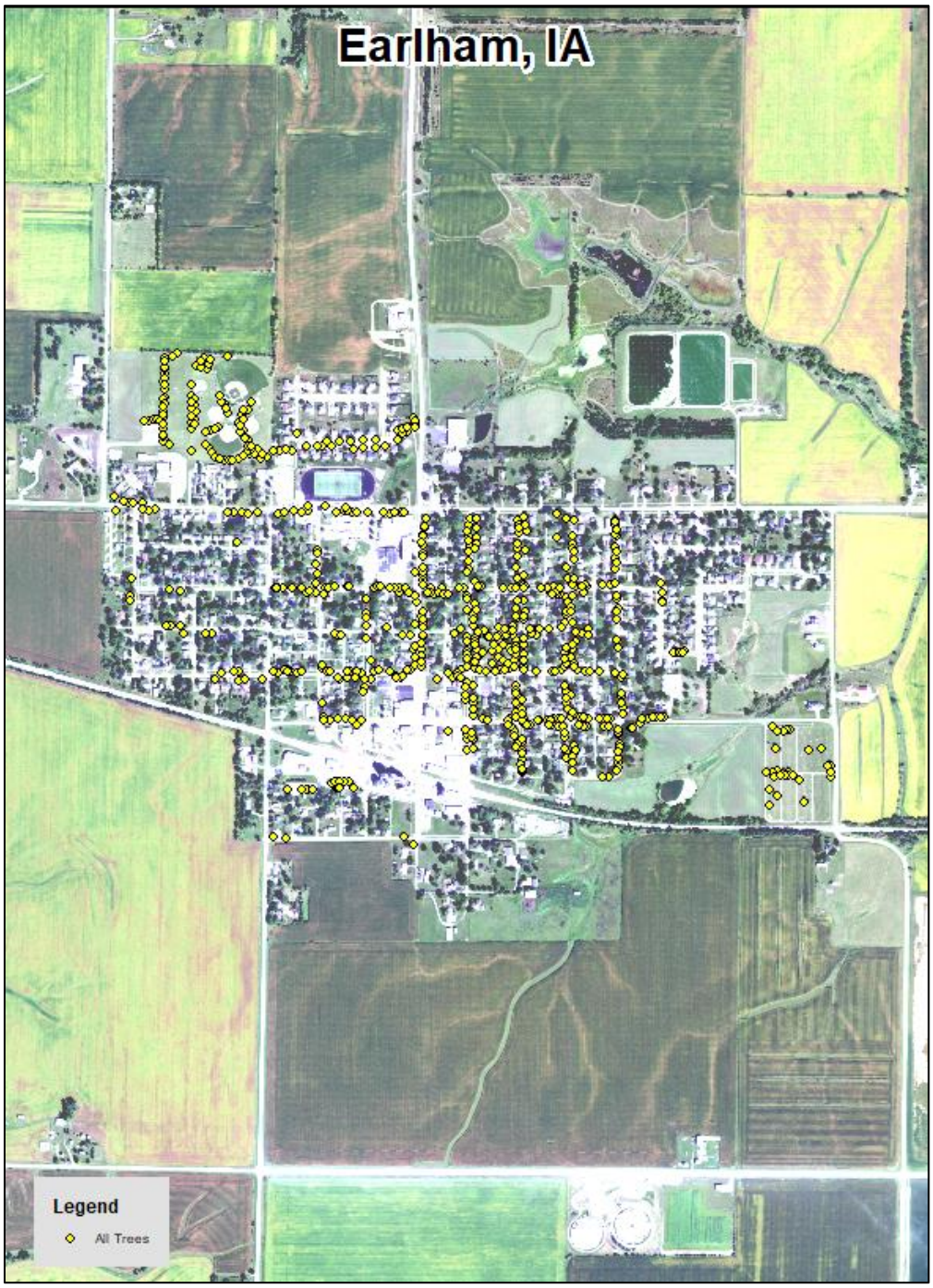
Earlham, IA



2022 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Earlham 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 12% of Earlham'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 706 trees inventoried.

- Earlham's trees provide $99,661 of benefits annually, an average of $141 a tree
- There are over 24 species of trees
- The top three genera are: Maple 36%, Apple 20%, and Ash 12%
- 19% 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, 26 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- 75 of the 86 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- 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 Earlham 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 Earlham, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2021, 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 wood pecker damage.

Inventory Results

The data collected for the 706 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Earlham's trees reduce energy related costs by approximately $29,649 annually (Appendix A, Table 1). These savings are both in Electricity (140.8 MWh) and in Natural Gas (19,351.4 Therms).

Annual Stormwater Benefits

Earlham's trees intercept about 1,394,487 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $37,791 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 Earlham, it is estimated that trees remove 1,826.1 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 $5,136 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Earlham, trees sequester about 465,342 lbs of carbon a year with an associated value of $3,490 (Appendix A, Table 5). In addition, the trees store 4,856,850 lbs of carbon, with a yearly benefit of $36,426 (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. Earlham receives $23,595 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, Earlham's trees provide $99,661 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 706 trees in Earlham provide approximately $141 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Earlham has over 24 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	257	36%
Apple	143	20%
Ash	86	12%
Oak	88	12%
Hackberry	24	3%
Pine	17	2%
Spruce	17	2%
Pear	9	1%
Locust	4	<1%
Walnut	4	<1%
Ginkgo	4	<1%
Aspen	4	<1%
Linden/Basswood	3	<1%
Sycamore	2	<1%
Cottonwood	2	<1%
Eastern Red Cedar	2	<1%
Redbud	2	<1%
Japanese tree lilac	2	<1%
Kentucky coffeetree	2	<1%
Black cherry	1	<1%
Black Poplar	1	<1%
Flowering dogwood	1	<1%
Tulip tree	1	<1%
Broadleaf Deciduous	8	1%
Conifer Evergreen	11	2%

Age Class

Most of Earlham's trees (41%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Earlham'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 Earlham indicate that 78% of the trees are in good health, with only 17% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 72% of Earlham'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 11% of the population. This 19% 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).

Tree Removal	56	8%
Crown Cleaning	37	5%
Crown Reduction	34	5%
Crown Raising	4	<1%
Pest / Disease Treatment	4	<1%

Canopy Cover

The total canopy with both private and public trees is 619 acres. The canopy cover on city own properties included in the Earlham inventory includes approximately 89 acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 1%, in 30 years on all lands. To achieve this goal it is estimated that 15 trees need to be planted annually on public and/or private lands.

Land Use and Location

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

Land Use	
Single family residential	73%
Park/vacant/other	25%
Industrial/Large commercial	<1%
Small commercial	<1%
Multifamily residential	<1%

Location	
Planting strip	70%
Front yard	30%

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

Earlham has 19 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 13 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 192 trees with these needs.

Poor tree species

After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 19 removals, 12 are ash trees. There are a total of 86 ash trees, and 65 of those have signs and symptoms that have been associated with EAB. In addition, there are 32 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 Earlham.

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 maple (36%) (Appendix A, Figure 1). Maples 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.

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 wood pecker damage.

Budget and Emerald Ash Borer Plan

Six Year Maintenance Plan with <u>No Additional Funding</u>
Current Budget $4,167 /year, Total $25,000 over 6 years

FY 2022
Removal: 4 largest critical concern trees, $3,200
Planting and Replacement: 9 trees to be planted in open locations, $900
Visual Survey for signs and symptoms of EAB

FY 2023
Removal: 4 largest critical concern trees, $3,200
Planting and Replacement: 5 trees to be planted in open locations, $500
Young Tree Pruning & Maintenance: $400
Visual Survey for signs and symptoms of EAB

FY 2024
Removal: 4 largest critical concern trees, $3,200
Planting and Replacement: 5 trees to be planted in open locations, $500
Young Tree Pruning & Maintenance: $400
Visual Survey for signs and symptoms of EAB

FY 2025
Removal: 4 largest critical concern trees, $3,200
Planting and Replacement: 5 trees to be planted in open locations, $500
Young Tree Pruning & Maintenance: $400
Visual Survey for signs and symptoms of EAB

FY 2026
Removal: 4 largest critical concern trees, $3,200
Planting and Replacement: 5 trees to be planted in open locations, $500
Young Tree Pruning & Maintenance: $400
Visual Survey for signs and symptoms of EAB

FY 2027

Removal: 4 largest critical concern trees, $3,200
Planting and Replacement: 5 trees to be planted in open locations, $500
Young Tree Pruning & Maintenance: $400
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: Approximately 65 ash trees removed (approximately 75% of ash). It will take approximately 16 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 to 15 years of its arrival.
**To remove all ash trees within 6 years, the budget would need to be increased to $12,834 a year.

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 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. 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 wood pecker damage.

Proposed Budget Increase

EAB could potentially kill all ash trees in Earlham within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $30,213 per year. Additionally, it is recommended that Earlham 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.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For instance, in this treatment scenario, the average ash diameter is 20 inches and at $15 per inch, about 4 trees could be treated per year (every other year treatment) would be $1,200. This would be 11 trees selected for treatment, and Earlham would still need to find $10,000 per year for removal. Alternatively, if there are 11 treatable trees, it would cost approximately $2,970 a year for treatment. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Earlham. It is suggested to consider increasing the budget to plan for this.

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. City 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, DJ and JF 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

Earlham

Annual Energy Benefits of Public Trees

4/4/2022

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	15.3	1,164	2,358.6	2,311	3,476	(N/A)	20.3	11.7	24.30
Black maple	31.3	2,376	4,357.6	4,270	6,646	(N/A)	16.2	22.4	58.30
Green ash	18.5	1,406	2,478.3	2,429	3,835	(N/A)	9.2	12.9	58.99
Silver maple	13.5	1,025	1,786.4	1,751	2,775	(N/A)	6.1	9.4	64.54
Red maple	5.9	448	756.5	741	1,189	(N/A)	5.0	4.0	33.97
Northern red oak	3.7	281	507.9	498	779	(N/A)	4.4	2.6	25.11
Norway maple	7.9	599	1,145.6	1,123	1,721	(N/A)	4.4	5.8	55.52
Sugar maple	4.5	342	607.3	595	937	(N/A)	3.8	3.2	34.71
Northern hackberry	10.1	768	1,382.9	1,355	2,123	(N/A)	3.4	7.2	88.47
White ash	5.0	379	559.8	549	928	(N/A)	2.8	3.1	46.40
Bur oak	2.5	189	326.7	320	509	(N/A)	2.4	1.7	29.97
Austrian pine	2.3	175	309.4	303	478	(N/A)	2.3	1.6	29.86
Swamp white oak	1.5	112	195.9	192	304	(N/A)	1.7	1.0	25.34
Oak	0.3	20	32.1	31	51	(N/A)	1.7	0.2	4.29
Conifer Evergreen Large	1.6	122	212.3	208	330	(N/A)	1.6	1.1	30.01
Northern pin oak	1.7	129	254.7	250	379	(N/A)	1.1	1.3	47.33
Elm	0.5	41	72.6	71	112	(N/A)	1.0	0.4	15.97
Spruce	0.6	46	80.8	79	125	(N/A)	1.0	0.4	17.83
Broadleaf Deciduous Large	0.3	22	43.0	42	65	(N/A)	1.0	0.2	9.22
Blue spruce	1.0	72	123.0	121	193	(N/A)	1.0	0.7	27.55
Pin oak	2.0	151	263.6	258	409	(N/A)	1.0	1.4	58.46
Callery pear	1.1	81	144.9	142	223	(N/A)	0.7	0.8	44.70
Amur maple	0.8	60	116.4	114	174	(N/A)	0.7	0.6	34.79
Pear	0.7	51	107.7	106	157	(N/A)	0.6	0.5	39.15
Ginkgo	0.6	44	66.7	65	109	(N/A)	0.6	0.4	27.27
Black walnut	0.9	69	128.0	125	194	(N/A)	0.6	0.7	48.55
Quaking aspen	1.1	84	154.7	152	236	(N/A)	0.6	0.8	58.90
Eastern red cedar	0.2	17	32.9	32	49	(N/A)	0.3	0.2	24.57
Japanese tree lilac	0.1	7	16.6	16	24	(N/A)	0.3	0.1	11.80
Black locust	0.5	36	59.0	58	94	(N/A)	0.3	0.3	46.78
American elm	0.3	25	39.2	38	64	(N/A)	0.3	0.2	31.77
Eastern redbud	0.3	21	44.5	44	64	(N/A)	0.3	0.2	32.17
Maple	0.4	28	46.6	46	74	(N/A)	0.3	0.2	36.76
Siberian elm	0.3	20	38.4	38	58	(N/A)	0.3	0.2	29.02
Eastern cottonwood	0.8	62	110.0	108	170	(N/A)	0.3	0.6	84.77
Norway spruce	0.4	28	49.2	48	76	(N/A)	0.3	0.3	38.17
Kentucky coffeetree	0.0	0	0.9	1	1	(N/A)	0.3	0.0	0.66
Littleleaf linden	0.2	15	24.4	24	39	(N/A)	0.3	0.1	19.64
Honeylocust	0.4	28	48.6	48	76	(N/A)	0.3	0.3	37.98
American sycamore	0.4	32	60.6	59	92	(N/A)	0.3	0.3	45.77
Black ash	0.0	3	6.2	6	9	(N/A)	0.1	0.0	8.99
Flowering dogwood	0.0	0	0.6	1	1	(N/A)	0.1	0.0	0.87
Black cherry	0.1	6	12.8	13	18	(N/A)	0.1	0.1	18.19
Scotch pine	0.2	14	24.6	24	38	(N/A)	0.1	0.1	38.17
Black spruce	0.1	11	19.5	19	30	(N/A)	0.1	0.1	29.65
Tulip tree	0.4	29	53.7	53	82	(N/A)	0.1	0.3	82.02
American basswood	0.4	27	51.4	50	77	(N/A)	0.1	0.3	77.27
White oak	0.0	0	0.5	0	1	(N/A)	0.1	0.0	0.66
Black poplar	0.3	20	38.1	37	57	(N/A)	0.1	0.2	57.32
Broadleaf Deciduous Mediu	0.0	0	0.0	0	0	(N/A)	0.0	0.0	0.00
Total	140.8	10,685	19,351.4	18,964	29,649	(N/A)	100.0	100.0	42.06

Table 2: Annual Stormwater Benefits

Earlham

Annual Stormwater Benefits of Public Trees

4/4/2022

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	62,370	1,690	(N/A)	20.3	4.5	11.82
Black maple	308,701	8,366	(N/A)	16.2	22.1	73.38
Green ash	200,555	5,435	(N/A)	9.2	14.4	83.62
Silver maple	195,293	5,292	(N/A)	6.1	14.0	123.08
Red maple	39,005	1,057	(N/A)	5.0	2.8	30.20
Northern red oak	29,460	798	(N/A)	4.4	2.1	25.75
Norway maple	76,425	2,071	(N/A)	4.4	5.5	66.81
Sugar maple	37,355	1,012	(N/A)	3.8	2.7	37.49
Northern hackberry	115,517	3,131	(N/A)	3.4	8.3	130.44
White ash	40,446	1,096	(N/A)	2.8	2.9	54.80
Bur oak	24,873	674	(N/A)	2.4	1.8	39.65
Austrian pine	36,219	982	(N/A)	2.3	2.6	61.35
Swamp white oak	8,579	233	(N/A)	1.7	0.6	19.38
Oak	1,662	45	(N/A)	1.7	0.1	3.75
Conifer Evergreen Large	34,852	944	(N/A)	1.6	2.5	85.86
Northern pin oak	17,470	473	(N/A)	1.1	1.3	59.18
Elm	6,367	173	(N/A)	1.0	0.5	24.65
Spruce	9,298	252	(N/A)	1.0	0.7	36.00
Broadleaf Deciduous Large	1,895	51	(N/A)	1.0	0.1	7.34
Blue spruce	13,727	372	(N/A)	1.0	1.0	53.14
Pin oak	26,325	713	(N/A)	1.0	1.9	101.91
Callery pear	7,293	198	(N/A)	0.7	0.5	39.53
Amur maple	3,750	102	(N/A)	0.7	0.3	20.32
Pear	3,787	103	(N/A)	0.6	0.3	25.65
Ginkgo	2,455	67	(N/A)	0.6	0.2	16.63
Black walnut	10,649	289	(N/A)	0.6	0.8	72.15
Quaking aspen	14,942	405	(N/A)	0.6	1.1	101.23
Eastern red cedar	3,269	89	(N/A)	0.3	0.2	44.30
Japanese tree lilac	333	9	(N/A)	0.3	0.0	4.51
Black locust	2,818	76	(N/A)	0.3	0.2	38.19
American elm	1,823	49	(N/A)	0.3	0.1	24.70
Eastern redbud	1,439	39	(N/A)	0.3	0.1	19.49
Maple	2,229	60	(N/A)	0.3	0.2	30.21
Siberian elm	2,298	62	(N/A)	0.3	0.2	31.14
Eastern cottonwood	11,182	303	(N/A)	0.3	0.8	151.51
Norway spruce	9,209	250	(N/A)	0.3	0.7	124.79
Kentucky coffeetree	36	1	(N/A)	0.3	0.0	0.48
Littleleaf linden	1,266	34	(N/A)	0.3	0.1	17.16
Honeylocust	4,704	127	(N/A)	0.3	0.3	63.74
American sycamore	4,551	123	(N/A)	0.3	0.3	61.66
Black ash	163	4	(N/A)	0.1	0.0	4.41
Flowering dogwood	7	0	(N/A)	0.1	0.0	0.20
Black cherry	264	7	(N/A)	0.1	0.0	7.17
Scotch pine	4,605	125	(N/A)	0.1	0.3	124.79
Black spruce	2,312	63	(N/A)	0.1	0.2	62.66
Tulip tree	5,491	149	(N/A)	0.1	0.4	148.79
American basswood	4,609	125	(N/A)	0.1	0.3	124.90
White oak	18	0	(N/A)	0.1	0.0	0.48

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Black poplar	2,591	70	(N/A)	0.1	0.2	70.21
Broadleaf Deciduous Medium	0	0	(N/A)	0.0	0.0	0.00
Citywide total	1,394,487	37,791	(N/A)	100.0	100.0	53.60

Table 3: Annual Air Quality Benefits

Earlham

Annual Air Quality Benefits of Public Trees

4/4/2022

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
Apple	17.6	2.9	8.5	0.8	94	75.5	10.8	10.3	69.5	465	-0.1	0	195.9	559	(N/A)	20.3	3.91
Black maple	79.9	13.6	36.6	3.5	424	149.9	21.8	20.8	141.8	932	-26.0	-97	441.9	1,259	(N/A)	16.2	11.04
Green ash	25.6	4.1	12.2	1.1	136	87.9	12.8	12.2	83.9	549	0.0	0	240.0	685	(N/A)	9.2	10.54
Silver maple	36.6	6.2	17.8	1.6	197	63.8	9.3	8.9	61.1	399	-20.6	-77	184.8	519	(N/A)	6.1	12.06
Red maple	7.7	1.3	3.8	0.3	42	27.7	4.1	3.9	26.7	174	-2.8	-11	72.7	205	(N/A)	5.0	5.85
Northern red oak	5.5	1.0	2.8	0.2	30	17.6	2.6	2.5	16.8	110	-7.9	-30	41.1	110	(N/A)	4.4	3.56
Norway maple	15.9	2.7	7.8	0.7	86	38.3	5.5	5.3	35.8	237	-3.7	-14	108.3	309	(N/A)	4.4	9.97
Sugar maple	4.1	0.7	2.3	0.2	23	21.4	3.1	3.0	20.4	134	-3.4	-13	51.8	144	(N/A)	3.8	5.32
Northern hackberry	22.2	3.8	10.8	1.0	120	48.4	7.0	6.7	45.9	301	0.0	0	145.8	421	(N/A)	3.4	17.53
White ash	5.4	0.9	2.7	0.2	29	22.7	3.4	3.3	22.6	144	0.0	0	61.2	173	(N/A)	2.8	8.67
Bur oak	2.9	0.5	1.4	0.1	16	11.8	1.7	1.6	11.3	74	0.0	0	31.4	89	(N/A)	2.4	5.25
Austrian pine	5.7	1.1	4.6	0.7	38	10.9	1.6	1.5	10.4	68	-13.8	-52	22.8	54	(N/A)	2.3	3.36
Swamp white oak	1.2	0.2	0.7	0.1	7	7.0	1.0	1.0	6.7	44	-0.3	-1	17.5	49	(N/A)	1.7	4.11
Oak	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)	1.7	0.69
Conifer Evergreen Large	4.2	0.8	3.3	0.5	27	7.6	1.1	1.1	7.3	47	-18.9	-71	7.0	4	(N/A)	1.6	0.35
Northern pin oak	3.7	0.6	1.8	0.2	20	8.3	1.2	1.1	7.7	51	-0.9	-3	23.8	68	(N/A)	1.1	8.51
Elm	0.8	0.1	0.4	0.0	4	2.5	0.4	0.4	2.4	16	0.0	0	7.0	20	(N/A)	1.0	2.88
Spruce	1.0	0.2	0.9	0.1	7	2.9	0.4	0.4	2.7	18	-4.4	-17	4.2	8	(N/A)	1.0	1.16
Broadleaf Deciduous Large	0.1	0.0	0.1	0.0	0	1.4	0.2	0.2	1.3	9	0.0	0	3.3	9	(N/A)	1.0	1.33
Blue spruce	2.0	0.4	1.6	0.2	13	4.5	0.7	0.6	4.3	28	-5.1	-19	9.2	22	(N/A)	1.0	3.13
Pin oak	5.1	0.9	2.6	0.2	28	9.4	1.4	1.3	9.0	59	-9.3	-35	20.6	52	(N/A)	1.0	7.38
Callery pear	1.2	0.2	0.6	0.1	7	5.1	0.7	0.7	4.9	32	-0.3	-1	13.2	37	(N/A)	0.7	7.48
Amur maple	1.3	0.2	0.6	0.1	7	3.8	0.6	0.5	3.6	24	0.0	0	10.6	31	(N/A)	0.7	6.10
Pear	1.3	0.2	0.6	0.1	7	3.3	0.5	0.5	3.0	21	0.0	0	9.6	28	(N/A)	0.6	6.90
Ginkgo	0.4	0.1	0.2	0.0	2	2.6	0.4	0.4	2.6	17	-0.2	-1	6.6	18	(N/A)	0.6	4.61
Black walnut	1.3	0.2	0.6	0.1	7	4.4	0.6	0.6	4.1	27	0.0	0	11.9	34	(N/A)	0.6	8.54
Quaking aspen	2.1	0.3	0.9	0.1	11	5.3	0.8	0.7	5.0	33	0.0	0	15.3	44	(N/A)	0.6	11.00
Eastern red cedar	0.7	0.1	0.5	0.1	4	1.1	0.2	0.1	1.0	7	-1.8	-7	2.0	4	(N/A)	0.3	2.19
Japanese tree lilac	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3	(N/A)	0.3	1.63
Black locust	0.4	0.1	0.2	0.0	2	2.2	0.3	0.3	2.1	14	-0.1	0	5.6	16	(N/A)	0.3	7.92
American elm	0.1	0.0	0.1	0.0	1	1.5	0.2	0.2	1.5	10	0.0	0	3.7	10	(N/A)	0.3	5.11
Eastern redbud	0.5	0.1	0.2	0.0	3	1.4	0.2	0.2	1.2	8	0.0	0	3.8	11	(N/A)	0.3	5.45
Maple	0.4	0.1	0.2	0.0	2	1.7	0.3	0.2	1.7	11	-0.2	-1	4.4	12	(N/A)	0.3	6.20
Siberian elm	0.3	0.0	0.1	0.0	2	1.3	0.2	0.2	1.2	8	0.0	0	3.4	10	(N/A)	0.3	4.78
Eastern cottonwood	2.1	0.3	0.9	0.1	11	3.9	0.6	0.5	3.7	24	0.0	0	12.1	35	(N/A)	0.3	17.51
Norway spruce	1.1	0.2	0.9	0.1	7	1.8	0.3	0.2	1.7	11	-5.7	-21	0.6	-3	(N/A)	0.3	-1.58
Kentucky coffeetree	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	0.08
Littleleaf linden	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	-0.1	0	2.3	6	(N/A)	0.3	3.25
Honeylocust	0.9	0.2	0.4	0.0	5	1.8	0.3	0.2	1.7	11	-0.8	-3	4.7	13	(N/A)	0.3	6.54
American sycamore	0.5	0.1	0.3	0.0	3	2.0	0.3	0.3	1.9	13	0.0	0	5.4	15	(N/A)	0.3	7.73
Black ash	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1	(N/A)	0.1	1.21
Flowering dogwood	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	(N/A)	0.1	0.11
Black cherry	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	0.1	2.55
Scotch pine	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)	0.1	-1.58
Black spruce	0.4	0.1	0.3	0.0	2	0.7	0.1	0.1	0.6	4	-0.9	-3	1.3	3	(N/A)	0.1	3.10
Tulip tree	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16	(N/A)	0.1	15.71
American basswood	0.7	0.1	0.3	0.0	4	1.7	0.2	0.2	1.6	11	-0.6	-2	4.4	12	(N/A)	0.1	12.18
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)	0.1	0.08
Black poplar	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.3	9	(N/A)	0.1	9.34
Broadleaf Deciduous Medium	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	(N/A)	0.0	0.00
Citywide total	265.1	45.2	132.0	13.0	1,438	672.4	97.9	93.3	637.8	4,188	-130.7	-490	1,826.1	5,136	(N/A)	100.0	7.28

Table 4: Annual Carbon Stored

Earlham

Stored CO2 Benefits of Public Trees

4/4/2022

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	283,093	2,123	(N/A)	20.3	5.8	14.85
Black maple	849,609	6,372	(N/A)	16.2	17.5	55.90
Green ash	843,373	6,325	(N/A)	9.2	17.4	97.31
Silver maple	959,779	7,198	(N/A)	6.1	19.8	167.40
Red maple	88,488	664	(N/A)	5.0	1.8	18.96
Northern red oak	113,314	850	(N/A)	4.4	2.3	27.41
Norway maple	261,598	1,962	(N/A)	4.4	5.4	63.29
Sugar maple	116,469	874	(N/A)	3.8	2.4	32.35
Northern hackberry	363,410	2,726	(N/A)	3.4	7.5	113.57
White ash	104,793	786	(N/A)	2.8	2.2	39.30
Bur oak	96,728	725	(N/A)	2.4	2.0	42.67
Austrian pine	46,026	345	(N/A)	2.3	0.9	21.57
Swamp white oak	20,810	156	(N/A)	1.7	0.4	13.01
Oak	3,806	29	(N/A)	1.7	0.1	2.38
Conifer Evergreen La	47,848	359	(N/A)	1.6	1.0	32.62
Northern pin oak	60,375	453	(N/A)	1.1	1.2	56.60
Elm	26,883	202	(N/A)	1.0	0.6	28.80
Spruce	10,420	78	(N/A)	1.0	0.2	11.16
Broadleaf Deciduous	3,152	24	(N/A)	1.0	0.1	3.38
Blue spruce	14,689	110	(N/A)	1.0	0.3	15.74
Pin oak	140,399	1,053	(N/A)	1.0	2.9	150.43
Callery pear	19,918	149	(N/A)	0.7	0.4	29.88
Amur maple	19,738	148	(N/A)	0.7	0.4	29.61
Pear	21,136	159	(N/A)	0.6	0.4	39.63
Ginkgo	5,835	44	(N/A)	0.6	0.1	10.94
Black walnut	43,785	328	(N/A)	0.6	0.9	82.10
Quaking aspen	67,671	508	(N/A)	0.6	1.4	126.88
Eastern red cedar	2,204	17	(N/A)	0.3	0.0	8.27
Japanese tree lilac	1,086	8	(N/A)	0.3	0.0	4.07
Black locust	7,248	54	(N/A)	0.3	0.1	27.18
American elm	3,945	30	(N/A)	0.3	0.1	14.79
Eastern redbud	7,651	57	(N/A)	0.3	0.2	28.69
Maple	4,725	35	(N/A)	0.3	0.1	17.72
Siberian elm	6,756	51	(N/A)	0.3	0.1	25.34
Eastern cottonwood	71,755	538	(N/A)	0.3	1.5	269.08
Norway spruce	14,981	112	(N/A)	0.3	0.3	56.18
Kentucky coffeetree	24	0	(N/A)	0.3	0.0	0.09
Littleleaf linden	3,608	27	(N/A)	0.3	0.1	13.53
Honeylocust	12,259	92	(N/A)	0.3	0.3	45.97
American sycamore	16,807	126	(N/A)	0.3	0.3	63.03
Black ash	218	2	(N/A)	0.1	0.0	1.64
Flowering dogwood	14	0	(N/A)	0.1	0.0	0.10
Black cherry	908	7	(N/A)	0.1	0.0	6.81
Scotch pine	7,490	56	(N/A)	0.1	0.2	56.18
Black spruce	2,661	20	(N/A)	0.1	0.1	19.96
Tulip tree	25,943	195	(N/A)	0.1	0.5	194.57
American basswood	24,952	187	(N/A)	0.1	0.5	187.14
White oak	12	0	(N/A)	0.1	0.0	0.09
Black poplar	8,458	63	(N/A)	0.1	0.2	63.43
Broadleaf Deciduous	0	0	(N/A)	0.0	0.0	0.00
Citywide total	4,856,850	36,426	(N/A)	100.0	100.0	51.67

Table 5: Annual Carbon Sequestered

Earlham

Annual CO Benefits of Public Trees

4/4/2022

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
Apple	24,434	183	-1,359	-208	-12	25,726	193	48,593	364 (N/A)	20.3	10.4	2.55
Black maple	18,842	141	-4,078	-298	-33	52,502	394	66,968	502 (N/A)	16.2	14.4	4.41
Green ash	41,812	314	-4,048	-190	-32	31,067	233	68,640	515 (N/A)	9.2	14.8	7.92
Silver maple	63,639	477	-4,608	-158	-36	22,643	170	81,516	611 (N/A)	6.1	17.5	14.22
Red maple	11,643	87	-425	-52	-4	9,891	74	21,057	158 (N/A)	5.0	4.5	4.51
Northern red oak	5,100	38	-544	-46	-4	6,207	47	10,717	80 (N/A)	4.4	2.3	2.59
Norway maple	10,652	80	-1,256	-84	-10	13,229	99	22,543	169 (N/A)	4.4	4.8	5.45
Sugar maple	8,282	62	-561	-47	-5	7,561	57	15,234	114 (N/A)	3.8	3.3	4.23
Northern hackberry	13,650	102	-1,744	-101	-14	16,974	127	28,779	216 (N/A)	3.4	6.2	8.99
White ash	7,328	55	-503	-41	-4	8,384	63	15,167	114 (N/A)	2.8	3.3	5.69
Bur oak	5,511	41	-465	-27	-4	4,183	31	9,203	69 (N/A)	2.4	2.0	4.06
Austrian pine	2,090	16	-221	-44	-2	3,859	29	5,684	43 (N/A)	2.3	1.2	2.66
Swamp white oak	2,585	19	-101	-14	-1	2,477	19	4,947	37 (N/A)	1.7	1.1	3.09
Oak	474	4	-19	-4	0	441	3	892	7 (N/A)	1.7	0.2	0.56
Conifer Evergreen Large	1,056	8	-230	-35	-2	2,698	20	3,489	26 (N/A)	1.6	0.7	2.38
Northern pin oak	2,261	17	-290	-19	-2	2,852	21	4,803	36 (N/A)	1.1	1.0	4.50
Elm	1,333	10	-129	-7	-1	898	7	2,094	16 (N/A)	1.0	0.5	2.24
Spruce	628	5	-50	-11	0	1,008	8	1,576	12 (N/A)	1.0	0.3	1.69
Broadleaf Deciduous Large	637	5	-15	-4	0	494	4	1,111	8 (N/A)	1.0	0.2	1.19
Blue spruce	845	6	-71	-17	-1	1,596	12	2,355	18 (N/A)	1.0	0.5	2.52
Pin oak	11,727	88	-674	-23	-5	3,336	25	14,366	108 (N/A)	1.0	3.1	15.39
Callery pear	1,852	14	-96	-10	-1	1,801	14	3,547	27 (N/A)	0.7	0.8	5.32
Amur maple	1,052	8	-95	-11	-1	1,324	10	2,270	17 (N/A)	0.7	0.5	3.40
Pear	114	1	-101	-12	-1	1,128	8	1,129	8 (N/A)	0.6	0.2	2.12
Ginkgo	460	3	-28	-7	0	967	7	1,392	10 (N/A)	0.6	0.3	2.61
Black walnut	2,234	17	-210	-10	-2	1,520	11	3,534	27 (N/A)	0.6	0.8	6.63
Quaking aspen	2,779	21	-325	-12	-3	1,857	14	4,298	32 (N/A)	0.6	0.9	8.06
Eastern red cedar	0	0	-11	-4	0	374	3	359	3 (N/A)	0.3	0.1	1.35
Japanese tree lilac	152	1	-5	-2	0	161	1	306	2 (N/A)	0.3	0.1	1.15
Black locust	772	6	-35	-4	0	790	6	1,523	11 (N/A)	0.3	0.3	5.71
American elm	332	2	-19	-3	0	555	4	865	6 (N/A)	0.3	0.2	3.24

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
Eastern redbud	114	1	-37	-5	0	459	3	531	4 (N/A)	0.3	0.1	1.99
Maple	648	5	-23	-3	0	616	5	1,239	9 (N/A)	0.3	0.3	4.65
Siberian elm	500	4	-32	-3	0	451	3	916	7 (N/A)	0.3	0.2	3.43
Eastern cottonwood	1,336	10	-344	-9	-3	1,365	10	2,347	18 (N/A)	0.3	0.5	8.80
Norway spruce	512	4	-72	-7	-1	622	5	1,055	8 (N/A)	0.3	0.2	3.96
Kentucky coffeetree	5	0	0	0	0	9	0	13	0 (N/A)	0.3	0.0	0.05
Littleleaf linden	532	4	-17	-2	0	341	3	853	6 (N/A)	0.3	0.2	3.20
Honeylocust	1,496	11	-59	-3	0	626	5	2,060	15 (N/A)	0.3	0.4	7.73
American sycamore	1,066	8	-81	-5	-1	711	5	1,691	13 (N/A)	0.3	0.4	6.34
Black ash	96	1	-2	-1	0	65	0	158	1 (N/A)	0.1	0.0	1.18
Flowering dogwood	9	0	0	0	0	6	0	14	0 (N/A)	0.1	0.0	0.10
Black cherry	114	1	-4	-1	0	124	1	232	2 (N/A)	0.1	0.0	1.74
Scotch pine	256	2	-36	-4	0	311	2	528	4 (N/A)	0.1	0.1	3.96
Black spruce	147	1	-13	-3	0	233	2	364	3 (N/A)	0.1	0.1	2.73
Tulip tree	960	7	-125	-4	-1	650	5	1,481	11 (N/A)	0.1	0.3	11.11
American basswood	1,365	10	-120	-4	-1	594	4	1,835	14 (N/A)	0.1	0.4	13.76
White oak	3	0	0	0	0	4	0	7	0 (N/A)	0.1	0.0	0.05
Black poplar	660	5	-41	-3	0	441	3	1,058	8 (N/A)	0.1	0.2	7.93
Broadleaf Deciduous Medi	0	0	0	0	0	0	0	0	0 (N/A)	0.0	0.0	0.00
Citywide total	254,093	1,906	-23,320	-1,561	-187	236,131	1,771	465,342	3,490 (N/A)	100.0	100.0	4.95

Table 6: Annual Social and Aesthetic Benefits

Earlham

Annual Aesthetic/Other Benefits of Public Trees

4/4/2022

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	1,409	(N/A)	20.3	6.0	9.85
Black maple	2,294	(N/A)	16.2	9.7	20.13
Green ash	3,482	(N/A)	9.2	14.8	53.56
Silver maple	4,688	(N/A)	6.1	19.9	109.02
Red maple	1,630	(N/A)	5.0	6.9	46.56
Northern red oak	457	(N/A)	4.4	1.9	14.75
Norway maple	999	(N/A)	4.4	4.2	32.21
Sugar maple	950	(N/A)	3.8	4.0	35.17
Northern hackberry	1,636	(N/A)	3.4	6.9	68.18
White ash	996	(N/A)	2.8	4.2	49.79
Bur oak	529	(N/A)	2.4	2.2	31.12
Austrian pine	297	(N/A)	2.3	1.3	18.57
Swamp white oak	282	(N/A)	1.7	1.2	23.52
Oak	104	(N/A)	1.7	0.4	8.64
Conifer Evergreen Large	273	(N/A)	1.6	1.2	24.86
Northern pin oak	209	(N/A)	1.1	0.9	26.14
Elm	146	(N/A)	1.0	0.6	20.79
Spruce	135	(N/A)	1.0	0.6	19.34
Broadleaf Deciduous Large	107	(N/A)	1.0	0.5	15.25
Blue spruce	154	(N/A)	1.0	0.7	21.95
Pin oak	843	(N/A)	1.0	3.6	120.49
Callery pear	187	(N/A)	0.7	0.8	37.35
Amur maple	62	(N/A)	0.7	0.3	12.36
Pear	6	(N/A)	0.6	0.0	1.60
Ginkgo	43	(N/A)	0.6	0.2	10.75
Black walnut	189	(N/A)	0.6	0.8	47.33
Quaking aspen	204	(N/A)	0.6	0.9	51.01
Eastern red cedar	0	(N/A)	0.3	0.0	0.00
Japanese tree lilac	8	(N/A)	0.3	0.0	4.23
Black locust	78	(N/A)	0.3	0.3	39.16
American elm	57	(N/A)	0.3	0.2	28.34
Eastern redbud	6	(N/A)	0.3	0.0	3.20
Maple	96	(N/A)	0.3	0.4	47.86
Siberian elm	51	(N/A)	0.3	0.2	25.68
Eastern cottonwood	94	(N/A)	0.3	0.4	47.08
Norway spruce	53	(N/A)	0.3	0.2	26.25
Kentucky coffeetree	11	(N/A)	0.3	0.0	5.26
Littleleaf linden	58	(N/A)	0.3	0.2	28.91
Honeylocust	389	(N/A)	0.3	1.6	194.64
American sycamore	94	(N/A)	0.3	0.4	47.07
Black ash	13	(N/A)	0.1	0.1	12.89
Flowering dogwood	0	(N/A)	0.1	0.0	0.03
Black cherry	6	(N/A)	0.1	0.0	6.40
Scotch pine	26	(N/A)	0.1	0.1	26.25
Black spruce	20	(N/A)	0.1	0.1	19.97
Tulip tree	67	(N/A)	0.1	0.3	66.60
American basswood	94	(N/A)	0.1	0.4	94.13

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
White oak	5	(N/A)	0.1	0.0	5.26
Black poplar	58	(N/A)	0.1	0.2	57.69
Broadleaf Deciduous Medium	0	(N/A)	0.0	0.0	0.00
Citywide total	23,595	(N/A)	100.0	100.0	33.47

Table 7: Summary of Benefits in Dollars

Earlham

Total Annual Benefits of Public Trees by Species ($)

4/4/2022

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Apple	3,476	364	559	1,690	1,409	7,498	(N/A)	7.5
Black maple	6,646	502	1,259	8,366	2,294	19,067	(N/A)	19.1
Green ash	3,835	515	685	5,435	3,482	13,951	(N/A)	14.0
Silver maple	2,775	611	519	5,292	4,688	13,886	(N/A)	13.9
Red maple	1,189	158	205	1,057	1,630	4,238	(N/A)	4.3
Northern red oak	779	80	110	798	457	2,225	(N/A)	2.2
Norway maple	1,721	169	309	2,071	999	5,269	(N/A)	5.3
Sugar maple	937	114	144	1,012	950	3,157	(N/A)	3.2
Northern hackberry	2,123	216	421	3,131	1,636	7,527	(N/A)	7.6
White ash	928	114	173	1,096	996	3,307	(N/A)	3.3
Bur oak	509	69	89	674	529	1,871	(N/A)	1.9
Austrian pine	478	43	54	982	297	1,853	(N/A)	1.9
Swamp white oak	304	37	49	233	282	905	(N/A)	0.9
Oak	51	7	8	45	104	215	(N/A)	0.2
Conifer Evergreen Large	330	26	4	944	273	1,578	(N/A)	1.6
Northern pin oak	379	36	68	473	209	1,165	(N/A)	1.2
Elm	112	16	20	173	146	466	(N/A)	0.5
Spruce	125	12	8	252	135	532	(N/A)	0.5
Broadleaf Deciduous La	65	8	9	51	107	240	(N/A)	0.2
Blue spruce	193	18	22	372	154	758	(N/A)	0.8
Pin oak	409	108	52	713	843	2,125	(N/A)	2.1
Callery pear	223	27	37	198	187	672	(N/A)	0.7
Amur maple	174	17	31	102	62	385	(N/A)	0.4
Pear	157	8	28	103	6	302	(N/A)	0.3
Ginkgo	109	10	18	67	43	248	(N/A)	0.2
Black walnut	194	27	34	289	189	733	(N/A)	0.7
Quaking aspen	236	32	44	405	204	921	(N/A)	0.9
Eastern red cedar	49	3	4	89	0	145	(N/A)	0.1
Japanese tree lilac	24	2	3	9	8	47	(N/A)	0.0
Black locust	94	11	16	76	78	276	(N/A)	0.3
American elm	64	6	10	49	57	186	(N/A)	0.2
Eastern redbud	64	4	11	39	6	125	(N/A)	0.1
Maple	74	9	12	60	96	251	(N/A)	0.3
Siberian elm	58	7	10	62	51	188	(N/A)	0.2
Eastern cottonwood	170	18	35	303	94	619	(N/A)	0.6
Norway spruce	76	8	-3	250	53	383	(N/A)	0.4
Kentucky coffeetree	1	0	0	1	11	13	(N/A)	0.0
Littleleaf linden	39	6	6	34	58	144	(N/A)	0.1
Honeylocust	76	15	13	127	389	621	(N/A)	0.6
American sycamore	92	13	15	123	94	337	(N/A)	0.3
Black ash	9	1	1	4	13	29	(N/A)	0.0
Flowering dogwood	1	0	0	0	0	1	(N/A)	0.0
Black cherry	18	2	3	7	6	36	(N/A)	0.0
Scotch pine	38	4	-2	125	26	192	(N/A)	0.2
Black spruce	30	3	3	63	20	118	(N/A)	0.1
Tulip tree	82	11	16	149	67	324	(N/A)	0.3
American basswood	77	14	12	125	94	322	(N/A)	0.3

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
White oak	1	0	0	0	5	7	(N/A)	0.0
Black poplar	57	8	9	70	58	202	(N/A)	0.2
Broadleaf Deciduous M	0	0	0	0	0	0	(N/A)	0.0
Citywide Total	29,649	3,490	5,136	37,791	23,595	99,661	(N/A)	100.0

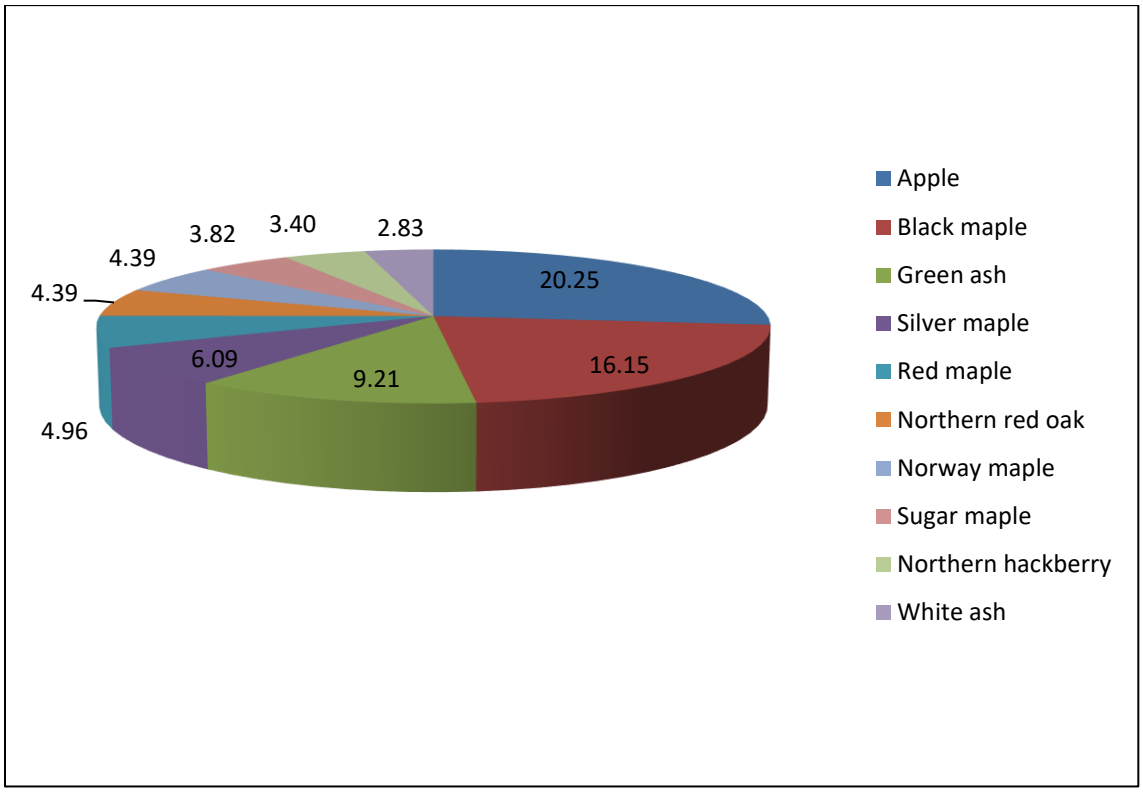

Figure 1: Species Distribution

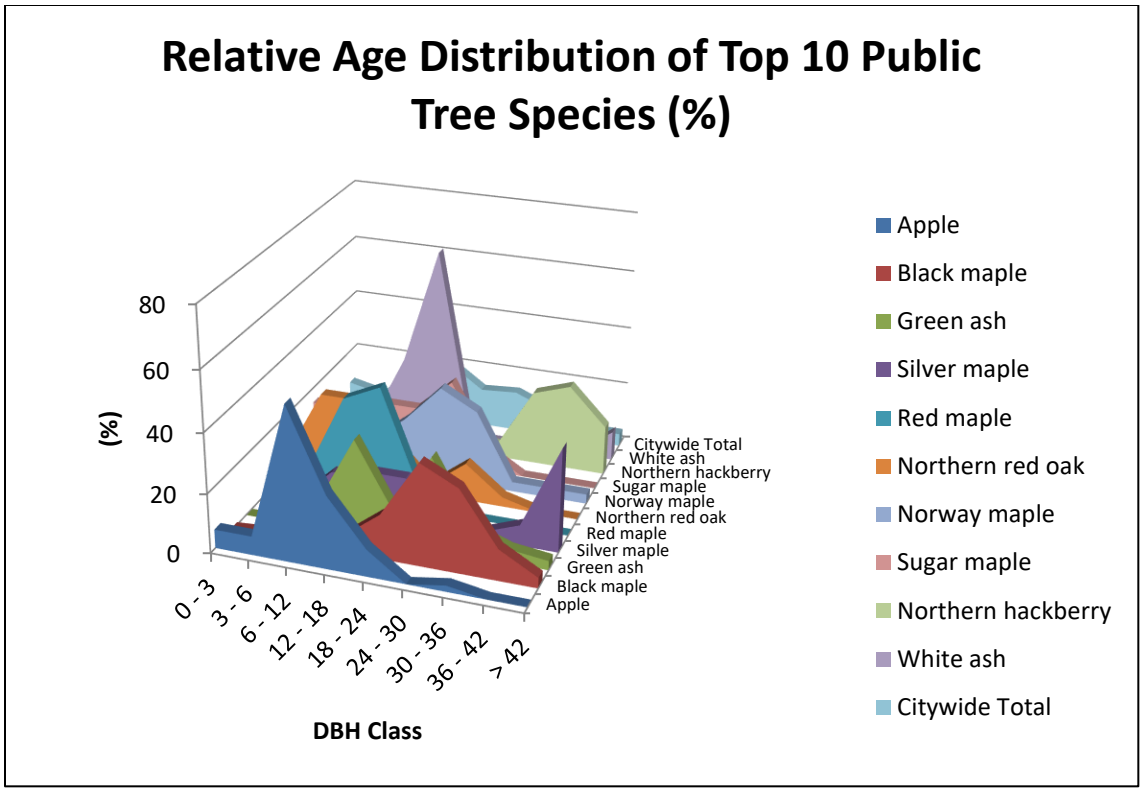

Figure 2: Relative Age Class

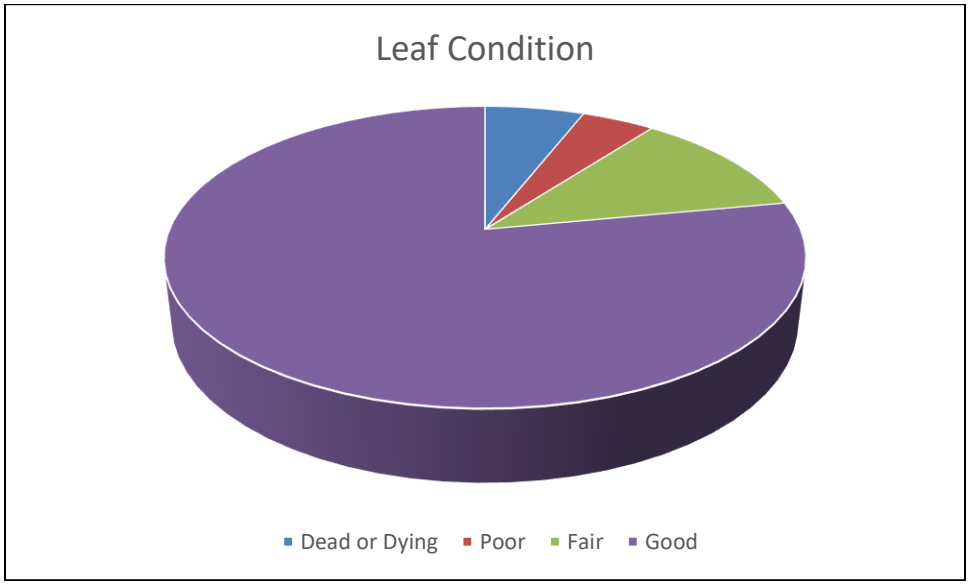

Figure 3: Foliage Condition

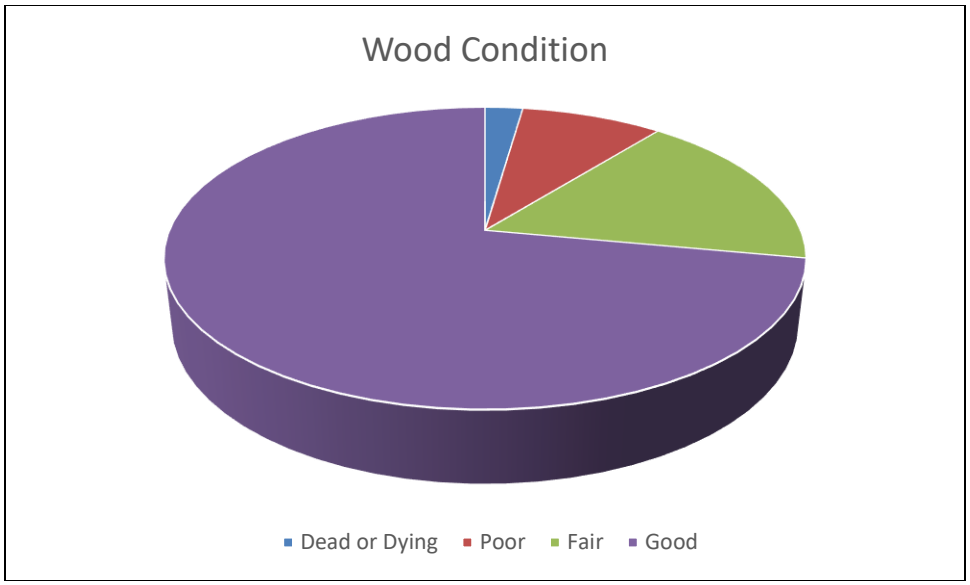

Figure 4: Wood Condition

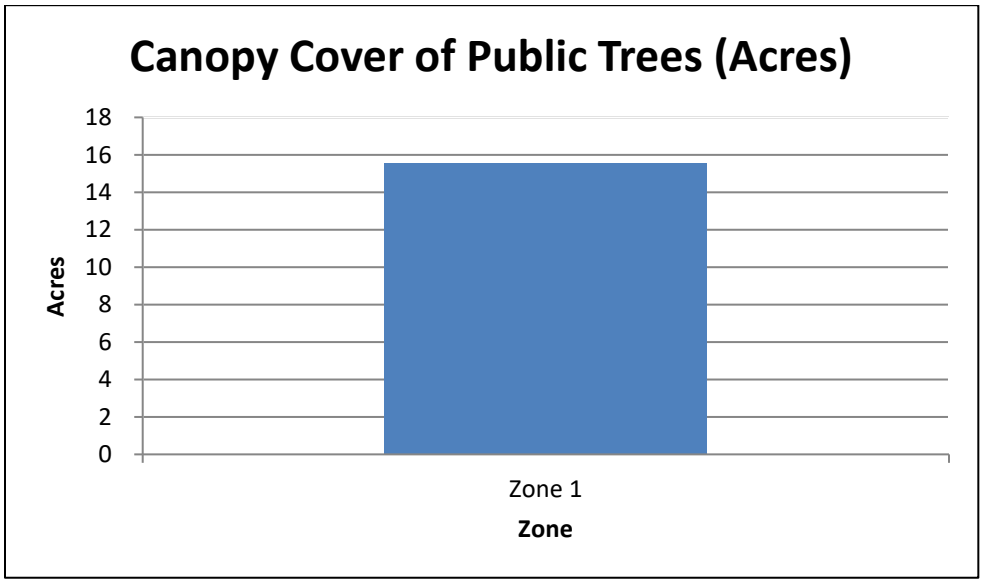

Figure 5: Canopy Cover in Acres

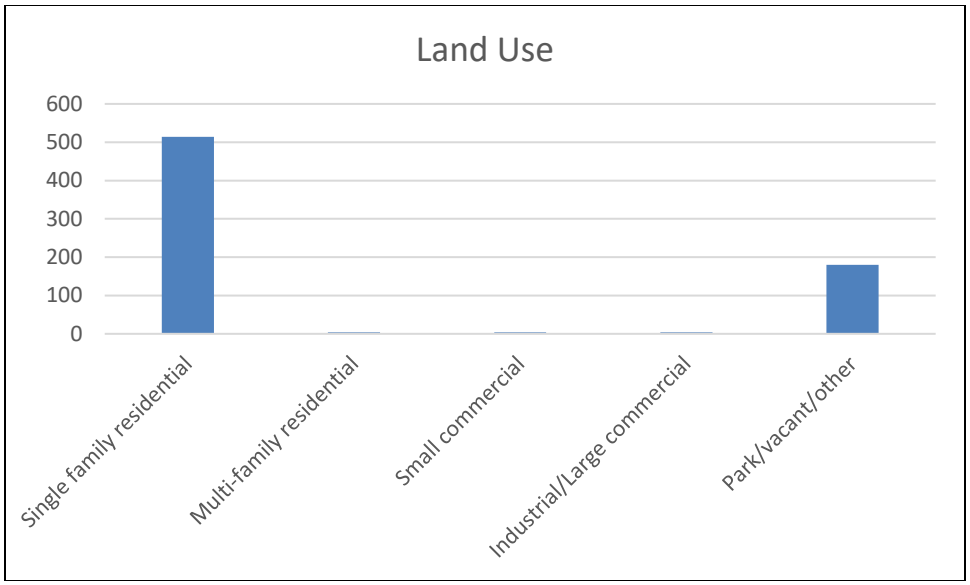

Figure 6: Land Use of city/park trees

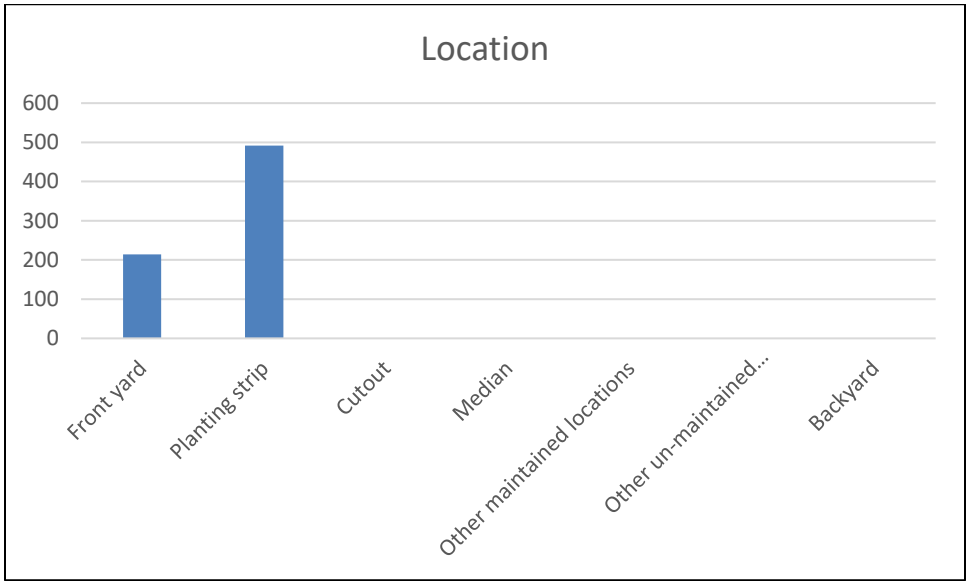

Figure 7: Location of city/park trees

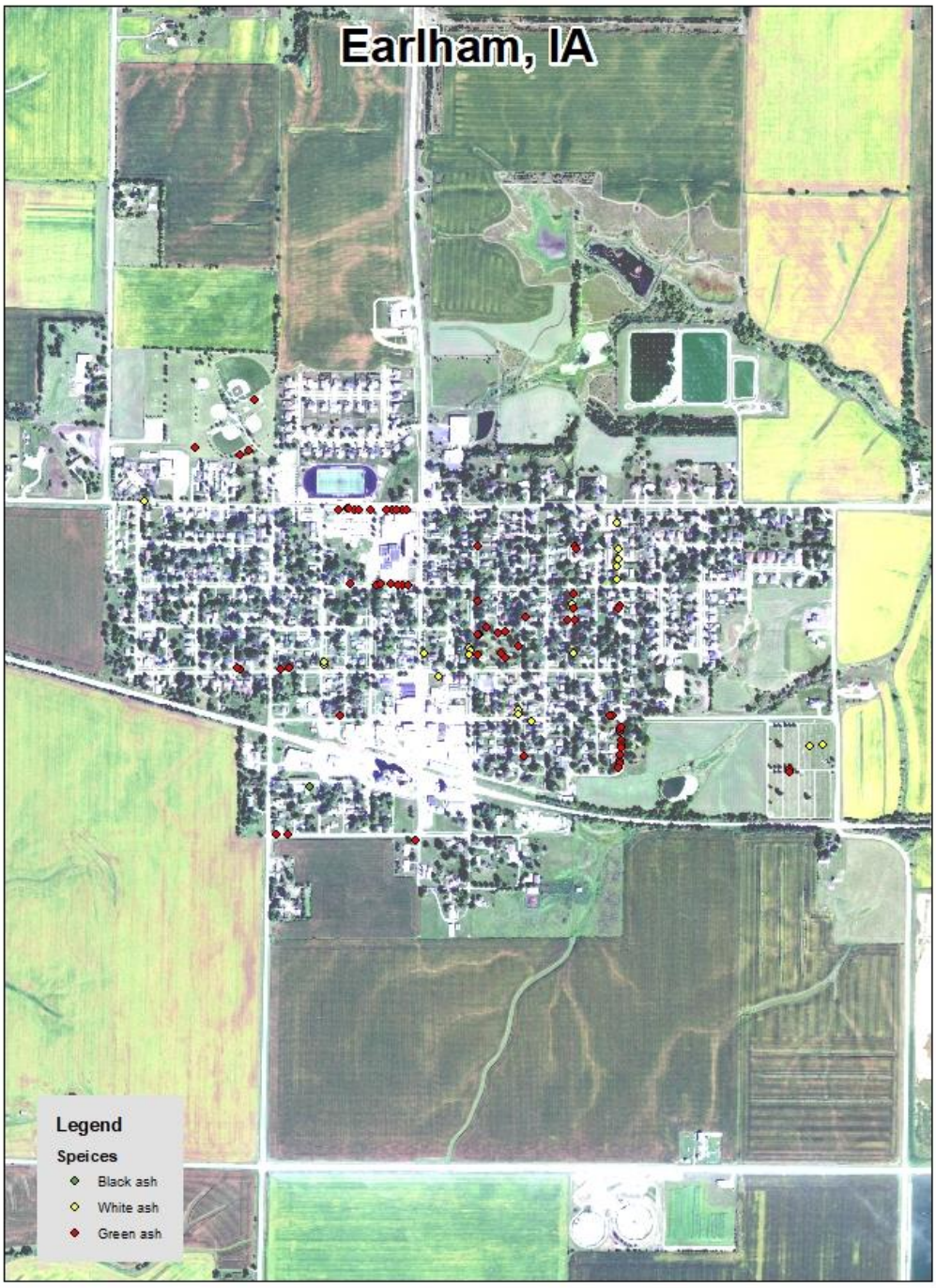

Figure 1: Location of Ash Trees

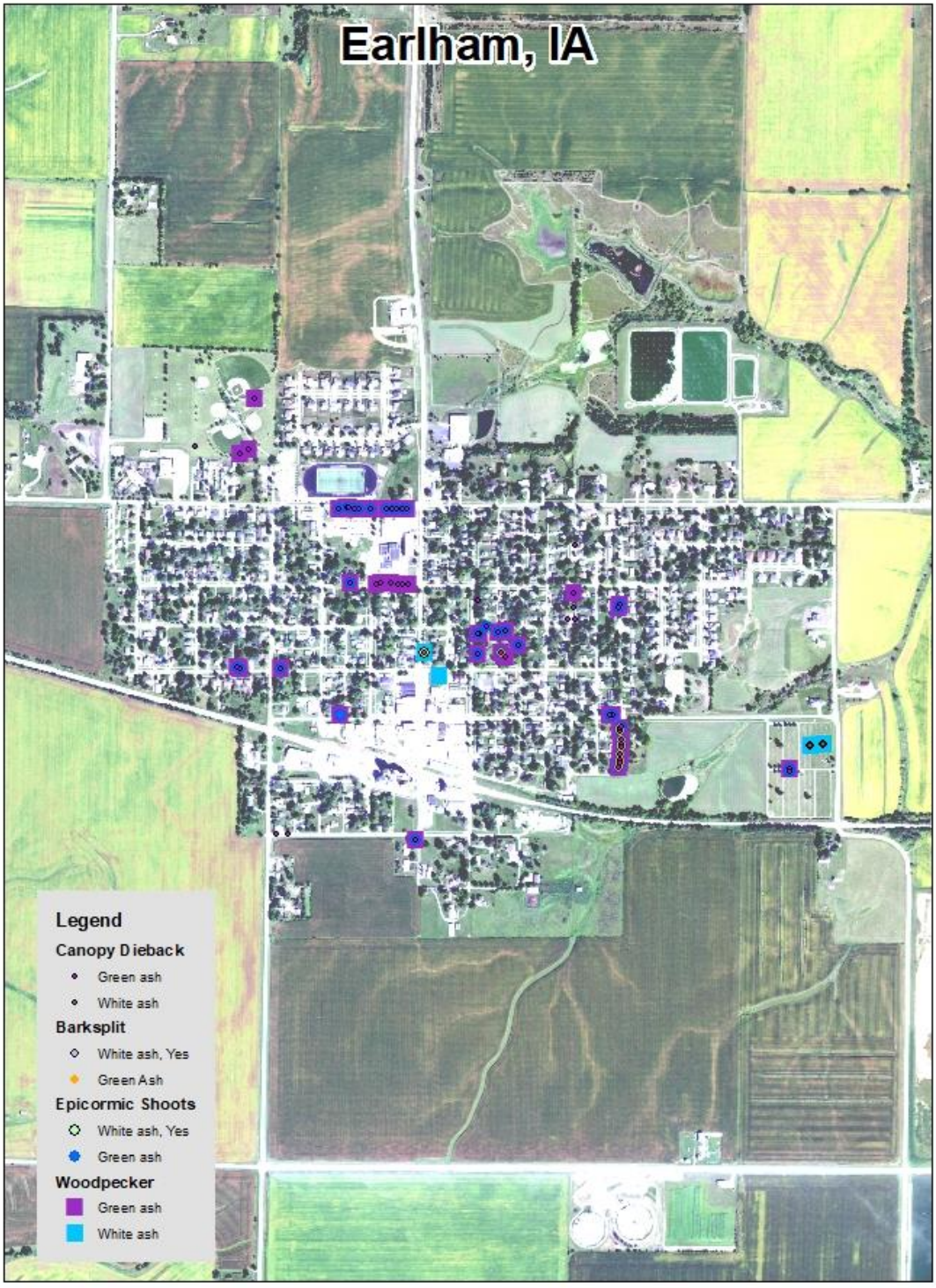

Figure 2: Location of EAB symptoms

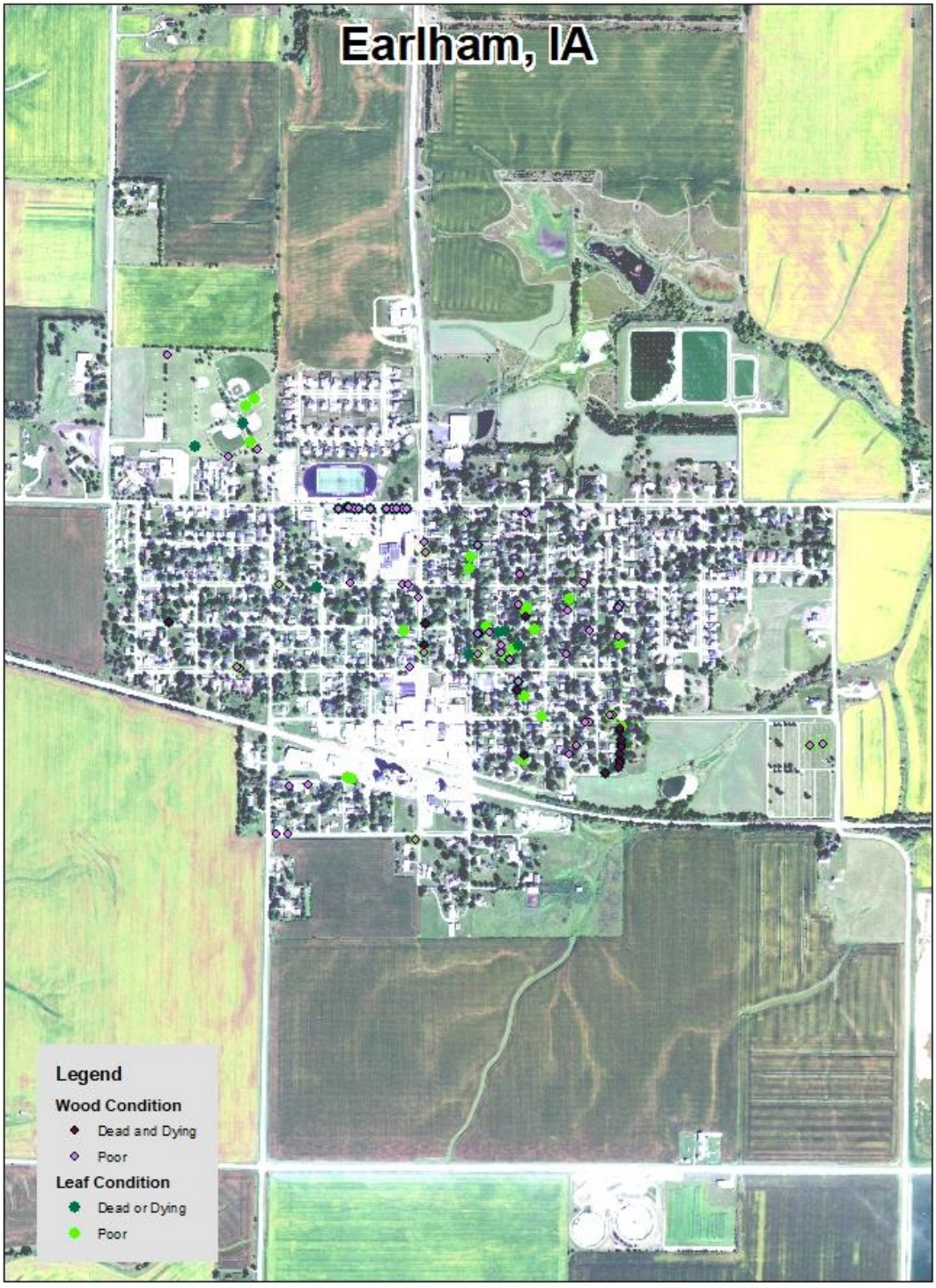

Figure 3: Location of Poor Condition Trees

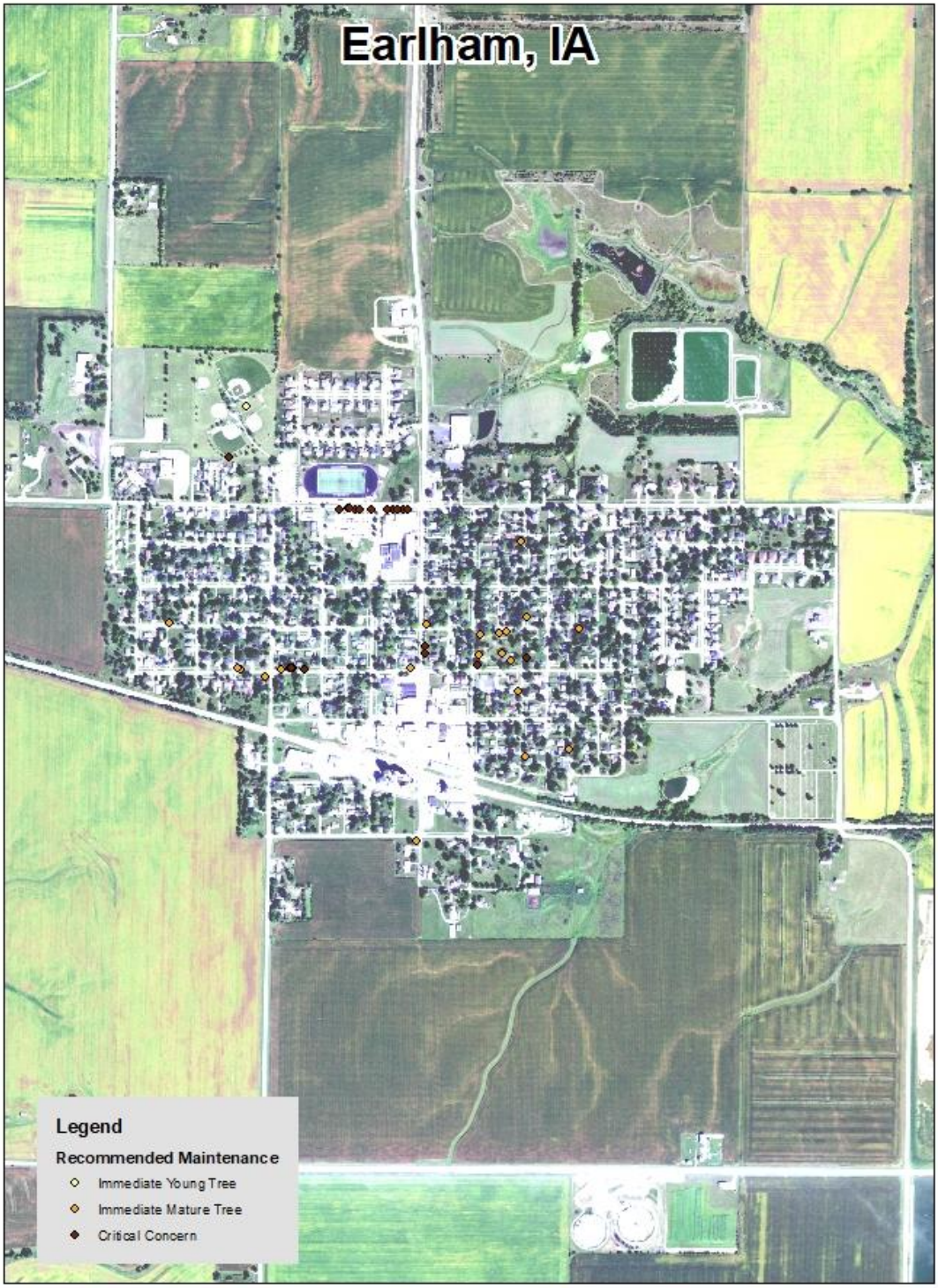

Figure 4: Location of Trees with Recommended Maintenance

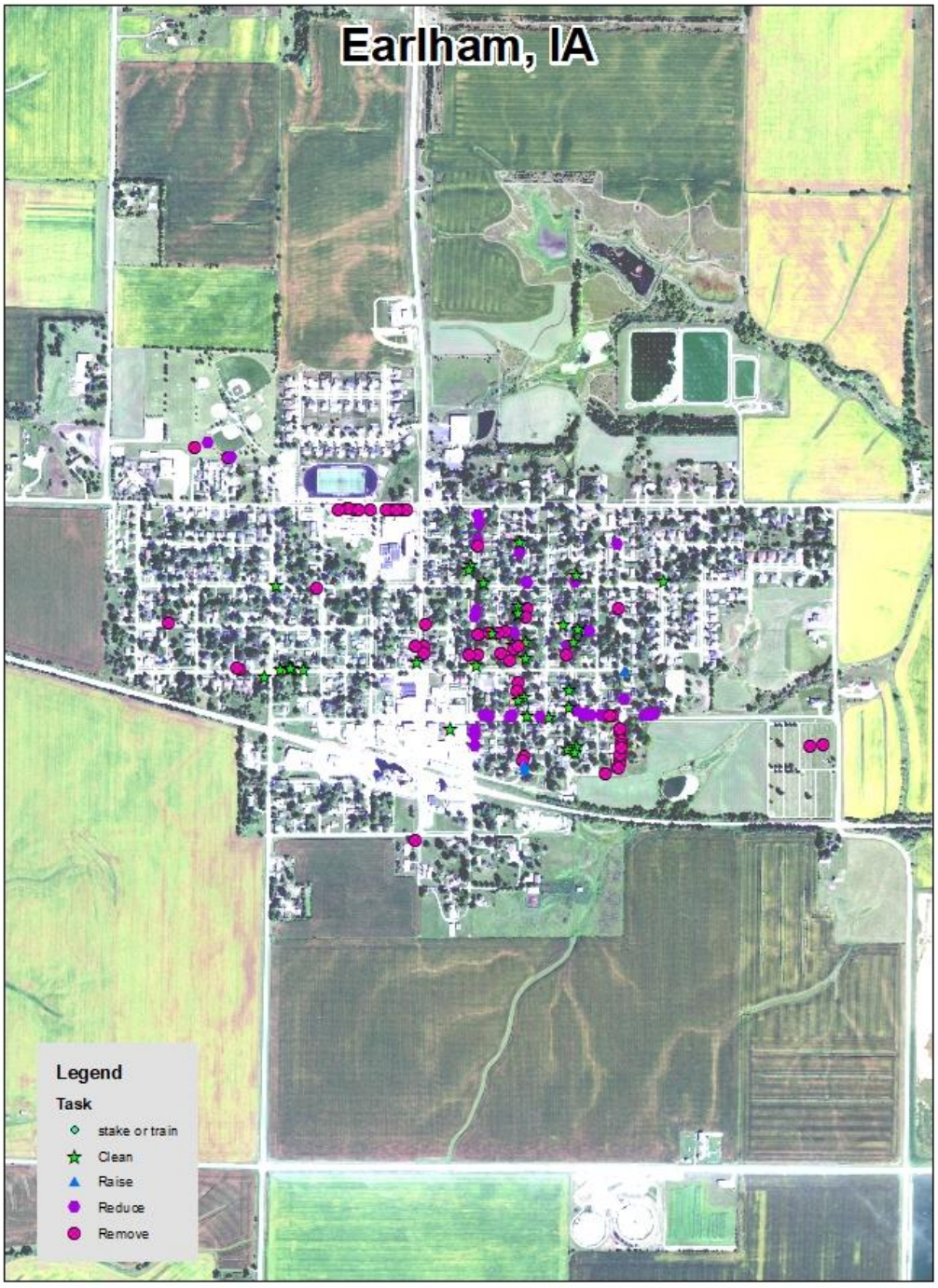

Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

CHAPTER 151
TREES

151.01 Definition
151.02 Planting Restrictions
151.03 Duty to Trim Trees
151.04 Trimming Trees to Be Supervised
151.05 Disease Control
151.06 Inspection and Removal

151.01 DEFINITION.

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

151.02 PLANTING RESTRICTIONS.

No tree shall be planted in any parking or street.

151.03 DUTY TO TRIM TREES.

The owner or agent of the abutting property shall keep the trees on or overhanging the street trimmed so that all branches will be at least 15 feet above the surface of the street and eight feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within 15 days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

(Code of Iowa, Sec. 364.12[2c, d & e])

151.04 TRIMMING TREES TO BE SUPERVISED.

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

151.05 DISEASE CONTROL.

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

151.06 INSPECTION AND REMOVAL.

The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased or damaged, and such trees and shrubs shall be subject to the following:

1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.

2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that 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 14 days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.
(Code of Iowa, Sec. 364.12[3b & h])

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

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

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