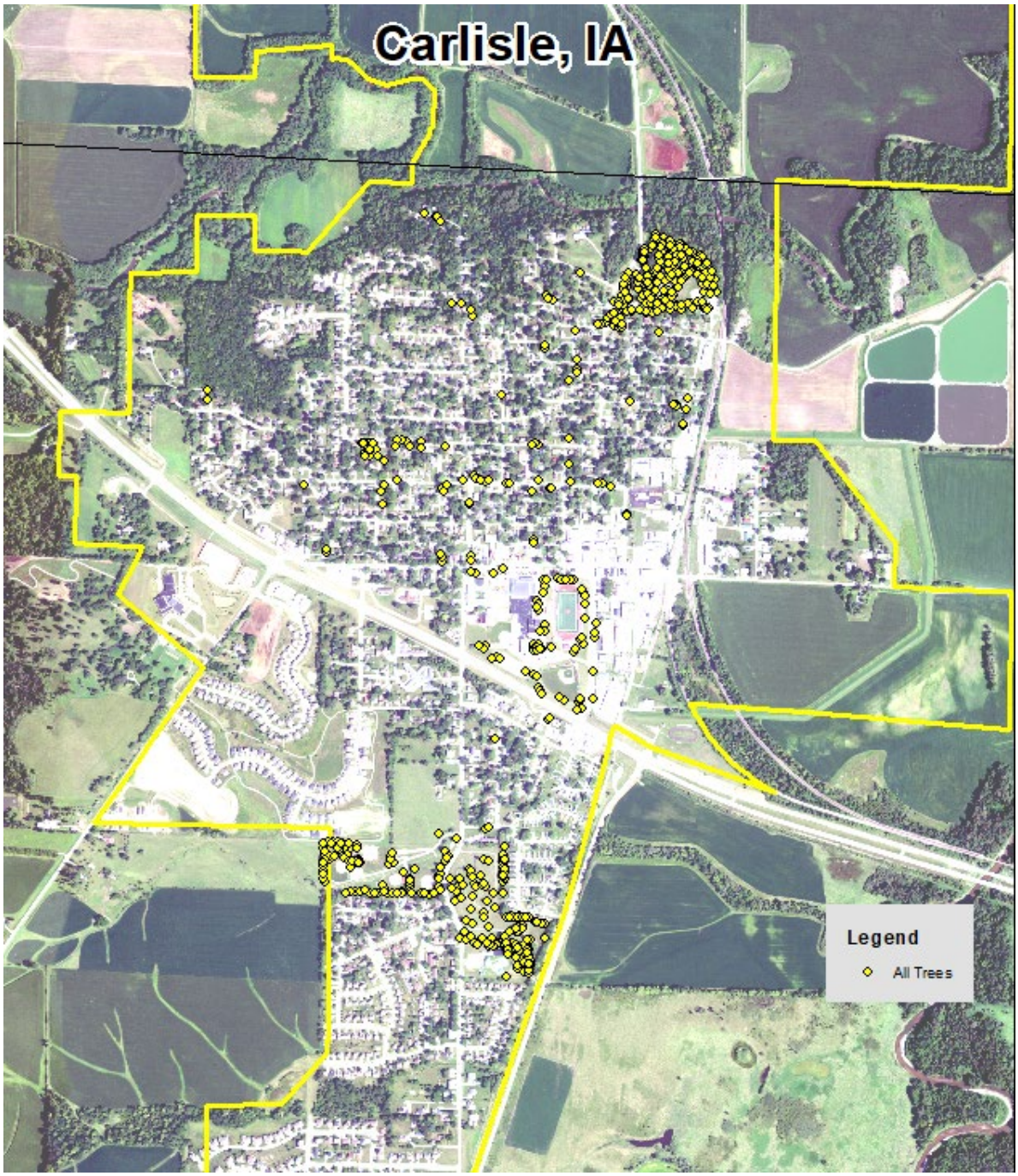
Carlisle, IA



2023 Urban Forest Management Plan
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Table of Contents

Executive Summary

Overview

This plan was developed to assist the City of Carlisle 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 4% of Carlisle's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. 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 2022, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 660 trees inventoried.

- Carlisle's trees provide $88,762 of benefits annually, an average of $134 a tree
- There are over 51 species of trees
- The top three genera are: Oak 21.5%, Maple 15.3%, and Black Walnut 8.5%
- 18.3% of trees are in need of some type of management
- 56 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 56 trees needing removal, 18 trees are over 18 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*
- 24 of the 26 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation and probably need removed
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly

Introduction

This plan was developed to assist Carlisle with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with more and more of that money spent on tree removal. With the recovery from Emerald Ash Borer (EAB), an invasive pest that kills native ash trees, it is time to prepare for the increased costs of tree removal or treatment and replacement planting. With proper planning and management of the current canopy in Carlisle, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

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

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

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

Inventory Results

The data collected for the 660 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis. Fin

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Carlisle's trees reduce energy related costs by approximately $24,887 annually (Appendix A, Table 1). These savings are both in Electricity (119 MWh) and in Natural Gas (16,180.1 Therms).

Annual Stormwater Benefits

Carlisle's trees intercept about 1,165,714 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $31,591 of benefits to the city.

Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and emitting volatile organic matter (ozone). In Carlisle, it is estimated that trees remove 1,417.3 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 $3,910 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Carlisle, trees sequester about 426,380 lbs of carbon a year with an associated value of $3,198 (Appendix A, Table 5). In addition, the trees store 3,688,085 lbs of carbon, with a yearly benefit of $27,661 (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. Carlisle receives $25,176 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STREETS analysis, Carlisle's trees provide $88,762 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 660 trees in Carlisle provide approximately $134 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Carlisle has over 51 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of 15 most common trees by genera is as follows:

Oak	142	21.5%
Maple	101	15.3%

Walnut	56	8.5%
Hackberry	51	7.7%
Apple (Crab)	41	6.2%
White pine	38	5.8%
Ash	26	3.8%
Basswood/Linden	24	3.6%
Spruce	16	2.4%
Honeylocust	16	2.4%
Kentucky Coffeetree	15	2.3%
River Birch	15	2.3%
Northern White Cedar	15	2.3%
Eastern Red Cedar	14	2.1%
Siberian elm	14	2.1%

Age Class

Most of Carlisle's trees (60.7%) are between 6 and 24 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Carlisle's size curve is in the mid range, indicating the trees are trending toward 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 Carlisle indicate that 93% of the trees are in good health, with 3% of the foliage in fair health, and 4% in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 87% of Carlisle'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 7% of the population. This 7% is an estimate of trees that need management follow up.

Management Needs

The following outlines the specific management needs of the street and park trees by number of trees and percent of canopy (Appendix B, Figure 3).

Crown Cleaning	65	9.8%
Tree Removal	56	8.5%
Tree Staking	13	0%
Crown Raising	56	0%
Crown Reduction	1	0%

Canopy Cover

The total canopy with both private and public trees is 15% and 517acres. The canopy cover on city own properties included in the Carlisle inventory includes approximately 12.5 acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 3%, in 30 years on all lands. To achieve this goal it is estimated that 260 trees need to be planted annually on public and/or private lands.

Land Use and Location

The majority of Carlisle'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	
Park/vacant/other	85%
Single Family Residential	13.5 %
Small commercial	<1%
Multifamily Residential	<1%

Location	
Front Yard	94%
Planting Strip	6%

Changes in Forest Structure Since plan in 2014

Please note any trends you have seen since that last plan, such as: reduction in maintenance needs, increase in tree diversity, loss of canopy cover, changes in age class, etc.

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

Carlisle has 2 critical concern trees that need immediate removal. This tree 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 before the other trees slated to be removed. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance.

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 56 removals, 24 are ash trees. There are a total of 26 ash trees, and 24 of those have signs and symptoms that have been associated with EAB. *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 Carlisle.

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, oak is the genus that makes up more than 20% of the forest at 21.5% (Appendix A, Figure 1). 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 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 decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and woodpecker damage.

Six Year Maintenance Plan

Year 1

Removal: 2 critical concern trees plus 6 more trees
Planting and Replacement: 10 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 8 trees in poor health
Planting and Replacement: 10 trees in open locations
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 3

Removal: 8 trees in poor health
Planting and Replacement: 10 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 4

Removal: 8 trees in poor health
Planting and Replacement: 10 trees in open locations
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 5

Removal: 8 trees in poor health
Planting and Replacement: 10 trees to be planted in open locations
Visual Survey for signs and symptoms of EAB

Year 6

Removal: 8 trees in poor health
Planting and Replacement: 10 trees in open locations
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Ash Tree Removal

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

Treatment of Ash Trees

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

EAB Quarantines

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

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

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

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

Wood Disposal

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

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance. The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow, or black walnut.

Postponed Work

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

Monitoring

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

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Carlisle

Annual Energy Benefits of Public Trees

2/1/2023

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern red oak	11.6	879	1,585.5	1,554	2,432	(N/A)	12.9	9.8	28.62
Black walnut	12.8	969	1,715.1	1,681	2,650	(N/A)	8.5	10.6	47.32
Northern hackberry	15.5	1,173	2,146.8	2,104	3,277	(N/A)	7.7	13.2	64.25
Apple	1.8	137	264.5	259	397	(N/A)	6.2	1.6	9.67
Eastern white pine	5.1	389	666.6	653	1,042	(N/A)	5.8	4.2	27.42
Silver maple	9.2	695	1,188.6	1,165	1,860	(N/A)	5.6	7.5	50.26
Pin oak	8.7	664	1,186.9	1,163	1,827	(N/A)	4.1	7.3	67.66
Green ash	5.4	407	704.0	690	1,097	(N/A)	3.8	4.4	43.89
Norway maple	2.6	201	387.2	379	580	(N/A)	3.5	2.3	25.23
Bur oak	5.3	400	713.7	699	1,099	(N/A)	3.5	4.4	47.80
Red maple	2.2	167	286.7	281	448	(N/A)	2.4	1.8	28.01
American basswood	3.3	249	479.3	470	719	(N/A)	2.4	2.9	44.92
Honeylocust	2.0	155	280.6	275	430	(N/A)	2.4	1.7	26.86
Kentucky coffeetree	3.0	225	407.4	399	624	(N/A)	2.3	2.5	41.62
Northern white cedar	0.8	62	136.9	134	196	(N/A)	2.3	0.8	13.05
River birch	3.0	228	432.6	424	652	(N/A)	2.3	2.6	43.45
Eastern red cedar	1.5	114	221.7	217	331	(N/A)	2.1	1.3	23.63
Black maple	3.3	251	440.9	432	683	(N/A)	2.1	2.7	48.81
Siberian elm	4.0	305	530.6	520	825	(N/A)	2.1	3.3	58.90
Spruce	1.4	108	170.4	167	275	(N/A)	1.8	1.1	22.90
Sugar maple	1.8	138	231.3	227	364	(N/A)	1.5	1.5	36.44
Broadleaf Deciduous Small	0.2	13	28.4	28	40	(N/A)	1.5	0.2	4.04
Littleleaf linden	2.1	159	312.5	306	465	(N/A)	1.4	1.9	51.71
American elm	1.5	116	203.4	199	316	(N/A)	1.2	1.3	39.45
Black cherry	1.5	114	211.2	207	321	(N/A)	1.2	1.3	40.13
Callery pear	1.2	87	151.7	149	236	(N/A)	0.9	0.9	39.34
Mulberry	1.0	72	137.2	135	207	(N/A)	0.8	0.8	41.33
Red pine	0.7	50	78.2	77	127	(N/A)	0.8	0.5	25.40
Oak	0.6	47	82.5	81	128	(N/A)	0.6	0.5	32.00
Conifer Evergreen Large	0.5	35	58.5	57	92	(N/A)	0.6	0.4	23.08
Ohio buckeye	0.6	48	94.0	92	140	(N/A)	0.6	0.6	34.90
American sycamore	1.2	93	167.3	164	257	(N/A)	0.6	1.0	64.34
Conifer Evergreen Small	0.0	1	2.7	3	4	(N/A)	0.6	0.0	0.93
Hickory	0.7	53	81.0	79	133	(N/A)	0.5	0.5	44.23
Blue spruce	0.3	21	35.2	35	56	(N/A)	0.5	0.2	18.66
Eastern redbud	0.2	16	28.5	28	44	(N/A)	0.3	0.2	21.77
Swamp white oak	0.0	1	1.6	2	2	(N/A)	0.3	0.0	1.10
Black locust	0.5	40	79.1	78	117	(N/A)	0.3	0.5	58.69
Elm	0.6	43	73.8	72	115	(N/A)	0.3	0.5	57.57
Conifer Evergreen Medium	0.1	5	10.2	10	15	(N/A)	0.2	0.1	14.80
Norway spruce	0.2	14	24.6	24	38	(N/A)	0.2	0.2	38.17
Boxelder	0.2	15	23.9	23	39	(N/A)	0.2	0.2	38.63
Yellowwood	0.0	0	0.8	1	1	(N/A)	0.2	0.0	1.10
White ash	0.3	20	28.4	28	48	(N/A)	0.2	0.2	48.12
White oak	0.0	0	0.5	0	1	(N/A)	0.2	0.0	0.66
Ginkgo	0.2	14	26.5	26	40	(N/A)	0.2	0.2	40.40
Sweetgum	0.0	0	0.5	0	1	(N/A)	0.2	0.0	0.66
Tulip tree	0.0	0	0.5	0	1	(N/A)	0.2	0.0	0.66
Catalpa	0.2	18	27.0	26	44	(N/A)	0.2	0.2	44.23
Lilac	0.0	2	3.8	4	5	(N/A)	0.2	0.0	5.40
Broadleaf Deciduous Mediu	0.2	18	29.5	29	47	(N/A)	0.2	0.2	46.78
Total	119.0	9,031	16,180.3	15,857	24,887	(N/A)	100.0	100.0	37.71

Table 2: Annual Stormwater Benefits

Carlisle

Annual Stormwater Benefits of Public Trees

2/1/2023

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern red oak	100,758	2,731	(N/A)	12.9	8.6	32.12
Black walnut	119,623	3,242	(N/A)	8.5	10.3	57.89
Northern hackberry	135,730	3,678	(N/A)	7.7	11.6	72.12
Apple	6,388	173	(N/A)	6.2	0.5	4.22
Eastern white pine	93,552	2,535	(N/A)	5.8	8.0	66.72
Silver maple	119,858	3,248	(N/A)	5.6	10.3	87.79
Pin oak	92,435	2,505	(N/A)	4.1	7.9	92.78
Green ash	45,240	1,226	(N/A)	3.8	3.9	49.04
Norway maple	17,114	464	(N/A)	3.5	1.5	20.16
Bur oak	59,465	1,611	(N/A)	3.5	5.1	70.07
Red maple	12,945	351	(N/A)	2.4	1.1	21.93
American basswood	35,745	969	(N/A)	2.4	3.1	60.54
Honeylocust	16,856	457	(N/A)	2.4	1.4	28.55
Kentucky coffeetree	27,095	734	(N/A)	2.3	2.3	48.95
Northern white cedar	8,550	232	(N/A)	2.3	0.7	15.45
River birch	24,119	654	(N/A)	2.3	2.1	43.57
Eastern red cedar	21,908	594	(N/A)	2.1	1.9	42.41
Black maple	29,375	796	(N/A)	2.1	2.5	56.86
Siberian elm	37,020	1,003	(N/A)	2.1	3.2	71.66
Spruce	18,008	488	(N/A)	1.8	1.5	40.67
Sugar maple	14,359	389	(N/A)	1.5	1.2	38.91
Broadleaf Deciduous Small	503	14	(N/A)	1.5	0.0	1.36
Littleleaf linden	22,675	614	(N/A)	1.4	1.9	68.28
American elm	13,330	361	(N/A)	1.2	1.1	45.16
Black cherry	6,347	172	(N/A)	1.2	0.5	21.50
Callery pear	6,808	185	(N/A)	0.9	0.6	30.75
Mulberry	4,348	118	(N/A)	0.8	0.4	23.56
Red pine	9,124	247	(N/A)	0.8	0.8	49.45
Oak	4,836	131	(N/A)	0.6	0.4	32.76
Conifer Evergreen Large	6,642	180	(N/A)	0.6	0.6	45.00
Ohio buckeye	6,419	174	(N/A)	0.6	0.6	43.49
American sycamore	16,844	456	(N/A)	0.6	1.4	114.12
Conifer Evergreen Small	98	3	(N/A)	0.6	0.0	0.66
Hickory	4,397	119	(N/A)	0.5	0.4	39.72
Blue spruce	3,345	91	(N/A)	0.5	0.3	30.22
Eastern redbud	735	20	(N/A)	0.3	0.1	9.96
Swamp white oak	24	1	(N/A)	0.3	0.0	0.33
Black locust	4,959	134	(N/A)	0.3	0.4	67.19
Elm	5,409	147	(N/A)	0.3	0.5	73.29
Conifer Evergreen Medium	755	20	(N/A)	0.2	0.1	20.47
Norway spruce	4,605	125	(N/A)	0.2	0.4	124.79
Boxelder	1,456	39	(N/A)	0.2	0.1	39.46
Yellowwood	12	0	(N/A)	0.2	0.0	0.33
White ash	1,663	45	(N/A)	0.2	0.1	45.05
White oak	18	0	(N/A)	0.2	0.0	0.48
Ginkgo	1,240	34	(N/A)	0.2	0.1	33.60
Sweetgum	18	0	(N/A)	0.2	0.0	0.48
Tulip tree	18	0	(N/A)	0.2	0.0	0.48
Catalpa	1,466	40	(N/A)	0.2	0.1	39.72

Lilac	69	2 (N/A)	0.2	0.0	1.86	
Broadleaf Deciduous Medium	1,409	38 (N/A)	0.2	0.1	38.19	
Citywide total	1,165,714	31,591 (N/A)	100.0	100.0	47.86	

Table 3: Annual Air Quality Benefits

Carlisle

Annual Air Quality Benefits of Public Trees

2/1/2023

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($) Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2							
Northern red oak	20.0	3.5	10.0	0.9	109	55.2	8.0	7.7	52.4	344	-28.6	-107	129.1	345 (N/A)	12.9	4.06
Black walnut	12.7	2.0	6.5	0.6	69	60.7	8.9	8.4	57.9	379	0.0	0	157.6	447 (N/A)	8.5	7.99
Northern hackberry	20.6	3.6	10.7	0.9	113	74.2	10.8	10.3	70.1	461	0.0	0	201.1	574 (N/A)	7.7	11.26
Apple	1.7	0.3	0.8	0.1	9	8.8	1.3	1.2	8.2	54	0.0	0	22.4	64 (N/A)	6.2	1.55
Eastern white pine	10.8	2.1	8.9	1.3	71	24.1	3.5	3.4	23.2	151	-43.5	-163	33.8	59 (N/A)	5.8	1.55
Silver maple	19.8	3.4	9.9	0.9	107	43.0	6.3	6.0	41.4	270	-10.8	-41	119.9	336 (N/A)	5.6	9.09
Pin oak	15.6	2.7	8.1	0.7	86	41.6	6.1	5.8	39.6	259	-29.2	-110	91.0	236 (N/A)	4.1	8.73
Green ash	4.4	0.7	2.3	0.2	24	25.3	3.7	3.5	24.3	159	0.0	0	64.5	183 (N/A)	3.8	7.30
Norway maple	2.5	0.4	1.4	0.1	14	12.9	1.9	1.8	12.0	80	-0.7	-3	32.2	91 (N/A)	3.5	3.95
Bur oak	8.0	1.3	3.8	0.4	42	25.1	3.7	3.5	23.9	156	0.0	0	69.5	199 (N/A)	3.5	8.64
Red maple	2.2	0.4	1.1	0.1	12	10.4	1.5	1.5	10.0	65	-0.9	-3	26.3	74 (N/A)	2.4	4.61
American basswood	4.7	0.8	2.3	0.2	26	16.0	2.3	2.2	14.9	99	-4.1	-15	39.4	109 (N/A)	2.4	6.82
Honeylocust	2.9	0.5	1.4	0.1	16	9.7	1.4	1.4	9.2	61	-2.2	-8	24.5	68 (N/A)	2.4	4.26
Kentucky coffeetree	2.7	0.4	1.4	0.1	15	14.2	2.1	2.0	13.4	88	0.0	0	36.3	103 (N/A)	2.3	6.87
Northern white cedar	0.7	0.1	0.8	0.1	5	4.1	0.6	0.5	3.7	25	-2.4	-9	8.2	21 (N/A)	2.3	1.42
River birch	4.4	0.8	2.2	0.2	24	14.5	2.1	2.0	13.6	90	-1.1	-4	38.8	110 (N/A)	2.3	7.34
Eastern red cedar	4.5	0.9	3.6	0.6	29	7.3	1.0	1.0	6.8	45	-12.1	-45	13.6	29 (N/A)	2.1	2.07
Black maple	7.3	1.2	3.4	0.3	39	15.7	2.3	2.2	15.0	98	-2.4	-9	44.9	128 (N/A)	2.1	9.11
Siberian elm	5.4	0.9	2.8	0.2	29	19.0	2.8	2.6	18.2	119	0.0	0	51.9	148 (N/A)	2.1	10.58
Spruce	2.0	0.4	1.7	0.2	13	6.6	1.0	0.9	6.4	41	-6.6	-25	12.6	30 (N/A)	1.8	2.48
Sugar maple	1.6	0.3	0.9	0.1	9	8.5	1.2	1.2	8.2	53	-1.3	-5	20.7	57 (N/A)	1.5	5.73
Broadleaf Deciduous Small	0.0	0.0	0.0	0.0	0	0.8	0.1	0.1	0.7	5	0.0	0	1.9	5 (N/A)	1.5	0.53
Littleleaf linden	3.8	0.7	1.9	0.2	21	10.3	1.5	1.4	9.5	63	-1.9	-7	27.3	77 (N/A)	1.4	8.56
American elm	1.2	0.2	0.7	0.1	7	7.3	1.1	1.0	6.9	45	0.0	0	18.4	52 (N/A)	1.2	6.51
Black cherry	2.1	0.3	1.0	0.1	11	7.2	1.0	1.0	6.8	45	0.0	0	19.6	56 (N/A)	1.2	7.00
Callery pear	1.0	0.2	0.5	0.0	5	5.5	0.8	0.8	5.2	34	-0.3	-1	13.7	39 (N/A)	0.9	6.43
Mulberry	1.5	0.2	0.7	0.1	8	4.6	0.7	0.6	4.3	29	0.0	0	12.7	36 (N/A)	0.8	7.27
Red pine	1.0	0.2	0.9	0.1	7	3.0	0.5	0.4	3.0	19	-3.6	-13	5.6	13 (N/A)	0.8	2.54
Oak	0.4	0.1	0.2	0.0	2	2.9	0.4	0.4	2.8	18	0.0	0	7.3	21 (N/A)	0.6	5.16
Conifer Evergreen Large	0.7	0.1	0.6	0.1	5	2.2	0.3	0.3	2.1	14	-2.6	-10	3.8	9 (N/A)	0.6	2.14
Ohio buckeye	1.4	0.2	0.7	0.1	7	3.1	0.4	0.4	2.8	19	-0.3	-1	8.8	25 (N/A)	0.6	6.27
American sycamore	2.9	0.5	1.3	0.1	15	5.9	0.9	0.8	5.6	37	0.0	0	17.9	52 (N/A)	0.6	12.90
Conifer Evergreen Small	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	0	0.0	0	0.1	0 (N/A)	0.6	0.09
Hickory	0.3	0.1	0.2	0.0	2	3.2	0.5	0.5	3.2	20	0.0	0	7.9	22 (N/A)	0.5	7.42
Blue spruce	0.4	0.1	0.3	0.0	3	1.3	0.2	0.2	1.3	8	-1.2	-4	2.7	7 (N/A)	0.5	2.18
Eastern redbud	0.2	0.0	0.1	0.0	1	1.0	0.1	0.1	0.9	6	0.0	0	2.6	7 (N/A)	0.3	3.63
Swamp white oak	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.3	0.14
Black locust	1.0	0.2	0.5	0.0	5	2.6	0.4	0.4	2.4	16	-0.2	-1	7.1	20 (N/A)	0.3	10.16
Elm	0.6	0.1	0.3	0.0	3	2.7	0.4	0.4	2.6	17	0.0	0	7.0	20 (N/A)	0.3	9.95
Conifer Evergreen Medium	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2 (N/A)	0.2	1.53
Norway spruce	0.6	0.1	0.4	0.1	4	0.9	0.1	0.1	0.8	5	-2.9	-11	0.3	-2 (N/A)	0.2	-1.58
Boxelder	0.1	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	-0.1	0	2.3	6 (N/A)	0.2	6.37
Yellowwood	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.2	0.14
White ash	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.2	8	0.0	0	3.0	8 (N/A)	0.2	8.32
White oak	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.2	0.08
Ginkgo	0.3	0.1	0.1	0.0	2	0.9	0.1	0.1	0.9	6	-0.1	0	2.4	7 (N/A)	0.2	6.92
Sweetgum	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.2	0.08
Tulip tree	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.2	0.08
Catalpa	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.2	7.42
Lilac	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1 (N/A)	0.2	0.71
Broadleaf Deciduous Medium	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8 (N/A)	0.2	7.92
Citywide total	174.7	30.1	94.7	9.4	973	566.9	82.6	78.8	539.2	3,534	-159.3	-597	1,417.3	3,910 (N/A)	100.0	5.92

Table 4: Annual Carbon Stored

Carlisle

Stored CO2 Benefits of Public Trees

2/1/2023

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern red oak	417,716	3,133	(N/A)	12.9	11.3	36.86
Black walnut	414,023	3,105	(N/A)	8.5	11.2	55.45
Northern hackberry	311,651	2,337	(N/A)	7.7	8.5	45.83
Apple	26,691	200	(N/A)	6.2	0.7	4.88
Eastern white pine	105,179	789	(N/A)	5.8	2.9	20.76
Silver maple	461,195	3,459	(N/A)	5.6	12.5	93.49
Pin oak	399,985	3,000	(N/A)	4.1	10.8	111.11
Green ash	143,737	1,078	(N/A)	3.8	3.9	43.12
Norway maple	42,596	319	(N/A)	3.5	1.2	13.89
Bur oak	266,572	1,999	(N/A)	3.5	7.2	86.93
Red maple	26,699	200	(N/A)	2.4	0.7	12.52
American basswood	171,144	1,284	(N/A)	2.4	4.6	80.22
Honeylocust	38,101	286	(N/A)	2.4	1.0	17.86
Kentucky coffeetree	87,977	660	(N/A)	2.3	2.4	43.99
Northern white cedar	3,632	27	(N/A)	2.3	0.1	1.82
River birch	73,497	551	(N/A)	2.3	2.0	36.75
Eastern red cedar	14,604	110	(N/A)	2.1	0.4	7.82
Black maple	78,093	586	(N/A)	2.1	2.1	41.84
Siberian elm	133,326	1,000	(N/A)	2.1	3.6	71.42
Spruce	14,388	108	(N/A)	1.8	0.4	8.99
Sugar maple	44,920	337	(N/A)	1.5	1.2	33.69
Broadleaf Deciduous	1,286	10	(N/A)	1.5	0.0	0.96
Littleleaf linden	80,983	607	(N/A)	1.4	2.2	67.49
American elm	32,740	246	(N/A)	1.2	0.9	30.69
Black cherry	31,708	238	(N/A)	1.2	0.9	29.73
Callery pear	16,698	125	(N/A)	0.9	0.5	20.87
Mulberry	22,597	169	(N/A)	0.8	0.6	33.90
Red pine	8,024	60	(N/A)	0.8	0.2	12.04
Oak	13,350	100	(N/A)	0.6	0.4	25.03
Conifer Evergreen La	5,940	45	(N/A)	0.6	0.2	11.14
Ohio buckeye	22,461	168	(N/A)	0.6	0.6	42.11
American sycamore	97,883	734	(N/A)	0.6	2.7	183.53
Conifer Evergreen Sn	10	0	(N/A)	0.6	0.0	0.02
Hickory	11,016	83	(N/A)	0.5	0.3	27.54
Blue spruce	2,279	17	(N/A)	0.5	0.1	5.70
Eastern redbud	3,215	24	(N/A)	0.3	0.1	12.06
Swamp white oak	34	0	(N/A)	0.3	0.0	0.13
Black locust	15,891	119	(N/A)	0.3	0.4	59.59
Elm	19,445	146	(N/A)	0.3	0.5	72.92
Conifer Evergreen Me	284	2	(N/A)	0.2	0.0	2.13
Norway spruce	7,490	56	(N/A)	0.2	0.2	56.18
Boxelder	3,624	27	(N/A)	0.2	0.1	27.18
Yellowwood	17	0	(N/A)	0.2	0.0	0.13
White ash	3,672	28	(N/A)	0.2	0.1	27.54
White oak	12	0	(N/A)	0.2	0.0	0.09
Ginkgo	4,203	32	(N/A)	0.2	0.1	31.52
Sweetgum	12	0	(N/A)	0.2	0.0	0.09
Tulip tree	12	0	(N/A)	0.2	0.0	0.09
Catalpa	3,672	28	(N/A)	0.2	0.1	27.54
Lilac	178	1	(N/A)	0.2	0.0	1.33
Broadleaf Deciduous	3,624	27	(N/A)	0.2	0.1	27.18
Citywide total	3,688,085	27,661	(N/A)	100.0	100.0	41.91

Table 5: Annual Carbon Sequestered

Carlisle

Annual CO Benefits of Public Trees

2/1/2023

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
Northern red oak	11,277	85	-2,006	-145	-16	19,420	146	28,546	214 (N/A)	12.9	6.7	2.52
Black walnut	29,470	221	-1,987	-129	-16	21,410	161	48,764	366 (N/A)	8.5	11.4	6.53
Northern hackberry	17,587	132	-1,496	-140	-12	25,924	194	41,874	314 (N/A)	7.7	9.8	6.16
Apple	2,782	21	-129	-26	-1	3,038	23	5,665	42 (N/A)	6.2	1.3	1.04
Eastern white pine	6,034	45	-505	-91	-4	8,593	64	14,031	105 (N/A)	5.8	3.3	2.77
Silver maple	35,639	267	-2,217	-99	-17	15,357	115	48,679	365 (N/A)	5.6	11.4	9.87
Pin oak	38,269	287	-1,920	-91	-15	14,666	110	50,924	382 (N/A)	4.1	11.9	14.15
Green ash	11,887	89	-690	-53	-6	9,001	68	20,146	151 (N/A)	3.8	4.7	6.04
Norway maple	4,980	37	-205	-27	-2	4,438	33	9,185	69 (N/A)	3.5	2.2	3.00
Bur oak	11,605	87	-1,280	-57	-10	8,839	66	19,108	143 (N/A)	3.5	4.5	6.23
Red maple	3,728	28	-128	-20	-1	3,695	28	7,274	55 (N/A)	2.4	1.7	3.41
American basswood	10,245	77	-822	-39	-6	5,502	41	14,886	112 (N/A)	2.4	3.5	6.98
Honeylocust	3,801	29	-186	-18	-2	3,420	26	7,017	53 (N/A)	2.4	1.6	3.29
Kentucky coffeetree	6,980	52	-422	-30	-3	4,975	37	11,502	86 (N/A)	2.3	2.7	5.75
Northern white cedar	755	6	-17	-17	0	1,360	10	2,080	16 (N/A)	2.3	0.5	1.04
River birch	4,667	35	-353	-31	-3	5,032	38	9,316	70 (N/A)	2.3	2.2	4.66
Eastern red cedar	126	1	-70	-27	-1	2,511	19	2,540	19 (N/A)	2.1	0.6	1.36
Black maple	9,325	70	-375	-30	-3	5,553	42	14,473	109 (N/A)	2.1	3.4	7.75
Siberian elm	7,141	54	-640	-41	-5	6,732	50	13,192	99 (N/A)	2.1	3.1	7.07
Spruce	1,333	10	-69	-23	-1	2,384	18	3,624	27 (N/A)	1.8	0.9	2.27
Sugar maple	3,172	24	-216	-18	-2	3,042	23	5,980	45 (N/A)	1.5	1.4	4.48
Broadleaf Deciduous Smal	292	2	-6	-5	0	277	2	558	4 (N/A)	1.5	0.1	0.42
Littleleaf linden	6,314	47	-389	-26	-3	3,517	26	9,417	71 (N/A)	1.4	2.2	7.85
American elm	1,707	13	-157	-14	-1	2,570	19	4,106	31 (N/A)	1.2	1.0	3.85
Black cherry	1,606	12	-152	-19	-1	2,520	19	3,955	30 (N/A)	1.2	0.9	3.71
Callery pear	1,992	15	-80	-10	-1	1,932	14	3,833	29 (N/A)	0.9	0.9	4.79
Mulberry	1,281	10	-108	-12	-1	1,595	12	2,756	21 (N/A)	0.8	0.6	4.13
Red pine	650	5	-39	-11	0	1,112	8	1,713	13 (N/A)	0.8	0.4	2.57
Oak	1,388	10	-64	-6	-1	1,042	8	2,359	18 (N/A)	0.6	0.6	4.42
Conifer Evergreen Large	471	4	-29	-8	0	774	6	1,209	9 (N/A)	0.6	0.3	2.27
Ohio buckeye	571	4	-109	-8	-1	1,050	8	1,505	11 (N/A)	0.6	0.4	2.82
American sycamore	2,370	18	-470	-14	-4	2,064	15	3,949	30 (N/A)	0.6	0.9	7.40
Conifer Evergreen Small	2	0	0	-1	0	24	0	26	0 (N/A)	0.6	0.0	0.05
Hickory	1,336	10	-53	-6	0	1,179	9	2,456	18 (N/A)	0.5	0.6	6.14
Blue spruce	193	1	-11	-4	0	474	4	652	5 (N/A)	0.5	0.2	1.63
Eastern redbud	306	2	-15	-3	0	346	3	633	5 (N/A)	0.3	0.1	2.37
Swamp white oak	11	0	0	0	0	14	0	25	0 (N/A)	0.3	0.0	0.09
Black locust	940	7	-76	-5	-1	880	7	1,738	13 (N/A)	0.3	0.4	6.52
Elm	1,302	10	-93	-5	-1	945	7	2,149	16 (N/A)	0.3	0.5	8.06
Conifer Evergreen Mediun	39	0	-1	-1	0	106	1	142	1 (N/A)	0.2	0.0	1.07
Norway spruce	256	2	-36	-4	0	311	2	528	4 (N/A)	0.2	0.1	3.96
Boxelder	418	3	-17	-2	0	336	3	735	6 (N/A)	0.2	0.2	5.51
Yellowwood	5	0	0	0	0	7	0	12	0 (N/A)	0.2	0.0	0.09
White ash	494	4	-18	-2	0	449	3	923	7 (N/A)	0.2	0.2	6.92
White oak	3	0	0	0	0	4	0	7	0 (N/A)	0.2	0.0	0.05
Ginkgo	225	2	-20	-3	0	319	2	521	4 (N/A)	0.2	0.1	3.91
Sweetgum	3	0	0	0	0	4	0	7	0 (N/A)	0.2	0.0	0.05
Tulip tree	3	0	0	0	0	4	0	7	0 (N/A)	0.2	0.0	0.05
Catalpa	445	3	-18	-2	0	393	3	819	6 (N/A)	0.2	0.2	6.14
Lilac	38	0	-1	-1	0	37	0	74	1 (N/A)	0.2	0.0	0.55
Broadleaf Deciduous Medi	386	3	-17	-2	0	395	3	762	6 (N/A)	0.2	0.2	5.71
Citywide total	245,846	1,844	-17,715	-1,325	-143	199,574	1,497	426,380	3,198 (N/A)	100.0	100.0	4.85

Table 6: Annual Social and Aesthetic Benefits

Carlisle

Annual Aesthetic/Other Benefits of Public Trees

2/1/2023

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern red oak	1,020	(N/A)	12.9	4.1	12.00
Black walnut	2,681	(N/A)	8.5	10.6	47.88
Northern hackberry	2,549	(N/A)	7.7	10.1	49.97
Apple	147	(N/A)	6.2	0.6	3.60
Eastern white pine	1,444	(N/A)	5.8	5.7	37.99
Silver maple	2,937	(N/A)	5.6	11.7	79.37
Pin oak	3,023	(N/A)	4.1	12.0	111.96
Green ash	1,145	(N/A)	3.8	4.5	45.79
Norway maple	548	(N/A)	3.5	2.2	23.81
Bur oak	1,001	(N/A)	3.5	4.0	43.50
Red maple	567	(N/A)	2.4	2.3	35.46
American basswood	764	(N/A)	2.4	3.0	47.73
Honeylocust	828	(N/A)	2.4	3.3	51.72
Kentucky coffeetree	653	(N/A)	2.3	2.6	43.56
Northern white cedar	223	(N/A)	2.3	0.9	14.85
River birch	475	(N/A)	2.3	1.9	31.64
Eastern red cedar	49	(N/A)	2.1	0.2	3.48
Black maple	1,136	(N/A)	2.1	4.5	81.16
Siberian elm	557	(N/A)	2.1	2.2	39.76
Spruce	369	(N/A)	1.8	1.5	30.73
Sugar maple	360	(N/A)	1.5	1.4	36.00
Broadleaf Deciduous Small	15	(N/A)	1.5	0.1	1.45
Littleleaf linden	652	(N/A)	1.4	2.6	72.43
American elm	264	(N/A)	1.2	1.0	32.96
Black cherry	93	(N/A)	1.2	0.4	11.61
Callery pear	209	(N/A)	0.9	0.8	34.85
Mulberry	75	(N/A)	0.8	0.3	15.05
Red pine	176	(N/A)	0.8	0.7	35.27
Oak	147	(N/A)	0.6	0.6	36.71
Conifer Evergreen Large	127	(N/A)	0.6	0.5	31.78
Ohio buckeye	59	(N/A)	0.6	0.2	14.67
American sycamore	175	(N/A)	0.6	0.7	43.87
Conifer Evergreen Small	17	(N/A)	0.6	0.1	4.27
Hickory	138	(N/A)	0.5	0.5	45.86
Blue spruce	63	(N/A)	0.5	0.2	20.92
Eastern redbud	18	(N/A)	0.3	0.1	8.77
Swamp white oak	5	(N/A)	0.3	0.0	2.74
Black locust	86	(N/A)	0.3	0.3	43.05
Elm	111	(N/A)	0.3	0.4	55.72
Conifer Evergreen Medium	21	(N/A)	0.2	0.1	21.08
Norway spruce	26	(N/A)	0.2	0.1	26.25
Boxelder	39	(N/A)	0.2	0.2	39.36
Yellowwood	3	(N/A)	0.2	0.0	2.74
White ash	64	(N/A)	0.2	0.3	63.74
White oak	5	(N/A)	0.2	0.0	5.26
Ginkgo	17	(N/A)	0.2	0.1	17.46
Sweetgum	5	(N/A)	0.2	0.0	5.26
Tulip tree	5	(N/A)	0.2	0.0	5.26

Catalpa	46 (N/A)	0.2	0.2	45.86
Lilac	2 (N/A)	0.2	0.0	2.06
Broadleaf Deciduous Medium	39 (N/A)	0.2	0.2	39.16
Citywide total	25,176 (N/A)	100.0	100.0	38.15

Table 7: Summary of Benefits in Dollars

Carlisle

Total Annual Benefits of Public Trees by Species ($)

2/1/2023

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Northern red oak	2,432	214	345	2,731	1,020	6,742	(N/A)	7.6
Black walnut	2,650	366	447	3,242	2,681	9,386	(N/A)	10.6
Northern hackberry	3,277	314	574	3,678	2,549	10,392	(N/A)	11.7
Apple	397	42	64	173	147	823	(N/A)	0.9
Eastern white pine	1,042	105	59	2,535	1,444	5,185	(N/A)	5.8
Silver maple	1,860	365	336	3,248	2,937	8,746	(N/A)	9.9
Pin oak	1,827	382	236	2,505	3,023	7,972	(N/A)	9.0
Green ash	1,097	151	183	1,226	1,145	3,801	(N/A)	4.3
Norway maple	580	69	91	464	548	1,752	(N/A)	2.0
Bur oak	1,099	143	199	1,611	1,001	4,054	(N/A)	4.6
Red maple	448	55	74	351	567	1,495	(N/A)	1.7
American basswood	719	112	109	969	764	2,672	(N/A)	3.0
Honeylocust	430	53	68	457	828	1,835	(N/A)	2.1
Kentucky coffeetree	624	86	103	734	653	2,201	(N/A)	2.5
Northern white cedar	196	16	21	232	223	687	(N/A)	0.8
River birch	652	70	110	654	475	1,960	(N/A)	2.2
Eastern red cedar	331	19	29	594	49	1,021	(N/A)	1.2
Black maple	683	109	128	796	1,136	2,852	(N/A)	3.2
Siberian elm	825	99	148	1,003	557	2,632	(N/A)	3.0
Spruce	275	27	30	488	369	1,189	(N/A)	1.3
Sugar maple	364	45	57	389	360	1,216	(N/A)	1.4
Broadleaf Deciduous Sn	40	4	5	14	15	78	(N/A)	0.1
Littleleaf linden	465	71	77	614	652	1,879	(N/A)	2.1
American elm	316	31	52	361	264	1,023	(N/A)	1.2
Black cherry	321	30	56	172	93	672	(N/A)	0.8
Callery pear	236	29	39	185	209	697	(N/A)	0.8
Mulberry	207	21	36	118	75	457	(N/A)	0.5
Red pine	127	13	13	247	176	576	(N/A)	0.6
Oak	128	18	21	131	147	444	(N/A)	0.5
Conifer Evergreen Large	92	9	9	180	127	417	(N/A)	0.5
Ohio buckeye	140	11	25	174	59	409	(N/A)	0.5
American sycamore	257	30	52	456	175	971	(N/A)	1.1
Conifer Evergreen Smal	4	0	0	3	17	24	(N/A)	0.0
Hickory	133	18	22	119	138	430	(N/A)	0.5
Blue spruce	56	5	7	91	63	221	(N/A)	0.2
Eastern redbud	44	5	7	20	18	93	(N/A)	0.1
Swamp white oak	2	0	0	1	5	9	(N/A)	0.0
Black locust	117	13	20	134	86	371	(N/A)	0.4
Elm	115	16	20	147	111	409	(N/A)	0.5
Conifer Evergreen Medi	15	1	2	20	21	59	(N/A)	0.1
Norway spruce	38	4	-2	125	26	192	(N/A)	0.2
Boxelder	39	6	6	39	39	129	(N/A)	0.1
Yellowwood	1	0	0	0	3	4	(N/A)	0.0
White ash	48	7	8	45	64	172	(N/A)	0.2
White oak	1	0	0	0	5	7	(N/A)	0.0
Ginkgo	40	4	7	34	17	102	(N/A)	0.1
Sweetgum	1	0	0	0	5	7	(N/A)	0.0
Tulip tree	1	0	0	0	5	7	(N/A)	0.0

Catalpa	44	6	7	40	46	143 (N/A)	0.2
Lilac	5	1	1	2	2	11 (N/A)	0.0
Broadleaf Deciduous M	47	6	8	38	39	138 (N/A)	0.2
Citywide Total	24,887	3,198	3,910	31,591	25,176	88,762 (N/A)	100.0

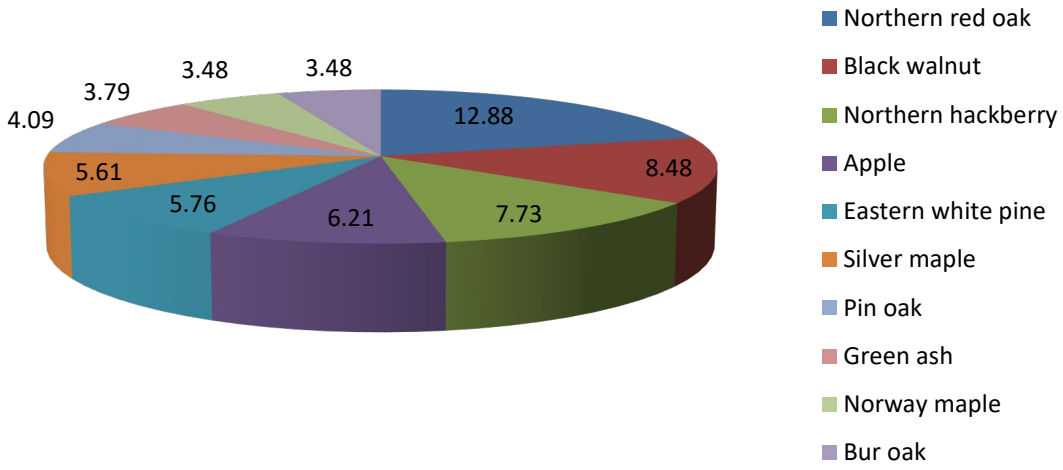

Figure 1: Species Distribution

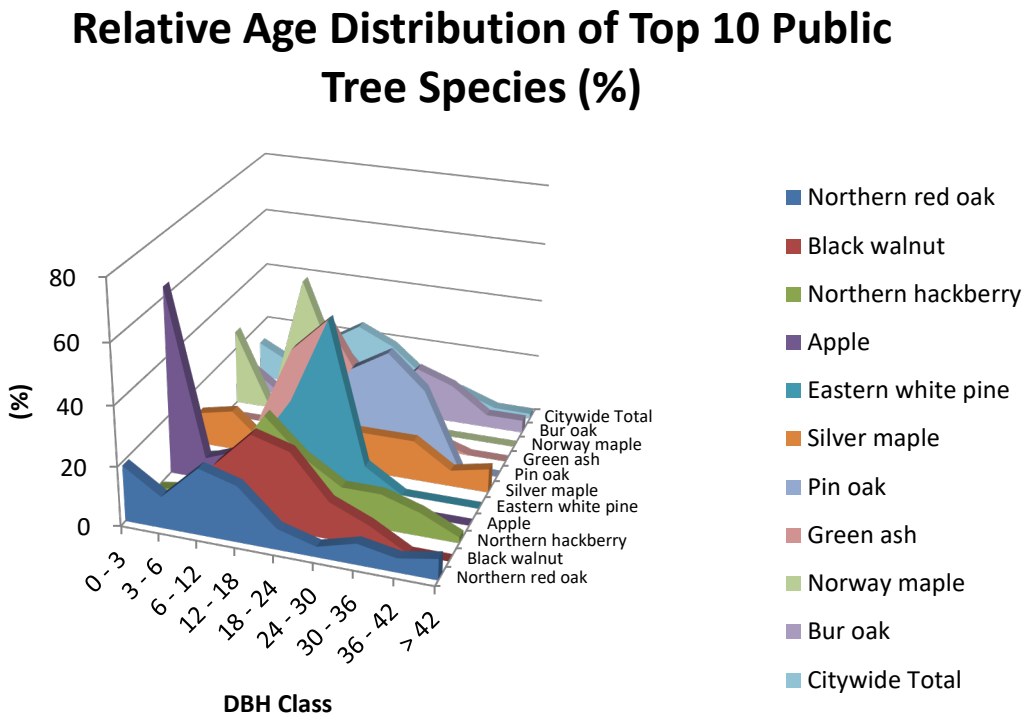

Figure 2: Relative Age Class

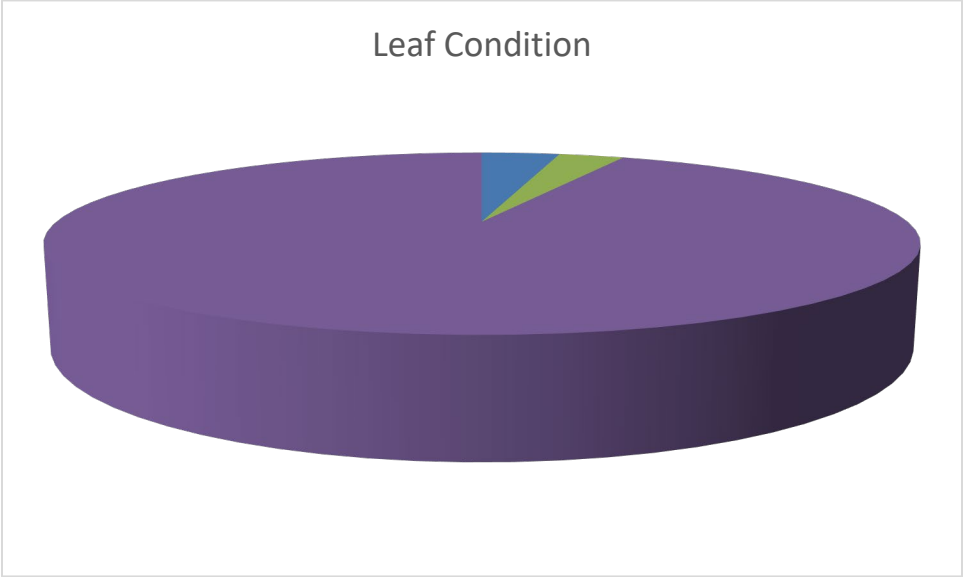

Figure 3: Foliage Condition

Figure 4: Wood Condition

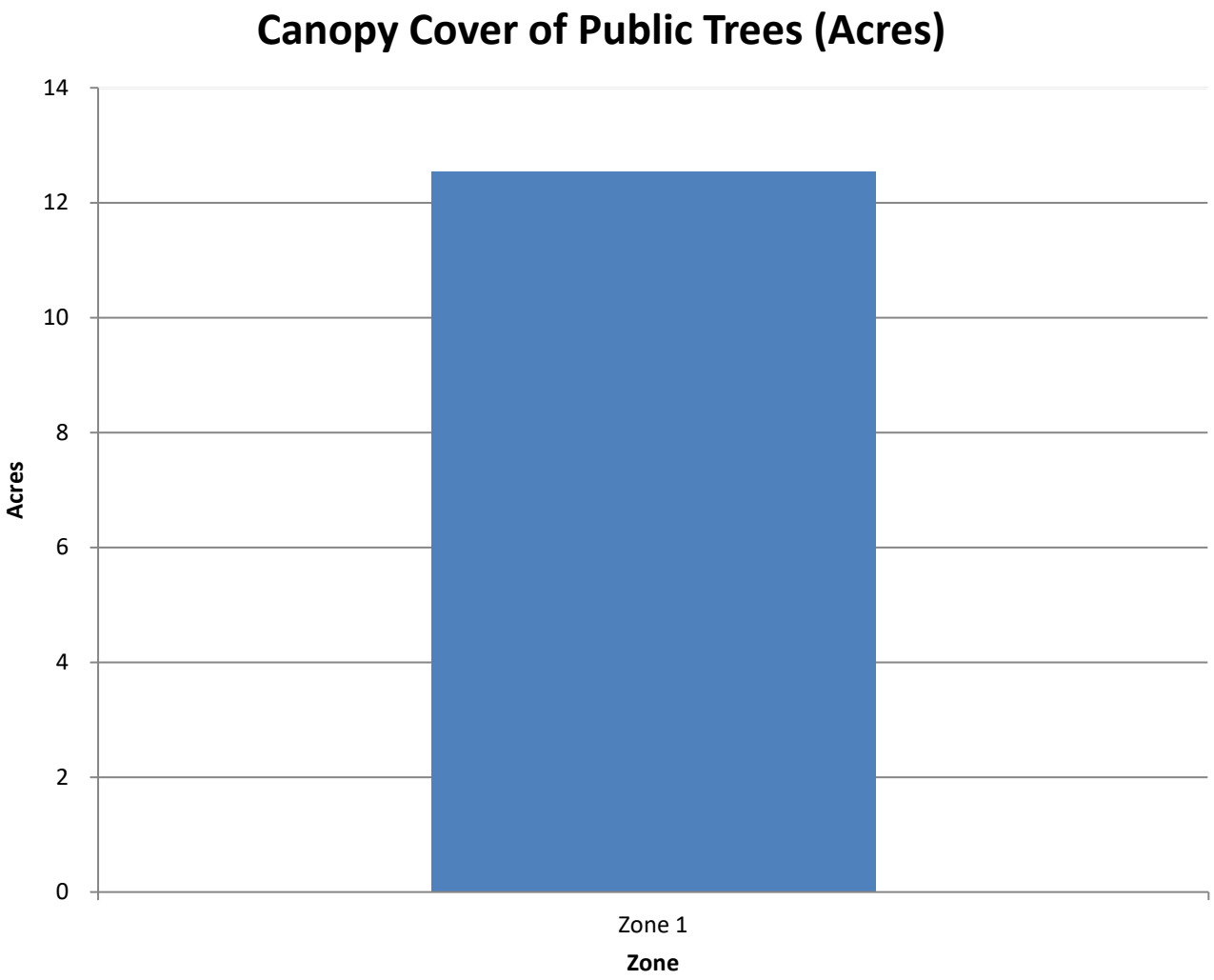

Figure 5: Canopy Cover in Acres

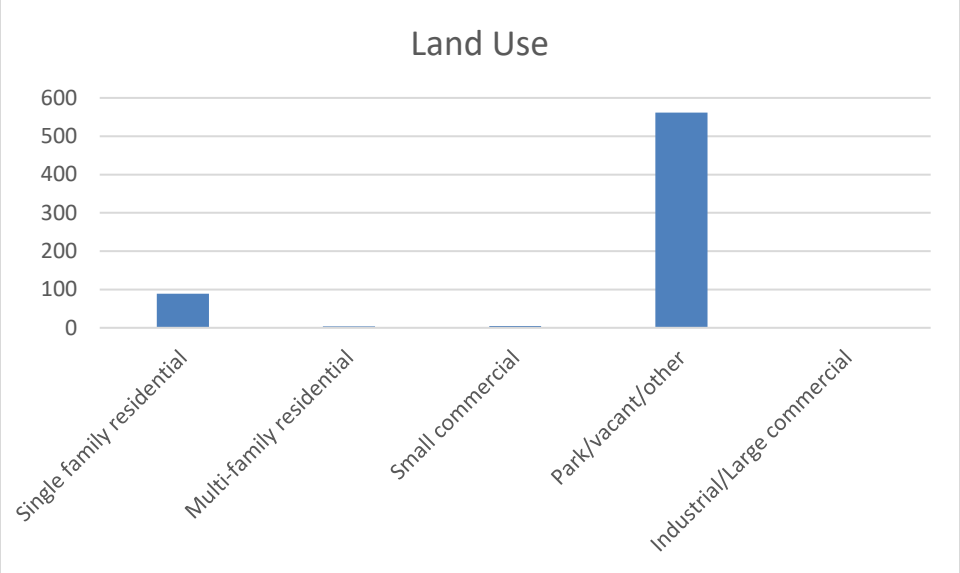

Figure 6: Land Use of city/park trees

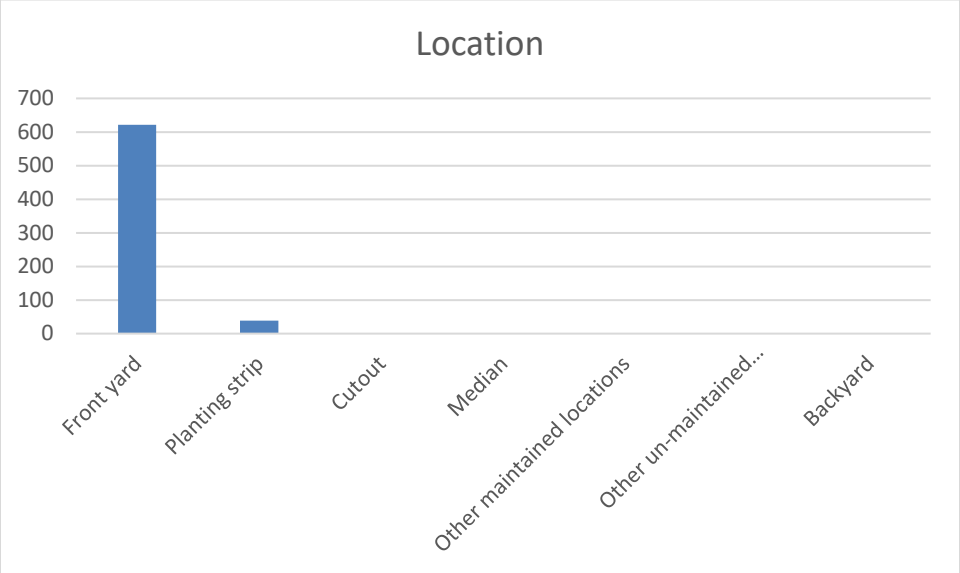

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

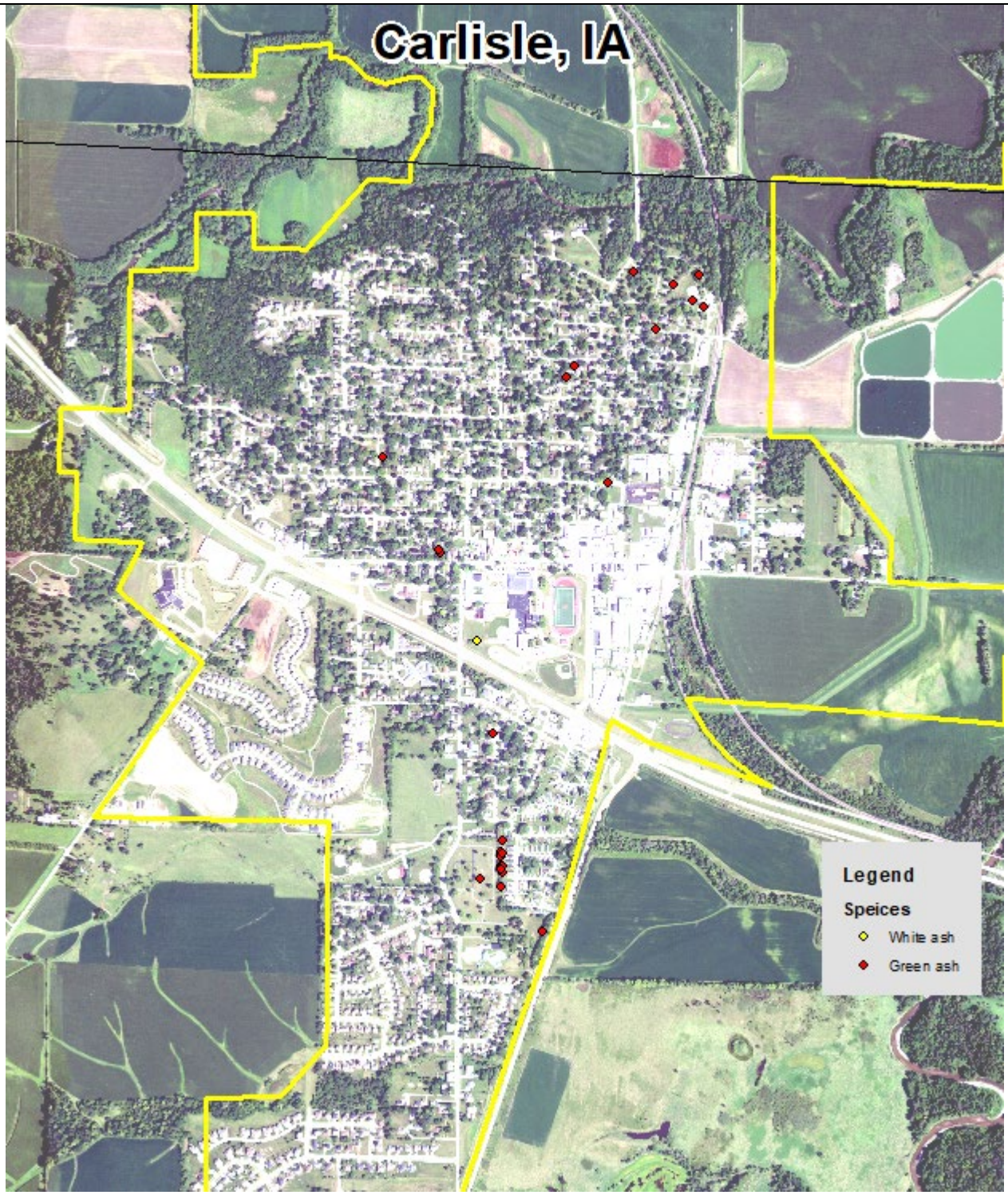

Figure 1: Location of Ash Trees

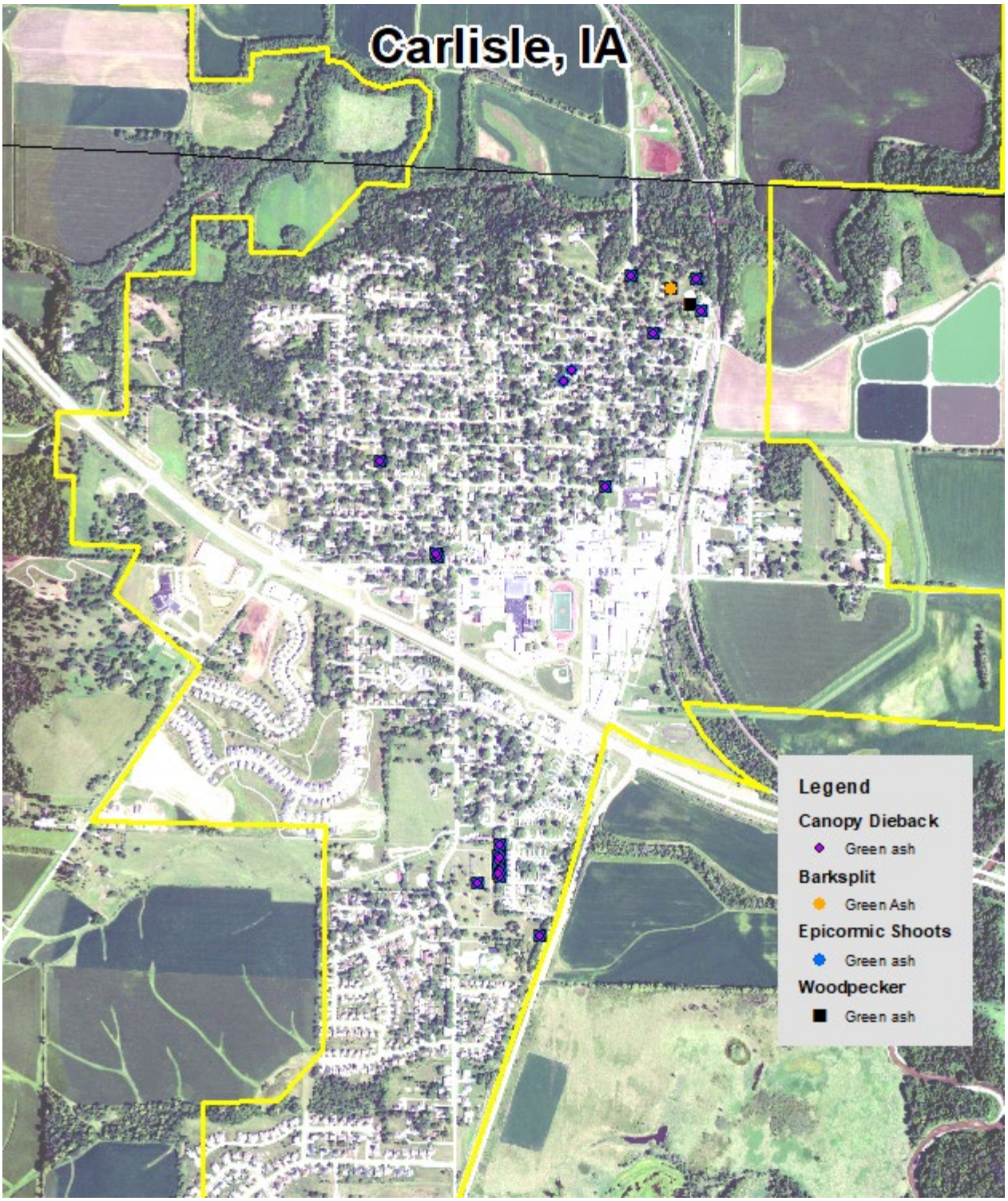

Figure 2: Location of EAB symptoms

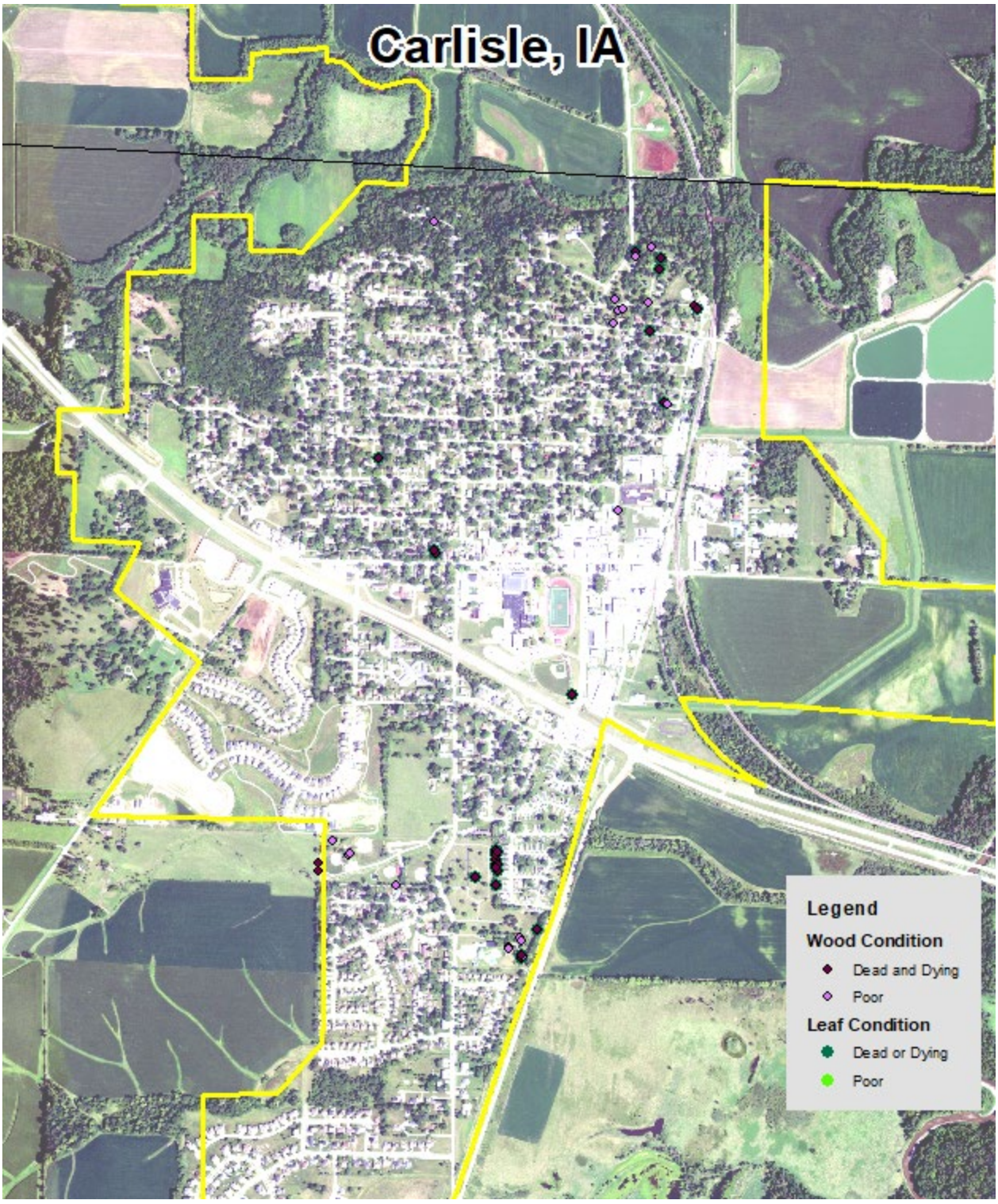

Figure 3: Location of Poor Condition Trees

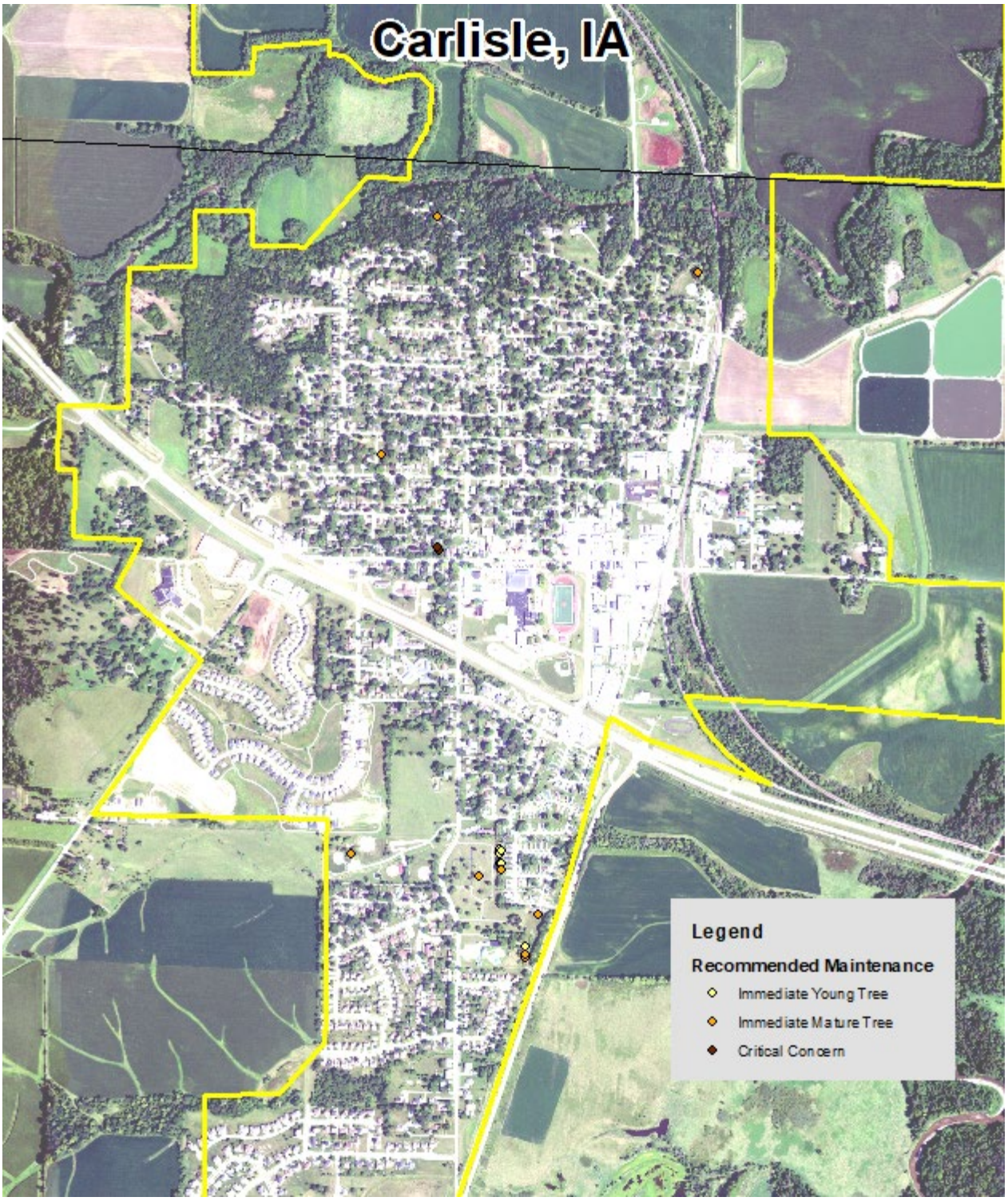

Figure 4: Location of Trees with Recommended Maintenance

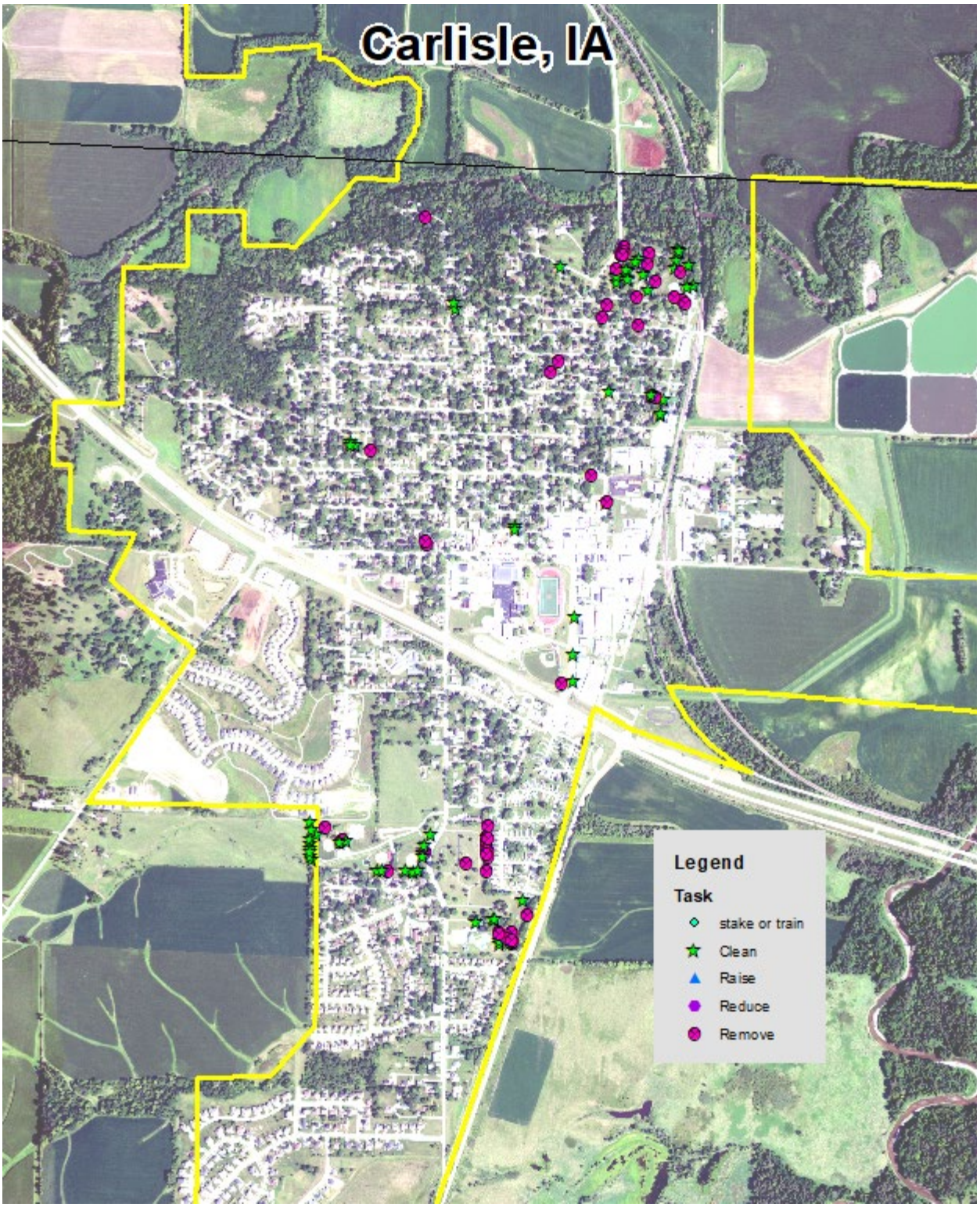

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

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