ST. CHARLES, IA

St. Charles, IA

Legend

◇ Inventory_Iowa

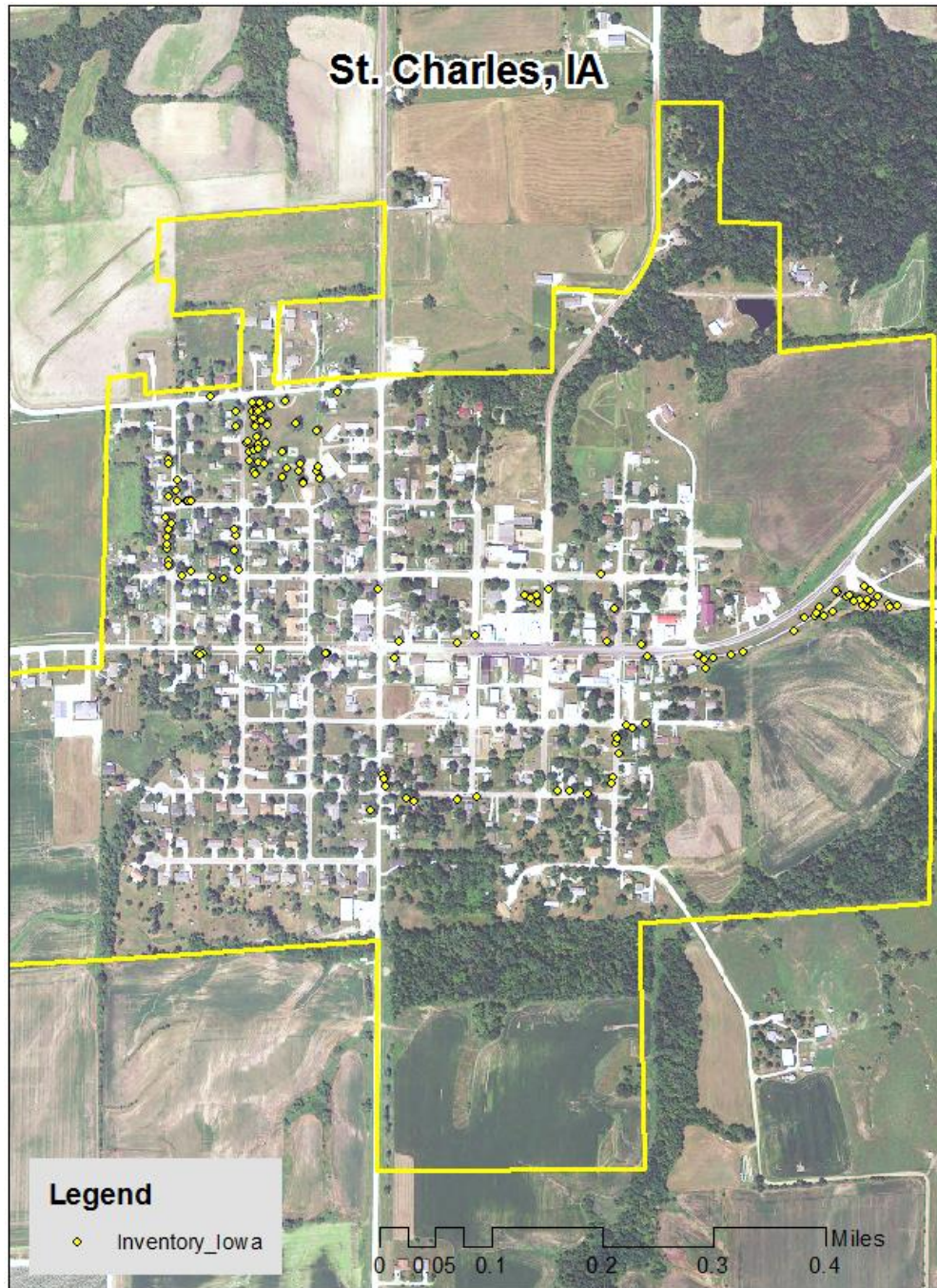0 0.05 0.1   0.2   0.3   Miles
                                       0.4

2014 Urban Forest Plan
Prepared by Jeremy Cochran
Bureau of Forestry, Iowa DNR

DNR

Table of Contents

Executive Summary_____

Overview

This plan was developed to assist the city of St. Charles 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 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 11% of St. Charles 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 2013, 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 140 trees inventoried.

- St. Charles' trees provide $23,411 of benefits annually, an average of $167 a tree
- There are over 27 species of trees
- The top three genus are: Maple 16%, Catalpa 15%, and Ash 11%
- 32% of trees are in need of some type of management
- 20 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 20 trees needing removal, 15 trees are critical concern and should be addressed immediately *St. Charles ownership of the trees recommended for removal should be verified prior to any removal*
- 1 of the 14 ash trees will need follow up because it is displaying signs and symptoms associated with EAB
- All trees should be pruned on a routine schedule- one third of the St. Charles every other year
- Plant a diverse mix of trees that do not include: ash, maple, catalpa, 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 St. Charles 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 St. Charles, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of St. Charles' 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 St. Charles 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 St. Charles urban forestry goals.

Inventory

In 2013, a tree inventory was conducted that included 100% of the St. Charles 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 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 140 St. Charles 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. St. Charles' trees reduce energy related costs by approximately $6,137 annually (Appendix A, Table 1). These savings are both in Electricity (29.1 MWh) and in Natural Gas (4,007 Therms).

Annual Stormwater Benefits

St. Charles' trees intercept about 346,604 gallons of rainfall or snowmelt a year (Appendix A, Table 2). This interception provides $9,394 of benefits to the St. Charles.

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 St. Charles, it is estimated that trees remove 370 lbs. of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $1,029 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In St. Charles, trees store about 1,395,613 lbs. of carbon a year with an associated value of $10,467 (Appendix A, Table 4). In addition, the trees sequester 106,831 lbs. of carbon, with a yearly benefit of $801 (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, St. Charles livability and much more. St. Charles receives $6,050 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, St. Charles trees provide $23,411 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 140 trees in St. Charles provide approximately $167 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

St. Charles has over 27 different tree *species* along St. Charles' streets and parks (Appendix A, Figure 1).

The distribution is as follows:

Species Distribution of Public Trees (%)

Species	Percent
Catalpa	14.29
Ash	10.71
Eastern white pine	10.00
Silver maple	8.57
Apple	8.57
Northern hackberry	4.29
Chinese elm	4.29
Norway maple	3.57
Sugar maple	3.57
Eastern redbud	3.57
Other species	28.57
Total	100.00

Age Class

Most of St. Charles trees (40%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). The maximum annual benefits are often provided by trees near 18" DBH due to high vigor with a healthy, fully grown canopy.

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 St. Charles indicate that 64% of the trees are in good health, with only 11% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 34% of St. Charles' 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 32% of the population.

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).

None	95	68%
Tree Removal	20	14%
Crown Cleaning	14	10%
Crown Raising	11	8%
Tree Staking	0	
Crown Reduction	0	

Canopy Cover

The canopy cover of St. Charles is approximately 3.4 acres (Appendix A, Figure 5).   According to the 2000 census, St. Charles occupies 358 acres. Thus the canopy cover on St. Charles land is less than 1%.

Land Use and Location

The majority of St. Charles' 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	34%
Park/vacant/other	66%

Location
Planting strip	64%
Front yard	36%

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
St. Charles has 15 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. 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 that do not include trimming.

Poor tree species

After the removal of the critical concern trees, trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 20 removals, 4 are ash trees. There are a total of 14 ash trees, and 2 of those have signs and symptoms that have been associated with EAB. In addition, there are 34 trees that are in poor health. *St. Charles 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 St. Charles.

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 heavily planted with Catalpa and Maples (Appendix A, Figure 1). These trees 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. All trees planted must meet the restrictions in St. Charles 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

Year 1

      Removal: 8 of the largest critical concern trees

      Planting and Replacement: 4 trees to be planted in open locations

      Visual Survey for signs and symptoms of EAB

Year 2

      Removal: 7 remaining critical concern trees

      Planting and Replacement: 4 trees in open locations from year one removals

      Routine trimming: Contract to trim 1/3 of the St. Charles trees

      Visual Survey for signs and symptoms of EAB

Year 3

      Removal: 2 trees in poor health - removal of any new critical concern

      Planting and Replacement: 4 trees to be planted in open locations and locations from previous removals

      Visual Survey for signs and symptoms of EAB

Year 4

      Removal: 1 tree in poor health - removal of any new critical concern trees

      Planting and Replacement: 4 trees in open locations from previous removals

      Routine trimming: Contract to trim 1/3 of the St. Charles trees

      Visual Survey for signs and symptoms of EAB

Year 5

      Removal: 1 tree in poor health - removal of any new critical concern trees

      Planting and Replacement: 4 trees to be planted in open locations and locations from previous removals

      Visual Survey for signs and symptoms of EAB

Year 6

      Removal: 1 tree in poor health - removal of any new critical concern trees

      Planting and Replacement: 4 trees in open locations from previous removals

      Routine trimming: Contract to trim 1/3 of the St. Charles trees

      Visual Survey for signs and symptoms of EAB

This work plan only addresses the current 15 critical concern trees and 5 other trees with poor structure that need replaced. Additional, efforts will be needed to start replacing ash trees if EAB is confirmed in your town. EAB can kill a tree in less than 4 years.

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). *St. Charles ownership of the tree recommended for removal should be verified prior to any removal*

Treatment of Ash Trees

Chemical treatment can be effective, spreading 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 over 25 million ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

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

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

Wood Disposal

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

Canopy Replacement

As budget permits, all removed ash trees will be replaced. All trees will meet the restrictions in St. Charles ordinance. The new plantings will be a diverse mix and will not include ash, maple, catalpa, 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.

Works Cited

Census Bureau. 2010. http://censtats.census.gov/data/IA/1601964290.pdf (April, 2013)

USDA Forest Service, et al. 2006. i-Tree Software Suite v1.0 User's Manual. Pp. 27-40.

McPherson EG, Simpson JR, Peper PJ, Gardner SL, Vargas KE, Ho J, Maco S, Xiao Q. 2005b. St. Charles of Charleston, South Carolina, municipal forest resource analysis. Internal Tech Rep. Davis, CA: U.S. Department of Agriculture, Center for Urban Forest Research. p. 57

Nowak, D.J. and J.F. Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

Peper, Paula J.; McPherson, E. Gregory; Simpson, James R.; Vargas, Kelaine E.; Xiao, Qingfu 2009. Lower Midwest community tree guide: benefits, costs, and strategic planting.   Gen. Tech. Rep. PSW-GTR-219. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. p.115

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

St Charles

Annual Energy Benefits of Public Trees by Species

2/24/2014

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Catalpa	6.7	507	910.9	893	1,399	(N/A)	14.3	22.8	69.97
Ash	3.1	239	449.7	441	679	(N/A)	10.7	11.1	45.28
Eastern white pine	2.0	150	259.9	255	405	(N/A)	10.0	6.6	28.90
Silver maple	4.2	321	550.0	539	860	(N/A)	8.6	14.0	71.64
Apple	0.9	68	147.7	145	213	(N/A)	8.6	3.5	17.72
Northern hackberry	1.5	113	216.9	213	326	(N/A)	4.3	5.3	54.28
Chinese elm	2.3	173	312.1	306	479	(N/A)	4.3	7.8	79.79
Norway maple	1.0	76	138.9	136	212	(N/A)	3.6	3.5	42.41
Sugar maple	1.4	104	182.4	179	283	(N/A)	3.6	4.6	56.60
Eastern redbud	0.2	12	28.0	27	40	(N/A)	3.6	0.7	7.96
Black walnut	1.1	87	155.0	152	238	(N/A)	3.6	3.9	47.69
Spruce	0.4	28	57.7	57	85	(N/A)	3.6	1.4	16.96
Honeylocust	1.1	87	142.4	140	226	(N/A)	2.9	3.7	56.53
Eastern red cedar	0.4	34	65.8	64	98	(N/A)	2.9	1.6	24.57
Kentucky coffeetree	0.7	54	94.4	93	147	(N/A)	2.1	2.4	48.96
Northern red oak	0.1	11	20.8	20	31	(N/A)	2.1	0.5	10.34
Amur maple	0.1	7	16.6	16	24	(N/A)	1.4	0.4	11.80
Conifer Evergreen Large	0.1	9	19.0	19	27	(N/A)	1.4	0.4	13.58
Swamp white oak	0.1	8	17.6	17	26	(N/A)	1.4	0.4	12.79
Littleleaf linden	0.1	4	7.9	8	12	(N/A)	1.4	0.2	5.81
Other street trees	1.6	120	213.1	209	329	(N/A)	5.7	5.4	41.08
Citywide total	29.1	2,210	4,006.8	3,927	6,137	(N/A)	100.0	100.0	43.84

Table 2: Annual Stormwater Benefits

St Charles

Annual Stormwater Benefits of Public Trees by Species

2/24/2014

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Catalpa	83,372	2,260	(N/A)	14.3	24.1	112.98
Ash	27,734	752	(N/A)	10.7	8.0	50.11
Eastern white pine	39,069	1,059	(N/A)	10.0	11.3	75.63
Silver maple	60,798	1,648	(N/A)	8.6	17.5	137.31
Apple	3,184	86	(N/A)	8.6	0.9	7.19
Northern hackberry	13,207	358	(N/A)	4.3	3.8	59.65
Chinese elm	34,135	925	(N/A)	4.3	9.9	154.19
Norway maple	7,788	211	(N/A)	3.6	2.3	42.22
Sugar maple	17,723	480	(N/A)	3.6	5.1	96.07
Eastern redbud	539	15	(N/A)	3.6	0.2	2.92
Black walnut	12,114	328	(N/A)	3.6	3.5	65.66
Spruce	5,351	145	(N/A)	3.6	1.5	29.00
Honeylocust	7,575	205	(N/A)	2.9	2.2	51.33
Eastern red cedar	6,538	177	(N/A)	2.9	1.9	44.30
Kentucky coffeetree	7,563	205	(N/A)	2.1	2.2	68.33
Northern red oak	715	19	(N/A)	2.1	0.2	6.46
Amur maple	333	9	(N/A)	1.4	0.1	4.51
Conifer Evergreen Large	1,191	32	(N/A)	1.4	0.3	16.14
Swamp white oak	598	16	(N/A)	1.4	0.2	8.11
Littleleaf linden	187	5	(N/A)	1.4	0.1	2.54
Other street trees	16,890	458	(N/A)	5.7	4.9	57.22
Citywide total	346,604	9,394	(N/A)	100.0	100.0	67.10

Table 3: Annual Air Quality Benefits

St Charles

Annual Air Quality Benefits of Public Trees by Species

2/24/2014

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$_2$							
Catalpa	13.1	2.1	6.0	0.6	69	31.9	4.6	4.4	30.3	198	0.0	0	93.0	268 (N/A)	14.3	13.38
Ash	5.5	0.9	2.7	0.2	30	15.2	2.2	2.1	14.3	94	-1.3	-5	41.9	119 (N/A)	10.7	7.94
Eastern white pine	4.6	0.9	3.7	0.6	30	9.3	1.4	1.3	8.9	58	-20.3	-76	10.4	12 (N/A)	10.0	0.88
Silver maple	10.9	1.8	5.3	0.5	58	19.9	2.9	2.8	19.1	124	-5.7	-21	57.5	162 (N/A)	8.6	13.46
Apple	0.6	0.1	0.3	0.0	3	4.5	0.6	0.6	4.1	27	0.0	0	10.9	31 (N/A)	8.6	2.57
Northern hackberry	2.4	0.4	1.2	0.1	13	7.2	1.0	1.0	6.8	45	0.0	0	20.1	58 (N/A)	4.3	9.63
Chinese elm	5.2	0.8	2.3	0.2	27	10.9	1.6	1.5	10.3	68	0.0	0	32.8	95 (N/A)	4.3	15.80
Norway maple	1.4	0.2	0.7	0.1	8	4.8	0.7	0.7	4.5	30	-0.3	-1	12.8	36 (N/A)	3.6	7.26
Sugar maple	3.3	0.6	1.6	0.1	18	6.5	1.0	0.9	6.2	41	-2.6	-10	17.6	49 (N/A)	3.6	9.73
Eastern redbud	0.1	0.0	0.0	0.0	0	0.8	0.1	0.1	0.7	5	0.0	0	1.9	5 (N/A)	3.6	1.08
Black walnut	1.4	0.2	0.7	0.1	8	5.4	0.8	0.8	5.2	34	0.0	0	14.6	42 (N/A)	3.6	8.32
Spruce	0.5	0.1	0.5	0.1	4	1.8	0.3	0.2	1.7	11	-2.0	-8	3.2	7 (N/A)	3.6	1.47
Honeylocust	1.3	0.2	0.6	0.1	7	5.3	0.8	0.7	5.2	33	-0.8	-3	13.4	37 (N/A)	2.9	9.33
Eastern red cedar	1.4	0.3	1.1	0.2	9	2.2	0.3	0.3	2.0	13	-3.6	-14	4.1	9 (N/A)	2.9	2.19
Kentucky coffeetree	0.9	0.1	0.4	0.0	5	3.4	0.5	0.5	3.2	21	0.0	0	9.2	26 (N/A)	2.1	8.71
Northern red oak	0.1	0.0	0.1	0.0	0	0.7	0.1	0.1	0.6	4	-0.1	0	1.5	4 (N/A)	2.1	1.42
Amur maple	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)	1.4	1.63
Conifer Evergreen Large	0.1	0.0	0.1	0.0	1	0.6	0.1	0.1	0.5	3	-0.3	-1	1.1	3 (N/A)	1.4	1.48
Swamp white oak	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.3	4 (N/A)	1.4	1.80
Littleleaf linden	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)	1.4	0.80
Other street trees	3.4	0.6	1.7	0.2	19	7.5	1.1	1.0	7.2	47	-2.0	-7	20.7	58 (N/A)	5.7	7.27
Citywide total	56.4	9.6	29.2	3.0	310	139.2	20.3	19.3	132.0	867	-39.2	-147	369.8	1,029 (N/A)	100.0	7.35

Table 4: Annual Carbon Stored

St Charles

Stored CO2 Benefits of Public Trees by Species

2/24/2014

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Catalpa	444,314	3,332	(N/A)	14.3	31.8	166.62
Ash	91,247	684	(N/A)	10.7	6.5	45.62
Eastern white pine	50,699	380	(N/A)	10.0	3.6	27.16
Silver maple	254,166	1,906	(N/A)	8.6	18.2	158.85
Apple	11,564	87	(N/A)	8.6	0.8	7.23
Northern	38,493	289	(N/A)	4.3	2.8	48.12
Chinese elm	173,949	1,305	(N/A)	4.3	12.5	217.44
Norway maple	23,156	174	(N/A)	3.6	1.7	34.73
Sugar maple	104,187	781	(N/A)	3.6	7.5	156.28
Eastern redbud	1,619	12	(N/A)	3.6	0.1	2.43
Black walnut	47,457	356	(N/A)	3.6	3.4	71.19
Spruce	4,370	33	(N/A)	3.6	0.3	6.55
Honeylocust	15,854	119	(N/A)	2.9	1.1	29.73
Eastern red cedar	4,408	33	(N/A)	2.9	0.3	8.27
Kentucky	30,650	230	(N/A)	2.1	2.2	76.62
Northern red oak	1,224	9	(N/A)	2.1	0.1	3.06
Amur maple	1,086	8	(N/A)	1.4	0.1	4.07
Conifer Evergreen	513	4	(N/A)	1.4	0.0	1.93
Swamp white oak	1,118	8	(N/A)	1.4	0.1	4.19
Littleleaf linden	373	3	(N/A)	1.4	0.0	1.40
Other street trees	43,167	714	(N/A)	5.7	6.8	89.22
Citywide total	1,395,613	10,467	(N/A)	100.0	100.0	74.76

Table 5: Annual Carbon Sequestered

St Charles

Annual CO$_2$ Benefits of Public Trees by Species

2/24/2014

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($) Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Catalpa	13,485	101	-2,133	-4	-16	11,199	84	22,547	169 (N/A)	14.3	21.1	8.46
Ash	4,087	31	-438	-3	-3	5,271	40	8,917	67 (N/A)	10.7	8.4	4.46
Eastern white pine	2,413	18	-243	-3	-2	3,314	25	5,481	41 (N/A)	10.0	5.1	2.94
Silver maple	18,155	136	-1,220	-2	-9	7,087	53	24,019	180 (N/A)	8.6	22.5	15.01
Apple	1,368	10	-56	-2	0	1,500	11	2,811	21 (N/A)	8.6	2.6	1.76
Northern hackberry	1,689	13	-185	-1	-1	2,498	19	4,001	30 (N/A)	4.3	3.8	5.00
Chinese elm	4,968	37	-835	-1	-6	3,820	29	7,952	60 (N/A)	4.3	7.4	9.94
Norway maple	1,717	13	-111	-1	-1	1,677	13	3,282	25 (N/A)	3.6	3.1	4.92
Sugar maple	3,959	30	-500	-1	-4	2,305	17	5,763	43 (N/A)	3.6	5.4	8.64
Eastern redbud	266	2	-8	-1	0	273	2	530	4 (N/A)	3.6	0.5	0.79
Black walnut	2,679	20	-228	-1	-2	1,913	14	4,363	33 (N/A)	3.6	4.1	6.54
Spruce	398	3	-21	-1	0	624	5	1,000	8 (N/A)	3.6	0.9	1.50
Honeylocust	2,359	18	-76	-1	-1	1,913	14	4,195	31 (N/A)	2.9	3.9	7.87
Eastern red cedar	86	1	-21	-1	0	747	6	811	6 (N/A)	2.9	0.8	1.52
Kentucky coffeetree	1,614	12	-147	-1	-1	1,202	9	2,668	20 (N/A)	2.1	2.5	6.67
Northern red oak	207	2	-6	-1	0	236	2	436	3 (N/A)	2.1	0.4	1.09
Amur maple	152	1	-5	0	0	161	1	308	2 (N/A)	1.4	0.3	1.15
Conifer Evergreen	105	1	-2	0	0	189	1	291	2 (N/A)	1.4	0.3	1.09
Swamp white oak	229	2	-5	0	0	183	1	407	3 (N/A)	1.4	0.4	1.52
Littleleaf linden	119	1	-2	0	0	87	1	204	2 (N/A)	1.4	0.2	0.76
Other street trees	4,654	35	-457	-2	-3	2,649	20	6,845	51 (N/A)	5.7	6.4	6.42
Citywide total	64,709	485	-6,699	-27	-50	48,848	366	106,831	801 (N/A)	100.0	100.0	5.72

Table 6: Annual Social and Aesthetic Benefits

St Charles

Annual Aesthetic/Other Benefits of Public Trees by Species

2/24/2014

Species	Total ($) Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Catalpa	1,045 (N/A)	14.3	17.3	52.24
Ash	410 (N/A)	10.7	6.8	27.34
Eastern white pine	468 (N/A)	10.0	7.7	33.44
Silver maple	1,371 (N/A)	8.6	22.7	114.28
Apple	77 (N/A)	8.6	1.3	6.43
Northern hackberry	259 (N/A)	4.3	4.3	43.09
Chinese elm	349 (N/A)	4.3	5.8	58.12
Norway maple	167 (N/A)	3.6	2.8	33.43
Sugar maple	374 (N/A)	3.6	6.2	74.75
Eastern redbud	15 (N/A)	3.6	0.2	2.93
Black walnut	235 (N/A)	3.6	3.9	47.03
Spruce	109 (N/A)	3.6	1.8	21.75
Honeylocust	503 (N/A)	2.9	8.3	125.68
Eastern red cedar	27 (N/A)	2.9	0.5	6.84
Kentucky coffeetree	141 (N/A)	2.1	2.3	47.00
Northern red oak	25 (N/A)	2.1	0.4	8.33
Amur maple	8 (N/A)	1.4	0.1	4.23
Conifer Evergreen Large	31 (N/A)	1.4	0.5	15.42
Swamp white oak	29 (N/A)	1.4	0.5	14.48
Littleleaf linden	21 (N/A)	1.4	0.4	10.52
Other street trees	386 (N/A)	5.7	6.4	48.27
Citywide total	6,050 (N/A)	100.0	100.0	43.21

Table 7: Summary of Benefits in Dollars

Average Annual Benefits of Public Trees by Species

Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Catalpa	1,399	169	268	2,260	1,045	$5,141	(±0)	21.96
Ash	679	67	119	752	410	$2,027	(±0)	8.66
Eastern white pine	405	41	12	1,059	468	$1,985	(±0)	8.48
Silver maple	860	180	162	1,648	1,371	$4,220	(±0)	18.03
Apple	213	21	31	86	77	$428	(±0)	1.83
Northern hackberry	326	30	58	358	259	$1,030	(±0)	4.40
Chinese elm	479	60	95	925	349	$1,907	(±0)	8.15
Norway maple	212	25	36	211	167	$651	(±0)	2.78
Sugar maple	283	43	49	480	374	$1,229	(±0)	5.25
Eastern redbud	40	4	5	15	15	$78	(±0)	0.33
Black walnut	238	33	42	328	235	$876	(±0)	3.74
Spruce	85	7	7	145	109	$353	(±0)	1.51
Honeylocust	226	31	37	205	503	$1,003	(±0)	4.28
Eastern red cedar	98	6	9	177	27	$318	(±0)	1.36
Kentucky coffeetree	147	20	26	205	141	$539	(±0)	2.30
Northern red oak	31	3	4	19	25	$83	(±0)	0.35
Amur maple	24	2	3	9	8	$47	(±0)	0.20
Conifer Evergreen Large	27	2	3	32	31	$95	(±0)	0.41
Swamp white oak	26	3	4	16	29	$77	(±0)	0.33
Littleleaf linden	12	2	2	5	21	$41	(±0)	0.17
Other street trees	329	51	58	458	386	$1,282	(±0)	5.48
Citywide total	6,137	801	1,029	9,394	6,050	$23,411	(±0)	100.00

Legend:
- Catalpa
- Ash
- Eastern white pine
- Silver maple
- Apple
- Northern hackberry
- Chinese elm
- Norway maple
- Sugar maple
- Eastern redbud
- Other species

Values shown: 14.29, 10.71, 10.00, 8.57, 8.57, 4.29, 4.29, 3.57, 3.57, 3.57, 28.57
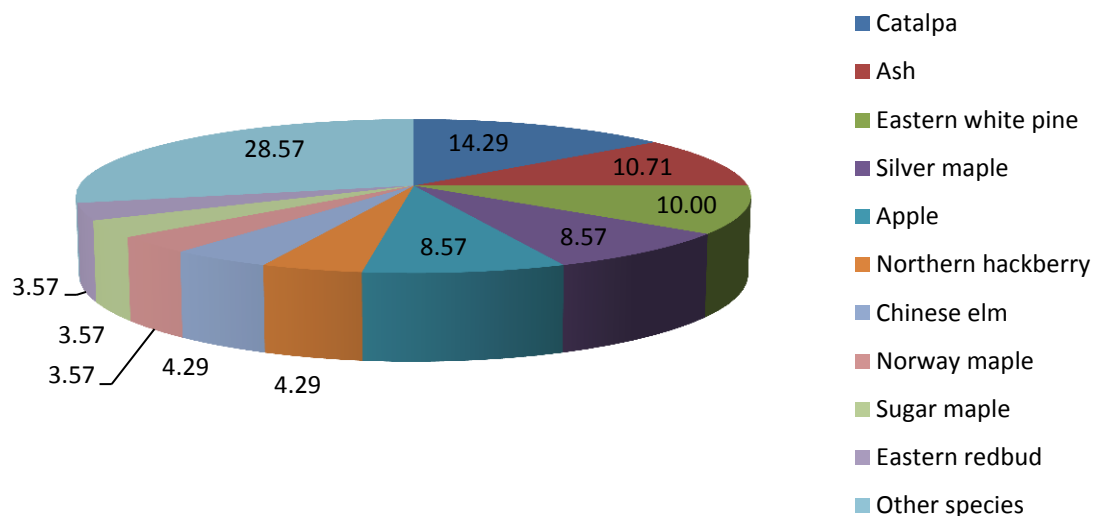
Figure 1: Species Distribution

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

(%) / DBH Class

Legend:
- Catalpa
- Ash
- Eastern white pine
- Silver maple
- Apple
- Northern hackberry
- Chinese elm
- Norway maple
- Sugar maple
- Eastern redbud
- Citywide total
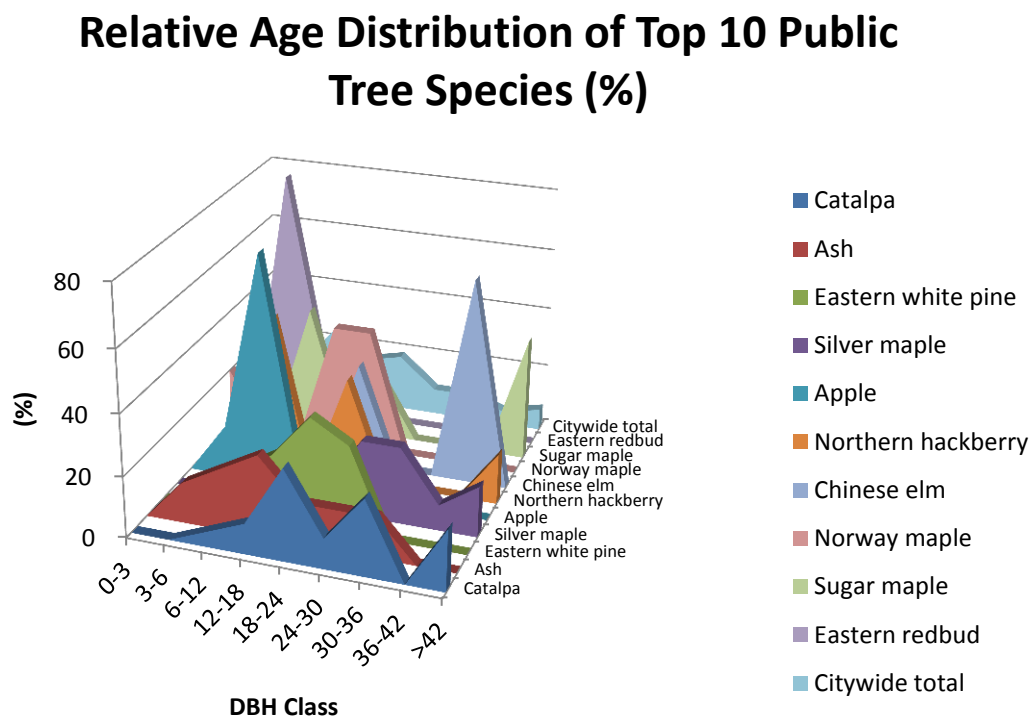
Figure 2: Relative Age Class

Leaf Condition

Dead or Dying
9%

Poor
2%

Fair
25%

Good
64%

- Dead or Dying
- Poor
- Fair
- Good
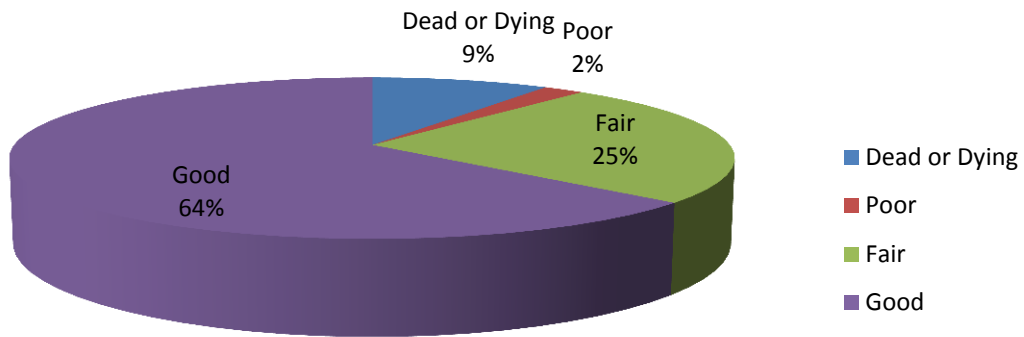
Figure 3: Foliage Condition

Wood Condition

Dead or Dying
9%

Poor
23%

Good
34%

Fair
34%

- Dead or Dying
- Poor
- Fair
- Good
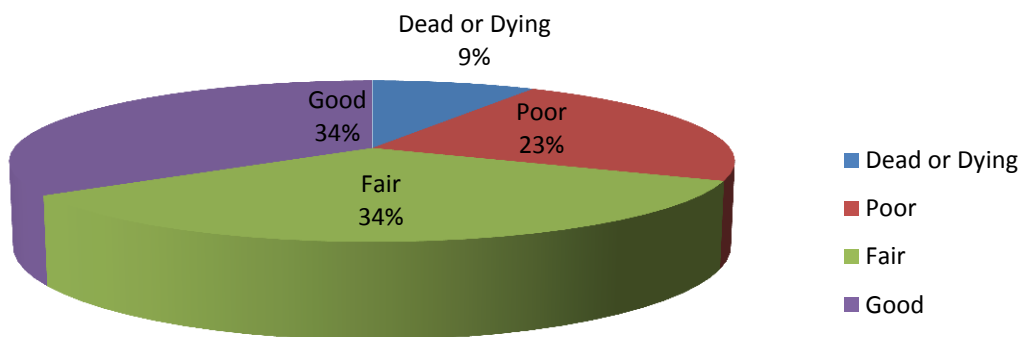
Figure 4: Wood Condition

Canopy Cover
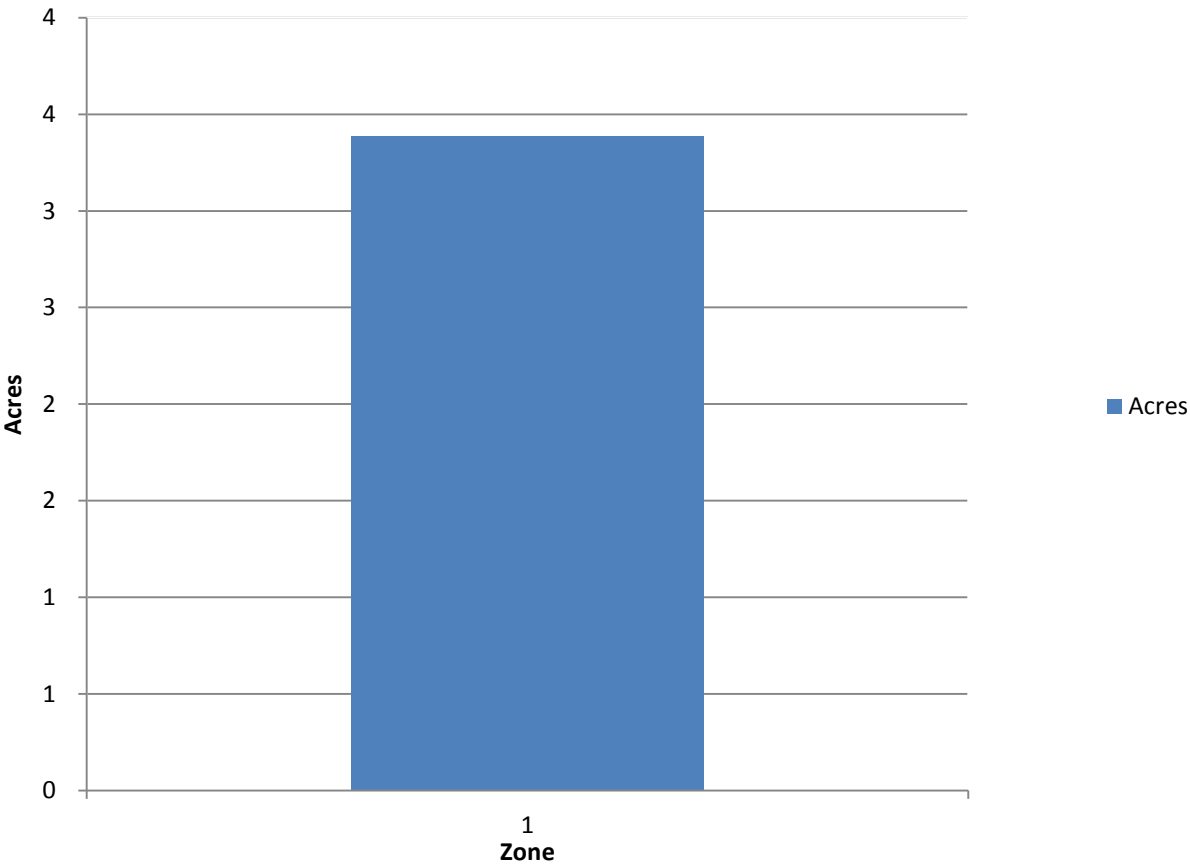
Figure 5: Canopy Cover in Acres

Land use Public Trees by Zone (%)
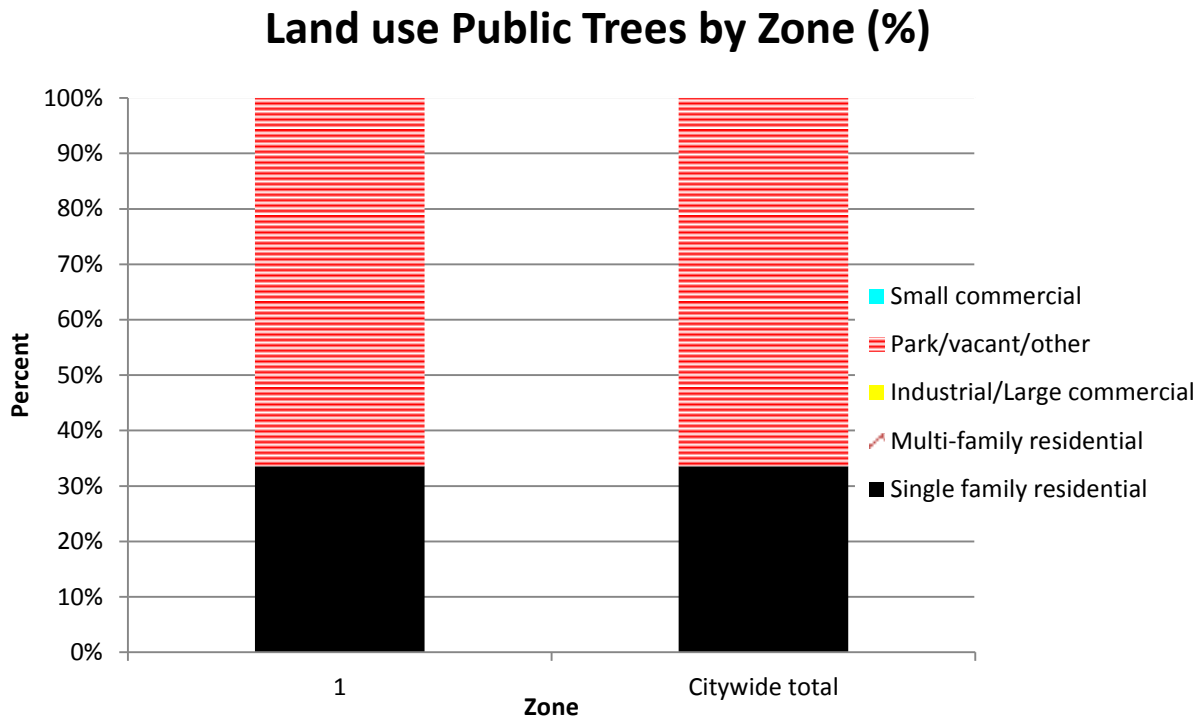
Figure 6: Land Use of city/park trees

Location Public Trees by Zone (%)
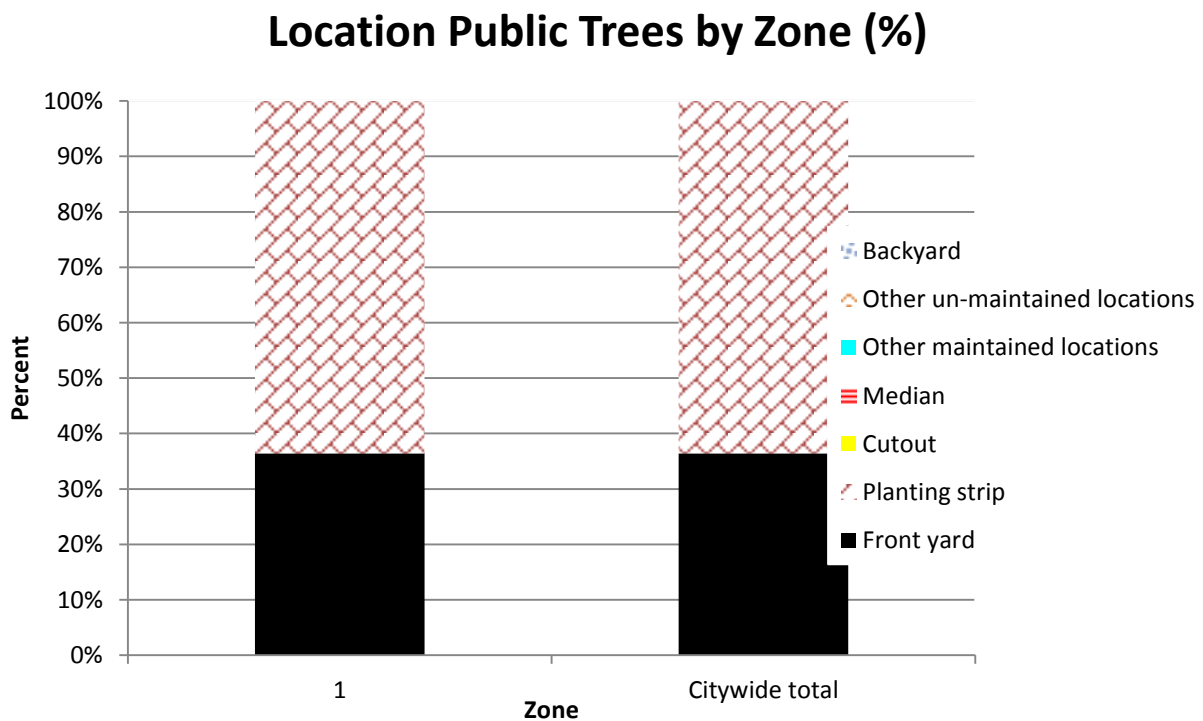
Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping
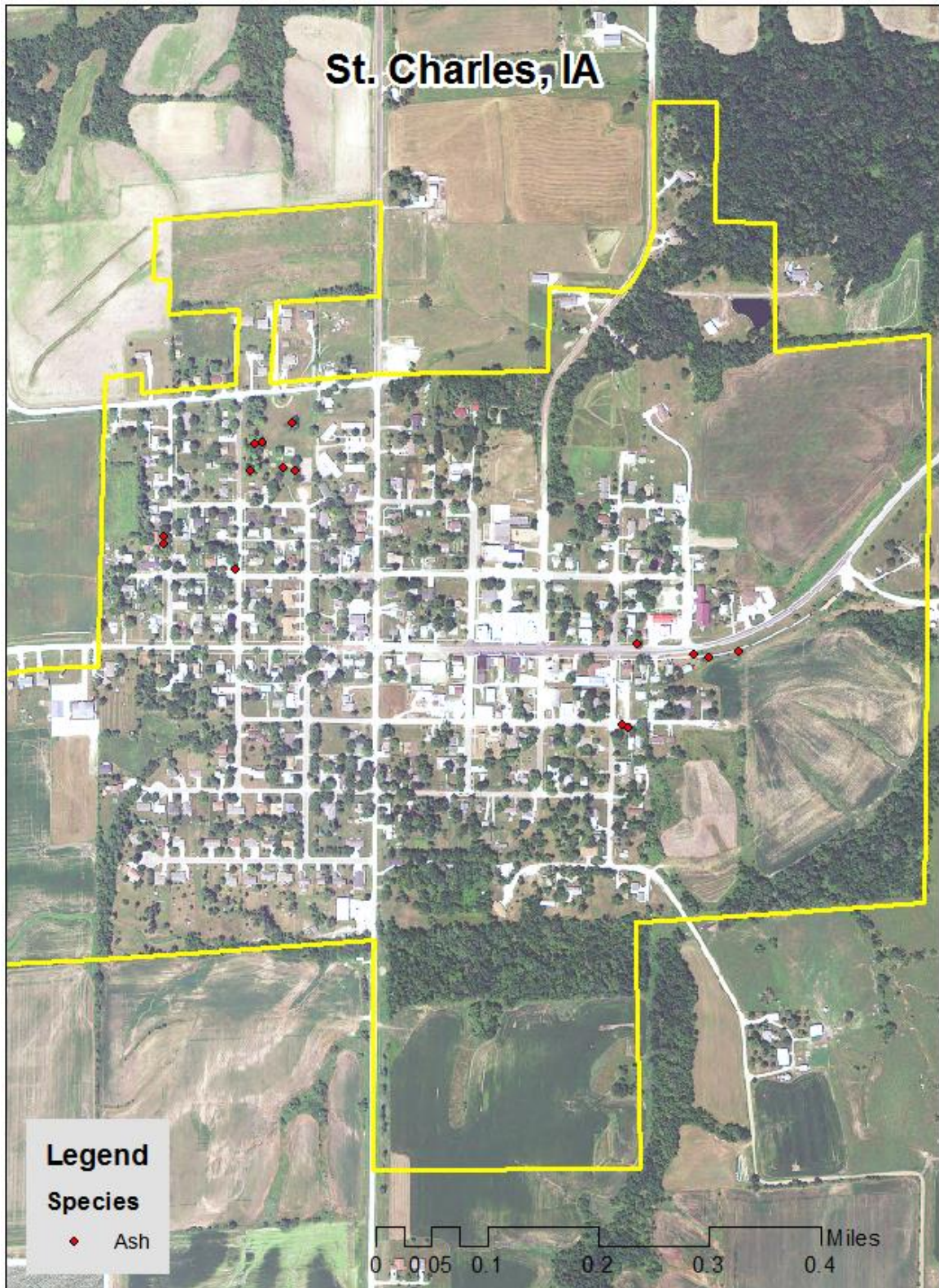
Figure 1: Location of Ash Trees
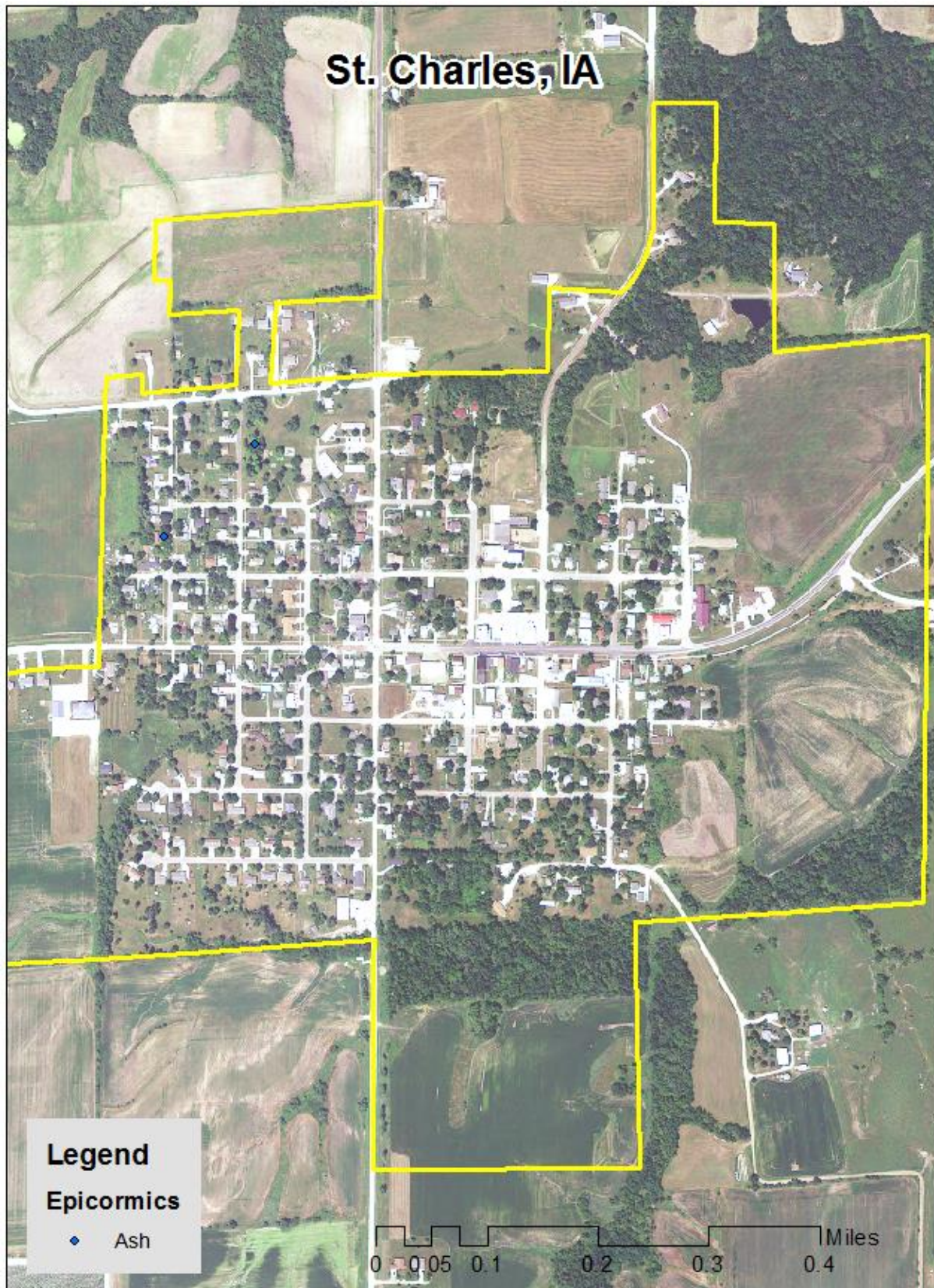
Figure 2: Location of EAB symptoms
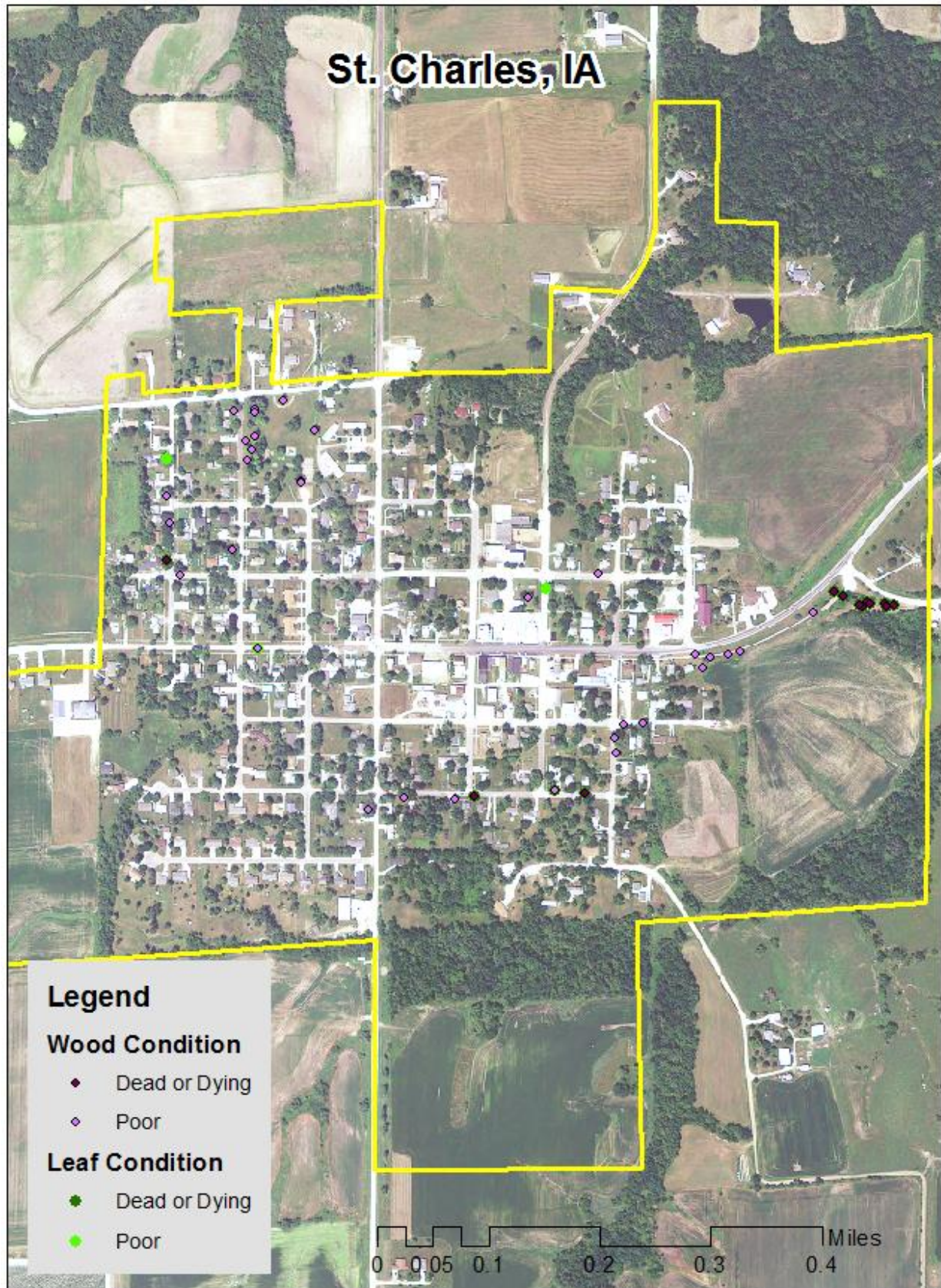
Figure 3: Location of Poor Condition Trees
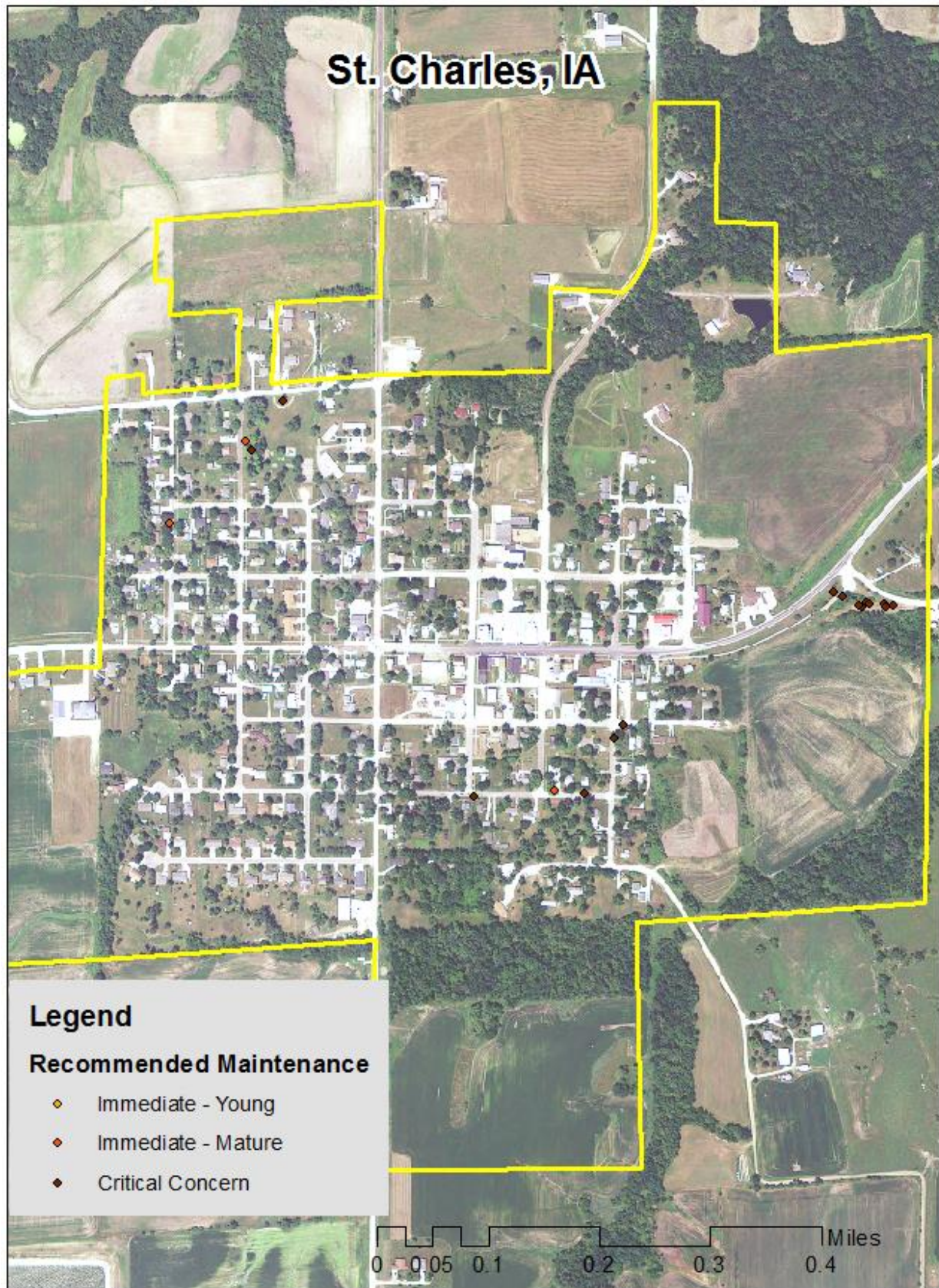
Figure 4: Location of Trees with Recommended Maintenance
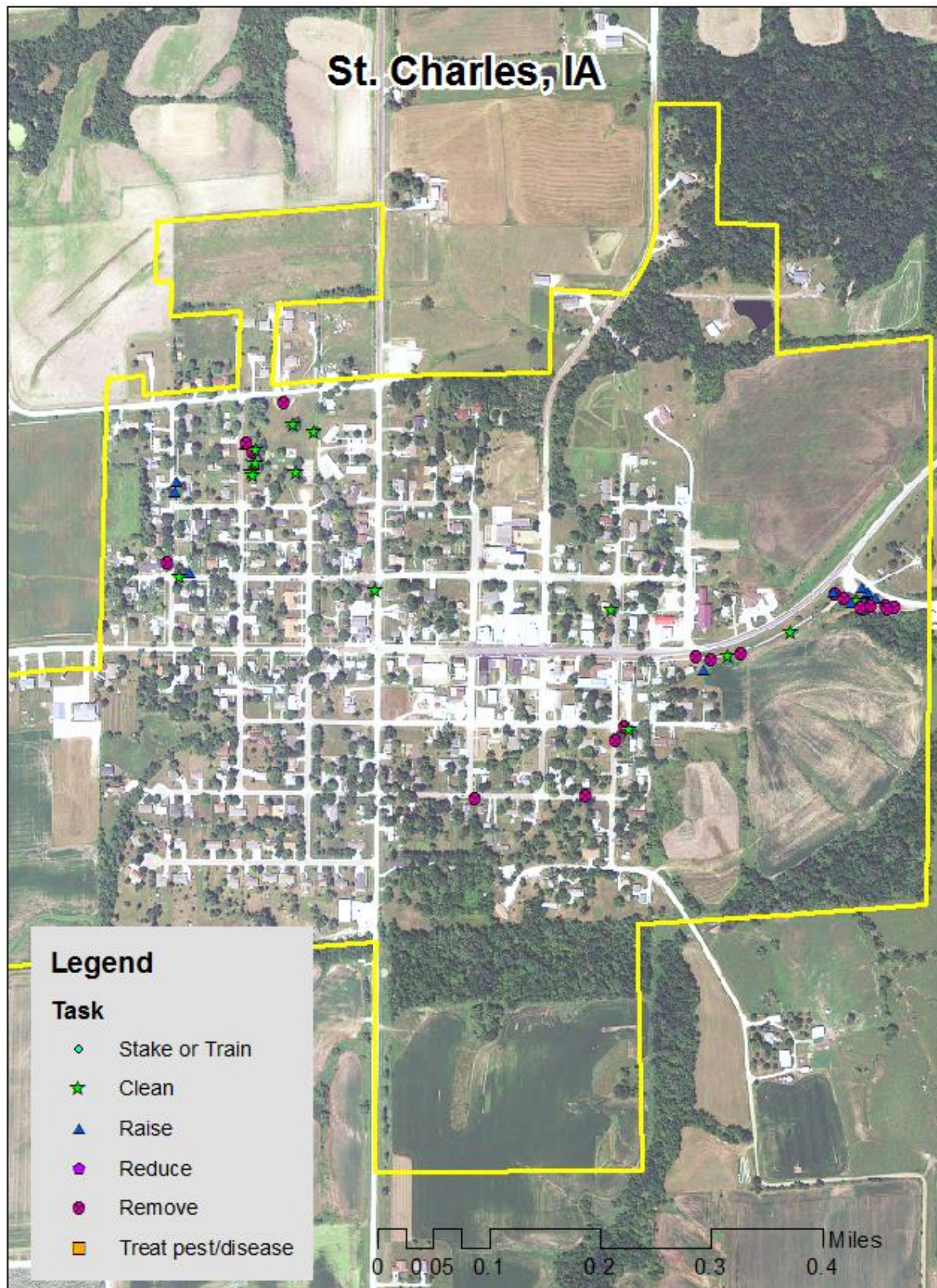
Figure 5: Maintenance Tasks *St. Charles ownership of the trees recommended for removal should be verified prior to any removal*