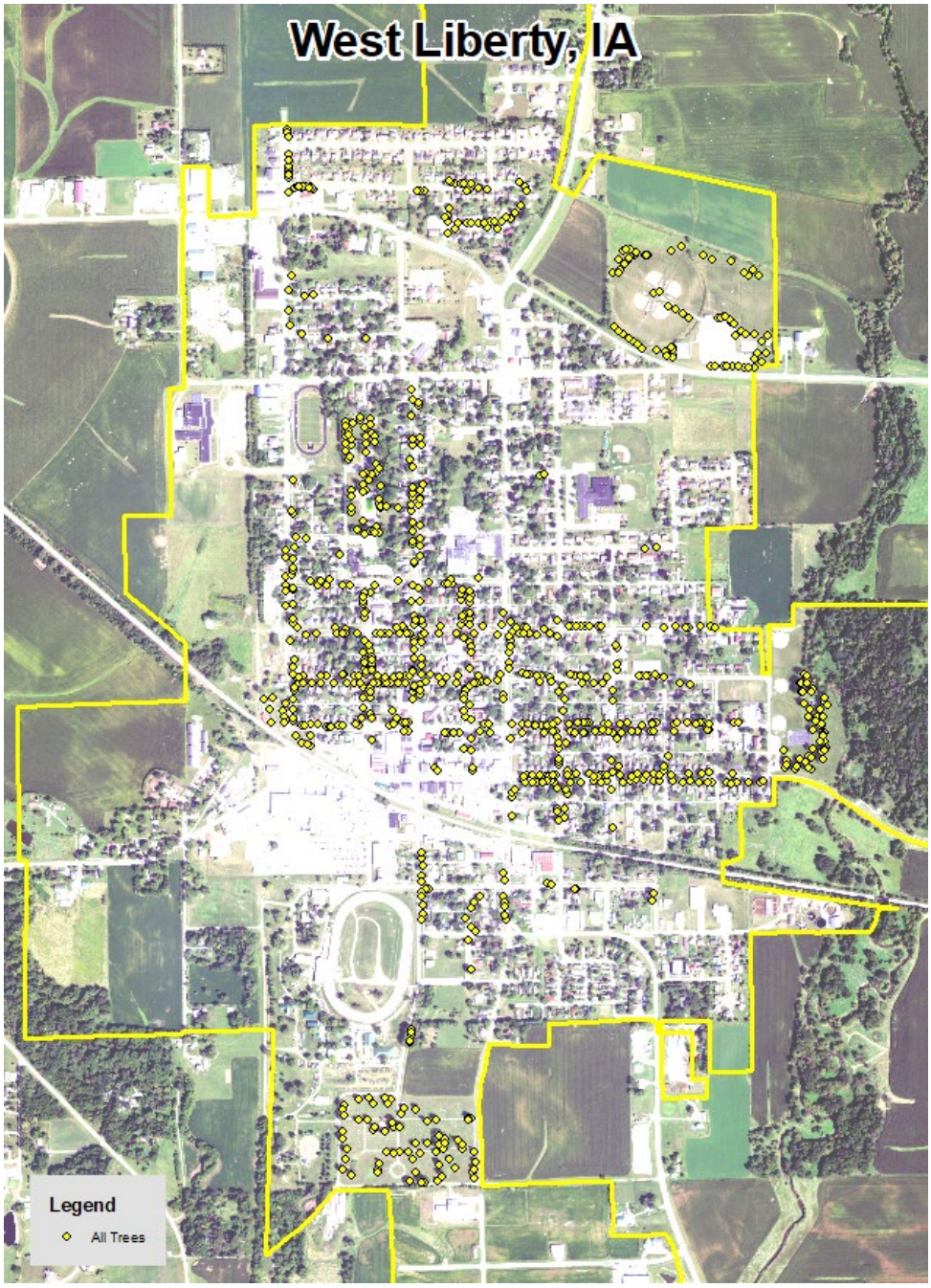
West Liberty, IA



2022 Urban Forest Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of West Liberty 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 1% of West Liberty's city owned trees (ash) 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 2021, 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 864 trees inventoried.

- West Liberty's trees provide $129,363 of benefits annually, an average of $150 a tree
- There are over 50 species of trees
- The top three genera are: Maple 45%, Ash 17%, and Oak 15%
- 8% of trees are in need of some type of management
- 16 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 16 trees needing removal, 5 are critical *City ownership of the trees recommended for removal should be verified prior to any removal*
- 1 of the 10 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 West Liberty 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 West Liberty, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of West Liberty'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 West Liberty 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 West Liberty'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 864 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. West Liberty's trees reduce energy related costs by approximately $34,074 annually (Appendix A, Table 1). These savings are both in Electricity (162.6 MWh) and in Natural Gas (22,173.6 Therms).

Annual Stormwater Benefits
West Liberty's trees intercept about 1,721,772 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $46,660 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 West Liberty, it is estimated that trees remove 2,001.6 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 $5,534 (Appendix A, Table 3).

Annual Carbon Benefits
Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In West Liberty, trees sequester about 389,722 lbs of carbon a year with an associated value of $4,719 (Appendix A, Table 5). In addition, the trees store 6,569,919 lbs of carbon, with a yearly benefit of $49,274 (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. West Liberty receives $38,376 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, West Liberty's trees provide $129,363 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 864 trees in West Liberty provide approximately $150 annually (Appendix A, Table 7).

Forest Structure

Species Distribution
West Liberty has over 60 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genera is as follows:

Maple	363	42%
Oak	154	18%
Apple (crabapple)	52	6%
Honeylocust	48	6%
Linden	44	5%
Red Cedar	36	4%
Hackberry	19	2%
Spruce	19	2%
Elm	17	2%
Cherry/Plum	11	1%
Other Large	10	1%
Ash	10	1%
Sycamore	10	1%
Tuliptree	8	1%
Pear	8	1%

Redbud	7	1%
Magnolia	7	1%
Walnut	5	1%
Red Cedar	5	1%
Other Small	4	<1%
Kentucky Coffee	4	<1%
Birch	3	<1%
Pine	3	<1%
Other Medium	2	<1%
Hickory	2	<1%
Catalpa	2	<1%
Conifer Other	2	<1%
Ginkgo	2	<1%
Poplar	2	<1%
Mulberry	1	<1%
Hophornbeam	1	<1%
Sumac	1	<1%
Willow	1	<1%
Lilac	1	<1%

Age Class

Most of West Liberty's trees (27%) are under 6 inches in diameter at 4.5 ft (Appendix A, Figure 2). This 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. West Liberty'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 West Liberty indicate that 94% of the trees are in good health, with only 2% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 55% of West Liberty'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 8% of the population. This 8% 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	46	5%
Crown Raising	3	<1%
Tree Staking	1	<1%
Tree Removal	16	2%
Crown Reduction	7	1%

Canopy Cover

The total canopy with both private and public trees is 23%, 254 acres. The canopy cover on city own properties included in the West Liberty inventory includes approximately 18 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 81 trees need to be planted annually on public and/or private lands.

Land Use and Location

The majority of West Liberty'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	66%
Park/vacant/other	29%
Industrial/Large commercial	2%
Small commercial	<1%
Multifamily residential	1%

Location	
Planting strip	68%
Other maintained locations	0%
Median	2%
Front yard	29%

Changes in Forest Structure Since plan in 2011

A smaller percent of the trees need immediate maintenance than in 2011. Most of the ash since the 2011 plan have been removed, however total tree have increased due to replanting.

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

West Liberty has 5 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 6 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 25 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 17 removals, none are ash trees. There are a total of 10 ash trees, and 1 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 West Liberty.

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 (42%) (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. All trees planted must meet the restrictions in city ordinance chapter 9 and the planting permit (Appendix C).

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 $7,000/year, Total $42,000 over 6 years

FY 2022

Removal: 8 largest critical concern trees, $5,600
- Planting and Replacement: 9 trees to be planted in open locations, $900
- Young Tree Pruning & Maintenance: $500
- Visual Survey for signs and symptoms of EAB

FY 2023

- Removal: 6 trees with poor health
- Planting and Replacement: 6 trees in open locations from year one removals, $600
- Young Tree Pruning & Maintenance: $500
- Routine trimming: Critical First $1,700
- Visual Survey for signs and symptoms of EAB

FY 2024

- Removal: 8 trees - removal of trees in poor health and ash
- Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals, $900
- Young Tree Pruning & Maintenance: $500
- Visual Survey for signs and symptoms of EAB

FY 2025

Removal: 6 trees - ash in poor health
Planting and Replacement: 7 trees in open locations from previous removals, $600
Routine trimming: Contract to trim 1/3 of the city trees, $1,700
Young Tree Pruning & Maintenance: $500
Visual Survey for signs and symptoms of EAB

FY 2026

Removal: 8 trees - removal of any new critical concern trees and ash in poor health
Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals, $900
Young Tree Pruning & Maintenance: $500
Visual Survey for signs and symptoms of EAB

FY 2027

Removal: 6 trees - removal of any new critical concern trees and ash in poor health
Planting and Replacement: 7 trees in open locations from previous removals, $600
Routine trimming: Contract to trim 1/3 of the city trees, $1,700
Young Tree Pruning & Maintenance: $500
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 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 Chapter 9 (Appendix C). The new plantings will be a diverse mix and adhere to the tree planting application requirements

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.

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.

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 8 trees selected for treatment, and West Liberty would still need to find $8,000 for removal. This is alternatives to straight removal of ash trees. 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 West Liberty. It is suggested to consider increasing the budget to plan for this.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

West Liberty

Annual Energy Benefits of Public Trees

5/30/2022

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	31.3	2,379	4,375.8	4,288	6,667	(N/A)	15.6	19.6	49.76
Red maple	12.3	936	1,631.5	1,599	2,534	(N/A)	10.0	7.4	29.47
Silver maple	17.3	1,310	2,240.8	2,196	3,506	(N/A)	7.6	10.3	53.93
Sugar maple	13.4	1,019	1,778.7	1,743	2,762	(N/A)	6.8	8.1	47.62
Pin oak	20.2	1,537	2,689.5	2,636	4,172	(N/A)	6.7	12.2	73.20
Apple	2.0	152	339.7	333	485	(N/A)	6.1	1.4	9.33
Northern red oak	11.8	893	1,660.3	1,627	2,520	(N/A)	5.8	7.4	50.41
Honeylocust	9.7	734	1,276.8	1,251	1,985	(N/A)	5.6	5.8	41.35
Northern white cedar	0.7	54	117.3	115	169	(N/A)	4.2	0.5	4.69
American basswood	5.4	412	778.7	763	1,176	(N/A)	2.6	3.5	53.44
Littleleaf linden	4.4	336	616.1	604	940	(N/A)	2.6	2.8	42.71
Swamp white oak	1.8	135	253.1	248	383	(N/A)	2.2	1.1	20.16
Northern hackberry	4.0	300	558.4	547	847	(N/A)	2.2	2.5	44.60
Bur oak	5.2	393	712.1	698	1,091	(N/A)	1.9	3.2	68.19
Maple	0.3	21	43.3	42	64	(N/A)	1.9	0.2	3.97
American sycamore	2.8	215	390.0	382	597	(N/A)	1.2	1.8	59.75
Spruce	0.1	7	15.5	15	22	(N/A)	1.2	0.1	2.19
White ash	2.3	171	266.0	261	432	(N/A)	1.1	1.3	47.96
American elm	0.0	2	2.8	3	5	(N/A)	0.8	0.0	0.67
Eastern redbud	0.6	43	83.2	82	124	(N/A)	0.8	0.4	17.76
Tulip tree	1.5	113	197.3	193	307	(N/A)	0.8	0.9	43.82
Norway spruce	1.3	96	167.3	164	260	(N/A)	0.8	0.8	37.07
Pear	0.4	28	56.0	55	83	(N/A)	0.8	0.2	11.79
Black walnut	1.4	107	199.2	195	302	(N/A)	0.6	0.9	60.36
Oak	0.0	1	2.3	2	3	(N/A)	0.6	0.0	0.66
Eastern red cedar	0.6	42	82.2	81	123	(N/A)	0.6	0.4	24.57
Sweetbay	0.9	65	101.0	99	164	(N/A)	0.6	0.5	32.86
Cherry plum	0.2	19	42.9	42	61	(N/A)	0.6	0.2	12.17
Siberian elm	1.7	131	237.5	233	364	(N/A)	0.6	1.1	72.73
Elm	0.4	30	55.1	54	84	(N/A)	0.5	0.2	21.00
Northern pin oak	1.2	89	174.0	170	259	(N/A)	0.5	0.8	64.76
Kentucky coffeetree	0.1	8	15.1	15	23	(N/A)	0.5	0.1	5.65
Broadleaf Deciduous Small	0.2	16	33.5	33	49	(N/A)	0.5	0.1	12.18
Eastern white pine	0.2	15	25.9	25	40	(N/A)	0.4	0.1	13.34
White oak	1.3	100	176.9	173	273	(N/A)	0.4	0.8	91.02
Paper birch	0.2	18	27.9	27	46	(N/A)	0.4	0.1	15.18
Plum	0.1	9	20.4	20	29	(N/A)	0.4	0.1	9.67
Black cherry	0.4	28	49.3	48	76	(N/A)	0.2	0.2	38.13
Conifer Evergreen Large	0.4	28	49.2	48	76	(N/A)	0.2	0.2	38.17
Ginkgo	0.3	20	35.0	34	54	(N/A)	0.2	0.2	26.89
Hickory	0.3	25	47.3	46	72	(N/A)	0.2	0.2	35.78
Southern magnolia	0.6	49	73.1	72	120	(N/A)	0.2	0.4	60.06
Broadleaf Deciduous Mediu	0.0	3	7.0	7	10	(N/A)	0.2	0.0	5.04
Black poplar	0.3	25	40.7	40	65	(N/A)	0.2	0.2	32.43
Black maple	0.6	43	79.8	78	121	(N/A)	0.2	0.4	60.68
Catalpa	0.5	40	76.2	75	115	(N/A)	0.2	0.3	57.32
Broadleaf Deciduous Large	0.4	27	51.8	51	78	(N/A)	0.2	0.2	38.98
Eastern hophornbeam	0.0	1	1.2	1	2	(N/A)	0.2	0.0	0.87
Blue spruce	0.2	14	25.4	25	39	(N/A)	0.2	0.1	19.66
Willow	0.0	0	0.8	1	1	(N/A)	0.1	0.0	1.10
Boxelder	0.2	15	23.9	23	39	(N/A)	0.1	0.1	38.63
Japanese maple	0.2	15	31.6	31	46	(N/A)	0.1	0.1	46.14
Green ash	0.2	18	27.0	26	44	(N/A)	0.1	0.1	44.23
Mulberry	0.2	14	24.7	24	38	(N/A)	0.1	0.1	38.13
Japanese tree lilac	0.1	6	12.8	13	18	(N/A)	0.1	0.1	18.19
Kwanzan cherry	0.0	2	3.8	4	5	(N/A)	0.1	0.0	5.40
Chinese elm	0.0	2	3.7	4	6	(N/A)	0.1	0.0	5.82
Sumac	0.2	15	31.6	31	46	(N/A)	0.1	0.1	46.14
Callery pear	0.0	3	6.2	6	9	(N/A)	0.1	0.0	8.99
Sweetgum	0.2	18	27.0	26	44	(N/A)	0.1	0.1	44.23
Total	162.6	12,344	22,173.6	21,730	34,074	(N/A)	100.0	100.0	39.76

Table 2: Annual Stormwater Benefits

West Liberty

Annual Stormwater Benefits of Public Trees

5/30/2022

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	261,849	7,096	(N/A)	15.6	15.2	52.96
Red maple	84,627	2,293	(N/A)	10.0	4.9	26.67
Silver maple	234,515	6,355	(N/A)	7.6	13.6	97.77
Sugar maple	145,774	3,950	(N/A)	6.8	8.5	68.11
Pin oak	247,241	6,700	(N/A)	6.7	14.4	117.55
Apple	6,897	187	(N/A)	6.1	0.4	3.59
Northern red oak	136,641	3,703	(N/A)	5.8	7.9	74.06
Honeylocust	101,981	2,764	(N/A)	5.6	5.9	57.58
Northern white cedar	7,181	195	(N/A)	4.2	0.4	5.41
American basswood	67,027	1,816	(N/A)	2.6	3.9	82.57
Littleleaf linden	44,059	1,194	(N/A)	2.6	2.6	54.27
Swamp white oak	10,137	275	(N/A)	2.2	0.6	14.46
Northern hackberry	35,847	971	(N/A)	2.2	2.1	51.13
Bur oak	77,077	2,089	(N/A)	1.9	4.5	130.55
Maple	1,414	38	(N/A)	1.9	0.1	2.40
American sycamore	36,840	998	(N/A)	1.2	2.1	99.84
Spruce	1,034	28	(N/A)	1.2	0.1	2.80
White ash	18,065	490	(N/A)	1.1	1.0	54.39
American elm	117	3	(N/A)	0.8	0.0	0.45
Eastern redbud	2,007	54	(N/A)	0.8	0.1	7.77
Tulip tree	19,940	540	(N/A)	0.8	1.2	77.20
Norway spruce	30,597	829	(N/A)	0.8	1.8	118.45
Pear	1,287	35	(N/A)	0.8	0.1	4.98
Black walnut	16,575	449	(N/A)	0.6	1.0	89.84
Oak	89	2	(N/A)	0.6	0.0	0.48
Eastern red cedar	8,173	221	(N/A)	0.6	0.5	44.30
Sweetbay	6,218	168	(N/A)	0.6	0.4	33.70
Cherry plum	870	24	(N/A)	0.6	0.1	4.71
Siberian elm	18,143	492	(N/A)	0.6	1.1	98.34
Elm	5,544	150	(N/A)	0.5	0.3	37.56
Northern pin oak	12,487	338	(N/A)	0.5	0.7	84.60
Kentucky coffeetree	662	18	(N/A)	0.5	0.0	4.48
Broadleaf Deciduous Small	1,196	32	(N/A)	0.5	0.1	8.11
Eastern white pine	4,702	127	(N/A)	0.4	0.3	42.48
White oak	21,717	589	(N/A)	0.4	1.3	196.17
Paper birch	1,501	41	(N/A)	0.4	0.1	13.56
Plum	402	11	(N/A)	0.4	0.0	3.63
Black cherry	1,333	36	(N/A)	0.2	0.1	18.06
Conifer Evergreen Large	9,209	250	(N/A)	0.2	0.5	124.79
Ginkgo	1,939	53	(N/A)	0.2	0.1	26.27
Hickory	3,961	107	(N/A)	0.2	0.2	53.67
Southern magnolia	8,138	221	(N/A)	0.2	0.5	110.27
Broadleaf Deciduous Medium	175	5	(N/A)	0.2	0.0	2.37
Black poplar	2,073	56	(N/A)	0.2	0.1	28.09
Black maple	5,734	155	(N/A)	0.2	0.3	77.70
Catalpa	5,181	140	(N/A)	0.2	0.3	70.21
Broadleaf Deciduous Large	3,199	87	(N/A)	0.2	0.2	43.34
Eastern hophornbeam	15	0	(N/A)	0.2	0.0	0.20
Blue spruce	2,300	62	(N/A)	0.2	0.1	31.16
Willow	12	0	(N/A)	0.1	0.0	0.33
Boxelder	1,456	39	(N/A)	0.1	0.1	39.46
Japanese maple	1,174	32	(N/A)	0.1	0.1	31.82
Green ash	1,466	40	(N/A)	0.1	0.1	39.72
Mulberry	667	18	(N/A)	0.1	0.0	18.06
Japanese tree lilac	264	7	(N/A)	0.1	0.0	7.17
Kwanzan cherry	69	2	(N/A)	0.1	0.0	1.86
Chinese elm	172	5	(N/A)	0.1	0.0	4.65
Sumac	1,174	32	(N/A)	0.1	0.1	31.82
Callery pear	163	4	(N/A)	0.1	0.0	4.41
Sweetgum	1,466	40	(N/A)	0.1	0.1	39.72
Citywide total	1,721,772	46,660	(N/A)	100.0	100.0	54.45

Table 3: Annual Air Quality Benefits

West Liberty

Annual Air Quality Benefits of Public Trees

5/30/2022

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							
Norway maple	50.5	8.7	25.2	2.2	274	150.7	21.9	20.8	142.2	937	-12.1	-45	410.2	1,165 (N/A)	15.6	8.70
Red maple	17.0	2.9	8.3	0.8	92	58.3	8.5	8.1	55.8	364	-6.1	-23	153.7	433 (N/A)	10.0	5.04
Silver maple	38.7	6.6	19.2	1.7	209	81.1	11.9	11.4	78.1	508	-20.4	-76	228.2	641 (N/A)	7.6	9.86
Sugar maple	19.2	3.3	9.6	0.9	104	63.5	9.3	8.9	60.8	397	-15.1	-57	160.3	445 (N/A)	6.8	7.66
Pin oak	46.2	8.1	23.3	2.1	252	95.8	14.0	13.4	91.7	599	-84.8	-318	209.7	532 (N/A)	6.7	9.34
Apple	1.1	0.2	0.7	0.1	6	10.1	1.4	1.4	9.1	62	0.0	0	24.0	68 (N/A)	6.1	1.31
Northern red oak	30.2	5.2	14.4	1.3	162	56.6	8.2	7.8	53.3	351	-43.7	-164	133.4	350 (N/A)	5.8	6.99
Honeylocust	19.5	3.2	9.0	0.9	103	45.6	6.7	6.4	43.8	285	-15.3	-57	119.8	332 (N/A)	5.6	6.91
Northern white cedar	0.4	0.1	0.5	0.0	3	3.6	0.5	0.5	3.2	22	-2.1	-8	6.6	17 (N/A)	4.2	0.47
American basswood	9.7	1.7	4.7	0.4	52	26.3	3.8	3.6	24.7	163	-8.1	-30	66.8	185 (N/A)	2.6	8.40
Littleleaf linden	7.5	1.3	3.7	0.3	41	21.3	3.1	2.9	20.1	132	-3.6	-14	56.6	159 (N/A)	2.6	7.23
Swamp white oak	1.3	0.2	0.8	0.1	7	8.6	1.2	1.2	8.1	53	-0.4	-1	21.0	59 (N/A)	2.2	3.12
Northern hackberry	5.4	0.9	2.8	0.2	29	19.1	2.8	2.6	17.9	118	0.0	0	51.7	148 (N/A)	2.2	7.78
Bur oak	11.5	1.8	5.2	0.5	60	24.8	3.6	3.4	23.5	154	0.0	0	74.4	215 (N/A)	1.9	13.42
Maple	0.2	0.0	0.1	0.0	1	1.4	0.2	0.2	1.3	8	-0.1	0	3.2	9 (N/A)	1.9	0.57
American sycamore	5.1	0.8	2.3	0.2	27	13.6	2.0	1.9	12.9	84	0.0	0	38.7	111 (N/A)	1.2	11.11
Spruce	0.1	0.0	0.1	0.0	0	0.5	0.1	0.1	0.4	3	-0.3	-1	0.8	2 (N/A)	1.2	0.19
White ash	1.9	0.3	1.0	0.1	10	10.4	1.5	1.5	10.2	66	0.0	0	26.8	76 (N/A)	1.1	8.42
American elm	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)	0.8	0.10
Eastern redbud	0.5	0.1	0.3	0.0	3	2.7	0.4	0.4	2.6	17	0.0	0	6.9	20 (N/A)	0.8	2.82
Tulip tree	3.3	0.5	1.5	0.1	18	7.1	1.0	1.0	6.8	44	0.0	0	21.4	62 (N/A)	0.8	8.82
Norway spruce	3.8	0.7	3.0	0.5	24	6.0	0.9	0.8	5.7	37	-18.6	-70	2.7	-8 (N/A)	0.8	-1.14
Pear	0.3	0.0	0.2	0.0	2	1.8	0.3	0.2	1.7	11	0.0	0	4.5	13 (N/A)	0.8	1.81
Black walnut	2.1	0.3	1.0	0.1	11	6.8	1.0	0.9	6.4	42	0.0	0	18.5	53 (N/A)	0.6	10.60
Oak	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	0.08
Eastern red cedar	1.7	0.3	1.4	0.2	11	2.7	0.4	0.4	2.5	17	-4.5	-17	5.1	11 (N/A)	0.6	2.19
Sweetbay	1.8	0.4	1.5	0.2	12	3.9	0.6	0.6	3.9	25	0.0	0	12.9	37 (N/A)	0.6	7.39
Cherry plum	0.1	0.0	0.1	0.0	1	1.3	0.2	0.2	1.1	8	0.0	0	3.0	8 (N/A)	0.6	1.69
Siberian elm	2.9	0.5	1.4	0.1	16	8.2	1.2	1.1	7.8	51	0.0	0	23.4	67 (N/A)	0.6	13.43
Elm	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)	0.5	3.99
Northern pin oak	2.7	0.5	1.3	0.1	15	5.7	0.8	0.8	5.3	35	-0.6	-2	16.6	47 (N/A)	0.5	11.87
Kentucky coffeetree	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3 (N/A)	0.5	0.81
Broadleaf Deciduous Small	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	3.0	9 (N/A)	0.5	2.17
Eastern white pine	0.6	0.1	0.4	0.1	4	0.9	0.1	0.1	0.9	6	-2.9	-11	0.3	-1 (N/A)	0.4	-0.49
White oak	3.5	0.6	1.5	0.2	18	6.2	0.9	0.9	6.0	39	0.0	0	19.7	57 (N/A)	0.4	19.04
Paper birch	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.7	8 (N/A)	0.4	2.53
Plum	0.1	0.0	0.0	0.0	0	0.6	0.1	0.1	0.5	4	0.0	0	1.4	4 (N/A)	0.4	1.32
Black cherry	0.4	0.1	0.2	0.0	2	1.7	0.3	0.2	1.7	11	0.0	0	4.6	13 (N/A)	0.2	6.56
Conifer Evergreen Large	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)	0.2	-1.58
Ginkgo	0.5	0.1	0.3	0.0	3	1.2	0.2	0.2	1.2	8	-0.2	-1	3.5	10 (N/A)	0.2	4.97
Hickory	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	13 (N/A)	0.2	6.28
Southern magnolia	2.8	0.6	2.2	0.3	18	2.9	0.4	0.4	2.9	18	-1.9	-7	10.6	29 (N/A)	0.2	14.73
Broadleaf Deciduous Medium	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1 (N/A)	0.2	0.67
Black poplar	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)	0.2	5.21
Black maple	1.5	0.3	0.7	0.1	8	2.7	0.4	0.4	2.6	17	-0.5	-2	8.1	23 (N/A)	0.2	11.54
Catalpa	0.5	0.1	0.3	0.0	3	2.5	0.4	0.4	2.4	16	0.0	0	6.6	19 (N/A)	0.2	9.34
Broadleaf Deciduous Large	0.3	0.0	0.2	0.0	2	1.7	0.3	0.2	1.6	11	0.0	0	4.4	12 (N/A)	0.2	6.17
Eastern hophornbeam	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)	0.2	0.11
Blue spruce	0.3	0.1	0.2	0.0	2	0.9	0.1	0.1	0.9	6	-0.8	-3	1.8	4 (N/A)	0.2	2.21
Willow	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	0.14
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)	0.1	6.37
Japanese maple	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8 (N/A)	0.1	8.35
Green ash	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)	0.1	7.42
Mulberry	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7 (N/A)	0.1	6.56
Japanese tree lilac	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
Kwanzan cherry	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)	0.1	0.71
Chinese elm	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)	0.1	0.87
Sumac	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8 (N/A)	0.1	8.35
Callery pear	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
Sweetgum	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)	0.1	7.42
Citywide total	299.9	51.4	151.0	14.3	1,632	775.3	113.0	107.7	736.9	4,832	-247.9	-930	2,001.6	5,534 (N/A)	100.0	6.46

Table 4: Annual Carbon Stored

West Liberty

Stored CO2 Benefits of Public Trees

5/30/2022

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	834,010	6,255	(N/A)	15.6	12.7	46.68
Red maple	195,230	1,464	(N/A)	10.0	3.0	17.03
Silver maple	860,622	6,455	(N/A)	7.6	13.1	99.30
Sugar maple	555,754	4,168	(N/A)	6.8	8.5	71.86
Pin oak	1,245,780	9,343	(N/A)	6.7	19.0	163.92
Apple	23,114	173	(N/A)	6.1	0.4	3.33
Northern red oak	682,377	5,118	(N/A)	5.8	10.4	102.36
Honeylocust	252,815	1,896	(N/A)	5.6	3.8	39.50
Northern white cedar	2,114	16	(N/A)	4.2	0.0	0.44
American basswood	362,560	2,719	(N/A)	2.6	5.5	123.60
Littleleaf linden	160,777	1,206	(N/A)	2.6	2.4	54.81
Swamp white oak	22,739	171	(N/A)	2.2	0.3	8.98
Northern hackberry	80,609	605	(N/A)	2.2	1.2	31.82
Bur oak	383,534	2,877	(N/A)	1.9	5.8	179.78
Maple	2,437	18	(N/A)	1.9	0.0	1.14
American sycamore	164,957	1,237	(N/A)	1.2	2.5	123.72
Spruce	279	2	(N/A)	1.2	0.0	0.21
White ash	44,659	335	(N/A)	1.1	0.7	37.22
American elm	260	2	(N/A)	0.8	0.0	0.28
Eastern redbud	8,259	62	(N/A)	0.8	0.1	8.85
Tulip tree	114,722	860	(N/A)	0.8	1.7	122.92
Norway spruce	48,285	362	(N/A)	0.8	0.7	51.73
Pear	5,072	38	(N/A)	0.8	0.1	5.43
Black walnut	66,981	502	(N/A)	0.6	1.0	100.47
Oak	61	0	(N/A)	0.6	0.0	0.09
Eastern red cedar	5,510	41	(N/A)	0.6	0.1	8.27
Sweetbay	20,468	154	(N/A)	0.6	0.3	30.70
Cherry plum	2,915	22	(N/A)	0.6	0.0	4.37
Siberian elm	70,688	530	(N/A)	0.6	1.1	106.03
Elm	25,980	195	(N/A)	0.5	0.4	48.71
Northern pin oak	44,451	333	(N/A)	0.5	0.7	83.35
Kentucky coffeetree	1,071	8	(N/A)	0.5	0.0	2.01
Broadleaf Deciduous	6,784	51	(N/A)	0.5	0.1	12.72
Eastern white pine	7,495	56	(N/A)	0.4	0.1	18.74
White oak	117,776	883	(N/A)	0.4	1.8	294.44
Paper birch	3,696	28	(N/A)	0.4	0.1	9.24
Plum	1,263	9	(N/A)	0.4	0.0	3.16
Black cherry	6,074	46	(N/A)	0.2	0.1	22.78
Conifer Evergreen La	14,981	112	(N/A)	0.2	0.2	56.18
Ginkgo	7,878	59	(N/A)	0.2	0.1	29.54
Hickory	15,785	118	(N/A)	0.2	0.2	59.19
Southern magnolia	21,430	161	(N/A)	0.2	0.3	80.36
Broadleaf Deciduous	235	2	(N/A)	0.2	0.0	0.88
Black poplar	4,706	35	(N/A)	0.2	0.1	17.65
Black maple	15,891	119	(N/A)	0.2	0.2	59.59
Catalpa	16,915	127	(N/A)	0.2	0.3	63.43
Broadleaf Deciduous	9,492	71	(N/A)	0.2	0.1	35.60
Eastern hophornbeam	28	0	(N/A)	0.2	0.0	0.10
Blue spruce	1,402	11	(N/A)	0.2	0.0	5.26
Willow	17	0	(N/A)	0.1	0.0	0.13
Boxelder	3,624	27	(N/A)	0.1	0.1	27.18
Japanese maple	6,743	51	(N/A)	0.1	0.1	50.57
Green ash	3,672	28	(N/A)	0.1	0.1	27.54
Mulberry	3,037	23	(N/A)	0.1	0.0	22.78
Japanese tree lilac	908	7	(N/A)	0.1	0.0	6.81
Kwanzan cherry	178	1	(N/A)	0.1	0.0	1.33
Chinese elm	185	1	(N/A)	0.1	0.0	1.39
Sumac	6,743	51	(N/A)	0.1	0.1	50.57
Callery pear	218	2	(N/A)	0.1	0.0	1.64
Sweetgum	3,672	28	(N/A)	0.1	0.1	27.54
Citywide total	6,569,919	49,274	(N/A)	100.0	100.0	57.50

Table 5: Annual Carbon Sequestered

West Liberty

Annual CO Benefits of Public Trees

5/30/2022

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
Norway maple	46,662	350	-4,005	-310	-32	52,575	394	94,923	712 (N/A)	15.6	15.1	5.31
Red maple	19,816	149	-938	-115	-8	20,675	155	39,438	296 (N/A)	10.0	6.3	3.44
Silver maple	67,568	507	-4,135	-187	-32	28,942	217	92,188	691 (N/A)	7.6	14.7	10.64
Sugar maple	29,314	220	-2,669	-144	-21	22,519	169	49,021	368 (N/A)	6.8	7.8	6.34
Pin oak	104,760	786	-5,980	-221	-47	33,960	255	132,520	994 (N/A)	6.7	21.1	17.44
Apple	3,189	24	-112	-37	-1	3,360	25	6,400	48 (N/A)	6.1	1.0	0.92
Northern red oak	3,642	27	-3,276	-160	-26	19,745	148	19,951	150 (N/A)	5.8	3.2	2.99
Honeylocust	24,822	186	-1,220	-77	-10	16,212	122	39,736	298 (N/A)	5.6	6.3	6.21
Northern white cedar	586	4	-10	-18	0	1,191	9	1,749	13 (N/A)	4.2	0.3	0.36
American basswood	20,120	151	-1,740	-66	-14	9,115	68	27,430	206 (N/A)	2.6	4.4	9.35
Littleleaf linden	9,157	69	-772	-56	-6	7,420	56	15,749	118 (N/A)	2.6	2.5	5.37
Swamp white oak	3,335	25	-111	-18	-1	2,983	22	6,189	46 (N/A)	2.2	1.0	2.44
Northern hackberry	4,673	35	-387	-37	-3	6,633	50	10,882	82 (N/A)	2.2	1.7	4.30
Bur oak	12,040	90	-1,841	-59	-14	8,690	65	18,829	141 (N/A)	1.9	3.0	8.83
Maple	370	3	-12	-5	0	466	3	819	6 (N/A)	1.9	0.1	0.38
American sycamore	6,962	52	-792	-31	-6	4,756	36	10,896	82 (N/A)	1.2	1.7	8.17
Spruce	84	1	-1	-3	0	149	1	229	2 (N/A)	1.2	0.0	0.17
White ash	4,993	37	-214	-18	-2	3,778	28	8,538	64 (N/A)	1.1	1.4	7.11
American elm	89	1	-2	-2	0	42	0	127	1 (N/A)	0.8	0.0	0.14
Eastern redbud	848	6	-40	-8	0	945	7	1,746	13 (N/A)	0.8	0.3	1.87
Tulip tree	2,701	20	-551	-17	-4	2,506	19	4,639	35 (N/A)	0.8	0.7	4.97
Norway spruce	956	7	-232	-26	-2	2,112	16	2,810	21 (N/A)	0.8	0.4	3.01
Pear	559	4	-24	-5	0	611	5	1,140	9 (N/A)	0.8	0.2	1.22
Black walnut	3,542	27	-322	-15	-3	2,355	18	5,560	42 (N/A)	0.6	0.9	8.34
Oak	13	0	0	-1	0	22	0	33	0 (N/A)	0.6	0.0	0.05
Eastern red cedar	43	0	-26	-10	0	934	7	941	7 (N/A)	0.6	0.1	1.41
Sweetbay	773	6	-98	-9	-1	1,443	11	2,109	16 (N/A)	0.6	0.3	3.16
Cherry plum	388	3	-14	-4	0	415	3	785	6 (N/A)	0.6	0.1	1.18
Siberian elm	3,357	25	-339	-18	-3	2,893	22	5,893	44 (N/A)	0.6	0.9	8.84
Elm	967	7	-125	-5	-1	663	5	1,501	11 (N/A)	0.5	0.2	2.81
Northern pin oak	940	7	-213	-14	-2	1,957	15	2,670	20 (N/A)	0.5	0.4	5.01
Kentucky coffeetree	217	2	-5	-2	0	172	1	382	3 (N/A)	0.5	0.1	0.72
Broadleaf Deciduous Smal	505	4	-33	-3	0	352	3	820	6 (N/A)	0.5	0.1	1.54
Eastern white pine	263	2	-36	-4	0	323	2	546	4 (N/A)	0.4	0.1	1.37
White oak	2,736	21	-565	-15	-4	2,203	17	4,359	33 (N/A)	0.4	0.7	10.90
Paper birch	451	3	-18	-2	0	402	3	832	6 (N/A)	0.4	0.1	2.08
Plum	190	1	-6	-2	0	199	1	380	3 (N/A)	0.4	0.1	0.95
Black cherry	535	4	-29	-4	0	617	5	1,119	8 (N/A)	0.2	0.2	4.20
Conifer Evergreen Large	512	4	-72	-7	-1	622	5	1,055	8 (N/A)	0.2	0.2	3.96
Ginkgo	335	3	-38	-4	0	431	3	725	5 (N/A)	0.2	0.1	2.72
Hickory	859	6	-76	-4	-1	557	4	1,337	10 (N/A)	0.2	0.2	5.01
Southern magnolia	856	6	-103	-6	-1	1,072	8	1,819	14 (N/A)	0.2	0.3	6.82
Broadleaf Deciduous Medi	101	1	-2	-1	0	72	1	170	1 (N/A)	0.2	0.0	0.64
Black poplar	654	5	-23	-3	0	552	4	1,180	9 (N/A)	0.2	0.2	4.43
Black maple	0	0	-76	-5	-1	954	7	872	7 (N/A)	0.2	0.1	3.27
Catalpa	1,319	10	-81	-5	-1	883	7	2,115	16 (N/A)	0.2	0.3	7.93
Broadleaf Deciduous Large	868	7	-46	-4	0	600	5	1,419	11 (N/A)	0.2	0.2	5.32
Eastern hophornbeam	17	0	0	0	0	11	0	28	0 (N/A)	0.2	0.0	0.10
Blue spruce	129	1	-7	-3	0	319	2	439	3 (N/A)	0.2	0.1	1.64
Willow	5	0	0	0	0	7	0	12	0 (N/A)	0.1	0.0	0.09
Boxelder	418	3	-17	-2	0	336	3	735	6 (N/A)	0.1	0.1	5.51
Japanese maple	0	0	-32	-4	0	335	3	299	2 (N/A)	0.1	0.0	2.24
Green ash	445	3	-18	-2	0	393	3	819	6 (N/A)	0.1	0.1	6.14
Mulberry	268	2	-15	-2	0	308	2	560	4 (N/A)	0.1	0.1	4.20
Japanese tree lilac	114	1	-4	-1	0	124	1	232	2 (N/A)	0.1	0.0	1.74
Kwanzan cherry	38	0	-1	-1	0	37	0	74	1 (N/A)	0.1	0.0	0.55
Chinese elm	74	1	-1	-1	0	49	0	121	1 (N/A)	0.1	0.0	0.91
Sumac	0	0	-32	-4	0	335	3	299	2 (N/A)	0.1	0.0	2.24
Callery pear	96	1	-2	-1	0	65	0	158	1 (N/A)	0.1	0.0	1.18
Sweetgum	445	3	-18	-2	0	393	3	819	6 (N/A)	0.1	0.1	6.14
Citywide total	389,722	2,923	-31,558	-1,791	-250	272,790	2,046	629,164	4,719 (N/A)	100.0	100.0	5.51

Table 6: Annual Social and Aesthetic Benefits

West Liberty

Annual Aesthetic/Other Benefits of Public Trees

5/30/2022

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	4,557	(N/A)	15.6	11.9	34.00
Red maple	2,876	(N/A)	10.0	7.5	33.44
Silver maple	5,515	(N/A)	7.6	14.4	84.85
Sugar maple	3,075	(N/A)	6.8	8.0	53.02
Pin oak	7,767	(N/A)	6.7	20.2	136.26
Apple	172	(N/A)	6.1	0.4	3.31
Northern red oak	249	(N/A)	5.8	0.6	4.97
Honeylocust	6,062	(N/A)	5.6	15.8	126.28
Northern white cedar	260	(N/A)	4.2	0.7	7.21
American basswood	1,381	(N/A)	2.6	3.6	62.78
Littleleaf linden	977	(N/A)	2.6	2.5	44.43
Swamp white oak	382	(N/A)	2.2	1.0	20.13
Northern hackberry	684	(N/A)	2.2	1.8	35.98
Bur oak	838	(N/A)	1.9	2.2	52.39
Maple	60	(N/A)	1.9	0.2	3.76
American sycamore	521	(N/A)	1.2	1.4	52.06
Spruce	67	(N/A)	1.2	0.2	6.73
White ash	613	(N/A)	1.1	1.6	68.14
American elm	17	(N/A)	0.8	0.0	2.41
Eastern redbud	48	(N/A)	0.8	0.1	6.85
Tulip tree	214	(N/A)	0.8	0.6	30.59
Norway spruce	126	(N/A)	0.8	0.3	17.98
Pear	30	(N/A)	0.8	0.1	4.35
Black walnut	284	(N/A)	0.6	0.7	56.81
Oak	26	(N/A)	0.6	0.1	5.26
Eastern red cedar	14	(N/A)	0.6	0.0	2.74
Sweetbay	57	(N/A)	0.6	0.1	11.46
Cherry plum	21	(N/A)	0.6	0.1	4.26
Siberian elm	233	(N/A)	0.6	0.6	46.66
Elm	82	(N/A)	0.5	0.2	20.60
Northern pin oak	86	(N/A)	0.5	0.2	21.53
Kentucky coffeetree	44	(N/A)	0.5	0.1	11.09
Broadleaf Deciduous Small	29	(N/A)	0.5	0.1	7.23
Eastern white pine	38	(N/A)	0.4	0.1	12.59
White oak	175	(N/A)	0.4	0.5	58.34
Paper birch	56	(N/A)	0.4	0.1	18.79
Plum	11	(N/A)	0.4	0.0	3.51
Black cherry	31	(N/A)	0.2	0.1	15.48
Conifer Evergreen Large	53	(N/A)	0.2	0.1	26.25
Ginkgo	26	(N/A)	0.2	0.1	12.85
Hickory	71	(N/A)	0.2	0.2	35.43
Southern magnolia	23	(N/A)	0.2	0.1	11.72
Broadleaf Deciduous Medium	16	(N/A)	0.2	0.0	7.81
Black poplar	74	(N/A)	0.2	0.2	37.21
Black maple	0	(N/A)	0.2	0.0	0.00
Catalpa	115	(N/A)	0.2	0.3	57.69
Broadleaf Deciduous Large	86	(N/A)	0.2	0.2	43.12
Eastern hophornbeam	0	(N/A)	0.2	0.0	0.03
Blue spruce	46	(N/A)	0.2	0.1	23.16
Willow	3	(N/A)	0.1	0.0	2.74
Boxelder	39	(N/A)	0.1	0.1	39.36
Japanese maple	0	(N/A)	0.1	0.0	0.00
Green ash	46	(N/A)	0.1	0.1	45.86
Mulberry	15	(N/A)	0.1	0.0	15.48
Japanese tree lilac	6	(N/A)	0.1	0.0	6.40
Kwanzan cherry	2	(N/A)	0.1	0.0	2.06
Chinese elm	15	(N/A)	0.1	0.0	14.73
Sumac	0	(N/A)	0.1	0.0	0.00
Callery pear	13	(N/A)	0.1	0.0	12.89
Sweetgum	46	(N/A)	0.1	0.1	45.86
Citywide total	38,376	(N/A)	100.0	100.0	44.78

Table 7: Summary of Benefits in Dollars

West Liberty

Total Annual Benefits of Public Trees by Species ($)

5/30/2022

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Norway maple	6,667	712	1,165	7,096	4,557	20,197	(N/A)	15.6
Red maple	2,534	296	433	2,293	2,876	8,433	(N/A)	6.5
Silver maple	3,506	691	641	6,355	5,515	16,708	(N/A)	12.9
Sugar maple	2,762	368	445	3,950	3,075	10,600	(N/A)	8.2
Pin oak	4,172	994	532	6,700	7,767	20,166	(N/A)	15.6
Apple	485	48	68	187	172	960	(N/A)	0.7
Northern red oak	2,520	150	350	3,703	249	6,971	(N/A)	5.4
Honeylocust	1,985	298	332	2,764	6,062	11,440	(N/A)	8.8
Northern white cedar	169	13	17	195	260	653	(N/A)	0.5
American basswood	1,176	206	185	1,816	1,381	4,764	(N/A)	3.7
Littleleaf linden	940	118	159	1,194	977	3,388	(N/A)	2.6
Swamp white oak	383	46	59	275	382	1,146	(N/A)	0.9
Northern hackberry	847	82	148	971	684	2,732	(N/A)	2.1
Bur oak	1,091	141	215	2,089	838	4,374	(N/A)	3.4
Maple	64	6	9	38	60	177	(N/A)	0.1
American sycamore	597	82	111	998	521	2,309	(N/A)	1.8
Spruce	22	2	2	28	67	121	(N/A)	0.1
White ash	432	64	76	490	613	1,674	(N/A)	1.3
American elm	5	1	1	3	17	26	(N/A)	0.0
Eastern redbud	124	13	20	54	48	259	(N/A)	0.2
Tulip tree	307	35	62	540	214	1,158	(N/A)	0.9
Norway spruce	260	21	-8	829	126	1,228	(N/A)	0.9
Pear	83	9	13	35	30	169	(N/A)	0.1
Black walnut	302	42	53	449	284	1,130	(N/A)	0.9
Oak	3	0	0	2	26	33	(N/A)	0.0
Eastern red cedar	123	7	11	221	14	376	(N/A)	0.3
Sweetbay	164	16	37	168	57	443	(N/A)	0.3
Cherry plum	61	6	8	24	21	120	(N/A)	0.1
Siberian elm	364	44	67	492	233	1,200	(N/A)	0.9
Elm	84	11	16	150	82	344	(N/A)	0.3
Northern pin oak	259	20	47	338	86	751	(N/A)	0.6
Kentucky coffeetree	23	3	3	18	44	91	(N/A)	0.1
Broadleaf Deciduous Sn	49	6	9	32	29	125	(N/A)	0.1
Eastern white pine	40	4	-1	127	38	208	(N/A)	0.2
White oak	273	33	57	589	175	1,126	(N/A)	0.9
Paper birch	46	6	8	41	56	156	(N/A)	0.1
Plum	29	3	4	11	11	57	(N/A)	0.0
Black cherry	76	8	13	36	31	165	(N/A)	0.1
Conifer Evergreen Large	76	8	-3	250	53	383	(N/A)	0.3
Ginkgo	54	5	10	53	26	147	(N/A)	0.1
Hickory	72	10	13	107	71	272	(N/A)	0.2
Southern magnolia	120	14	29	221	23	407	(N/A)	0.3
Broadleaf Deciduous M	10	1	1	5	16	33	(N/A)	0.0
Black poplar	65	9	10	56	74	215	(N/A)	0.2
Black maple	121	7	23	155	0	306	(N/A)	0.2
Catalpa	115	16	19	140	115	405	(N/A)	0.3
Broadleaf Deciduous La	78	11	12	87	86	274	(N/A)	0.2
Eastern hophornbeam	2	0	0	0	0	3	(N/A)	0.0
Blue spruce	39	3	4	62	46	156	(N/A)	0.1
Willow	1	0	0	0	3	4	(N/A)	0.0
Boxelder	39	6	6	39	39	129	(N/A)	0.1
Japanese maple	46	2	8	32	0	89	(N/A)	0.1
Green ash	44	6	7	40	46	143	(N/A)	0.1
Mulberry	38	4	7	18	15	82	(N/A)	0.1
Japanese tree lilac	18	2	3	7	6	36	(N/A)	0.0
Kwanzan cherry	5	1	1	2	2	11	(N/A)	0.0
Chinese elm	6	1	1	5	15	27	(N/A)	0.0
Sumac	46	2	8	32	0	89	(N/A)	0.1
Callery pear	9	1	1	4	13	29	(N/A)	0.0
Sweetgum	44	6	7	40	46	143	(N/A)	0.1
Citywide Total	34,074	4,719	5,534	46,660	38,376	129,363	(N/A)	100.0

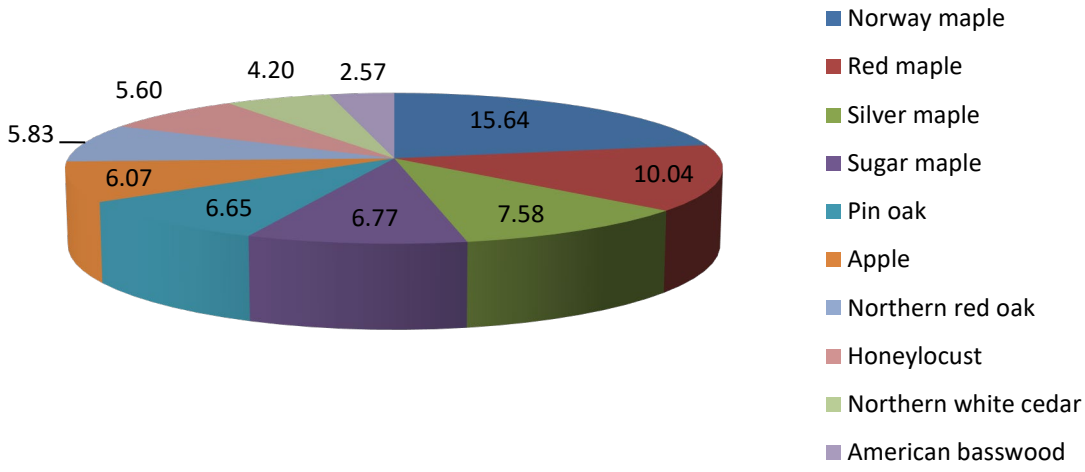

Figure 1: Species Distribution

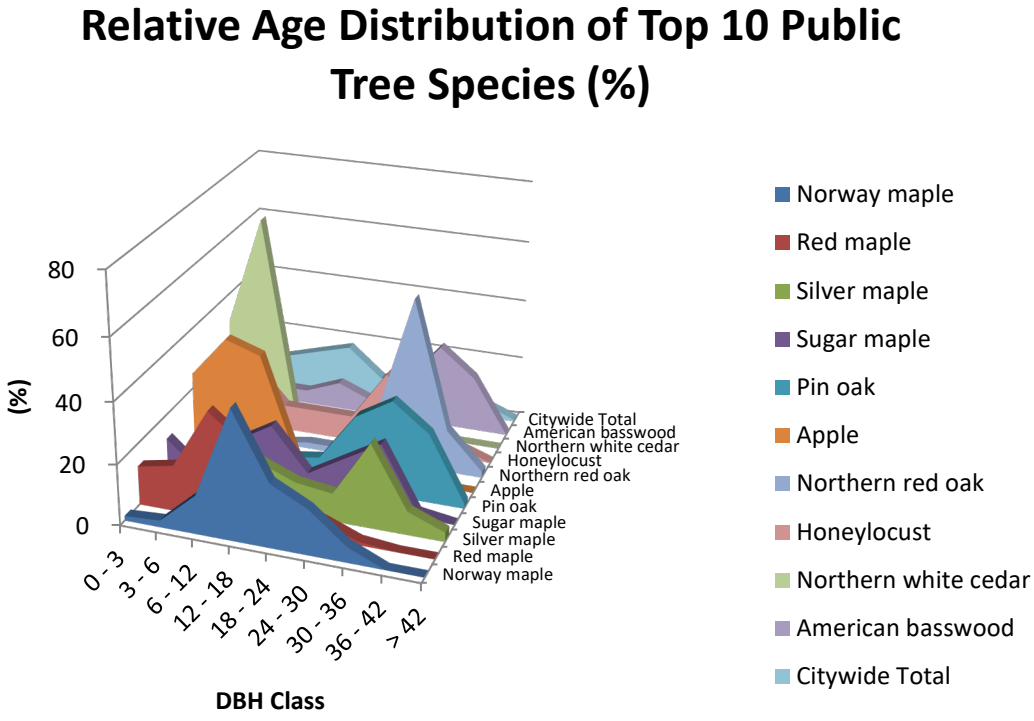

Figure 2: Relative Age Class

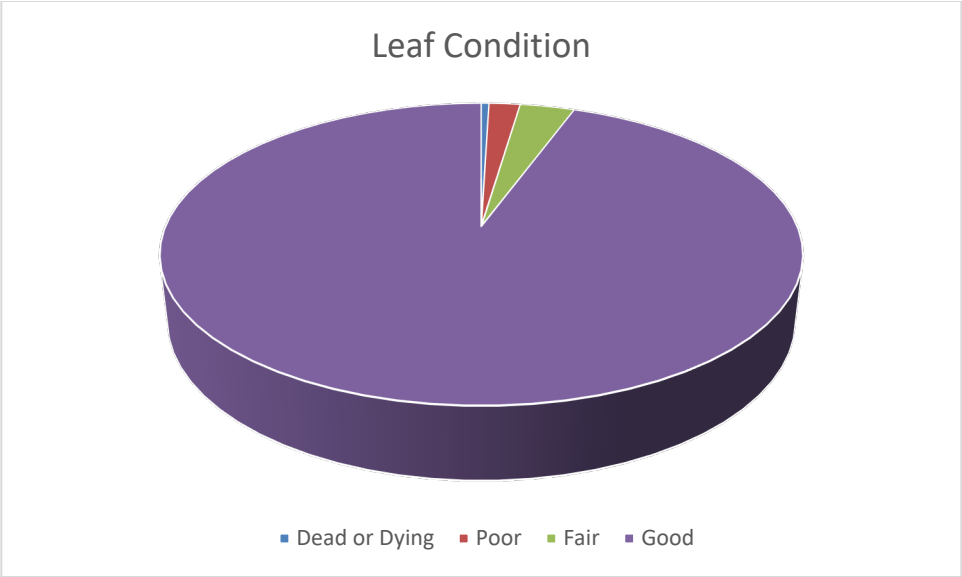

Figure 3: Foliage Condition

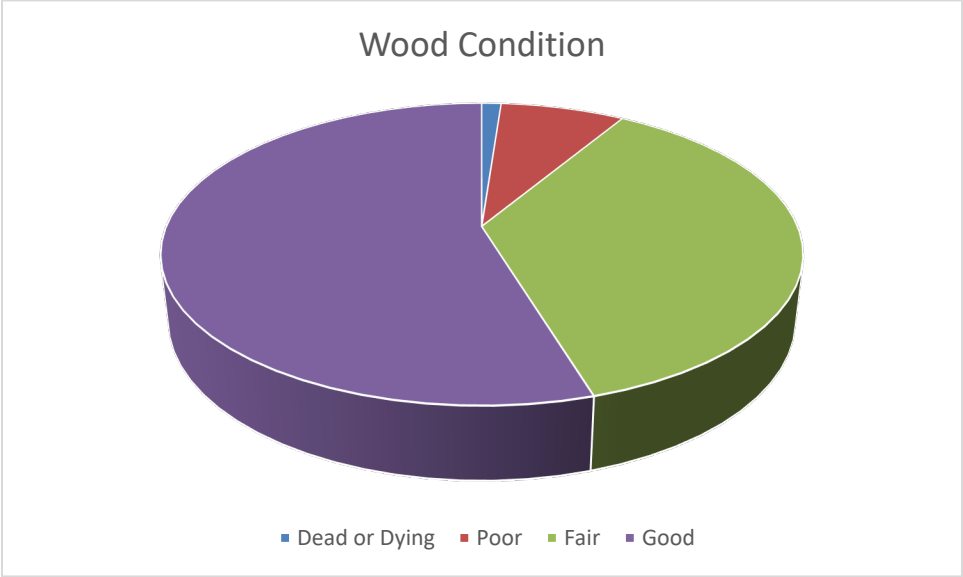

Figure 4: Wood Condition

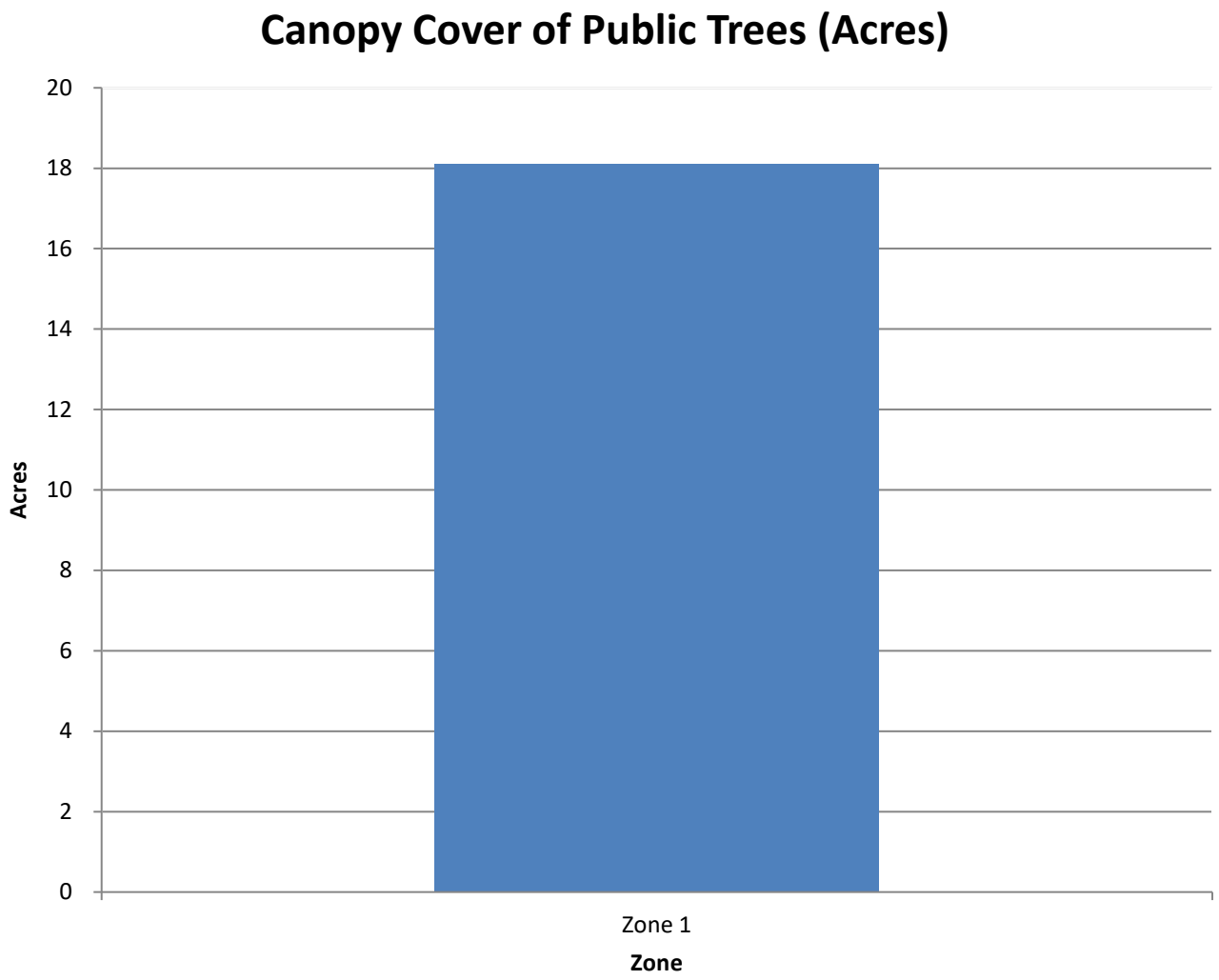

Figure 5: Canopy Cover in Acres

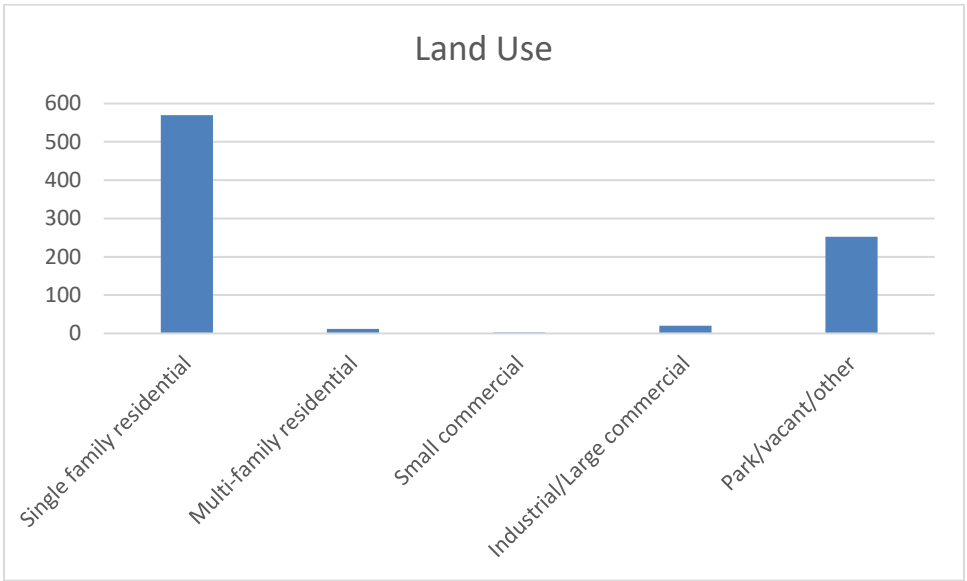

Figure 6: Land Use of city/park trees

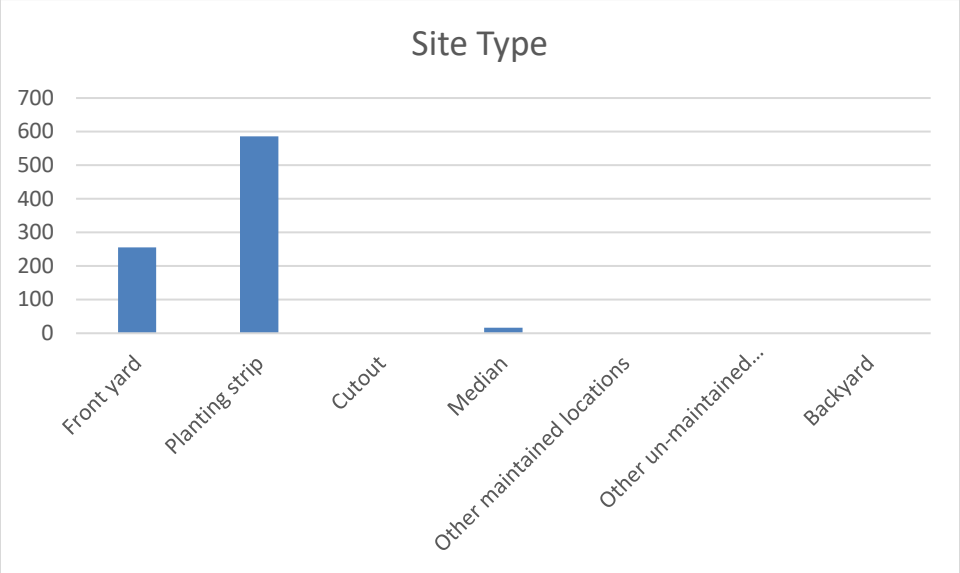

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

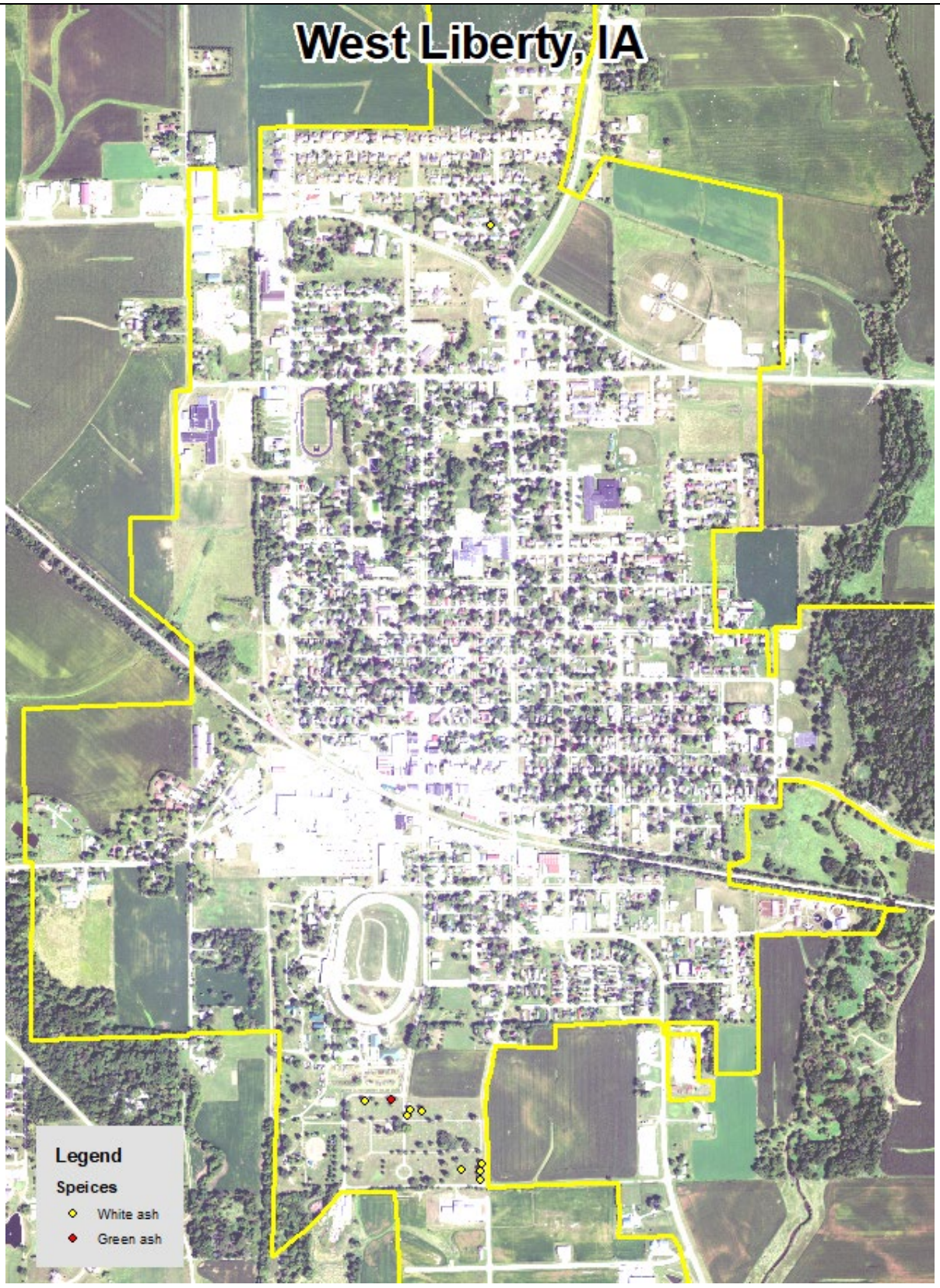

Figure 1: Location of Ash Trees

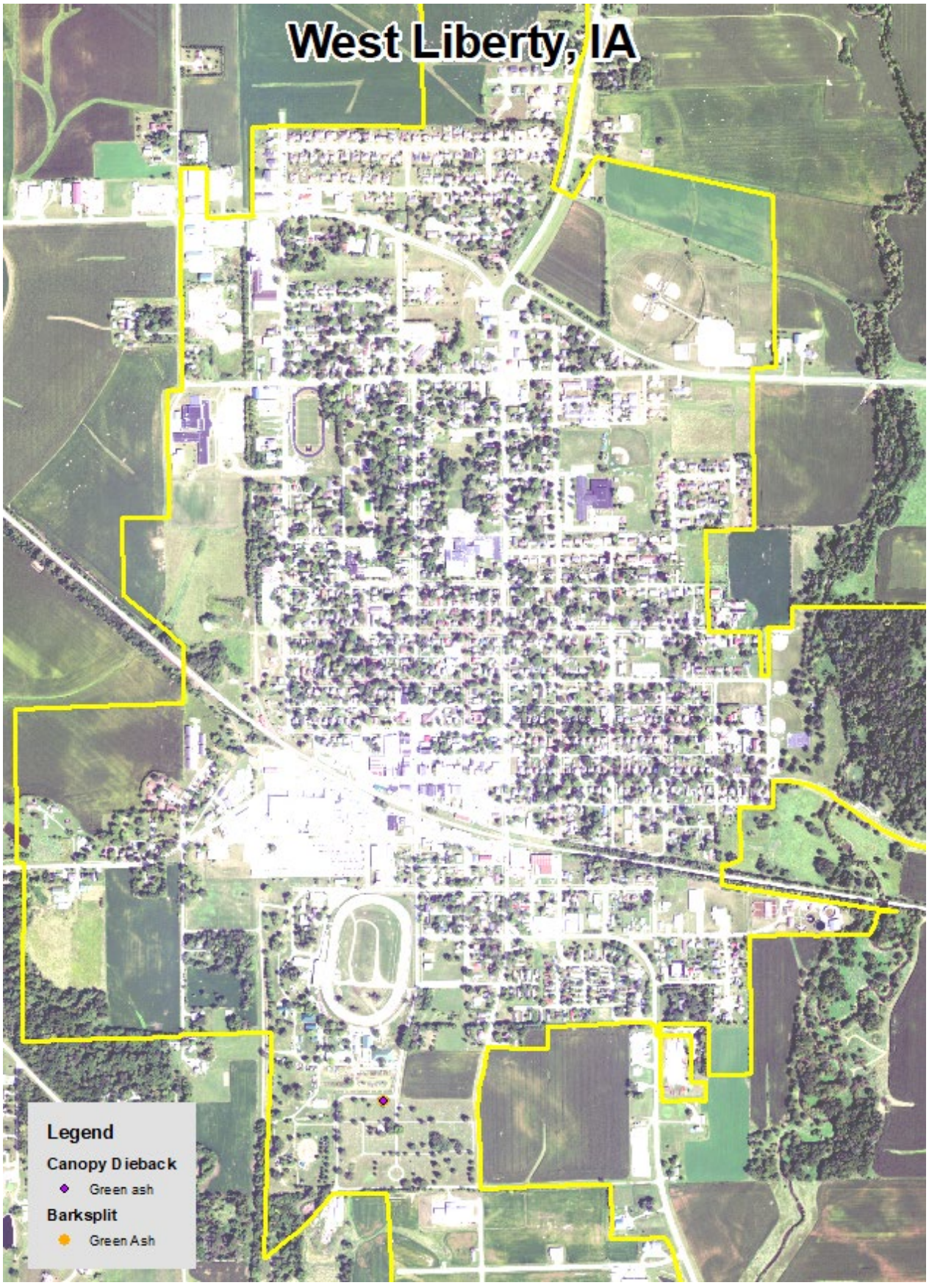

Figure 2: Location of EAB symptoms

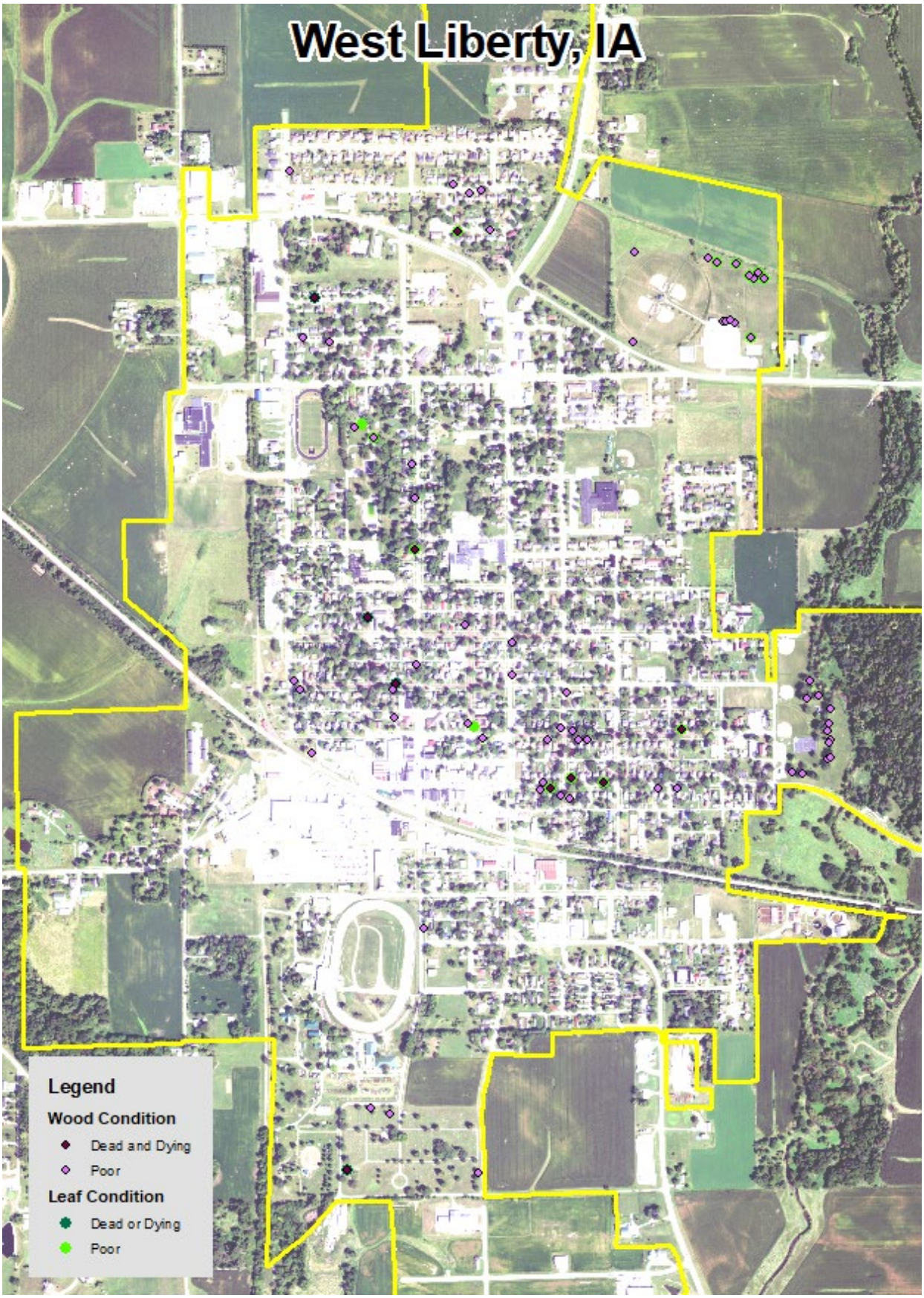

Figure 3: Location of Poor Condition Trees

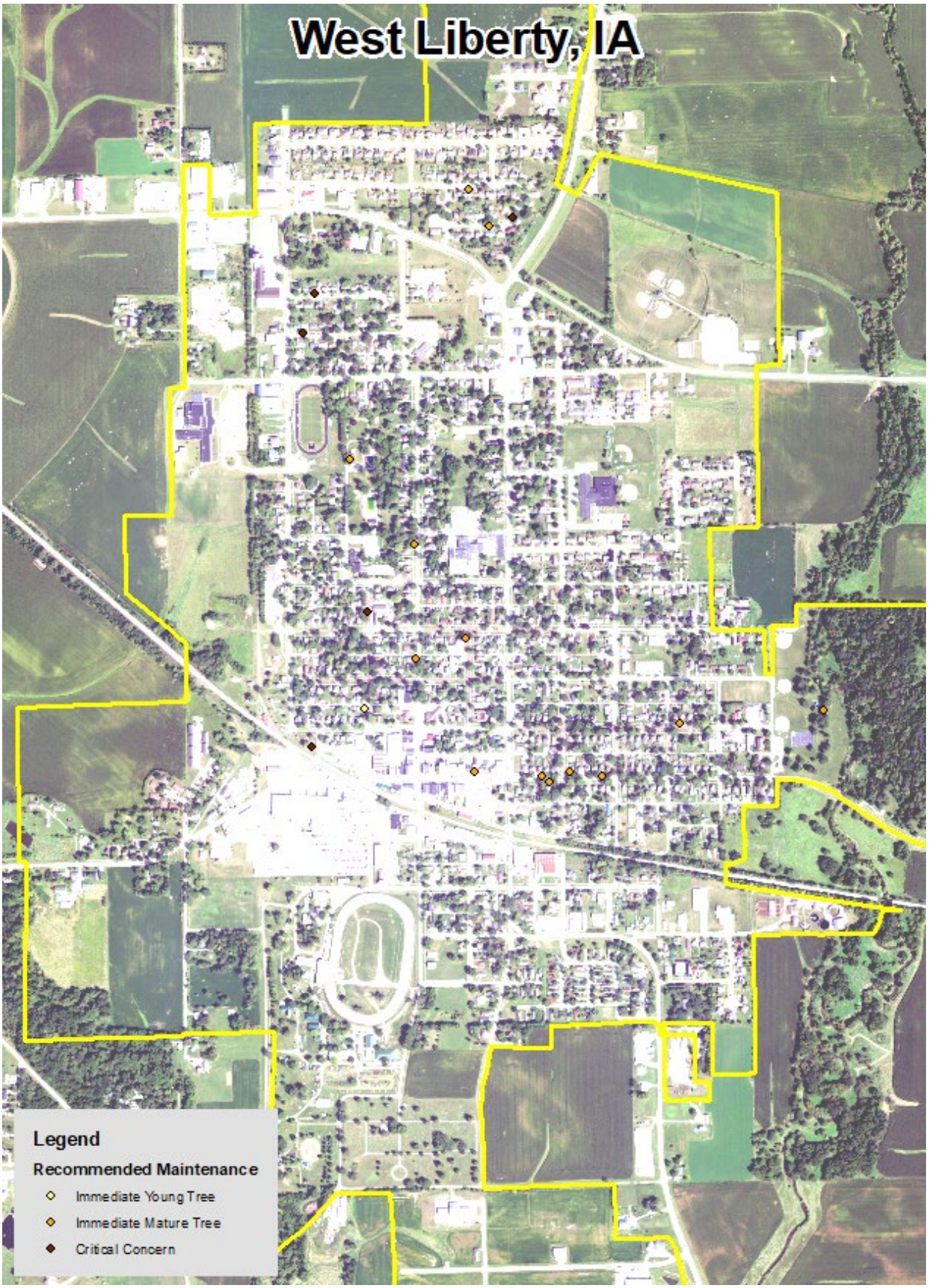

Figure 4: Location of Trees with Recommended Maintenance

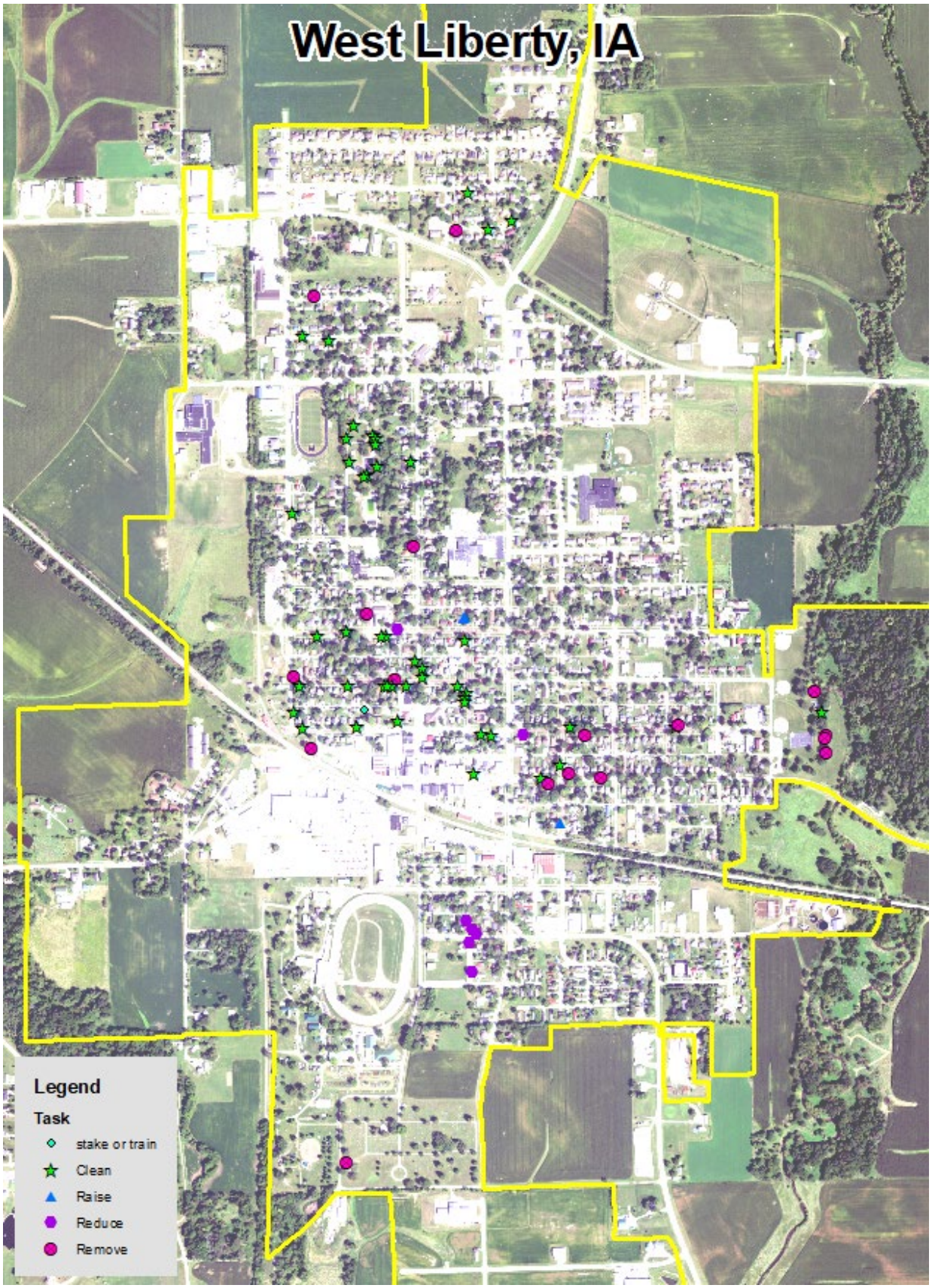

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

CHAPTER 9

TREES

SECTION:

7-9-1 : SHORT TITLE:

This chapter shall be known and may be cited as the *MUNICIPAL TREE ORDINANCE OF THE CITY OF WEST LIBERTY*. (Ord. 2-91, 2-5-1991)

7-9-2 : DEFINITIONS:

For the purpose of this chapter, the following terms, phrases, words, and their derivations shall have the meanings given herein. When not inconsistent with the context, words used in the present tense include the future, words in the plural include the singular, and words in the singular include the plural. The word "shall" is mandatory and not merely directory.

LARGE TREES: Those trees attaining a height of forty five feet (45') or more.

MEDIUM TREES: Those trees attaining a height of thirty feet (30') to forty five feet (45').

MUNICIPAL ARBORIST: A qualified, designated official of the city of West Liberty, assigned to carry out the enforcement of this chapter.

MUNICIPALITY: The city of West Liberty, county of Muscatine, state of Iowa.

PARKS: All public parks having individual names.

PERSON: Any person, firm, partnership, association, corporation, company, or organization of any kind.

PRINCIPAL THOROUGHFARE: Any street upon which trucks are not prohibited.

PROPERTY LINE: The outer edge of a street or highway.

PUBLIC PLACES: All other grounds owned by title or controlled by easement by the city of West Liberty, Iowa.

PUBLIC TREES: All shade and ornamental trees now or hereafter growing on any public right of way or any public places/areas where otherwise indicated.

SMALL TREES OR SHRUBS: Those woody plants attaining a height of thirty feet (30') or less.

STREET OR HIGHWAY: The entire width of every public way or right of way when any part thereof is open to the use of the public, as a matter of right, for purposes of vehicular and pedestrian traffic

TREELAWN: That part of a street or highway, not covered by sidewalk or other paving, lying between the property line and that portion of the street or highway usually used for vehicular traffic. (Ord. 2-91, 2-5-1991)

7-9-3 : TREE COMMITTEE:

A. Committee Established: The parks and recreation commission (title 2, chapter 1 of this code) shall serve as the tree committee for the city. The municipal arborist shall serve as an ex officio member of the tree committee. (Ord. 2-91, 2-5-1991; amd. Ord. 04-01, 6-15-2004)

B. Duties: The duties of said Tree Committee shall be as follows:

1. To study the problems and determine the needs of the City, in connection with its tree planting program.

2. To recommend to the proper authority, the type and kind of trees to be planted upon such City streets or parts of City streets or in parks as is designated.

3. To assist the properly constituted officials of the City, as well as the City Council and citizens of the City, in the dissemination of news and information regarding the selection, planting, and maintenance of trees within the corporate limits, whether the same be on private or public property, and to make such recommendations, from time to time, to the City Council as to desirable legislation concerning the tree program and activities for the City.

4. To provide regular and special meetings at which the subject of trees insofar as it relates to the City may be discussed by the members of the Committee, officers and personnel of the City and its several divisions, and all others interested in the tree program. (Ord. 2-91, 2-5-1991)

7-9-4 : MUNICIPAL ARBORIST:

A. Duties: The Municipal Arborist shall have the authority to set forth the rules and regulations of the Arboricultural Specifications and Standards of Practice governing the planting, maintenance, removal, fertilization, pruning, and bracing of trees on the streets or other public places, and shall direct, regulate, and control the planting, maintenance, and removal of all trees growing now or hereafter in any public place of the City. He shall cause the provisions of this Chapter to be enforced. In his absence, these duties shall be the responsibility of a qualified alternate designated by the City.

B. Authority:

1. Generally: The City Arborist shall have the authority and jurisdiction of regulating the planting, maintenance, and removal of trees on streets and public places to ensure safety or preserve the aesthetics of such public sites.

2. Supervision: The Municipal Arborist shall have the authority and it shall be his duty to supervise or inspect all work done under a permit in accordance with the terms of this Chapter.

3. Conditions Of Permit: The Municipal Arborist shall have the authority to affix reasonable conditions to the granting of a permit in accordance with the terms of this Chapter.

4. Master Street Tree Plan: The Municipal Arborist shall have the authority to formulate a Master Street Tree Plan with the advice, a hearing, and approval of the Tree Committee. The Master Street Tree Plan shall specify the species of trees to be planted on each of the streets or other public places of the City. From and after the effective date of the Master Street Tree Plan, or any amendment thereof, all planting shall conform thereto.

a. Utility And Environmental Factors: The Municipal Arborist shall consider all existing and future utility and environmental factors when recommending a specific species for each of the streets and other public places of the City.

b. Amendment Of Plan: The Municipal Arborist, with the approval of the Tree Committee, shall have the authority to amend or add to the Master Street Tree Plan at any time that circumstances make it advisable. (Ord. 2-91, 2-5-1991)

7-9-5 : PERMITS REQUIRED:

A. Planting, Maintenance, Or Removal On Public Right Of Way:

1. No person shall plant, spray, fertilize, preserve, prune, remove, cut above ground, or otherwise disturb any tree on any street or public place without first filing an application and procuring a permit from the Municipal

Arborist or otherwise specified City authority. The person receiving the permit shall abide by the Arboricultural Specifications and Standards of Practice adopted by the Municipal Arborist.

2. Applications for permits must be made at the office of the Municipal Arborist not less than forty eight (48) hours in advance of the time the work is to be done.

3. Standards Of Issuance: The Municipal Arborist shall issue the permits provided for herein if, in his judgment, the proposed work is desirable and the proposed method and workmanship thereof are of a satisfactory nature. Any permit granted shall contain a definite date of expiration and the work shall be completed in the time allowed on the permit and in the manner as therein described. Any permit shall be void if its terms are violated.

4. A certificate of insurance for bodily injury and property damage coverage in the minimum amount of five hundred thousand dollars ($500,000.00) shall be required as a condition of receiving a permit to perform any work under this Chapter. Such a certificate will need to be filed sufficiently in advance of the proposed work to allow time for investigation and approval.

5. Notice of completion shall be given within five (5) days to the Municipal Arborist for his inspection.

B. Planting:

1. Application Data: The application required herein shall state the number of trees to be set out; the location, grade, species, cultivar or variety of each tree; the method of planting; and such other information as the Municipal Arborist shall find reasonably necessary to a fair determination of whether a permit should be issued.

2. Improper Planting: Whenever any tree shall be planted or set out in conflict with the provisions of this Section, it shall be lawful for the Municipal Arborist to remove or cause removal of the same, and the exact cost thereof shall be assessed to the owner as provided by law in the case of special assessments.

C. Maintenance, Application Data: The application required herein shall state the number and kinds of trees to be sprayed, fertilized, pruned, or otherwise preserved; the kind of treatment to be administered; the composition of the spray material to be applied; and such other information as the Municipal Arborist shall find reasonably necessary to a fair determination of whether a permit should be issued.

D. Removal, Planting, And Replacement:

1. Wherever it is necessary to remove a tree or trees from a treelawn in connection with the paving of a sidewalk, or the paving or widening of the portion of a street or highway used for vehicular traffic, the City shall replant such trees or replace them subject to the City's specifications.

2. No person or property owner shall remove a tree from the treelawn for the purpose of construction, or for any other reason, without first filing an application and procuring a permit from the Municipal Arborist. The person or property owner requesting the removal shall bear the cost of all trees removed. The City shall bear the costs of trees removed for its purposes, including those diseased or dangerous trees it deems hazardous. (Ord. 2-91, 2-5-1991)

7-9-6 : OBSTRUCTION; TREES PRUNED:

It shall be the duty of the City to prune such trees in such manner that they will not obstruct or shade the street lights, obstruct the passage of pedestrians on sidewalks, obstruct vision of traffic signs, or obstruct view of any street or alley intersection. The minimum clearance of any overhanging portion thereof shall be ten feet (10') over sidewalks, and twelve feet (12') over all streets except truck thoroughfares which shall have a clearance of sixteen feet (16'). (Ord. 2-91, 2-5-1991)

7-9-7 : ABUSE OR MUTILATION OF PUBLIC TREES:

Unless specifically authorized by the Municipal Arborist, no person shall intentionally damage, cut, carve, transplant, or remove any tree; attach any rope, wire, nails, advertising posters, or other contrivance to any tree; allow any gaseous liquid or solid substance which is harmful to such trees to come in contact with them; or set fire or permit any fire to burn when such fire or the heat thereof will injure any portion of any tree. (Ord. 2-91, 2-5-1991)

7-9-8 : PROTECTION OF TREES:

A. Fence Or Frame: All trees on any street or other public place near any excavation or construction of any building, structure, or street work shall be guarded with a good substantial fence, frame, or box not less than

four feet (4') high and eight feet (8') square, or at a distance in feet from the tree equal to the diameter of the trunk in inches, measured at a height of five feet (5'), whichever is greater, and all building material, dirt, or other debris shall be kept outside the barrier. (Ord. 2-91, 2-5-1991; amd. 1998 Code)

B. Excavation Permit Required: No person shall excavate any ditches, tunnels, or trenches, or lay any drive within a radius of ten feet (10') from any public tree without first obtaining a written permit from the Municipal Arborist.

C. Parking On Treelawn: No person shall park any vehicle on any treelawn or otherwise endanger the roots of any tree, except by written permit of the Municipal Arborist.

D. Maintenance By Property Owners: Property owners shall maintain private trees located within property lines in a manner consistent with horticulturally acceptable standards of safety. (Ord. 2-91, 2-5-1991)

E. City Tree Policy: The City tree policy shall include by reference subsection 11-4-3E of this Code. (Ord. 2- 91, 2-5-1991; amd. 1998 Code)

7-9-9 : PLACING MATERIALS ON PUBLIC PROPERTY:

No person shall deposit, place, store, or maintain upon any public place of the City, any stone, brick, sand, concrete, or other materials which may impede the free passage of water, air, and fertilizer to the roots of any tree growing therein, except by written permit of the Municipal Arborist. (Ord. 2-91, 2-5-1991)

7-9-10 : PENALTY:

Any person violating or failing to comply with any of the provisions of this Chapter shall be guilty of a misdemeanor and, upon conviction thereof, shall be subject to penalty as provided in Section 1-4-1 of this Code. (Ord. 2-91, 2-5-1991; amd. 1998 Code)

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