Lisbon, IA:

2020 Urban Forest Management Plan

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Executive Summary

EXECUTIVE SUMMARY

Overview

This plan was developed to assist the City of Lisbon in managing its urban forest, including budgeting and future planning. Trees bring numerous benefits to a community, and sound management helps leaders take advantage of these benefits. Management is especially important now considering the serious threats posed by forest pests like 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 except mountain ash. There is a strong possibility that 8 percent of Lisbon's city-owned trees will die once EAB becomes established in the community, unless local leaders begin preventative treatment. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

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Inventory and Results

In 2020, JEO conducted a tree inventory 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 713 trees inventoried.

- Lisbon's trees provide $105,535 of benefits annually, an average of $148.02 per tree
- There are over 29 species of trees
- The top three genera are: maple 35%, apple 20%, and ash 8%
- 46.5 percent of trees need some type of management
- 52 trees should be removed

Recommendations

Below are some key recommendations, for further details see the Recommendation and Emerald Ash Borer Plan Sections:

- Out of the 52 trees needing removal, 23 trees are over 24 inches in diameter at 4.5 feet and must be addressed immediately. *City ownership of the trees recommended for removal should be verified prior to any removal*
- 20 of the 60 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 yearly with a visual survey.
- With the current budget it will take 3 years to remove only ash. JEO recommended applying for grants for additional removals and plantings.

Introduction

INTRODUCTION

This plan was developed to assist Lisbon with managing, budgeting, and future planning of their urban forest. Across the state, forestry budgets continue to decrease as a higher percentage of the budgets are devoted to tree removal. With the anticipated arrival of Emerald Ash Borer (EAB), an invasive pest that kills native ash trees, it is time to prepare for the increased costs of tree removal, treatment, and replacement planting. With proper planning and management of the current canopy in Lisbon, these costs can be spread out over the years and public safety issues from dead and dying ash trees can be mitigated.

Trees are an important part of Lisbon's infrastructure and one of the city's greatest assets. The benefits of trees are immense. Trees improve air quality, intercept stormwater runoff, conserve energy, lower traffic speeds, increase property values, reduce crime, improve mental health, and create a desirable place to live, to name just a few. Good urban forestry management will maintain these important benefits for the people of Lisbon and future generations.

Urban forestry management sets goals and develops management strategies to achieve them. To develop management strategies, a comprehensive public tree inventory must be conducted. The inventory informs maintenance, removal schedules, tree planting, and budgeting. Aligning management actions with the tree inventory results will help meet Lisbon's urban forestry goals.

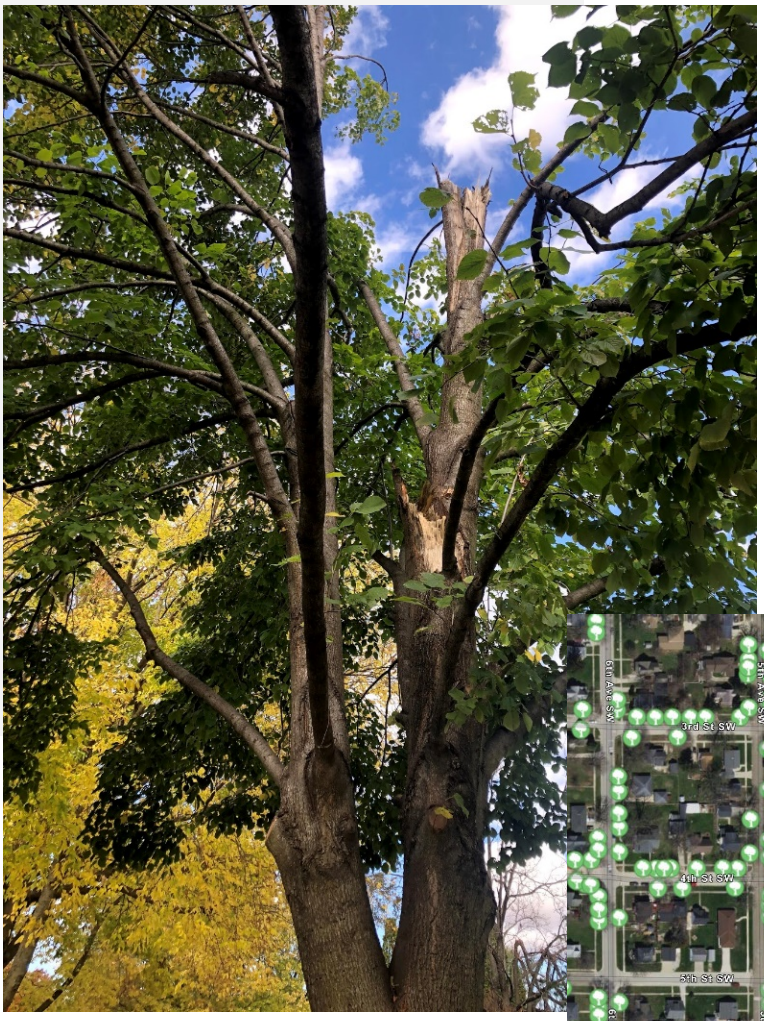
Assist Lisbon with Managing its Urban Forest

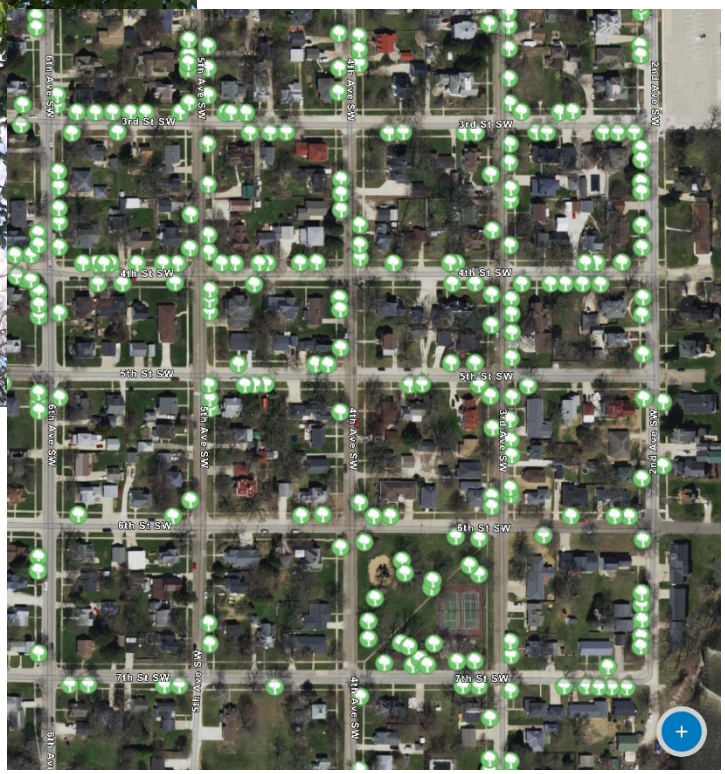
Inform on the Benefits of a Healthy Urban Forest

Establish Preventative Treatment for Emerald Ash Borer

Develop Efficient City Tree Management Techniques

Mitigate Public Safety Issues





Inventory Results

INVENTORY

In 2020, JEO conducted a tree inventory that included 100 percent of the city-owned trees on both streets and parks. The team collected tree data 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 ArcGIS 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 data collectors' programming 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 feet, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, for all ash trees, the team notes signs and symptoms associated with EAB including canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

INVENTORY RESULTS

JEO entered the data collected for the 713 city trees into the USDA Forest Service Program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. Following are results from the i-Tree STREETS analysis.

ANNUAL BENEFITS

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Lisbon's trees reduce energy-related costs by approximately $29,556 annually (Appendix A, Table 1). These savings are both in electricity (140.1 MWh) and in natural gas (19,306.8 Therms).

Annual Stormwater Benefits

Lisbon's trees intercept about 1,422,607 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $38,553 in benefit 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 lessens emissions of volatile organic matter (ozone). In Lisbon, it is estimated that trees remove 1,788.1 pounds 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 $5,018 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Lisbon, trees sequester about 313,028 pounds of carbon per year with an associated value of $2,348 (Appendix A, Table 5). In addition, the trees store 5,196,479 pounds of carbon, with a yearly benefit of $38,974 (Appendix A, Table 4).

Annual Aesthetics Benefits

The social benefits of trees are hard to capture. The i-Tree 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. Lisbon receives $28,496 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, Lisbon's trees provide $105,535 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 713 trees in Lisbon provide approximately $148.02 annually (Appendix A, Table 7).

ENERGY	STORMWATER	AIR QUALITY	CARBON	AESTHETICS	SUMMARY
• Reduce energy cost by **$29,556**	• Intercept **1,422,607 gallons** • Provides **$38,553** benefit	• Remove **1,788.1 lbs** of pollution • Net value of **$5,018**	• Sequester **313,028 lbs** • Value of **$2,348** • Store **5,196,479 lbs** • Value of **$38,974**	• **$28,496** in social benefits	• **$105,535** annual benefits • Each tree provides **$148.02** annually

FOREST STRUCTURE

Species Distribution

Lisbon has over 29 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Maple	247	35%
Apple	146	20%
Ash	60	8%
Oak	46	6%
Cedar	36	5%
Pear	36	5%
Basswood/Linden	22	3%
Hackberry	17	2%
Walnut	14	2%
Japanese tree lilac	12	1%
Amur maple	10	1%
Sycamore	9	1%
Locust	7	<1%
Cherry	6	<1%
Elm	5	<1%

Birch	5	<1%
Eastern redbud	5	<1%
Pine	4	<1%
Spruce	4	<1%
Ginkgo	3	<1%
Magnolia	3	<1%
Aspen	2	<1%
Mulberry	2	<1%
Tulip tree	1	<1%
Kentucky coffee	1	<1%
Hophornbeam	1	<1%
Dogwood	1	<1%
Other Deciduous	6	3%
Other Evergreen	2	1%

Age Class

Most of Lisbon's trees (39 percent) are between 12 and 24 inches in diameter at 4.5 feet (Appendix A, Figure 2).

To prepare for natural mortality and to maintain canopy cover, most trees should be in the smallest size category (a downward slope), indicating youth. Lisbon's size curve is very middle-aged, indicating a young to middle-aged average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the urban forest's overall health. The foliage condition results for Lisbon indicate that 95 percent of the trees are in good health, with only 5 percent of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 90 percent of Lisbon's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Three percent of the tree population's wood condition is in poor health, dead, or dying. This 10 percent 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).

Action	Number of Trees	Percentage
Crown Cleaning	194	27%
Crown Raising	92	13%
Tree Removal	52	7%
Crown Reduction	41	6%
Tree Staking	5	<1%

Canopy Cover

The total canopy with both private and public trees is 265.8 acres or around 19 percent. The canopy cover included in the Lisbon inventory includes approximately 15 acres (Appendix A, Figure 4). The city's canopy goal is to increase canopy by 11 percent in 30 years. To achieve this goal it is estimated that 50 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Lisbon'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	Percentage
Single Family Residential	73%
Park/Vacant/Other	23%
Industrial/Large Commercial	3%
Small Commercial	<1%
Multifamily Residential	<1%

Recommendations

RECOMMENDATIONS

Risk Management

Hazardous trees can be a significant threat to both people and property. Trees that are dead, dying, or have large issues such as trunk cracks longer than 18 inches should be removed. Broken branches and branches that interfere with motorists' vision of pedestrians, vehicles, traffic signs and signals should be removed.

HAZARDOUS TREES

Lisbon has 13 trees in need of immediate removal. We recommend starting with the large-diameter, critical concern trees first. There are 23 trees over 24 inches in diameter at 4.5 feet that should be addressed immediately. Please refer to the Proposed Schedule and Budget 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 332 trees with maintenance needs.

POOR TREE SPECIES

After removing the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 52 removals, 19 are ash trees. There are a total of 60 ash trees, and 20 of those have signs and symptoms that have been associated with EAB. In addition, there are 36 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 removes lower branches that are two inches in diameter or larger to provide clearance for pedestrians or vehicles. Crown reduction removes individual limbs from structures or utility wires. We recommend that all trees be pruned on a routine schedule every five to seven years. Please refer to the Schedule and Budget for further information.

Planting

Most of the planting over the next five years will replace the trees that are removed. We recommend planting 1.2 trees for every tree removed, since survival rates will not be 100%. 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 Lisbon.

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 percent of the urban forest and a single species (i.e. silver maple, sugar maple, white oak, bur oak) not make up more than 10 percent of the total urban forest. Presently, the forest is heavily planted with maple (35 percent) (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: trees with thorns, cottonwood, cotton bearing poplars, elm trees prone to Dutch Elm Disease, box elder, ash, and silver maple as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (Appendix C).

Continual Monitoring

Due to the threat of EAB, it is important to continuously check the health of ash trees. We recommend 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.

EMERALD ASH BORER PLAN

Ash Tree Removal

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

Treatment of Ash Trees

Chemical treatment can be an effective tool for communities to spread removal costs out over several years while allowing trees to continue providing 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 normally disposed of 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 151.02 (Appendix C). The new plantings will be a diverse mix and will not include trees with thorns, cottonwood, cotton bearing poplars, elm trees prone to Dutch Elm Disease, box elder, ash, and silver maple.

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 EAB signs and symptoms including 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. City Code 151.07 states “The Clerk shall be notified prior to the time that any tree located on private property is to be trimmed or removed, if said tree or any
portion thereof will fall on a street, sidewalk, or alley. Such trimming or removal shall be performed in accordance with the following
safety requirements:
1. No tree shall be felled onto any street without having person stationed in the streets to stop traffic from all directions at the time the
tree is being dropped, unless the street has been duly barricaded by placing such signs, flags, flares, and barricades as are needed to warn
persons of the danger of using the street, sidewalk, or alley.
2. Trees or branches that are felled or trimmed onto public property must be removed immediately unless an extension of time is
granted by the Clerk in writing.
3. Before any tree or branch is felled onto public property, the person or contractor must show proof to the Clerk of a liability
insurance policy in the amount of $1,000,000 per person/$1,000,000 per accident for bodily injury liability and $1,000,000 per
person/$1,000,000 aggregate for property damage liability.”

Schedule & Budget

PROPOSED WORK SCHEDULE & BUDGET

Budget Allowance of $15,000/Year – (Based off Reported Yearly Tree Budget)

YEAR 1	Est. Cost
Remove 19 trees recommended for immediate removal	$13,300
Plant 11 trees in open locations	$1,650
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,950**

YEAR 2	Est. Cost
Remove 14 trees recommended for immediate removal	$9,800
Plant 10 trees in open locations	$1,500
Prune 1/3 of city owned trees	$3,565
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,865**

YEAR 3	Est. Cost
Remove 19 ash trees in poor condition	$13,300
Plant 11 trees in open locations	$1,650
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,950**

YEAR 4	Est. Cost
Remove 14 remaining ash	$9,800
Plant 10 trees in open locations	$1,500
Prune 1/3 of city owned trees	$3,565
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,865**

YEAR 5	Est. Cost
Remove 19 remaining ash	$13,300
Plant 11 trees in open locations	$1,650
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$14,950**

YEAR 6	Est. Cost
Remove 8 remaining ash	$5,600
Plant 25 trees in open locations	$3,750
Prune 1/3 of city owned trees	$3,565
Remaining removal, planting, and matinence	$2,085
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$15,000**

Estimated costs based on average costs of $700/tree for removal, $150/tree for planting and maintenance, and $15/tree for pruning.

Proposed Budget

EAB could potentially kill all ash trees in Lisbon within four years of its arrival. We recommend that Lisbon apply for grants to fund replacement trees and greenspace improvement. 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 considered by many communities is treating 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 removal 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 40 trees could be treated per year (every other year treatment). Forty-five trees would be selected for treatment, and Lisbon would still need to find $14,000 for removal. This is an alternative to only 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 Lisbon. We suggest considering an increased budget to plan for this.

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Appendices

APPENDIX A: i-TREE DATA

Lisbon

Annual Energy Benefits of Public Trees

1/29/2021

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	11.9	905	1,847.1	1,810	2,715	(N/A)	20.5	9.2	18.60
Norway maple	25.8	1,957	3,659.5	3,586	5,543	(N/A)	13.9	18.8	55.99
Silver maple	19.6	1,487	2,590.4	2,539	4,026	(N/A)	8.4	13.6	67.10
Sugar maple	11.8	895	1,571.4	1,540	2,435	(N/A)	6.0	8.2	56.63
Callery pear	7.4	563	1,042.7	1,022	1,585	(N/A)	5.0	5.4	44.03
Northern white cedar	1.7	127	198.4	194	322	(N/A)	4.6	1.1	9.75
Red maple	7.9	599	1,038.8	1,018	1,617	(N/A)	4.6	5.5	49.01
White ash	9.9	748	1,234.2	1,209	1,958	(N/A)	4.3	6.6	63.15
Green ash	8.1	611	1,072.1	1,051	1,662	(N/A)	3.9	5.6	59.35
Northern hackberry	3.7	284	532.2	522	806	(N/A)	2.4	2.7	47.39
Black walnut	4.7	359	647.6	635	993	(N/A)	2.0	3.4	70.95
Pin oak	4.8	364	642.8	630	994	(N/A)	1.8	3.4	76.45
Japanese tree lilac	0.7	50	114.7	112	163	(N/A)	1.7	0.6	13.55
Northern red oak	2.6	195	350.8	344	539	(N/A)	1.7	1.8	44.89
Maple	1.8	134	245.9	241	375	(N/A)	1.5	1.3	34.12
Littleleaf linden	2.1	163	309.6	303	466	(N/A)	1.5	1.6	42.39
Swamp white oak	2.3	176	342.4	336	512	(N/A)	1.4	1.7	51.20
American basswood	2.7	202	380.1	372	575	(N/A)	1.4	1.9	57.45
Amur maple	0.8	63	121.3	119	182	(N/A)	1.4	0.6	18.15
Bur oak	1.6	120	219.7	215	335	(N/A)	1.4	1.1	33.51
American sycamore	0.9	68	120.0	118	185	(N/A)	1.3	0.6	20.58
Honeylocust	1.5	113	193.2	189	302	(N/A)	1.0	1.0	43.16
Black cherry	0.7	51	98.2	96	147	(N/A)	0.8	0.5	24.48
Broadleaf Deciduous Small	0.0	3	6.9	7	10	(N/A)	0.8	0.0	1.62
Elm	0.6	47	75.1	74	121	(N/A)	0.7	0.4	24.15
River birch	1.3	100	195.9	192	292	(N/A)	0.7	1.0	58.47
Eastern redbud	0.1	8	19.0	19	27	(N/A)	0.7	0.1	5.40
Eastern red cedar	0.2	17	33.6	33	50	(N/A)	0.4	0.2	16.69
Eastern white pine	0.6	42	73.8	72	115	(N/A)	0.4	0.4	38.17
Southern magnolia	0.3	23	35.3	35	58	(N/A)	0.4	0.2	19.17
Ginkgo	0.0	1	1.2	1	2	(N/A)	0.4	0.0	0.57
Quaking aspen	0.0	0	0.9	1	1	(N/A)	0.3	0.0	0.66
Spruce	0.4	28	49.2	48	76	(N/A)	0.3	0.3	38.17
Mulberry	0.0	1	1.2	1	2	(N/A)	0.3	0.0	0.87
Ash	0.3	20	39.6	39	59	(N/A)	0.1	0.2	58.69
Black maple	0.0	0	0.7	1	1	(N/A)	0.1	0.0	1.03
Kentucky coffeetree	0.3	25	46.9	46	71	(N/A)	0.1	0.2	70.91
Scotch pine	0.1	11	19.7	19	30	(N/A)	0.1	0.1	30.47
Broadleaf Evergreen Small	0.0	1	1.5	1	2	(N/A)	0.1	0.0	2.12
Oak	0.3	20	38.1	37	57	(N/A)	0.1	0.2	57.32
Norway spruce	0.2	14	24.6	24	38	(N/A)	0.1	0.1	38.17
Basswood	0.0	2	3.7	4	6	(N/A)	0.1	0.0	5.82
Blue spruce	0.1	5	10.2	10	15	(N/A)	0.1	0.1	14.80
Eastern hophornbeam	0.2	14	24.7	24	38	(N/A)	0.1	0.1	38.13
Conifer Evergreen Large	0.2	14	24.6	24	38	(N/A)	0.1	0.1	38.17
Tulip tree	0.0	2	3.7	4	6	(N/A)	0.1	0.0	5.82
Dogwood	0.0	2	3.8	4	5	(N/A)	0.1	0.0	5.40
Total	140.1	10,635	19,306.8	18,921	29,556	(N/A)	100.0	100.0	41.45

Annual Stormwater Benefits of Public Trees

1/29/2021

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	46,098	1,249	(N/A)	20.5	3.2	8.56
Norway maple	234,731	6,361	(N/A)	13.9	16.5	64.25
Silver maple	291,813	7,908	(N/A)	8.4	20.5	131.80
Sugar maple	128,944	3,494	(N/A)	6.0	9.1	81.26
Callery pear	55,777	1,512	(N/A)	5.0	3.9	41.99
Northern white cedar	20,034	543	(N/A)	4.6	1.4	16.45
Red maple	66,529	1,803	(N/A)	4.6	4.7	54.63
White ash	96,257	2,609	(N/A)	4.3	6.8	84.15
Green ash	83,177	2,254	(N/A)	3.9	5.8	80.50
Northern hackberry	35,936	974	(N/A)	2.4	2.5	57.29
Black walnut	58,777	1,593	(N/A)	2.0	4.1	113.77
Pin oak	59,473	1,612	(N/A)	1.8	4.2	123.98
Japanese tree lilac	2,329	63	(N/A)	1.7	0.2	5.26
Northern red oak	25,858	701	(N/A)	1.7	1.8	58.40
Maple	15,108	409	(N/A)	1.5	1.1	37.22
Littleleaf linden	20,005	542	(N/A)	1.5	1.4	49.29
Swamp white oak	22,945	622	(N/A)	1.4	1.6	62.18
American basswood	33,370	904	(N/A)	1.4	2.3	90.43
Amur maple	2,945	80	(N/A)	1.4	0.2	7.98
Bur oak	16,913	458	(N/A)	1.4	1.2	45.83
American sycamore	12,855	348	(N/A)	1.3	0.9	38.71
Honeylocust	18,797	509	(N/A)	1.0	1.3	72.77
Black cherry	2,848	77	(N/A)	0.8	0.2	12.86
Broadleaf Deciduous Small	106	3	(N/A)	0.8	0.0	0.48
Elm	3,882	105	(N/A)	0.7	0.3	21.04
River birch	15,220	412	(N/A)	0.7	1.1	82.49
Eastern redbud	343	9	(N/A)	0.7	0.0	1.86
Eastern red cedar	3,294	89	(N/A)	0.4	0.2	29.75
Eastern white pine	13,814	374	(N/A)	0.4	1.0	124.79
Southern magnolia	2,086	57	(N/A)	0.4	0.1	18.84
Ginkgo	21	1	(N/A)	0.4	0.0	0.19
Quaking aspen	36	1	(N/A)	0.3	0.0	0.48
Spruce	9,209	250	(N/A)	0.3	0.6	124.79
Mulberry	15	0	(N/A)	0.3	0.0	0.20
Ash	2,479	67	(N/A)	0.1	0.2	67.19
Black maple	12	0	(N/A)	0.1	0.0	0.32
Kentucky coffeetree	3,943	107	(N/A)	0.1	0.3	106.85
Scotch pine	2,969	80	(N/A)	0.1	0.2	80.46
Broadleaf Evergreen Small	24	1	(N/A)	0.1	0.0	0.64
Oak	2,591	70	(N/A)	0.1	0.2	70.21
Norway spruce	4,605	125	(N/A)	0.1	0.3	124.79
Basswood	172	5	(N/A)	0.1	0.0	4.65
Blue spruce	755	20	(N/A)	0.1	0.1	20.47
Eastern hophornbeam	667	18	(N/A)	0.1	0.0	18.06
Conifer Evergreen Large	4,605	125	(N/A)	0.1	0.3	124.79
Tulip tree	172	5	(N/A)	0.1	0.0	4.65
Dogwood	69	2	(N/A)	0.1	0.0	1.86
Citywide total	1,422,607	38,553	(N/A)	100.0	100.0	54.07

Annual Air Quality Benefits of Public Trees

1/29/2021

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								
Apple	12.0	2.0	6.0	0.5	65	58.8	8.4	8.0	54.0	362	-0.1	0	149.7	426	(N/A)	20.5	2.92
Norway maple	47.5	8.2	23.4	2.1	257	124.5	18.0	17.2	117.0	772	-11.2	-42	346.7	987	(N/A)	13.9	9.97
Silver maple	52.2	8.8	25.5	2.3	281	92.5	13.5	12.9	88.6	578	-27.4	-103	269.0	756	(N/A)	8.4	12.61
Sugar maple	17.0	2.9	8.5	0.8	92	55.9	8.2	7.8	53.4	349	-13.4	-50	141.0	391	(N/A)	6.0	9.09
Callery pear	9.8	1.7	5.0	0.4	54	35.7	5.2	4.9	33.7	222	-2.4	-9	94.0	266	(N/A)	5.0	7.40
Northern white cedar	2.1	0.4	1.8	0.3	14	7.7	1.1	1.1	7.6	49	-7.1	-27	15.1	36	(N/A)	4.6	1.10
Red maple	16.0	2.7	7.4	0.7	85	37.3	5.5	5.2	35.8	233	-5.4	-20	105.3	298	(N/A)	4.6	9.04
White ash	12.6	2.0	6.2	0.6	68	46.0	6.8	6.5	44.6	289	0.0	0	125.2	357	(N/A)	4.3	11.50
Green ash	9.9	1.6	4.8	0.4	53	38.2	5.6	5.3	36.5	239	0.0	0	102.3	291	(N/A)	3.9	10.40
Northern hackberry	5.7	1.0	2.9	0.3	31	18.1	2.6	2.5	17.0	112	0.0	0	49.9	143	(N/A)	2.4	8.41
Black walnut	8.3	1.3	3.8	0.4	44	22.6	3.3	3.1	21.4	141	0.0	0	64.3	185	(N/A)	2.0	13.19
Pin oak	11.1	2.0	5.6	0.5	61	22.7	3.3	3.2	21.7	142	-20.4	-77	49.7	126	(N/A)	1.8	9.70
Japanese tree lilac	0.4	0.1	0.2	0.0	2	3.4	0.5	0.4	3.0	20	0.0	0	8.0	23	(N/A)	1.7	1.88
Northern red oak	5.5	0.9	2.7	0.2	30	12.2	1.8	1.7	11.6	76	-7.9	-29	28.9	76	(N/A)	1.7	6.37
Maple	3.6	0.6	1.7	0.2	19	8.5	1.2	1.2	8.0	53	-1.2	-4	23.7	67	(N/A)	1.5	6.11
Littleleaf linden	3.1	0.5	1.6	0.1	17	10.4	1.5	1.4	9.7	64	-1.6	-6	26.9	76	(N/A)	1.5	6.87
Swamp white oak	4.8	0.8	2.3	0.2	26	11.3	1.6	1.6	10.5	70	-1.1	-4	32.1	92	(N/A)	1.4	9.17
American basswood	4.9	0.8	2.4	0.2	26	12.9	1.9	1.8	12.1	80	-4.1	-15	32.8	91	(N/A)	1.4	9.09
Amur maple	0.8	0.1	0.4	0.0	4	4.0	0.6	0.6	3.7	25	0.0	0	10.2	29	(N/A)	1.4	2.89
Bur oak	2.4	0.4	1.2	0.1	13	7.6	1.1	1.0	7.2	47	0.0	0	21.0	60	(N/A)	1.4	6.00
American sycamore	2.4	0.4	1.0	0.1	12	4.2	0.6	0.6	4.0	26	0.0	0	13.4	39	(N/A)	1.3	4.32
Honeylocust	3.8	0.6	1.7	0.2	20	7.0	1.0	1.0	6.7	44	-3.0	-11	18.9	52	(N/A)	1.0	7.45
Black cherry	0.9	0.1	0.4	0.0	5	3.2	0.5	0.4	3.0	20	0.0	0	8.7	25	(N/A)	0.8	4.14
Broadleaf Deciduous Small	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)	0.8	0.21
Elm	0.2	0.0	0.2	0.0	1	2.9	0.4	0.4	2.8	18	0.0	0	7.0	20	(N/A)	0.7	3.92
River birch	3.5	0.6	1.7	0.2	19	6.5	0.9	0.9	6.0	40	-0.8	-3	19.4	56	(N/A)	0.7	11.11
Eastern redbud	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.5	3	0.0	0	1.3	4	(N/A)	0.7	0.71
Eastern red cedar	0.7	0.1	0.5	0.1	4	1.1	0.2	0.2	1.0	7	-1.8	-7	2.1	4	(N/A)	0.4	1.49
Eastern white pine	1.7	0.3	1.3	0.2	11	2.6	0.4	0.4	2.5	16	-8.6	-32	0.9	-5	(N/A)	0.4	-1.58
Southern magnolia	0.1	0.0	0.2	0.0	1	1.4	0.2	0.2	1.4	9	-0.5	-2	2.9	8	(N/A)	0.4	2.53
Ginkgo	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)	0.4	0.07
Quaking aspen	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
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
Mulberry	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	0.11
Ash	0.5	0.1	0.2	0.0	3	1.3	0.2	0.2	1.2	8	-0.1	0	3.6	10	(N/A)	0.1	10.16
Black maple	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	0.13

Lisbon

Annual Air Quality Benefits of Public Trees

Table 3 Continued

1/29/2021

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								
Kentucky coffeetree	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	12	(N/A)	0.1	12.48
Scotch pine	0.3	0.1	0.3	0.0	2	0.7	0.1	0.1	0.7	4	-1.4	-5	0.9	1	(N/A)	0.1	1.45
Broadleaf Evergreen Small	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)	0.1	0.27
Oak	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
Norway spruce	0.6	0.1	0.4	0.1	4	0.9	0.1	0.1	0.8	5	-2.9	-11	0.3	-2	(N/A)	0.1	-1.58
Basswood	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
Blue spruce	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2	(N/A)	0.1	1.53
Eastern hophornbeam	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
Conifer Evergreen Large	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
Tulip tree	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
Dogwood	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
Citywide total	247.1	42.0	123.2	11.6	1,339	670.0	97.5	92.9	635.0	4,171	-131.2	-492	1,788.1	5,018	(N/A)	100.0	7.04

Lisbon

Table 4: Annual Carbon Stored

Stored CO_2 Benefits of Public Trees

1/29/2021

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	197,921	1,484	(N/A)	20.5	3.8	10.17
Norway maple	781,054	5,858	(N/A)	13.9	15.0	59.17
Silver maple	1,232,117	9,241	(N/A)	8.4	23.7	154.01
Sugar maple	488,344	3,663	(N/A)	6.0	9.4	85.18
Callery pear	161,659	1,212	(N/A)	5.0	3.1	33.68
Northern white cedar	14,349	108	(N/A)	4.6	0.3	3.26
Red maple	173,068	1,298	(N/A)	4.6	3.3	39.33
White ash	258,819	1,941	(N/A)	4.3	5.0	62.62
Green ash	321,779	2,413	(N/A)	3.9	6.2	86.19
Northern hackberry	89,256	669	(N/A)	2.4	1.7	39.38
Black walnut	276,193	2,071	(N/A)	2.0	5.3	147.96
Pin oak	300,019	2,250	(N/A)	1.8	5.8	173.09
Japanese tree lilac	7,810	59	(N/A)	1.7	0.2	4.88
Northern red oak	118,667	890	(N/A)	1.7	2.3	74.17
Maple	38,959	292	(N/A)	1.5	0.7	26.56
Littleleaf linden	66,765	501	(N/A)	1.5	1.3	45.52
Swamp white oak	78,683	590	(N/A)	1.4	1.5	59.01
American basswood	186,342	1,398	(N/A)	1.4	3.6	139.76
Amur maple	12,218	92	(N/A)	1.4	0.2	9.16
Bur oak	84,166	631	(N/A)	1.4	1.6	63.12
American sycamore	82,010	615	(N/A)	1.3	1.6	68.34
Honeylocust	49,021	368	(N/A)	1.0	0.9	52.52
Black cherry	13,917	104	(N/A)	0.8	0.3	17.40
Broadleaf Deciduous	247	2	(N/A)	0.8	0.0	0.31
Elm	8,749	66	(N/A)	0.7	0.2	13.12
River birch	57,339	430	(N/A)	0.7	1.1	86.01
Eastern redbud	889	7	(N/A)	0.7	0.0	1.33
Eastern red cedar	2,207	17	(N/A)	0.4	0.0	5.52
Eastern white pine	22,471	169	(N/A)	0.4	0.4	56.18
Southern magnolia	1,997	15	(N/A)	0.4	0.0	4.99
Ginkgo	14	0	(N/A)	0.4	0.0	0.03
Quaking aspen	24	0	(N/A)	0.3	0.0	0.09
Spruce	14,981	112	(N/A)	0.3	0.3	56.18
Mulberry	28	0	(N/A)	0.3	0.0	0.10
Ash	7,945	60	(N/A)	0.1	0.2	59.59
Black maple	17	0	(N/A)	0.1	0.0	0.13
Kentucky coffeetree	15,773	118	(N/A)	0.1	0.3	118.30
Scotch pine	3,343	25	(N/A)	0.1	0.1	25.07
Broadleaf Evergreen S	14	0	(N/A)	0.1	0.0	0.10
Oak	8,458	63	(N/A)	0.1	0.2	63.43
Norway spruce	7,490	56	(N/A)	0.1	0.1	56.18
Basswood	185	1	(N/A)	0.1	0.0	1.39
Blue spruce	284	2	(N/A)	0.1	0.0	2.13
Eastern hophornbeam	3,037	23	(N/A)	0.1	0.1	22.78
Conifer Evergreen La	7,490	56	(N/A)	0.1	0.1	56.18
Tulip tree	185	1	(N/A)	0.1	0.0	1.39
Dogwood	178	1	(N/A)	0.1	0.0	1.33
Citywide total	5,196,479	38,974	(N/A)	100.0	100.0	54.66

The value of stored carbon dioxide is calculated as the total amount of carbon dioxide sequestered annually over the life of each tree, summed for the population. This value should not be added to the Replacement Value or double-counting of the carbon dioxide storage benefit will occur.

Lisbon

Annual CO_2 Benefits of Public Trees

1/29/2021

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	18,531	139	-951	-171	-8	19,998	150	37,407	281 (N/A)	20.5	7.2	1.92
Norway maple	34,943	262	-3,750	-266	-30	43,248	324	74,175	556 (N/A)	13.9	14.2	5.62
Silver maple	86,582	649	-5,916	-223	-46	32,870	247	113,312	850 (N/A)	8.4	21.7	14.16
Sugar maple	25,830	194	-2,345	-125	-19	19,782	148	43,142	324 (N/A)	6.0	8.3	7.52
Callery pear	12,925	97	-777	-71	-6	12,445	93	24,521	184 (N/A)	5.0	4.7	5.11
Northern white cedar	1,510	11	-69	-28	-1	2,814	21	4,226	32 (N/A)	4.6	0.8	0.96
Red maple	17,253	129	-831	-70	-7	13,247	99	29,599	222 (N/A)	4.6	5.7	6.73
White ash	25,406	191	-1,242	-81	-10	16,532	124	40,615	305 (N/A)	4.3	7.8	9.83
Green ash	18,496	139	-1,545	-80	-12	13,507	101	30,377	228 (N/A)	3.9	5.8	8.14
Northern hackberry	4,334	33	-428	-36	-3	6,279	47	10,147	76 (N/A)	2.4	1.9	4.48
Black walnut	10,764	81	-1,326	-51	-10	7,927	59	17,315	130 (N/A)	2.0	3.3	9.28
Pin oak	14,219	107	-1,440	-53	-11	8,043	60	20,769	156 (N/A)	1.8	4.0	11.98
Japanese tree lilac	1,033	8	-38	-11	0	1,110	8	2,095	16 (N/A)	1.7	0.4	1.31
Northern red oak	3,832	29	-570	-33	-5	4,309	32	7,539	57 (N/A)	1.7	1.4	4.71
Maple	3,793	28	-187	-17	-2	2,969	22	6,558	49 (N/A)	1.5	1.3	4.47
Littleleaf linden	7,000	53	-320	-25	-3	3,601	27	10,255	77 (N/A)	1.5	2.0	6.99
Swamp white oak	3,567	27	-379	-25	-3	3,900	29	7,063	53 (N/A)	1.4	1.4	5.30
American basswood	10,186	76	-894	-32	-7	4,466	33	13,725	103 (N/A)	1.4	2.6	10.29
Amur maple	1,238	9	-59	-11	-1	1,384	10	2,552	19 (N/A)	1.4	0.5	1.91
Bur oak	3,172	24	-404	-19	-3	2,649	20	5,399	40 (N/A)	1.4	1.0	4.05
American sycamore	1,457	11	-394	-12	-3	1,494	11	2,545	19 (N/A)	1.3	0.5	2.12
Honeylocust	32	0	-235	-12	-2	2,492	19	2,277	17 (N/A)	1.0	0.4	2.44
Black cherry	696	5	-67	-9	-1	1,119	8	1,738	13 (N/A)	0.8	0.3	2.17
Broadleaf Deciduous Smal	81	1	-1	-2	0	65	0	144	1 (N/A)	0.8	0.0	0.18
Elm	1,248	9	-42	-6	0	1,042	8	2,241	17 (N/A)	0.7	0.4	3.36
River birch	1,576	12	-276	-15	-2	2,219	17	3,504	26 (N/A)	0.7	0.7	5.26
Eastern redbud	190	1	-4	-3	0	186	1	368	3 (N/A)	0.7	0.1	0.55
Eastern red cedar	1	0	-11	-4	0	380	3	366	3 (N/A)	0.4	0.1	0.91
Eastern white pine	0	0	-108	-14	-1	933	7	811	6 (N/A)	0.4	0.2	2.03
Southern magnolia	175	1	-10	-3	0	506	4	668	5 (N/A)	0.4	0.1	1.67
Ginkgo	7	0	0	-1	0	11	0	17	0 (N/A)	0.4	0.0	0.04
Quaking aspen	5	0	0	0	0	9	0	13	0 (N/A)	0.3	0.0	0.05
Spruce	0	0	-72	-9	-1	622	5	541	4 (N/A)	0.3	0.1	2.03

Annual CO_2 Benefits of Public Trees

Table 5 Continued

1/29/2021

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
Mulberry	17	0	0	0	0	11	0	28	0 (N/A)	0.3	0.0	0.10
Ash	470	4	-38	-3	0	440	3	869	7 (N/A)	0.1	0.2	6.52
Black maple	3	0	0	0	0	7	0	9	0 (N/A)	0.1	0.0	0.07
Kentucky coffeetree	857	6	-76	-4	-1	552	4	1,330	10 (N/A)	0.1	0.3	9.97
Scotch pine	187	1	-16	-3	0	246	2	415	3 (N/A)	0.1	0.1	3.11
Broadleaf Evergreen Small	4	0	0	0	0	14	0	18	0 (N/A)	0.1	0.0	0.13
Oak	660	5	-41	-3	0	441	3	1,058	8 (N/A)	0.1	0.2	7.93
Norway spruce	256	2	-36	-4	0	311	2	528	4 (N/A)	0.1	0.1	3.96
Basswood	74	1	-1	-1	0	49	0	121	1 (N/A)	0.1	0.0	0.91
Blue spruce	39	0	-1	-1	0	106	1	142	1 (N/A)	0.1	0.0	1.07
Eastern hophornbeam	268	2	-15	-2	0	308	2	560	4 (N/A)	0.1	0.1	4.20
Conifer Evergreen Large	0	0	-36	-5	0	311	2	270	2 (N/A)	0.1	0.1	2.02
Tulip tree	74	1	-1	-1	0	49	0	121	1 (N/A)	0.1	0.0	0.91
Dogwood	38	0	-1	-1	0	37	0	74	1 (N/A)	0.1	0.0	0.55
Citywide total	313,028	2,348	-24,952	-1,546	-199	235,038	1,763	521,568	3,912 (N/A)	100.0	100.0	5.49

Annual Aesthetic/Other Benefits of Public Trees

1/29/2021

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	1,056	(N/A)	20.5	3.7	7.23
Norway maple	3,317	(N/A)	13.9	11.6	33.50
Silver maple	6,593	(N/A)	8.4	23.1	109.88
Sugar maple	2,713	(N/A)	6.0	9.5	63.10
Callery pear	1,289	(N/A)	5.0	4.5	35.80
Northern white cedar	518	(N/A)	4.6	1.8	15.71
Red maple	2,167	(N/A)	4.6	7.6	65.65
White ash	2,899	(N/A)	4.3	10.2	93.51
Green ash	1,559	(N/A)	3.9	5.5	55.66
Northern hackberry	648	(N/A)	2.4	2.3	38.13
Black walnut	822	(N/A)	2.0	2.9	58.70
Pin oak	1,095	(N/A)	1.8	3.8	84.26
Japanese tree lilac	57	(N/A)	1.7	0.2	4.79
Northern red oak	272	(N/A)	1.7	1.0	22.65
Maple	490	(N/A)	1.5	1.7	44.54
Littleleaf linden	743	(N/A)	1.5	2.6	67.54
Swamp white oak	332	(N/A)	1.4	1.2	33.15
American basswood	687	(N/A)	1.4	2.4	68.74
Amur maple	70	(N/A)	1.4	0.2	6.98
Bur oak	318	(N/A)	1.4	1.1	31.77
American sycamore	132	(N/A)	1.3	0.5	14.67
Honeylocust	1	(N/A)	1.0	0.0	0.17
Black cherry	39	(N/A)	0.8	0.1	6.58
Broadleaf Deciduous Small	2	(N/A)	0.8	0.0	0.37
Elm	150	(N/A)	0.7	0.5	29.95
River birch	139	(N/A)	0.7	0.5	27.74
Eastern redbud	10	(N/A)	0.7	0.0	2.06
Eastern red cedar	4	(N/A)	0.4	0.0	1.42
Eastern white pine	0	(N/A)	0.4	0.0	0.00
Southern magnolia	54	(N/A)	0.4	0.2	17.97
Ginkgo	1	(N/A)	0.4	0.0	0.37
Quaking aspen	11	(N/A)	0.3	0.0	5.26
Spruce	0	(N/A)	0.3	0.0	0.00
Mulberry	0	(N/A)	0.3	0.0	0.03
Ash	43	(N/A)	0.1	0.2	43.05
Black maple	0	(N/A)	0.1	0.0	0.04
Kentucky coffeetree	66	(N/A)	0.1	0.2	65.59
Scotch pine	47	(N/A)	0.1	0.2	47.08
Broadleaf Evergreen Small	0	(N/A)	0.1	0.0	0.50
Oak	58	(N/A)	0.1	0.2	57.69
Norway spruce	26	(N/A)	0.1	0.1	26.25
Basswood	15	(N/A)	0.1	0.1	14.73
Blue spruce	21	(N/A)	0.1	0.1	21.08
Eastern hophornbeam	15	(N/A)	0.1	0.1	15.48
Conifer Evergreen Large	0	(N/A)	0.1	0.0	0.00
Tulip tree	15	(N/A)	0.1	0.1	14.73
Dogwood	2	(N/A)	0.1	0.0	2.06
Citywide total	28,496	(N/A)	100.0	100.0	39.97

Lisbon

Total Annual Benefits, Net Benefits, and Costs for Public Trees

1/29/2021

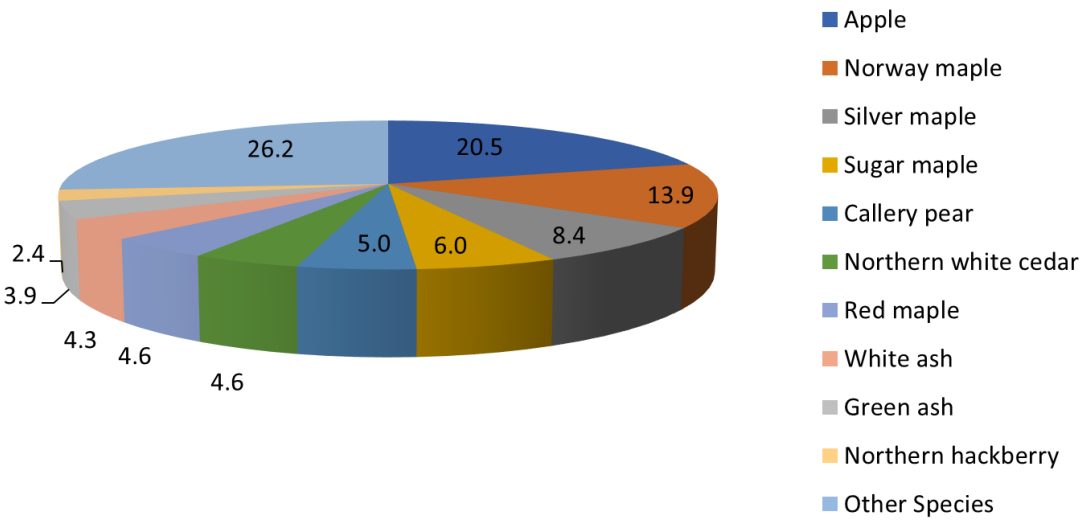
Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	29,556	(N/A)	41.45	(N/A)	0.00	(N/A)
CO2	3,912	(N/A)	5.49	(N/A)	0.00	(N/A)
Air Quality	5,018	(N/A)	7.04	(N/A)	0.00	(N/A)
Stormwater	38,553	(N/A)	54.07	(N/A)	0.00	(N/A)
Aesthetic/Other	28,496	(N/A)	39.97	(N/A)	0.00	(N/A)
Total Benefits	105,535	(N/A)	148.02	(N/A)	0.00	(N/A)
Costs						
Planting	0		0.00		0.00	
Contract Pruning	0		0.00		0.00	
Pest Management	0		0.00		0.00	
Irrigation	0		0.00		0.00	
Removal	0		0.00		0.00	
Administration	0		0.00		0.00	
Inspection/Service	0		0.00		0.00	
Infrastructure Repairs	0		0.00		0.00	
Litter Clean-up	0		0.00		0.00	
Liability/Claims	0		0.00		0.00	
Other Costs	0		0.00		0.00	
Total Costs	0		0.00		0.00	
Net Benefits	105,535	(N/A)	148.02	(N/A)	0.00	(N/A)
Benefit-cost ratio	0.00	(N/A)				

Lisbon

Species Distribution of Public Trees

1/29/2021

Figure 1: Species Distribution



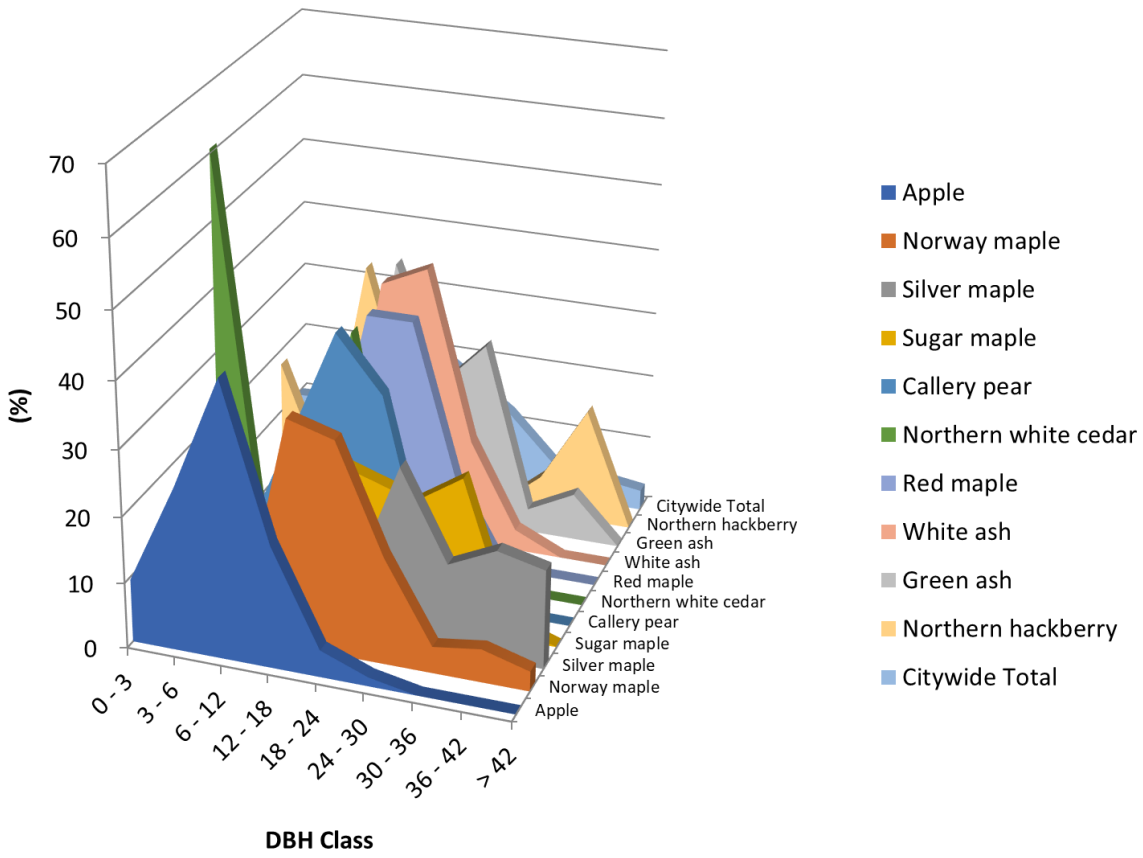
Species	Percent
Apple	20.5
Norway maple	13.9
Silver maple	8.4
Sugar maple	6.0
Callery pear	5.0
Northern white cedar	4.6
Red maple	4.6
White ash	4.3
Green ash	3.9
Northern hackberry	2.4
Other Species	26.2
Total	100.0

Lisbon

Figure 2: Relative Age Class

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

1/29/2021



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Apple	9.59	24.66	41.78	18.49	4.11	1.37	0.00	0.00	0.00
Norway maple	0.00	2.02	3.03	34.34	32.32	16.16	4.04	5.05	3.03
Silver maple	0.00	3.33	10.00	6.67	8.33	26.67	13.33	16.67	15.00
Sugar maple	0.00	2.33	9.30	23.26	20.93	18.60	23.26	2.33	0.00
Callery pear	0.00	5.56	22.22	38.89	30.56	2.78	0.00	0.00	0.00
Northern white cedar	60.61	0.00	3.03	36.36	0.00	0.00	0.00	0.00	0.00
Red maple	6.06	3.03	6.06	36.36	36.36	12.12	0.00	0.00	0.00
White ash	0.00	0.00	0.00	38.71	41.94	16.13	3.23	0.00	0.00
Green ash	0.00	0.00	0.00	39.29	21.43	28.57	3.57	7.14	0.00
Northern hackberry	17.65	0.00	35.29	11.76	11.76	0.00	5.88	17.65	0.00
Citywide Total	9.96	10.24	15.71	22.02	17.25	12.34	5.33	4.07	3.09

Figure 3: Foliage Condition

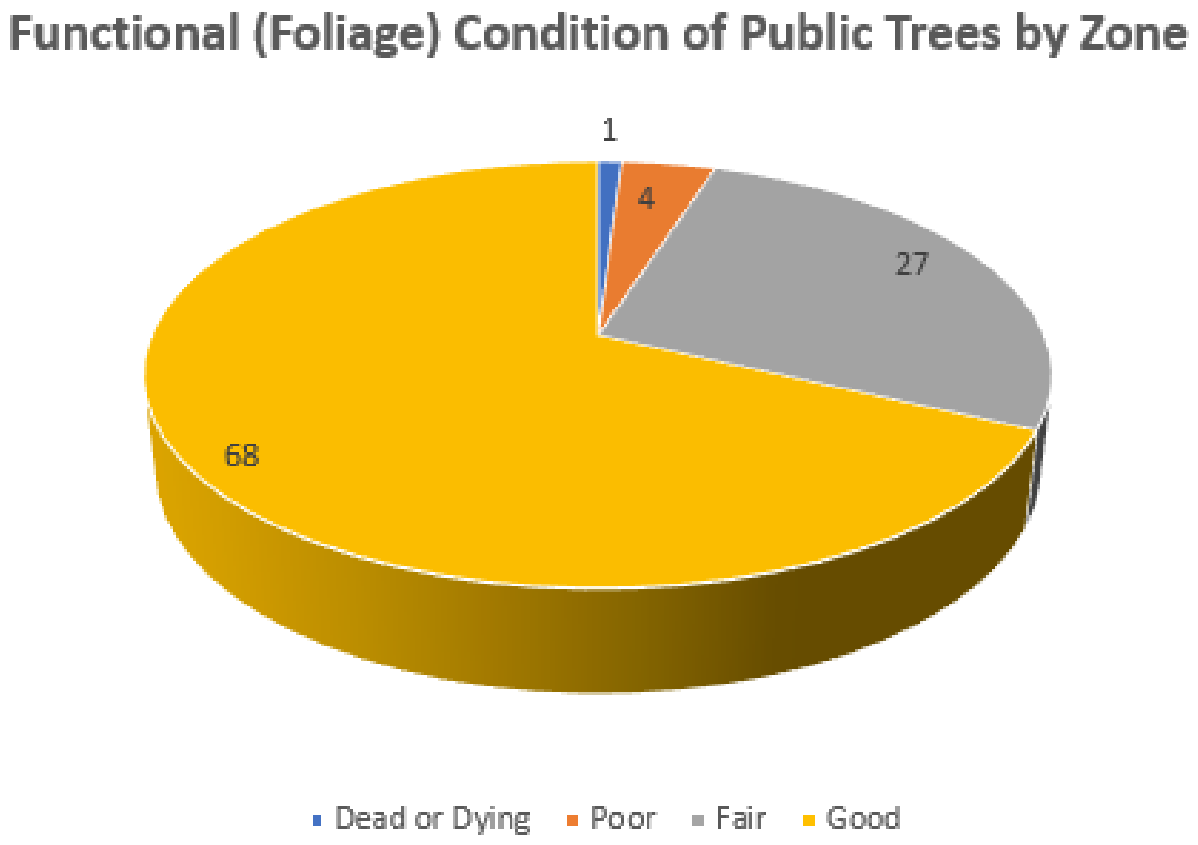


Figure 4: Wood Condition

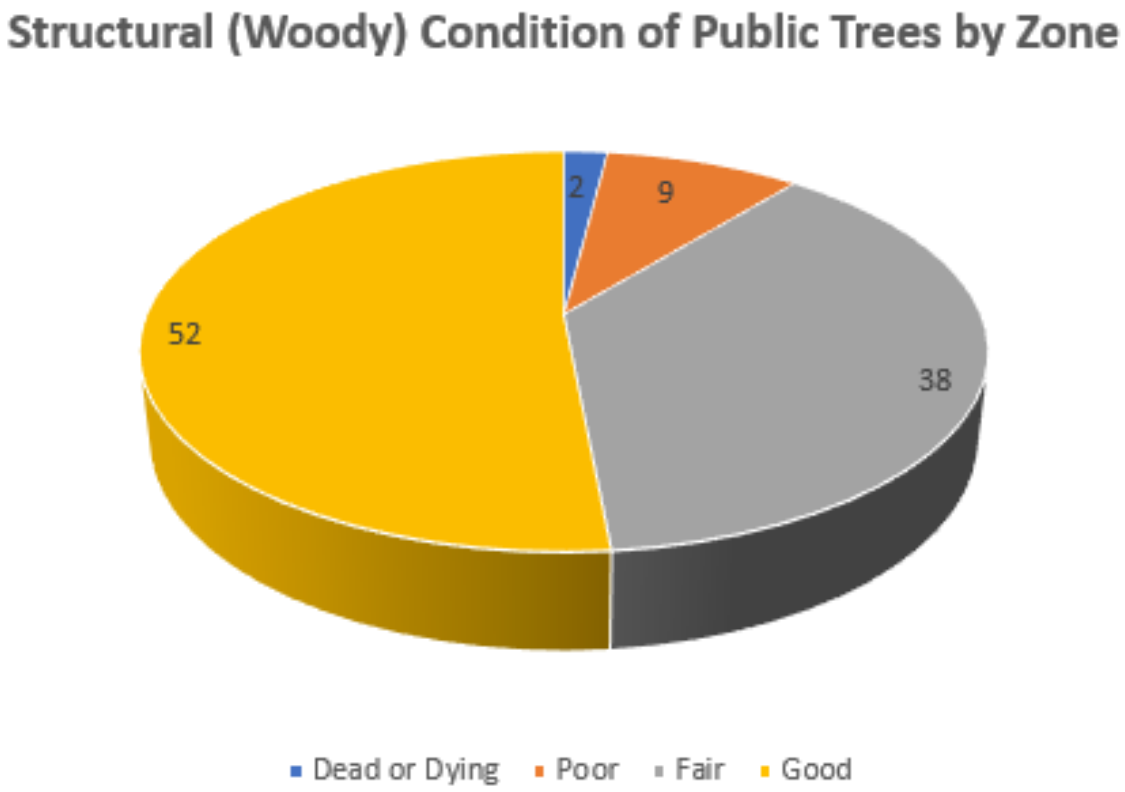
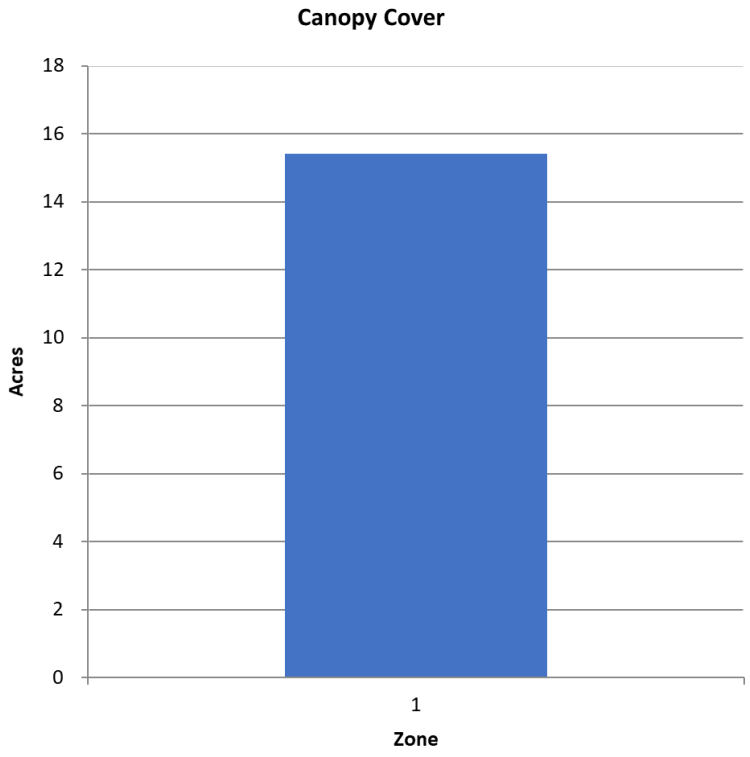


Figure 5: Canopy Cover in Acres

Lisbon

Canopy Cover of Public Trees (Acres)

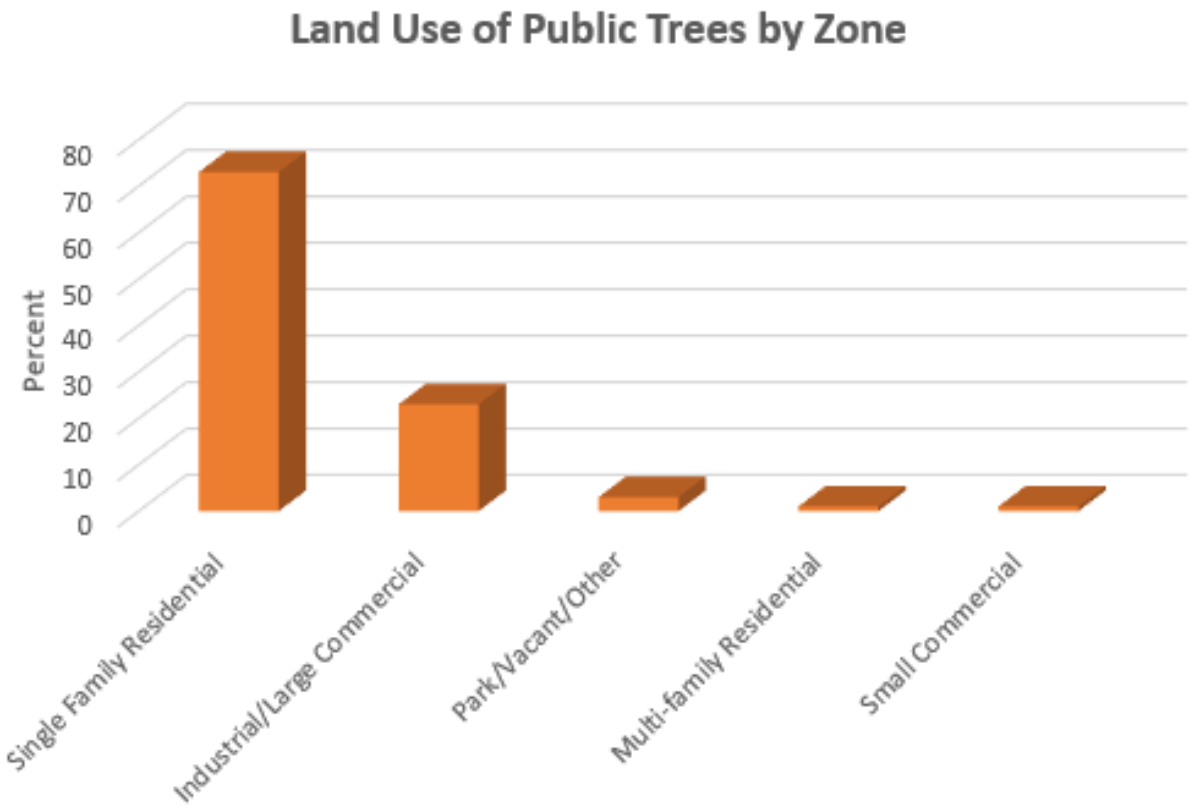
1/29/2021



Zone	Acres	% of Total Canopy Cover
1	15	100.0
Citywide total	15	100.0

	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide Total	0	0	15	0.00	0.00

Figure 6: Land Use of City/Park Trees



APPENDIX B: ArcGIS MAPPING

Figure 1: Location of Ash Trees

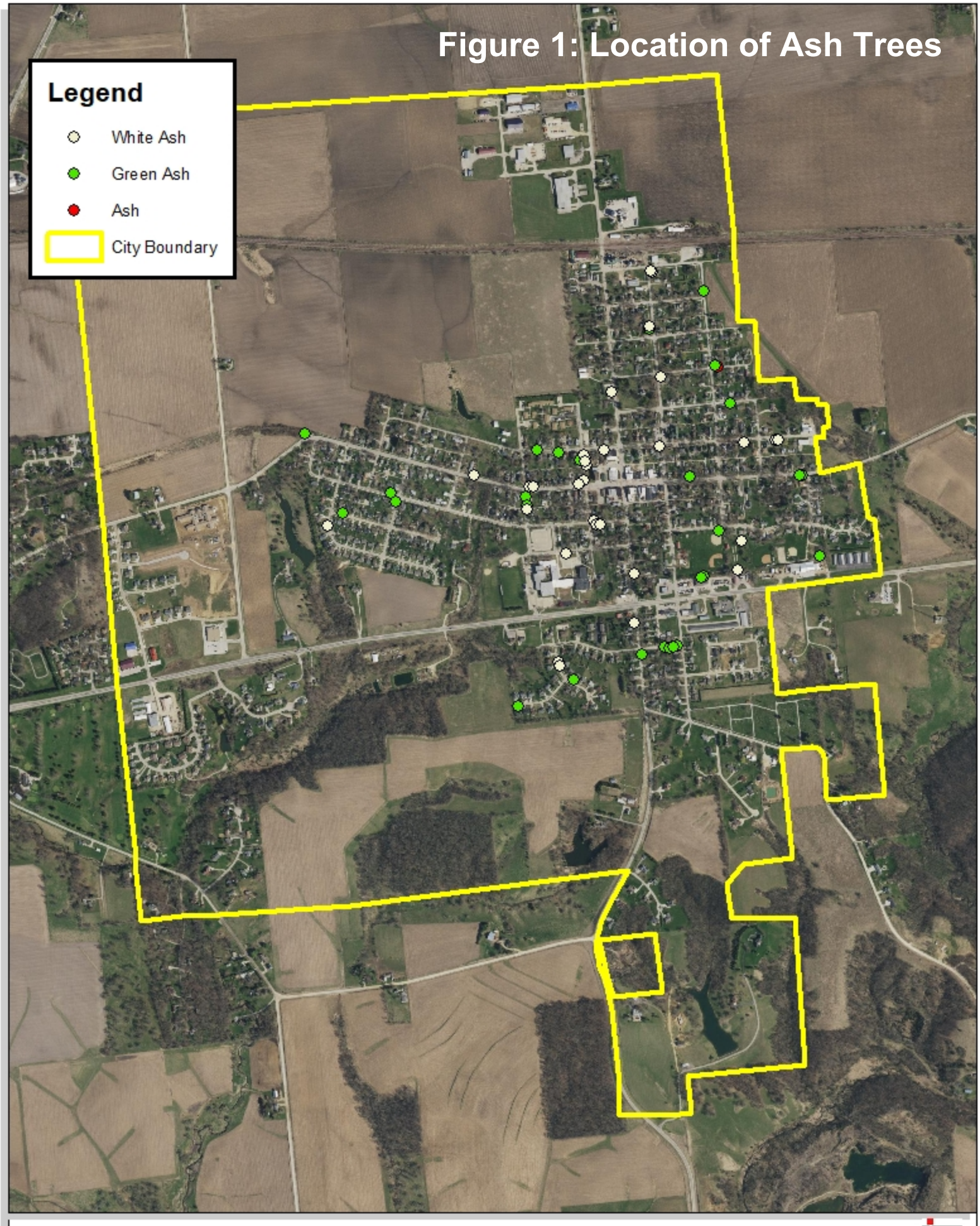


Figure 2: Location of EAB Symptoms

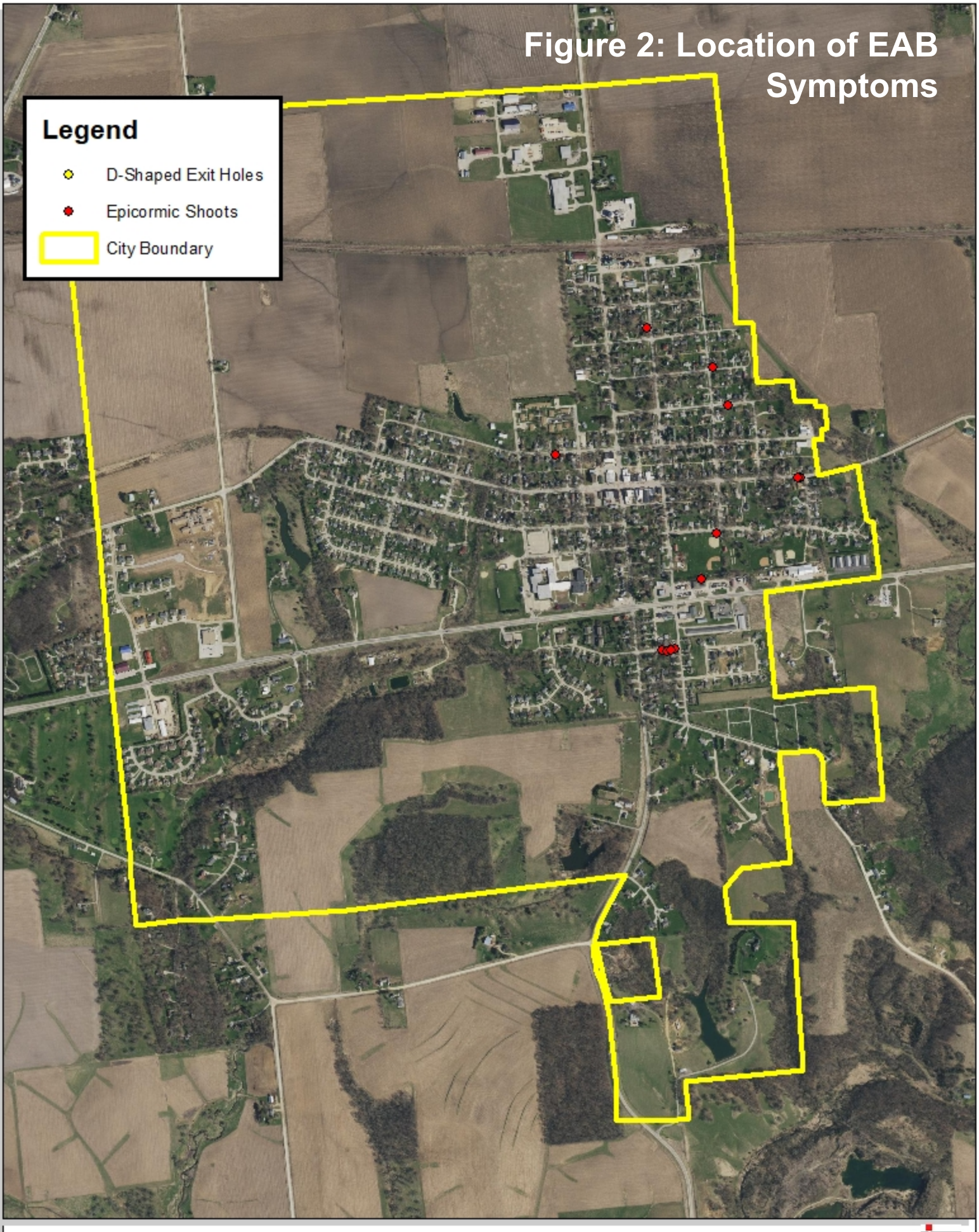
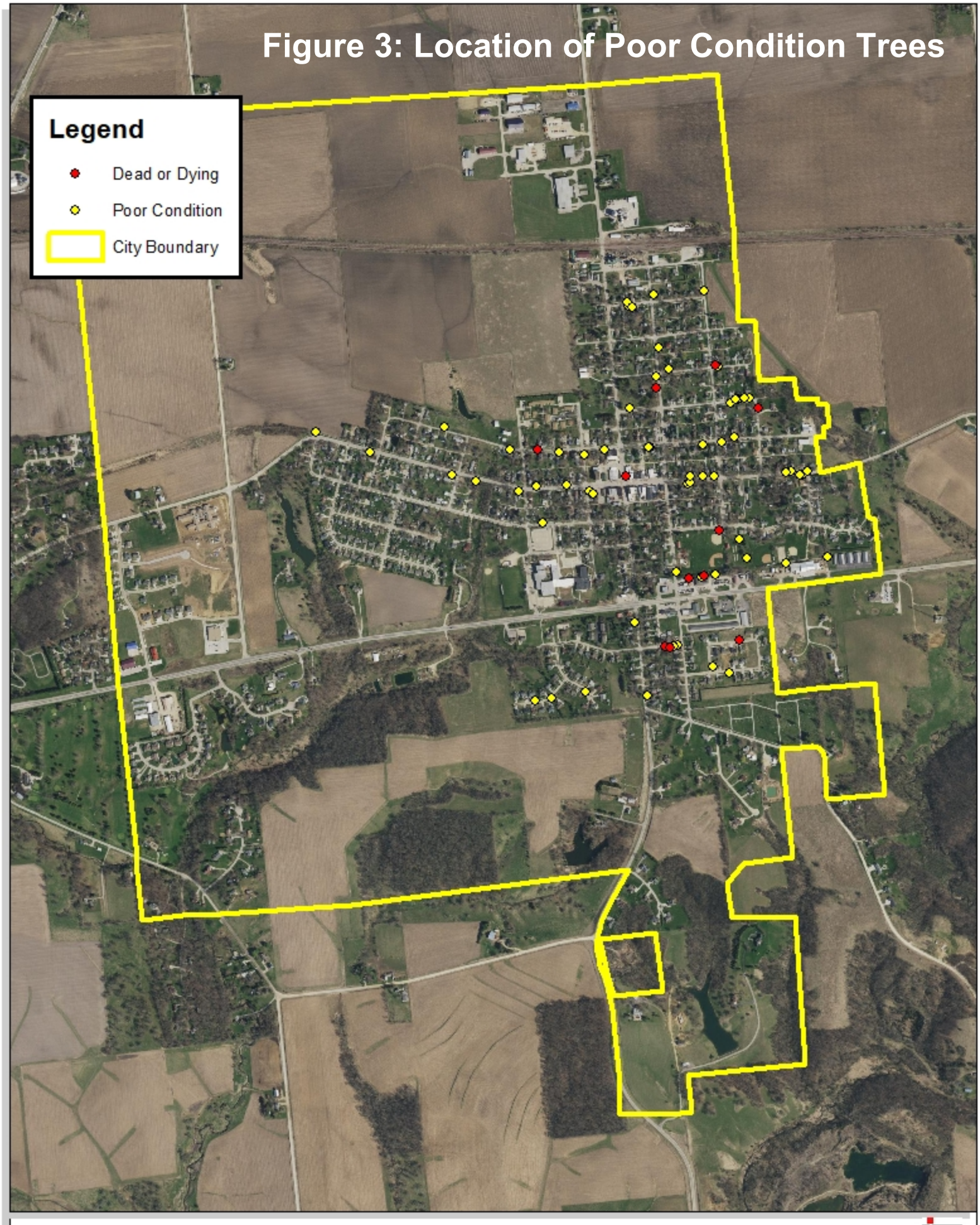
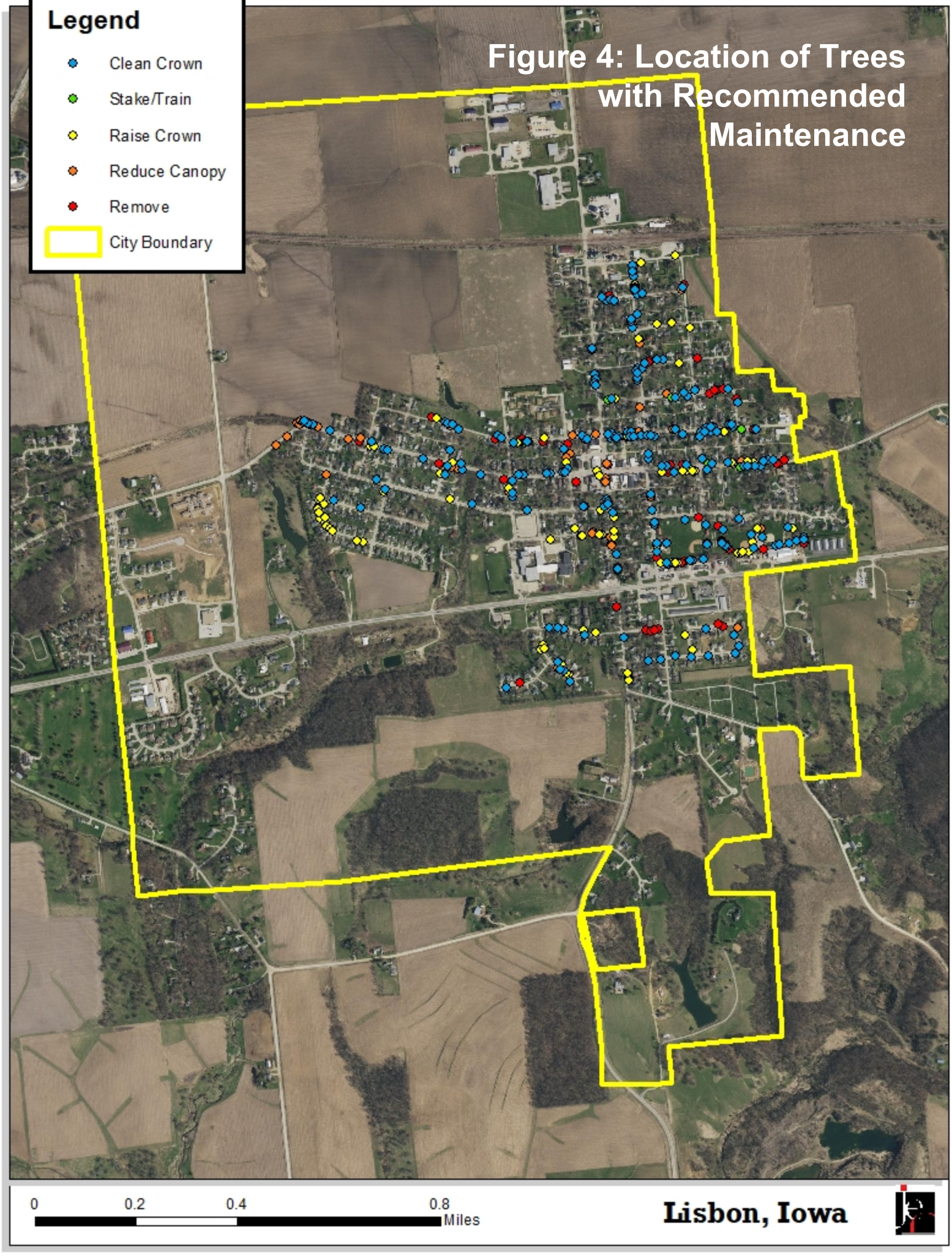


Figure 3: Location of Poor Condition Trees




Legend
Clean Crown
Stake/Train
Raise Crown
Reduce Canopy
Remove
City Boundary
Figure 4: Location of Trees with Recommended Maintenance
0
0.2
0.4
0.8
Miles
Lisbon, Iowa

APPENDIX C: LISBON TREE ORDINANCES

151.01 PURPOSE.

The purpose of this chapter is to assume charge, custody, and control of all plantings upon the public streets, parking, and upon public property by the City; to provide rules and regulation relating thereto and to define nuisances and provide for their abatement, in order to provide for the safety, preserve the health, promote the prosperity, improve the order, comfort and convenience of the City.

151.02 DEFINITIONS.

For use in this chapter, the following terms are defined:

1. "Corner lot" means a lot at all intersecting streets and on curves of a continuous street.
2. "Large tree" means any tree with a mature height of more than 30 feet.
3. "Park trees" means and includes trees, shrubs, and all other woody vegetation in public parks having individual names, and all areas owned by the City or to which the public has free access as a park.
4. "Parking" means that part of the street, avenue, or highway in the City not covered by sidewalk and lying between the lot line and 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.
5. "Property owner" means any person owning private property in the City as shown by the County Auditor's plats of the City.
6. "Public property" means any and all property located within the confines of the City and owned by the City or held in the name of the City by any of the departments, commissions, or agencies within the City government.
7. "Shrub" means any multiple stemmed woody plant.
8. "Small tree" means any tree with a mature height of 15 to 30 feet.
9. "Street tree" means and includes trees, shrubs, and all other woody vegetation on land lying between property lines on either side of all streets, avenues, or ways within the City.
10. "Tree" means a single stemmed woody plant with a mature height of a minimum of 15 feet.

151.03 PLANTING RESTRICTIONS.

1. No person shall plant any tree on the parking, street, or other public property without first obtaining City approval.
2. Restricted Trees. The Tree Board shall recommend and the Council shall adopt, after consideration of the Tree Board's recommendations, a list of restricted trees. The list of restricted trees provides that "no person shall plant any of the following trees on the

parking, street or any other public property." The list of restricted trees is on file in the office of the Clerk. The list of restricted trees may be amended from time to time upon approval of the Council.

3. Spacing. All trees hereafter planted in any street shall be planted midway between the outer line of the sidewalk and curb. In the event a curb line is not established, trees shall be planted on a line between the outer line of the sidewalk (or property) and the edge of the vehicular travel way, and at a place reasonably consistent with the pattern of those plantings that are adjacent to hard-surface streets. Small trees shall not be planted closer than 20 feet from one another or closer than 40 feet to a large tree. Large trees shall not be planted closer than 40 feet from one another.

4. Planting.

    a. Size. All trees planted on public property shall be of sufficient size to warrant satisfactory results and stand common abuse.

    b. Grade. Unless otherwise allowed for substantial reasons, all standard sized trees shall have comparatively straight trunks, well-developed leaders, and top and root characteristics of the species or variety showing evidence of proper nursery pruning. All trees must be free of insects, disease, mechanical injuries, and other objectionable features at the time of planting.

    c. Method of Support. Trees may be guyed or supported in an upright position according to accepted arboricultural practices. The guys or supports shall be fastened in such a way that they will not girdle or cause serious injury to the trees or endanger public safety.

    d. Distance from Street Corners, Alleys, and Fireplugs. No street trees shall be planted closer than 20 feet to the intersecting lot lines of a corner lot. No street trees shall be planted within 7 feet of any alley or driveway. No street trees shall be planted closer than 10 feet of any fireplug or utility pole.

    e. Distance from Utilities. No street trees other than those species listed as small trees as approved by the City Council may be planted under or within 10 lateral feet of any overhead utility wire, or over or within 5 lateral feet of any underground water line or sewer line.

5. Trimming or Pruning.

    a. The owner or agent of private property shall be responsible for keeping the trees thereon which overhang the street trimmed so that all branches will be at least 13 feet above the surface of the street and 9 feet above sidewalks.

    b. If the property owner fails to trim the trees as required by this chapter, the City may serve notice on the property owner requiring that such action be taken within five days. If such trimming or pruning is not completed within five days of the written notice, the City may perform the required action and assess the costs against the property for collection in the same manner as a property tax.

151.04 PUBLIC TREE CARE.

The City shall have the right to plant, prune, maintain, and remove trees, plants, and shrubs within the lines of all streets, alleys, avenues, lanes, squares, and public grounds, as may be necessary to insure public safety or to preserve or enhance the symmetry and beauty of such public grounds. The City may remove – or order to be removed – any tree or part thereof which is in an unsafe condition or which by reason of its nature is injurious to sewers, electric power lines, gas lines, water lines, or public improvements, or is affected with any injurious fungus, insect or other pest. This section does not prohibit the planting of trees by adjacent property owners, provided that the selection and location of such trees is in accordance with Section 151.03 of this chapter.

151.05 VISIBILITY AT INTERSECTIONS.

On a corner lot in any residential district, nothing shall be erected, placed, planted, or allowed to grow in such a manner as to materially impede vision between a height of 2½ and 10 feet above the centerline grades of the intersecting streets in the area bounded by the street lines of such corner lots and a line joining points along said street lines 25 feet from the point of intersection of the right-of-way lines. If a violation is discovered by a City employee, the City Administrator shall give a 20-day written notice to the property owner of occupant to remedy the violation. The notice shall specify the exact extent of the violation and provide that the property owner or occupant may appeal to the City Council if said owner or occupant disagrees with the notice. If the City Council finds that it agrees with the notice, it shall order the Street Superintendent to proceed with remedying any violations at the expense of the property owner or occupant.

151.06 PLANTINGS ON THE RIGHT-OF-WAY.

Shrubs, flowers, and/or any other plants may be grown on the public right-of-way if maintained under two feet above street level and if they present no safety hazard. Vegetables may not be grown on the public right- of-way.

151.07 FELLING OF TREES ONTO STREETS.

The Clerk shall be notified prior to the time that any tree located on private property is to be trimmed or removed, if said tree or any portion thereof will fall on a street, sidewalk, or alley. Such trimming or removal shall be performed in accordance with the following safety requirements:

1. No tree shall be felled onto any street without having person stationed in the streets to stop traffic from all directions at the time the tree is being dropped, unless the street has been duly barricaded by placing such signs, flags, flares, and barricades as are needed to warn persons of the danger of using the street, sidewalk, or alley.
2. Trees or branches that are felled or trimmed onto public property must be removed immediately unless an extension of time is granted by the Clerk in writing.
3. Before any tree or branch is felled onto public property, the person or contractor must show proof to the Clerk of a liability insurance policy in the amount of $1,000,000 per

person/$1,000,000 per accident for bodily injury liability and $1,000,000 per person/$1,000,000 aggregate for property damage liability.

151.08 REMOVAL OF TREES.

1. The removal of trees will normally be performed as part of any tree maintenance plan prepared by the Tree Board and approved by the City Council. The City Administrator has the authority to approve the trimming and removal of storm damaged trees.
2. On order of the Council, any tree on the streets of the City which interferes with the making of improvements or with travel shall be removed. The Council shall also order the removal of any trees on the street, not on private property, which are dead or have become diseased, or which constitute a danger to the public, or which may otherwise be declared a nuisance.

151.09 ABUSE OR MUTILATION OF PUBLIC TREES.

1. It is unlawful as a normal practice for any person, firm, or City department to top any tree on public property. Topping is defined as the severe cutting back of limbs to stubs larger than 3 inches in diameter within the tree's crown to such a degree so as to remove the normal canopy and disfigure the tree. Trees severely damaged by storms or other causes, or certain trees under utility wires or other obstructions where other pruning practices are impractical may be exempted from this chapter at the determination of the City Council. Unless specifically authorized by the City Tree Board, no person shall intentionally damage, cut, carve, transplant, or remove any tree on public property; attach any rope, wire, nail, advertising poster, or other contrivance to any tree on public property; allow any gaseous liquid or solid substance that is harmful to such trees to come in contact with them or with their roots; or set fire or permit any fire to burn when such fire or the heat thereof will injure any portion of any tree on public property.
2. The City shall assess to the person who causes damage to or loss of City trees the damage value based on estimate figures using the International Society of Arboriculture Standards.

151.10 PENALTY.

Any person violating any provisions of this chapter shall be in violation of this Code of Ordinances. Each day a violation occurs shall constitute a separate offense.

151.11 INTERFERENCE WITH CITY REPRESENTATIVE.

It is unlawful for any person to prevent, delay, or interfere with the City Tree Board, Street Superintendent, City Administrator, or any of their designees, while engaging in or participating in any planting, cultivation, mulching, pruning, spraying, removing or inspecting any street trees, park trees or other trees, shrubs, or other plantings on public property as specified in this chapter; provided, however, nothing herein shall be construed as an attempt to prohibit the pursuit of any remedy, legal or equitable, in any court of competent jurisdiction for the protection of property rights by the owner of any property within the City.

151.12 FUNDS RECEIVED FOR DAMAGES OR LOSS OF TREES.

Any funds received or collected by the City for damage or loss of street or park trees shall be placed in a City Tree Fund and designated for the purchase of replacement street and park trees.

151.13 APPEALS.

A decision of the Tree Board may be appealed to the City Council. All appeals must be made in writing, addressed to the Mayor and copies to the Chairperson of the Tree Board. The Council is required to hold a hearing on the appeal within 35 days of the receipt of said appeal. Written notice of the hearing date and time is to be mailed to the appellant and the Tree Board 10 days prior to said hearing date. The Council shall then make a written finding within 45 days of the hearing date, with a copy to the appellant and Tree Board. The decision of the Council will be final.