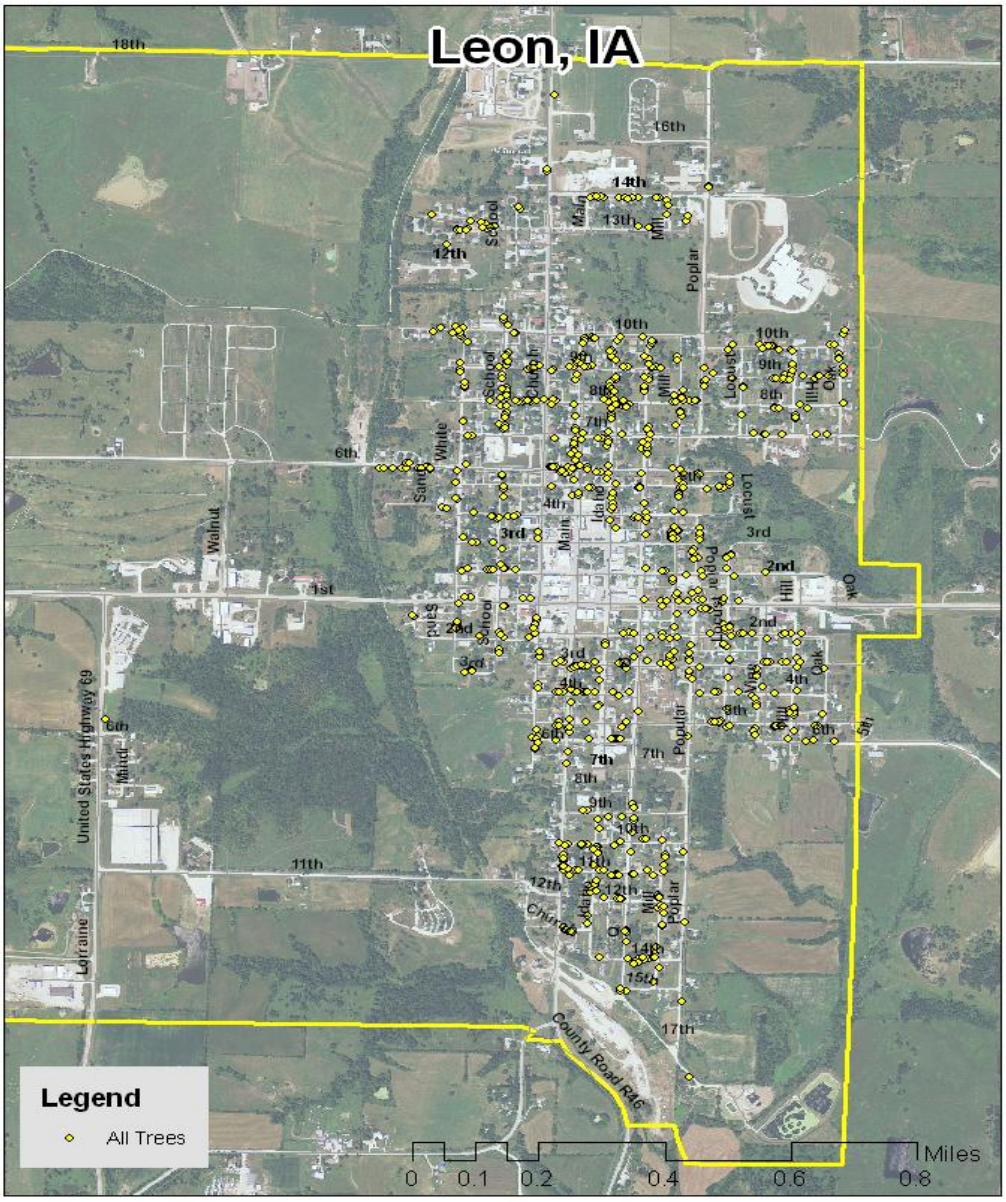
LEON, IA



2013 Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Leon 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 8.2% of Leon'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 854 trees inventoried.

- Leon's trees provide $142,545 of benefits annually, an average of $167 a tree
- There are over 49 species of trees
- The top three genus are: Maple 20%, Elm 18%, and Walnut 9%
- 52% of trees are in need of some type of management
- 137 trees are recommended for removal or for being evaluated further 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 137 trees recommended for removal/evaluation, six are "critical concern" trees and should be removed immediately (locations shown in Figure 4, Appendix B). 31 more trees are recommended for removal within the next 3 years. See "Hazardous Trees" page 7. *City ownership of the trees recommended for removal should be verified prior to any removal*.
- 19 of the 70 ash trees are in need of follow up because they are displaying signs and symptoms that may be associated with EAB. Check ash trees with a visual survey yearly.
- 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, silver maple, cottonwood, poplar, box elder, Chinese elm, Siberian elm, evergreen, willow, or black walnut. Suggested "Acceptable Trees List" is attached with this plan.
- With and estimated average tree removal cost of $500 per tree, it could take $35,000 or more to remove the 70 ash trees if EAB damage occurs. – Suggestion: request a budget increase of $5,000 annually over the next 10 years and apply for grants to plant replacement trees.

Introduction

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

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

Inventory

In 2012, a tree inventory was conducted that included 100% of the city owned trees on streets. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in 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 854 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Leon's trees reduce energy related costs by approximately $40,097 annually (Appendix A, Table 1). These savings are both in Electricity (191.9 MWh) and in Natural Gas (26,051 Therms).

Annual Stormwater Benefits

Leon's trees intercept about 1,898,664 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $51,457 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 Leon, it is estimated that trees remove 2,493 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 $6,851 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Leon, trees sequester about 431,576 lbs of carbon a year with an associated value of $5,408 (Appendix A, Table 5). In addition, the trees store 6,720,889 lbs of carbon, with a yearly benefit of $50,407 (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. Leon receives $38,722 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, Leon's trees provide $142,535 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 854 trees in Leon provide approximately $167 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

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

Maple	171	20%
Elm	156	18%
Walnut	74	9%
Ash	70	8%
E. Redbud	54	6%
E. Redcedar	51	6%
Mulberry	20	2%
Others	258	31%

Others include: Ohio buckeye, apple, Northern catalpa, Ginko, honeylocust, Tulip tree, spruce, pines, sycamore, E. cottonwood, chokecherry, pear, oaks, willow, Lilac, and basswood.

Age Class

Most of Leon's trees (46%) are between 6 and 18 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. Leon'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 Leon indicate that 83% of the trees are in good health, with only 5% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 65% of Leon'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 15% of the population. This is why so many trees are recommended for removal or to be evaluated further for removal.

Management Needs

The following outlines the specific management needs of the street trees by number of trees and percent of canopy (Appendix B, Figure 5).

Crown Cleaning	293	34%
Crown Raising	7	<1%
Tree Staking	7	<1%
Tree Removal	137	16%
Crown Reduction	0	0%

Canopy Cover

The canopy cover of Leon is approximately 21 acres (Appendix A, Figure 5). According to the 2000 census, *CITY* occupies 2,009.6 acres. Thus the canopy cover on city land is about 1%.

Land Use and Location

The majority of Lamoni's city 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	100%
Park/vacant/other	0%
Industrial/Large commercial	0%
Small commercial	0%
Multifamily residential	0%

Location	
Planting strip	100%
Other maintained locations	0%
Cutout (surrounded by pavement)	0%
Front yard	0%

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

Leon has 6 critical concern trees that need immediate removal. The location of these trees can be seen on the map (Appendix B, Figure 4). It is recommended to start with the larger diameter critical concern trees first. There are 3 silver maples (1, 24-30"diam., 1, 36-42"diam., and 1, 42+"diam.). There are also 3 elms, each 24-30"diameter at 4.5 ft. above ground that should be addressed immediately. After all of the critical concern trees are addressed, there should be follow up on the trees recommended for removal within the next 3 years. There are a total of 31 (23 mature and 8 younger) of these trees (see locations on map Appendix B, Figure 5). After that, there are 100 trees that should be evaluated for possible removal within the next 5 years.

Poor tree species

After the removal of the critical concern trees and those recommended for removal within 3 years, ash trees in poor health should be assessed for removal (Appendix B, Figures 1-4). Of the 31 recommended removals, 3 are ash trees. There are a total of 70 ash trees, and 19 of those have signs and symptoms that have been associated with EAB. In addition, there are 4 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 Leon.

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 Silver maple, elm, and Black walnut (Appendix A, Figure 1). These species 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, Siberian elm, evergreen, and willow. All trees planted must meet the restrictions in city ordinance.

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.

Six Year Maintenance Plan with <u>No Additional Funding</u> –Proposed

Remove critical concern trees first, then mature trees recommended for immediate (1-3 years) removal. Then, young trees recommended for immediate removal. Then, ash in poor condition.

Year 1

Removal: 4 largest critical concern trees
Routine trimming: Contract to trim 50 trees needing trimming
Planting and Replacement: 5 trees in open locations from removals
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 2 remaining critical concern trees, 3 ash trees recommended for immediate removal.
Planting and Replacement: 5 trees in open locations from removals
Routine trimming: Contract to trim 50 of the city trees needing trimming
Visual Survey for signs and symptoms of EAB

Year 3

Removal: 7 trees - and any new critical concern trees and ash in poor health
Planting and Replacement: 9 trees in open locations from removals
Routine trimming: Contract to trim 50 of the city trees needing trimming
Visual Survey for signs and symptoms of EAB

Year 4

Removal: 7 trees - and any new critical concern trees and ash in poor health
Planting and Replacement: 9 trees in open locations from removals
Routine trimming: Contract to trim 50 of the city trees needing trimming
Visual Survey for signs and symptoms of EAB

Year 5

Removal: 7 trees – and any new critical concern trees and ash in poor health
Planting and Replacement: 9 trees in open locations from removals
Routine trimming: Contract to trim 50 of the city trees needing trimming
Visual Survey for signs and symptoms of EAB

Year 6

Removal: 7 trees - and any new critical concern trees and ash in poor health
Planting and Replacement: 9 trees in open locations from removals
Routine trimming: Contract to trim 50 of the city trees needing trimming
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years will probably be minimal. EAB could potentially kill all ash within 4 years of infestation. After the 6 year recommended period to remove and trim everything with designated needs, concentrate on removing ash trees if needed, those in poor condition first. Any new critical concern trees and trees evaluated as needing removal are always top candidates for priority management.

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). *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 should be replaced with a suitable diversity of non-ash species. Suitable species are listed in the "Acceptable Tree List" attached with this plan. All trees must meet the restrictions in any city ordinance.

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 should 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. An "Emerald Ash Borer Symptoms List" and an EAB Pest Alert are provided with this plan for your information. If you suspect that you may actually have EAB damage, the first step is to contact the ISU Plant and Insect Diagnostic Clinic at 515-294-0581.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB. This should be done in accordance with any existing or new city code. Example Code: "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

Budget information was not provided by the city. Consequently, assuming that the budget for tree maintenance is minimal, the following are some estimated costs associated with the recommended maintenance work. If a budget does not exist, a recommendation would be to shoot for setting it at $2 per capita, which is a requirement for becoming a Tree City USA.

Tree removal costs average around $500 per tree, depending on the size and numbers of trees. the estimated range would be $350-$1,000.

Trimming (including cleaning, raising, reducing) averages $75 per tree and can range from $70 to $200 per tree.

New planting averages about $150 per tree (5' trees in 10 gallon containers are about $75-$100 plus the cost of watering).

Purposed Budget Increase

EAB could potentially kill all ash trees in Leon within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased by $6,000 a year or more. Additionally, it is recommended that Leon 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. For more information about grants please contact Emma Bruemmer, DNR State Urban Forester, at 515-281-5600 or by e-mail at Emma.Bruemmer@dnr.iowa.gov

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Leon

Annual Energy Benefits of Public Trees by Species

1/14/2013

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	41.8	3,174	5,480.5	5,371	8,545	(N/A)	16.4	21.3	61.04
Siberian elm	31.9	2,419	4,332.8	4,246	6,665	(N/A)	13.4	16.6	58.46
Black walnut	16.3	1,236	2,104.2	2,062	3,299	(N/A)	8.7	8.2	44.57
Green ash	18.0	1,368	2,363.9	2,317	3,685	(N/A)	8.2	9.2	52.64
Eastern redbud	9.2	697	1,329.8	1,303	2,000	(N/A)	6.3	5.0	37.03
Eastern red cedar	4.6	352	695.1	681	1,033	(N/A)	6.0	2.6	20.25
Elm	9.2	697	1,246.5	1,222	1,919	(N/A)	4.3	4.8	51.87
Broadleaf Deciduous	3.6	275	480.9	471	746	(N/A)	2.3	1.9	37.30
Mulberry	2.9	218	445.3	436	654	(N/A)	2.3	1.6	32.72
Sugar maple	4.1	313	539.3	528	842	(N/A)	2.2	2.1	44.31
Broadleaf Deciduous	4.3	330	615.8	604	933	(N/A)	2.1	2.3	51.84
Northern catalpa	5.1	384	692.9	679	1,063	(N/A)	2.1	2.7	59.08
Amur maple	1.9	142	280.1	275	416	(N/A)	2.0	1.0	24.48
Broadleaf Deciduous	2.2	167	350.0	343	510	(N/A)	2.0	1.3	29.99
Apple	1.6	121	233.1	228	349	(N/A)	2.0	0.9	20.53
Scotch pine	1.1	82	153.5	150	232	(N/A)	1.6	0.6	16.60
Northern pin oak	3.9	294	553.7	543	837	(N/A)	1.6	2.1	59.78
Lilac	2.7	206	407.9	400	606	(N/A)	1.6	1.5	43.28
Norway maple	2.6	197	349.9	343	540	(N/A)	1.3	1.4	49.10
American sycamore	4.0	301	534.4	524	825	(N/A)	1.3	2.1	74.98
Blue spruce	0.9	70	121.6	119	189	(N/A)	1.2	0.5	18.87
Maple	2.3	171	304.7	299	470	(N/A)	1.1	1.2	52.21
Honeylocust	2.3	177	317.3	311	488	(N/A)	1.1	1.2	54.27
Other street trees	15.5	1,176	2,117.7	2,075	3,251	(N/A)	8.9	8.1	42.78
Citywide total	191.9	14,567	26,051.0	25,530	40,097	(N/A)	100.0	100.0	46.95

Table 2: Annual Stormwater Benefits

Leon

Annual Stormwater Benefits of Public Trees by Species

1/14/2013

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	538,420	14,592	(N/A)	16.4	28.4	104.23
Siberian elm	294,066	7,970	(N/A)	13.4	15.5	69.91
Black walnut	135,510	3,673	(N/A)	8.7	7.1	49.63
Green ash	169,901	4,605	(N/A)	8.2	9.0	65.78
Eastern redbud	39,984	1,084	(N/A)	6.3	2.1	20.07
Eastern red cedar	67,117	1,819	(N/A)	6.0	3.5	35.67
Elm	96,254	2,609	(N/A)	4.3	5.1	70.50
Broadleaf Deciduous	31,728	860	(N/A)	2.3	1.7	42.99
Mulberry	13,978	379	(N/A)	2.3	0.7	18.94
Sugar maple	34,476	934	(N/A)	2.2	1.8	49.18
Broadleaf Deciduous	39,625	1,074	(N/A)	2.1	2.1	59.66
Northern catalpa	60,273	1,634	(N/A)	2.1	3.2	90.75
Amur maple	6,712	182	(N/A)	2.0	0.4	10.70
Broadleaf Deciduous	11,525	312	(N/A)	2.0	0.6	18.37
Apple	6,575	178	(N/A)	2.0	0.4	10.48
Scotch pine	12,109	328	(N/A)	1.6	0.6	23.44
Northern pin oak	38,814	1,052	(N/A)	1.6	2.0	75.14
Lilac	13,898	377	(N/A)	1.6	0.7	26.90
Norway maple	19,171	520	(N/A)	1.3	1.0	47.23
American sycamore	55,089	1,493	(N/A)	1.3	2.9	135.73
Blue spruce	10,999	298	(N/A)	1.2	0.6	29.81
Maple	20,545	557	(N/A)	1.1	1.1	61.87
Honeylocust	24,203	656	(N/A)	1.1	1.3	72.88
Other street trees	157,691	4,274	(N/A)	8.9	8.3	56.23
Citywide total	1,898,664	51,457	(N/A)	100.0	100.0	60.25

Table 3: Annual Air Quality Benefits

Leon

Annual Air Quality Benefits of Public Trees by Species

1/14/2013

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
Silver maple	87.3	14.8	43.7	3.9	473	197.0	28.9	27.6	189.2	1,233	-47.5	-178	544.8	1,528	(N/A)	16.4	10.91
Siberian elm	41.4	7.0	21.3	1.8	226	151.8	22.1	21.1	144.4	946	0.0	0	410.9	1,172	(N/A)	13.3	10.28
Black walnut	13.1	2.1	7.0	0.6	72	76.7	11.2	10.7	73.8	480	0.0	0	195.2	552	(N/A)	8.7	7.46
Green ash	19.2	3.1	9.6	0.9	103	85.1	12.5	11.9	81.7	533	0.0	0	223.9	636	(N/A)	8.2	9.09
Eastern redbud	13.1	2.2	6.1	0.6	70	44.5	6.4	6.1	41.6	275	-0.1	0	120.5	345	(N/A)	6.3	6.38
Eastern red cedar	13.0	2.6	10.4	1.6	85	22.6	3.3	3.1	21.0	140	-36.9	-138	40.5	86	(N/A)	6.0	1.68
Elm	11.3	1.8	5.5	0.5	61	43.8	6.4	6.1	41.6	273	0.0	0	117.1	334	(N/A)	4.3	9.02
Broadleaf Deciduous	3.7	0.6	1.9	0.2	20	17.1	2.5	2.4	16.4	107	0.0	0	44.7	127	(N/A)	2.3	6.34
Mulberry	4.6	0.8	2.1	0.2	24	14.2	2.0	1.9	13.0	87	0.0	0	38.9	112	(N/A)	2.3	5.58
Sugar maple	3.9	0.7	2.1	0.2	22	19.5	2.9	2.7	18.7	122	-3.2	-12	47.4	131	(N/A)	2.2	6.92
Broadleaf Deciduous	8.1	1.4	4.0	0.4	44	21.0	3.0	2.9	19.7	130	-1.9	-7	58.5	167	(N/A)	2.1	9.26
Northern catalpa	7.9	1.3	3.7	0.4	42	24.2	3.5	3.4	23.0	151	0.0	0	67.2	192	(N/A)	2.1	10.68
Amur maple	1.7	0.3	0.9	0.1	9	9.1	1.3	1.2	8.5	56	0.0	0	23.1	65	(N/A)	2.0	3.85
Broadleaf Deciduous	3.9	0.6	1.8	0.2	21	10.9	1.6	1.5	10.0	67	0.0	0	30.4	88	(N/A)	2.0	5.15
Apple	2.0	0.3	1.0	0.1	11	7.7	1.1	1.1	7.2	48	0.0	0	20.5	58	(N/A)	2.0	3.44
Scotch pine	1.2	0.2	1.1	0.1	8	5.2	0.8	0.7	4.9	32	-3.8	-14	10.4	26	(N/A)	1.6	1.86
Northern pin oak	8.3	1.4	4.0	0.4	45	18.8	2.7	2.6	17.6	116	-1.9	-7	53.9	154	(N/A)	1.6	11.00
Lilac	4.9	0.8	2.2	0.2	26	13.3	1.9	1.8	12.3	82	0.0	0	37.5	108	(N/A)	1.6	7.71
Norway maple	3.4	0.6	1.8	0.2	19	12.4	1.8	1.7	11.8	77	-0.8	-3	32.8	93	(N/A)	1.3	8.44
American sycamore	8.1	1.3	3.6	0.4	42	18.9	2.8	2.6	18.0	118	0.0	0	55.6	160	(N/A)	1.3	14.55
Blue spruce	1.2	0.2	1.1	0.2	8	4.3	0.6	0.6	4.1	27	-3.8	-14	8.7	21	(N/A)	1.2	2.13
Maple	5.1	0.9	2.4	0.2	27	10.7	1.6	1.5	10.2	67	-1.7	-6	30.9	88	(N/A)	1.1	9.76
Honeylocust	4.6	0.8	2.1	0.2	24	11.1	1.6	1.5	10.6	69	-3.5	-13	29.1	81	(N/A)	1.1	8.95
Other street trees	25.7	4.4	13.8	1.4	143	73.9	10.8	10.3	70.2	461	-20.2	-76	190.3	528	(N/A)	8.9	6.94
Citywide total	296.9	50.2	153.0	14.7	1,624	913.6	133.2	127.0	869.5	5,697	-125.4	-470	2,432.7	6,851	(N/A)	100.0	8.02

Table 4: Annual Carbon Stored

Leon

Stored CO2 Benefits of Public Trees by Species

1/14/2013

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	1,989,742	14,923	(N/A)	16.4	29.6	106.59
Siberian elm	1,018,169	7,636	(N/A)	13.4	15.2	66.98
Black walnut	428,774	3,216	(N/A)	8.7	6.4	43.46
Green ash	630,907	4,732	(N/A)	8.2	9.4	67.60
Eastern redbud	200,427	1,503	(N/A)	6.3	3.0	27.84
Eastern red cedar	42,732	320	(N/A)	6.0	0.6	6.28
Elm	371,187	2,784	(N/A)	4.3	5.5	75.24
Broadleaf	125,724	943	(N/A)	2.3	1.9	47.15
Mulberry	72,623	545	(N/A)	2.3	1.1	27.23
Sugar maple	110,947	832	(N/A)	2.2	1.7	43.79
Broadleaf	134,054	1,005	(N/A)	2.1	2.0	55.86
Northern catalpa	258,081	1,936	(N/A)	2.1	3.8	107.53
Amur maple	27,480	206	(N/A)	2.0	0.4	12.12
Broadleaf	61,888	464	(N/A)	2.0	0.9	27.30
Apple	31,417	236	(N/A)	2.0	0.5	13.86
Scotch pine	7,248	54	(N/A)	1.6	0.1	3.88
Northern pin oak	137,784	1,033	(N/A)	1.6	2.1	73.81
Lilac	75,870	569	(N/A)	1.6	1.1	40.64
Norway maple	56,641	425	(N/A)	1.3	0.8	38.62
American	269,583	2,022	(N/A)	1.3	4.0	183.81
Blue spruce	6,771	51	(N/A)	1.2	0.1	5.08
Maple	55,139	414	(N/A)	1.1	0.8	45.95
Honeylocust	58,956	442	(N/A)	1.1	0.9	49.13
Other street trees	248,909	4,116	(N/A)	8.9	8.2	54.15
Citywide total	6,720,889	50,407	(N/A)	100.0	100.0	59.02

Table 5: Annual Carbon Sequestered

Leon

Annual CO_2 Benefits of Public Trees by Species

1/14/2013

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	158,818	1,191	-9,551	-27	-72	70,145	526	219,385	1,645	(N/A)	16.4	30.4	11.75
Siberian elm	57,760	433	-4,887	-22	-37	53,452	401	106,303	797	(N/A)	13.4	14.7	6.99
Black walnut	35,787	268	-2,058	-14	-16	27,324	205	61,038	458	(N/A)	8.7	8.5	6.19
Green ash	39,864	299	-3,028	-14	-23	30,231	227	67,053	503	(N/A)	8.2	9.3	7.18
Eastern redbud	14,317	107	-962	-11	-7	15,394	115	28,738	216	(N/A)	6.3	4.0	3.99
Eastern red cedar	1,498	11	-205	-10	-2	7,775	58	9,058	68	(N/A)	6.0	1.3	1.33
Elm	21,482	161	-1,782	-7	-13	15,414	116	35,108	263	(N/A)	4.3	4.9	7.12
Broadleaf Deciduous	7,376	55	-603	-4	-5	6,069	46	12,838	96	(N/A)	2.3	1.8	4.81
Mulberry	2,384	18	-349	-4	-3	4,818	36	6,850	51	(N/A)	2.3	1.0	2.57
Sugar maple	7,484	56	-533	-4	-4	6,924	52	13,872	104	(N/A)	2.2	1.9	5.48
Broadleaf Deciduous	4,051	30	-643	-4	-5	7,284	55	10,688	80	(N/A)	2.1	1.5	4.45
Northern catalpa	11,937	90	-1,239	-4	-9	8,497	64	19,192	144	(N/A)	2.1	2.7	8.00
Amur maple	2,783	21	-132	-3	-1	3,130	23	5,777	43	(N/A)	2.0	0.8	2.55
Broadleaf Deciduous	2,357	18	-297	-3	-2	3,687	28	5,744	43	(N/A)	2.0	0.8	2.53
Apple	2,260	17	-151	-3	-1	2,663	20	4,769	36	(N/A)	2.0	0.7	2.10
Scotch pine	988	7	-35	-3	0	1,810	14	2,761	21	(N/A)	1.6	0.4	1.48
Northern pin oak	5,198	39	-661	-3	-5	6,505	49	11,039	83	(N/A)	1.6	1.5	5.91
Lilac	2,774	21	-364	-3	-3	4,555	34	6,962	52	(N/A)	1.6	1.0	3.73
Norway maple	4,235	32	-272	-2	-2	4,360	33	8,321	62	(N/A)	1.3	1.2	5.67
American sycamore	8,784	66	-1,294	-2	-10	6,653	50	14,141	106	(N/A)	1.3	2.0	9.64
Blue spruce	620	5	-32	-2	0	1,537	12	2,123	16	(N/A)	1.2	0.3	1.59
Maple	2,852	21	-265	-2	-2	3,784	28	6,369	48	(N/A)	1.1	0.9	5.31
Honeylocust	7,714	58	-283	-2	-2	3,921	29	11,351	85	(N/A)	1.1	1.6	9.46
Other street trees	28,251	212	-2,634	-15	-20	25,988	195	51,590	387	(N/A)	8.9	7.2	5.09
Citywide total	431,576	3,237	-32,260	-167	-243	321,920	2,414	721,069	5,408	(N/A)	100.0	100.0	6.33

Table 6: Annual Social and Aesthetic Benefits

Leon

Annual Aesthetic/Other Benefits of Public Trees by Species

1/14/2013

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	12,949	(N/A)	16.4	33.4	92.49
Siberian elm	4,540	(N/A)	13.4	11.7	39.82
Black walnut	3,412	(N/A)	8.7	8.8	46.11
Green ash	3,560	(N/A)	8.2	9.2	50.86
Eastern redbud	839	(N/A)	6.3	2.2	15.54
Eastern red cedar	612	(N/A)	6.0	1.6	12.00
Elm	1,858	(N/A)	4.3	4.8	50.20
Broadleaf Deciduous	761	(N/A)	2.3	2.0	38.04
Mulberry	138	(N/A)	2.3	0.4	6.88
Sugar maple	851	(N/A)	2.2	2.2	44.78
Broadleaf Deciduous	414	(N/A)	2.1	1.1	23.02
Northern catalpa	961	(N/A)	2.1	2.5	53.41
Amur maple	159	(N/A)	2.0	0.4	9.35
Broadleaf Deciduous	138	(N/A)	2.0	0.4	8.12
Apple	129	(N/A)	2.0	0.3	7.61
Scotch pine	283	(N/A)	1.6	0.7	20.25
Northern pin oak	478	(N/A)	1.6	1.2	34.11
Lilac	164	(N/A)	1.6	0.4	11.70
Norway maple	418	(N/A)	1.3	1.1	37.99
American sycamore	639	(N/A)	1.3	1.7	58.08
Blue spruce	223	(N/A)	1.2	0.6	22.28
Maple	357	(N/A)	1.1	0.9	39.69
Honeylocust	1,821	(N/A)	1.1	4.7	202.34
Other street trees	3,018	(N/A)	8.9	7.8	39.71
Citywide total	38,722	(N/A)	100.0	100.0	45.34

Table 7: Summary of Benefits in Dollars

Leon

Total Annual Benefits of Public Trees by Species ($)

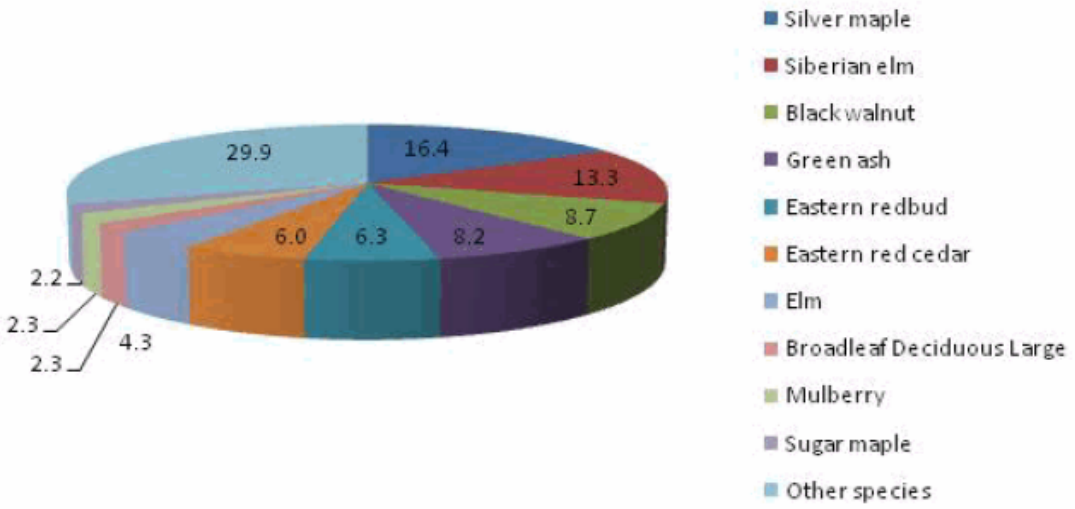
1/14/201

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	8,545	1,645	1,528	14,592	12,949	39,260	(±0)	27.5
Siberian elm	6,665	797	1,172	7,970	4,540	21,144	(±0)	14.8
Black walnut	3,299	458	552	3,673	3,412	11,393	(±0)	8.0
Green ash	3,685	503	636	4,605	3,560	12,988	(±0)	9.1
Eastern redbud	2,000	216	345	1,084	839	4,483	(±0)	3.1
Eastern red cedar	1,033	68	86	1,819	612	3,618	(±0)	2.5
Elm	1,919	263	334	2,609	1,858	6,982	(±0)	4.9
Broadleaf Deciduous	746	96	127	860	761	2,590	(±0)	1.8
Mulberry	654	51	112	379	138	1,334	(±0)	0.9
Sugar maple	842	104	131	934	851	2,862	(±0)	2.0
Broadleaf Deciduous	933	80	167	1,074	414	2,668	(±0)	1.9
Northern catalpa	1,063	144	192	1,634	961	3,995	(±0)	2.8
Amur maple	416	43	65	182	159	866	(±0)	0.6
Broadleaf Deciduous	510	43	88	312	138	1,091	(±0)	0.8
Apple	349	36	58	178	129	751	(±0)	0.5
Scotch pine	232	21	26	328	283	891	(±0)	0.6
Northern pin oak	837	83	154	1,052	478	2,603	(±0)	1.8
Lilac	606	52	108	377	164	1,307	(±0)	0.9
Norway maple	540	62	93	520	418	1,633	(±0)	1.1
American sycamore	825	106	160	1,493	639	3,223	(±0)	2.3
Blue spruce	189	16	21	298	223	747	(±0)	0.5
Maple	470	48	88	557	357	1,520	(±0)	1.1
Honeylocust	488	85	81	656	1,821	3,131	(±0)	2.2
Other street trees	3,251	387	528	4,274	3,018	11,457	(±0)	8.0
Citywide Total	40,097	5,408	6,851	51,457	38,722	142,535	(±0)	100.0

Leon

Species Distribution of Public Trees (%)

1/14/2013



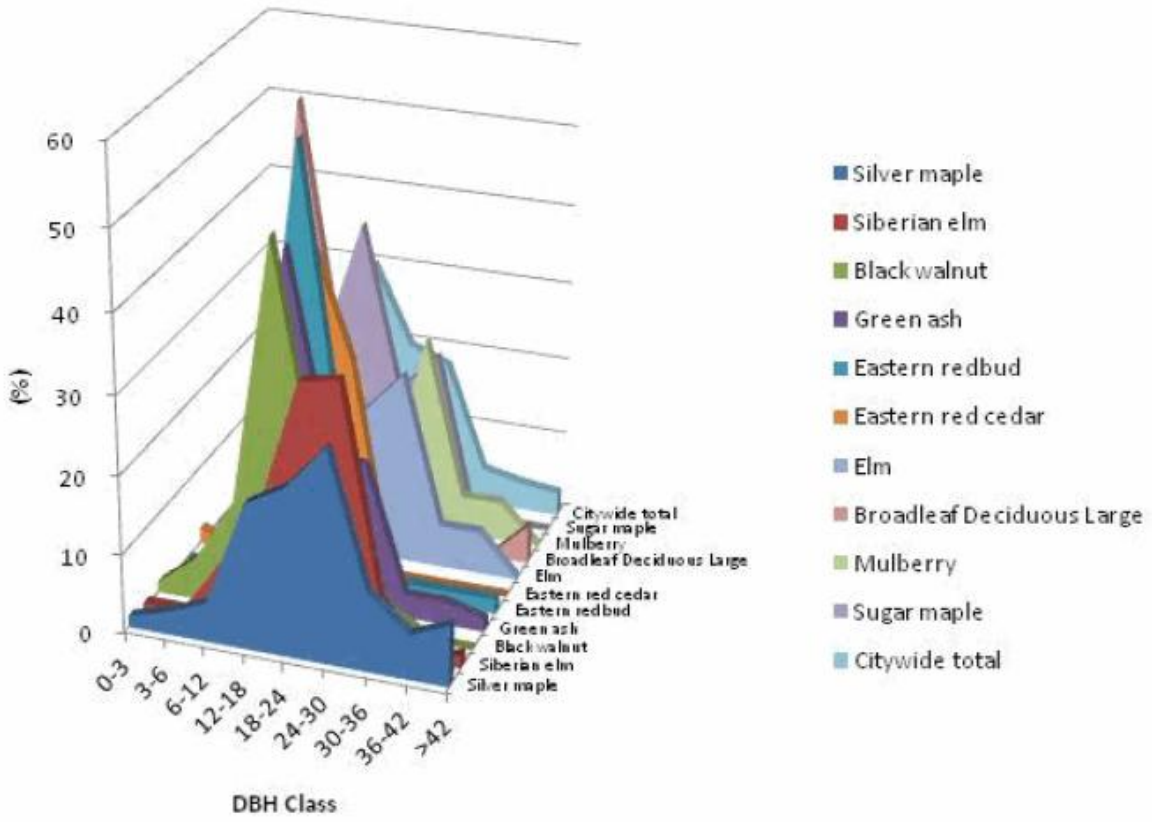
Species	Percent
Silver maple	16.4
Siberian elm	13.3
Black walnut	8.7
Green ash	8.2
Eastern redbud	6.3
Eastern red cedar	6.0
Elm	4.3
Broadleaf Deciduous	2.3
Mulberry	2.3
Sugar maple	2.2
Other species	29.9
Total	100.0

Figure 1: Species Distribution

Leon

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

1/14/2013



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Silver maple	1.4	2.9	5.0	18.6	21.4	27.1	10.0	5.7	7.9
Siberian elm	0.9	0.9	7.9	15.8	32.5	33.3	7.0	0.0	1.8
Black walnut	1.4	5.4	13.5	47.3	20.3	9.5	2.7	0.0	0.0
Green ash	0.0	0.0	10.0	44.3	20.0	18.6	2.9	2.9	1.4
Eastern redbud	0.0	0.0	16.7	55.6	20.4	1.9	1.9	1.9	1.9
Eastern red cedar	2.0	0.0	29.4	41.2	27.5	0.0	0.0	0.0	0.0
Elm	0.0	5.4	16.2	24.3	18.9	24.3	5.4	5.4	0.0
Broadleaf Deciduous	0.0	0.0	55.0	25.0	5.0	10.0	0.0	0.0	5.0
Mulberry	0.0	5.0	35.0	20.0	5.0	25.0	5.0	5.0	0.0
Sugar maple	0.0	5.3	21.1	36.8	15.8	21.1	0.0	0.0	0.0
Citywide total	1.2	3.6	16.3	30.1	19.9	17.9	4.6	3.5	2.9

Figure 2: Relative Age Class

Leon

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

1/14/2013

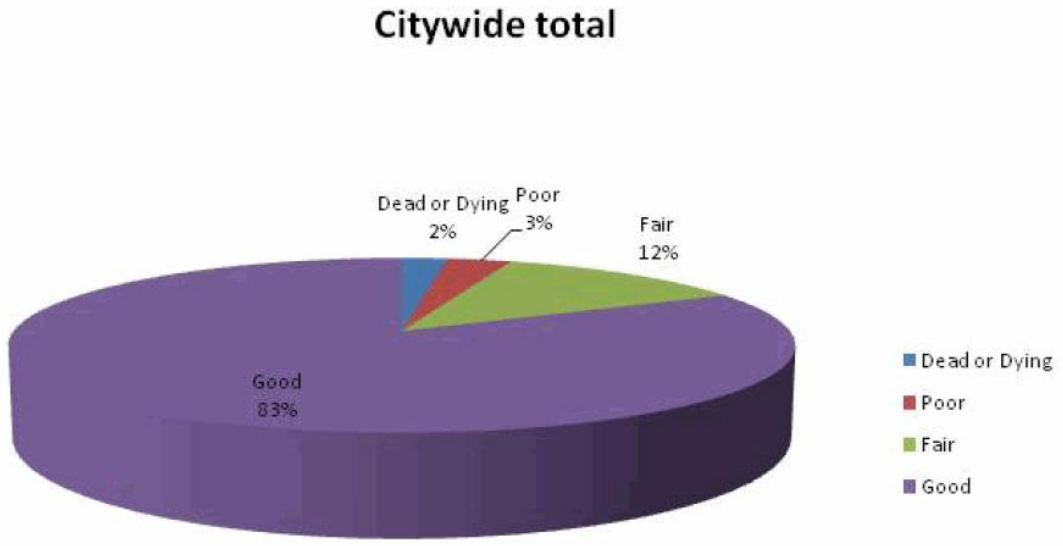


Figure 3: Foliage Condition

Leon

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

1/14/2013

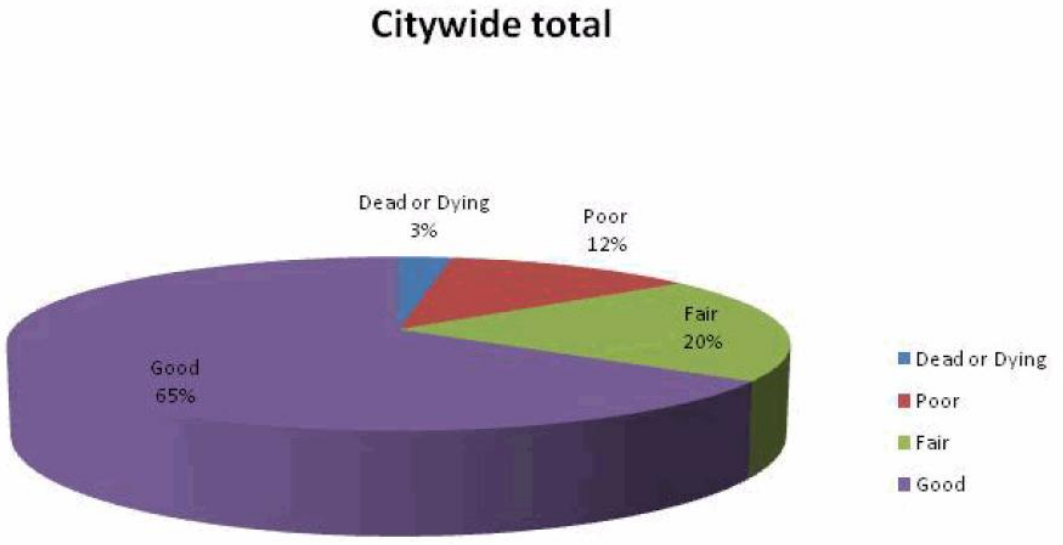
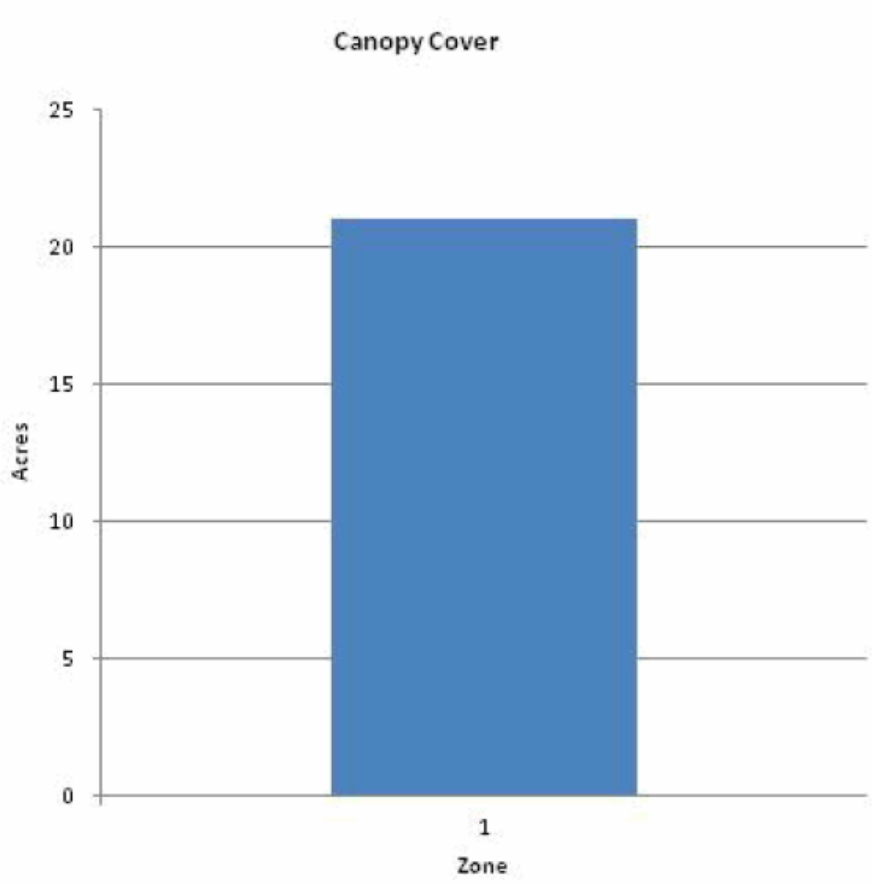


Figure 4: Wood Condition

Leon

Canopy Cover of Public Trees (Acres)

1/14/2013



Zone	Acres	% of Total Canopy Cover
1	21	100.0
Citywide total	21	100.0

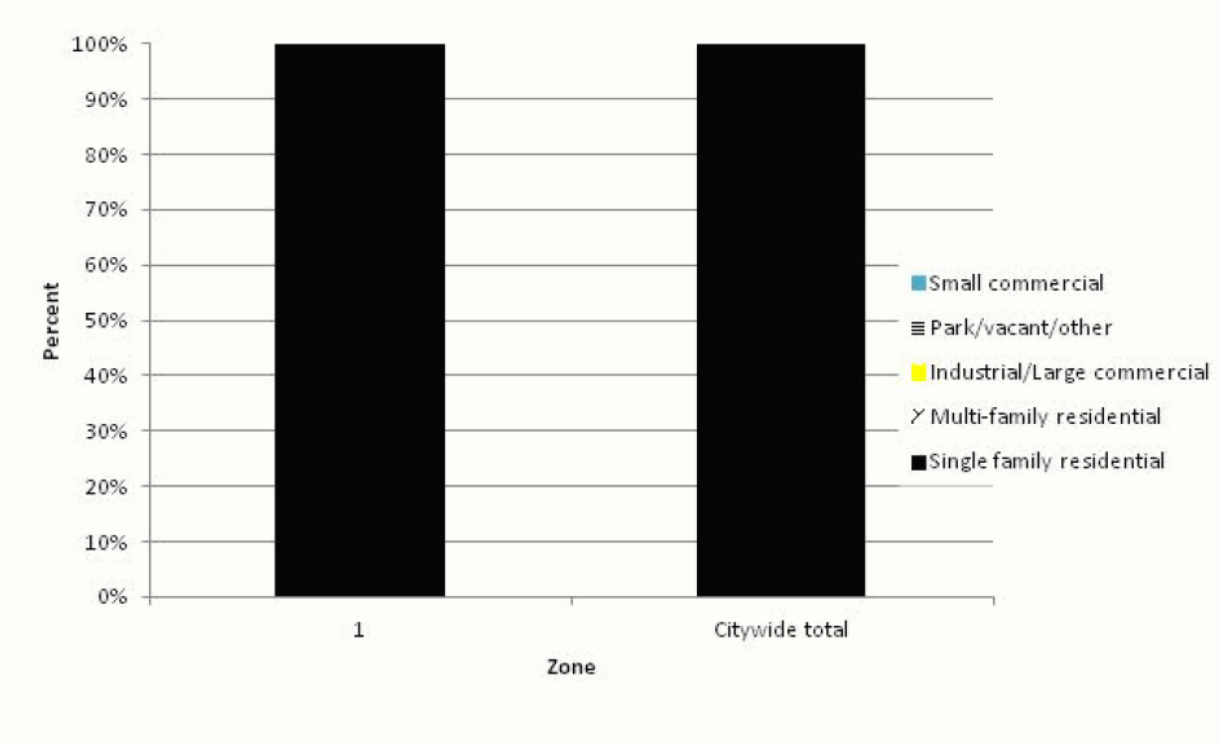
	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide	0	0	21		

Figure 5: Canopy Cover in Acres

Leon

Land Use of Public Trees by Zone (%)

1/14/2013



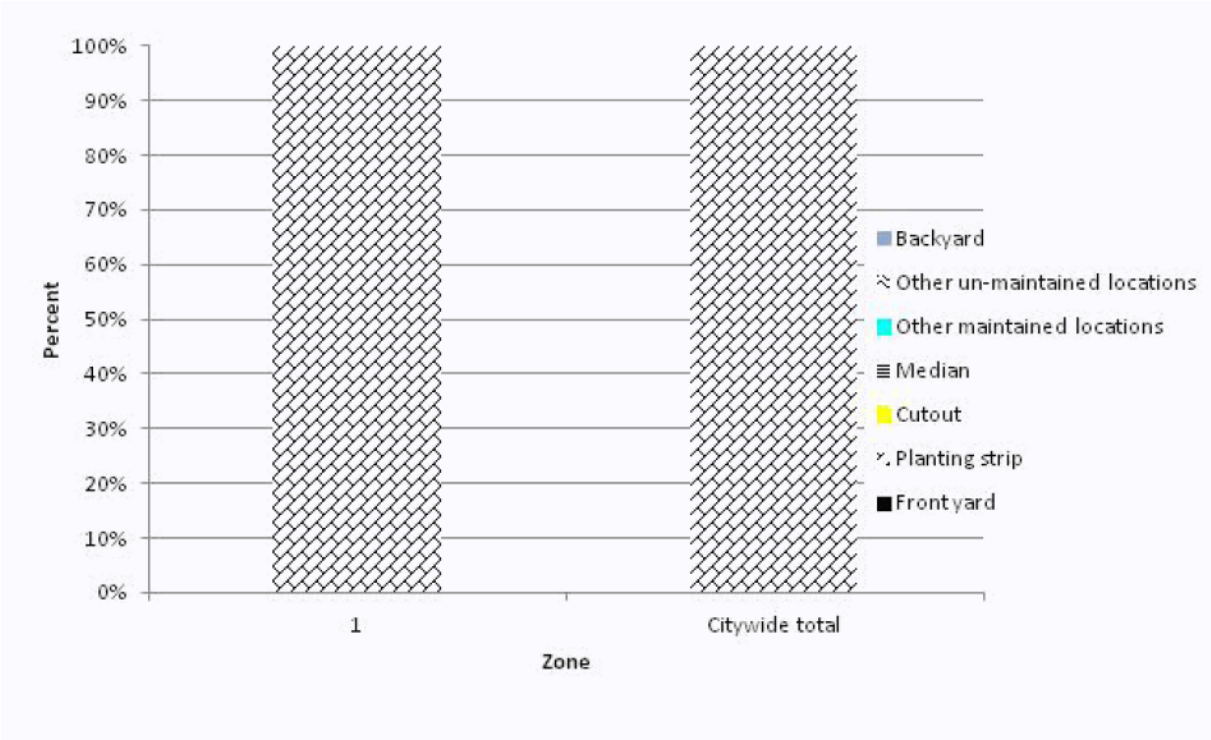
Zone	Single family residential	Multi-family residential	Industrial/ Large commercial	Park/vacant/ other	Small commercial
1	100.0	0.0	0.0	0.0	0.0
Citywide total	100.0	0.0	0.0	0.0	0.0

Figure 6: Land Use of city/park trees

Leon

Location of Public Trees by Zone (%)

1/14/2013



Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Citywide total	0.0	100.0	0.0	0.0	0.0	0.0	0.0

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

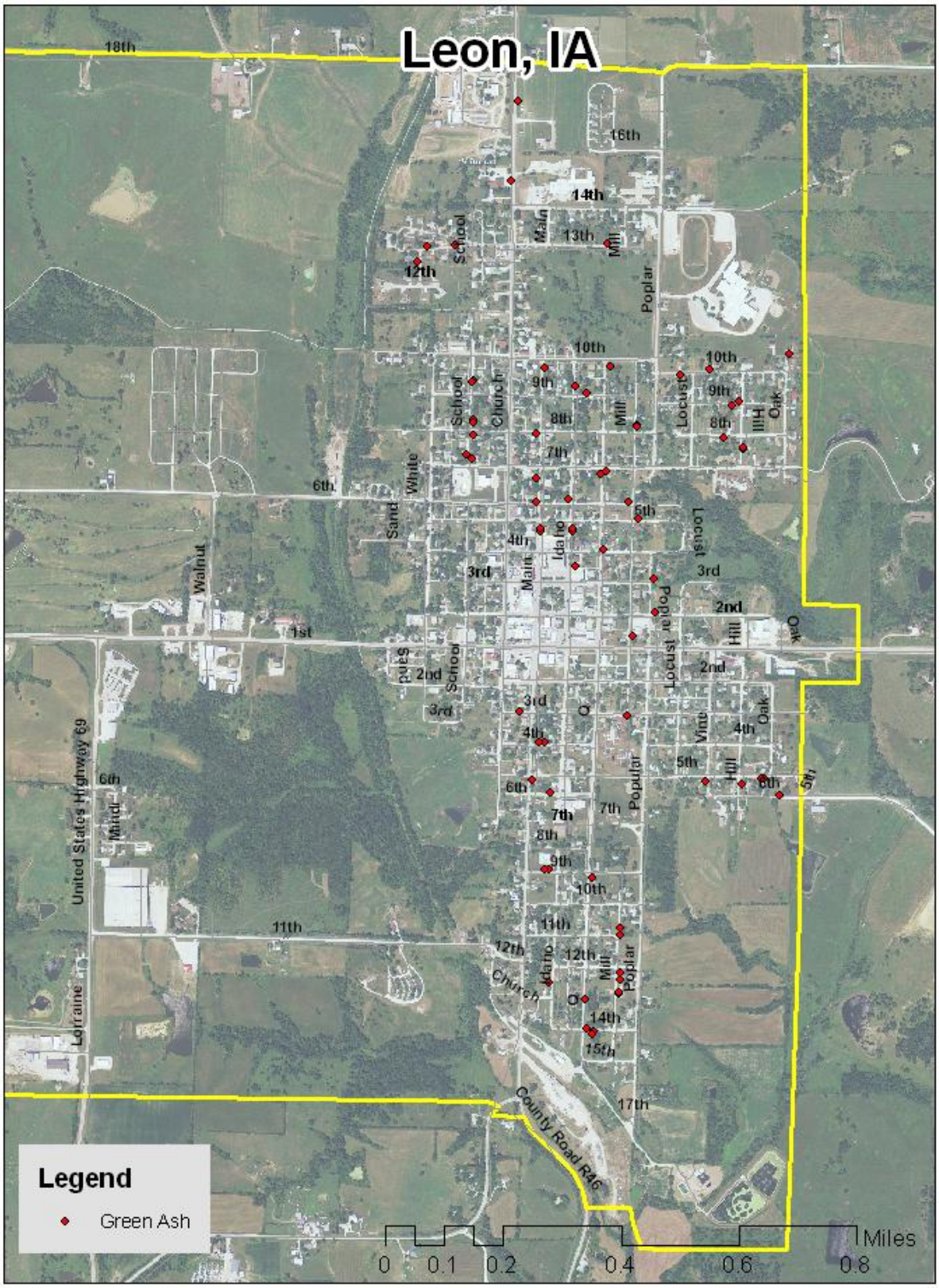


Figure 1: Location of Ash Trees

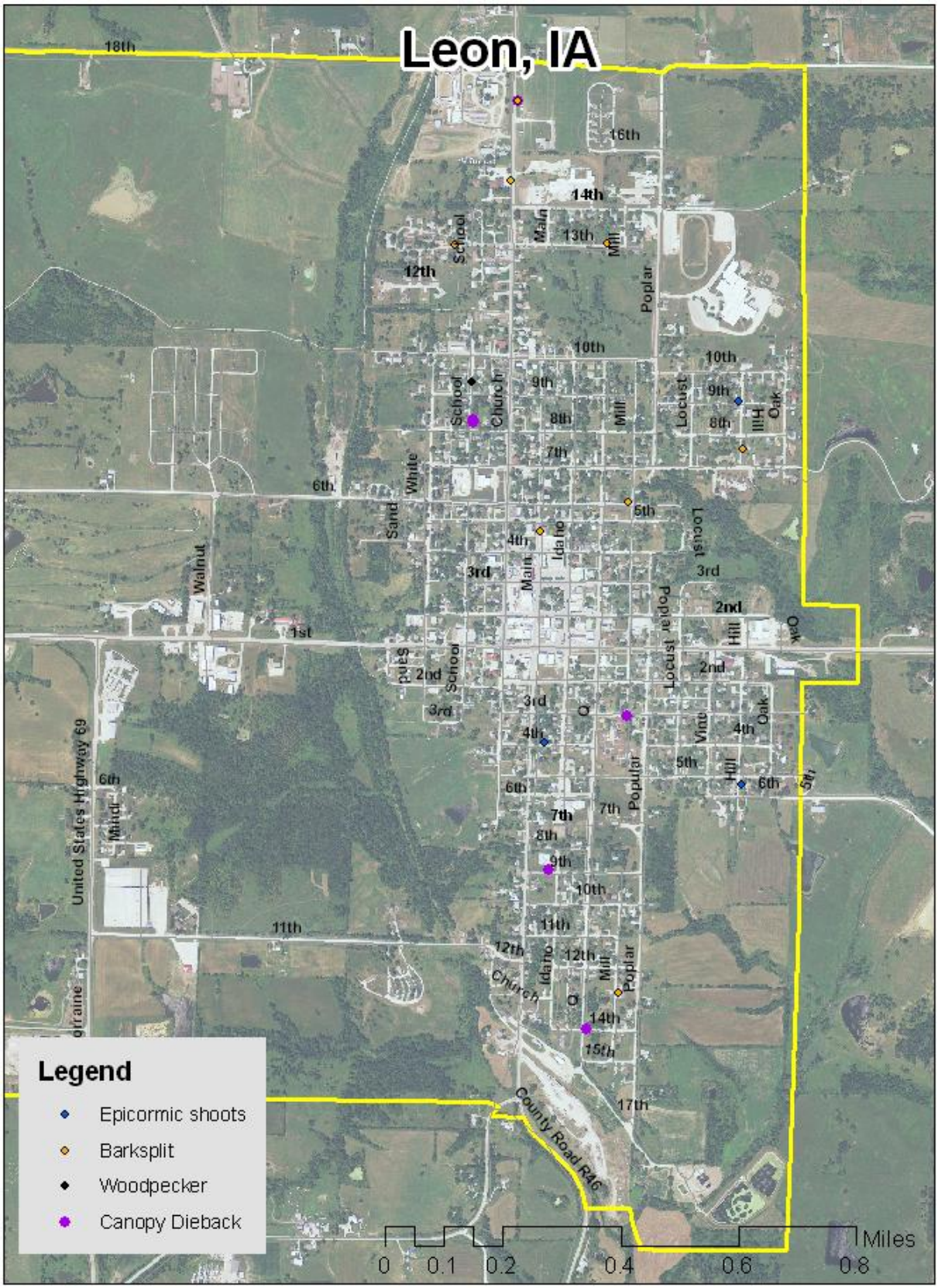


Figure 2: Location of EAB symptoms

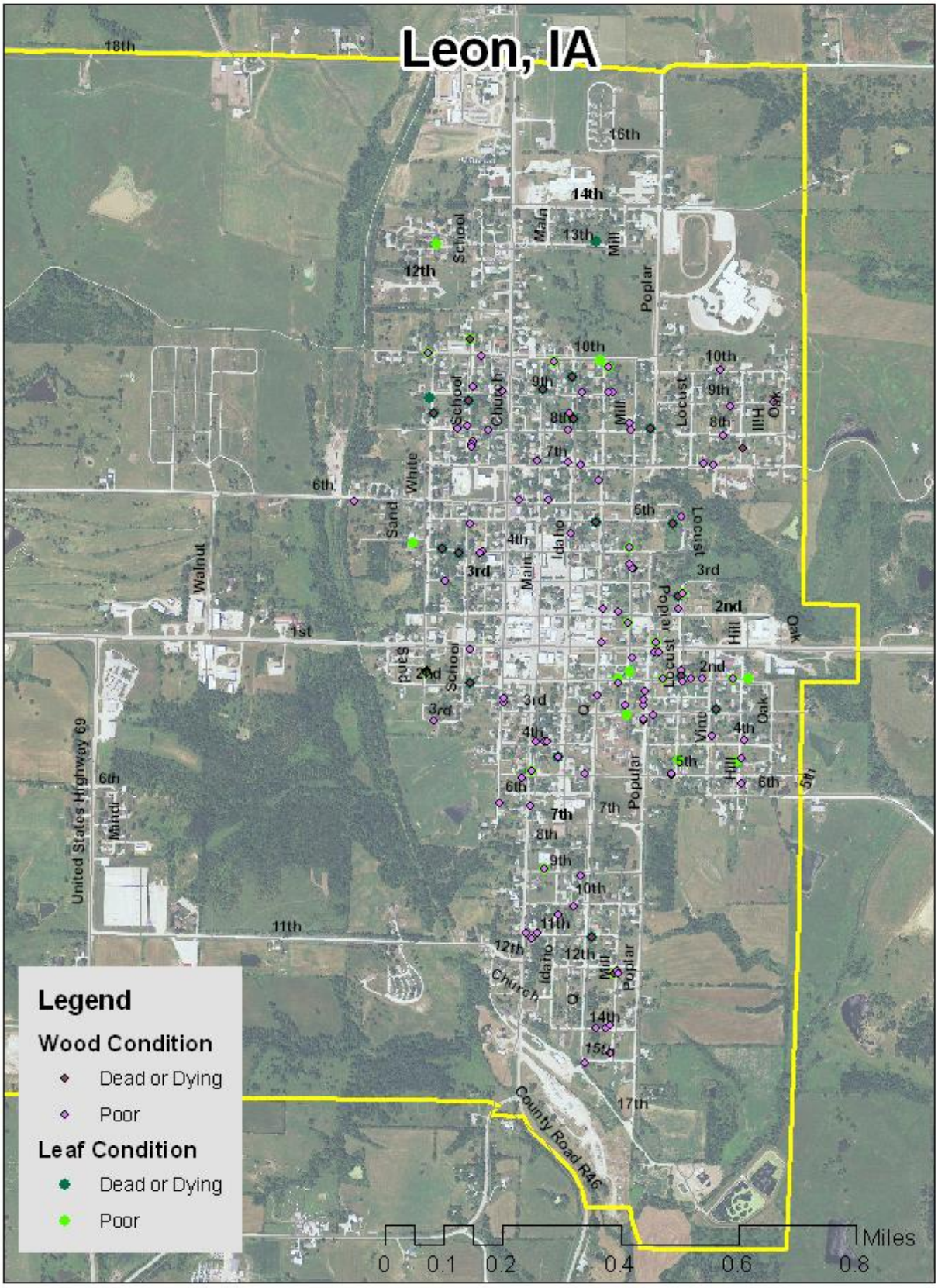


Figure 3: Location of Poor Condition Trees

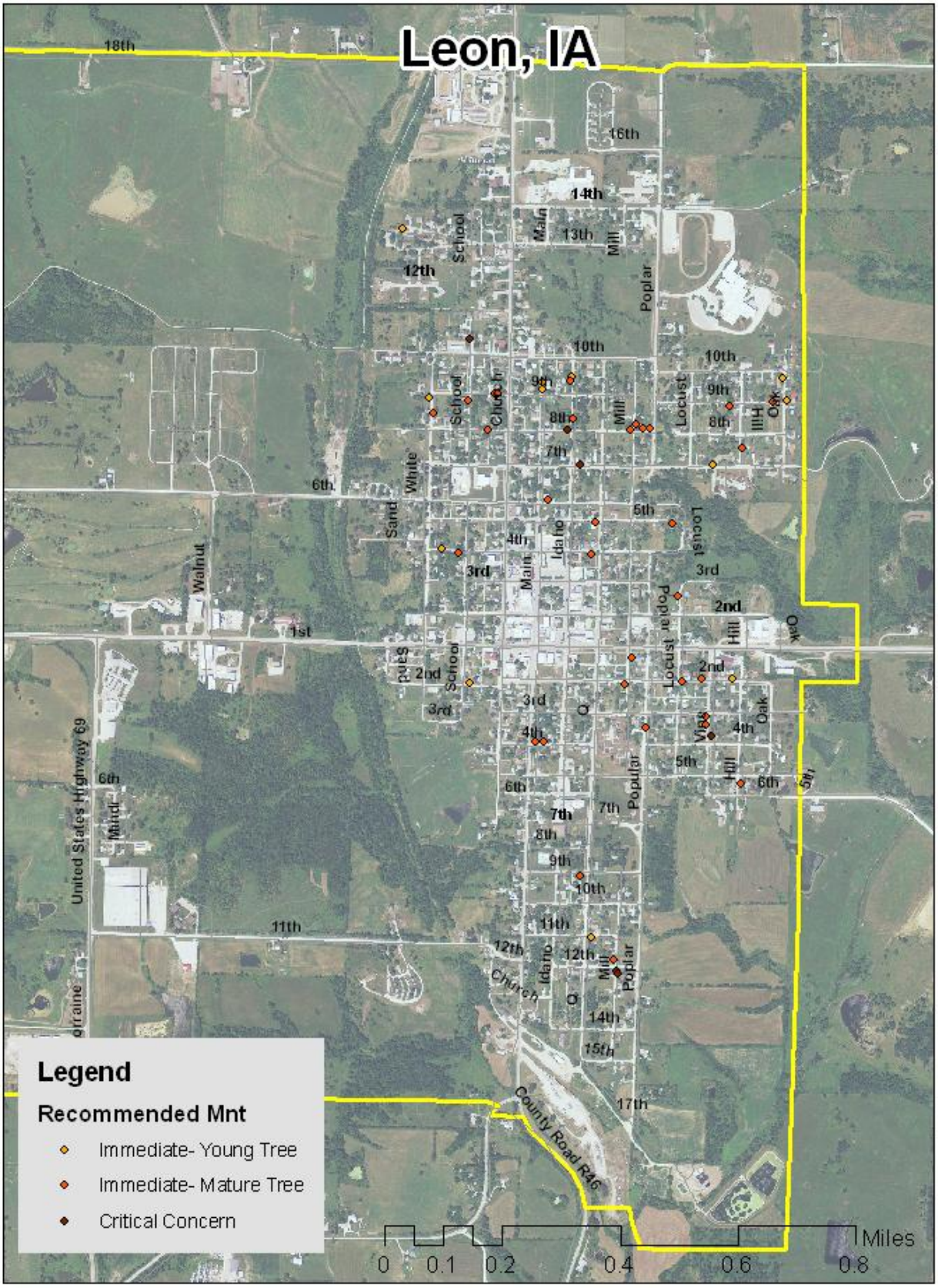


Figure 4: Location of Trees with Recommended Maintenance

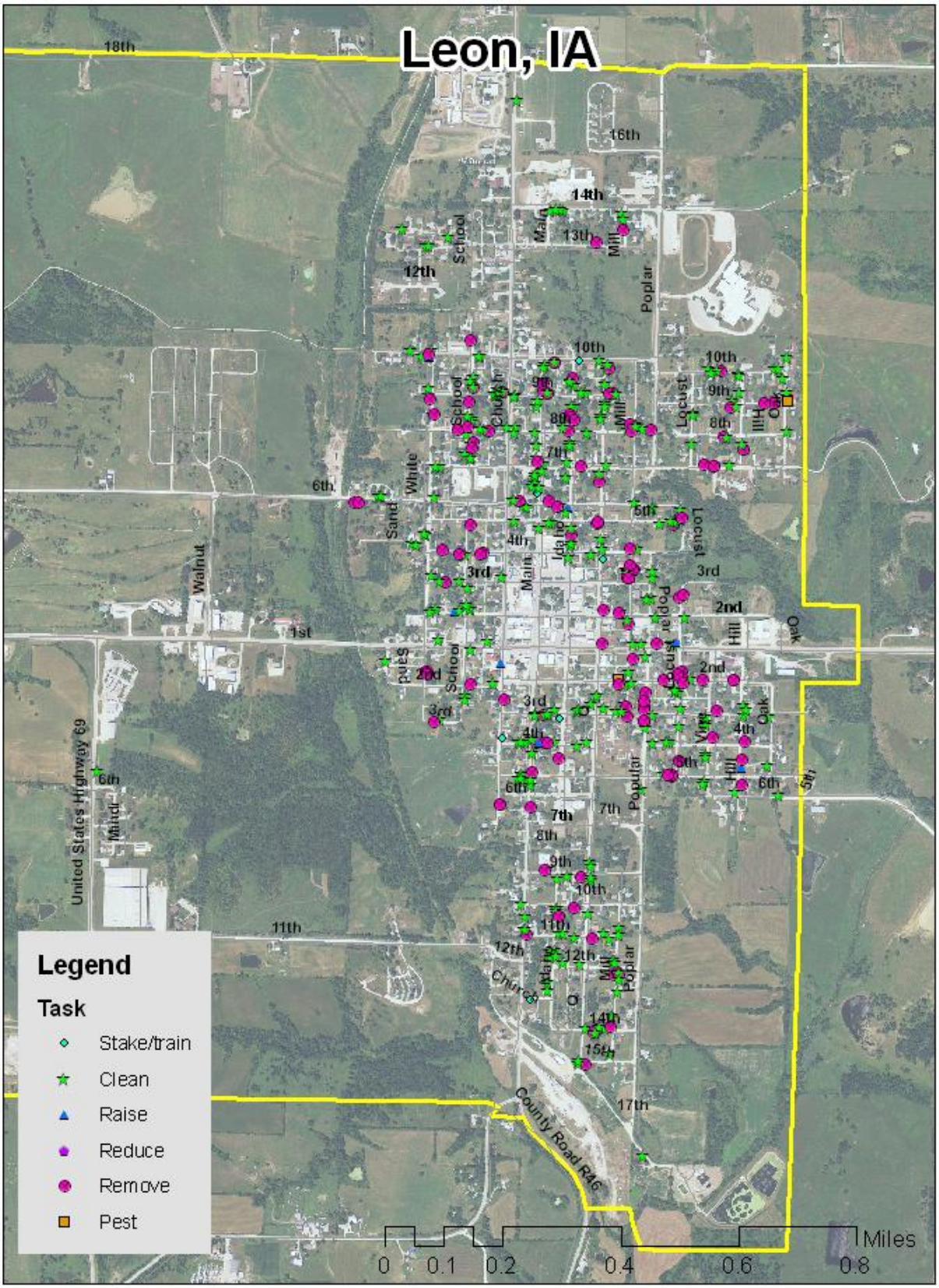


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Leon Tree Ordinances

None provided by the city.

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