Le Claire, IA

2018 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Le Claire 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 16% of Le Claire's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2018, 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 176 trees inventoried.

- Le Claire's trees provide $25,857 of benefits annually, an average $147 a tree
- There are over 20 species of trees
- The top three genera are: Maple 23%, Oak 18%, and Pear 16.5%.
- 41% of trees are in need of some type of management
- 30 trees (20 ash) 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 30 trees needing removal, 7 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- 26 of the 28 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
- With the current budget it could take 7 years to remove ash – Suggestion: request a budget increase to $4,600 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2018, 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 176 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. Le Claire's trees reduce energy related costs by approximately $7,162 annually (Appendix A, Table 1). These savings are both in Electricity (34.06 MWh) and in Natural Gas (4,670 Therms).

Annual Stormwater Benefits

Le Claire's trees intercept about 394,898 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $10,702 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 Le Claire it is estimated that trees remove 461 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $1,316 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Le Claire trees sequester about 66,060 lbs of carbon a year with an associated value of $495 (Appendix A, Table 5). In addition, the trees store 1,932,332 lbs of carbon, with a yearly benefit of $14,492 lbs (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. Le Claire receives $5,826 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, Le Claire's trees provide $25,857 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 176 trees in Le Claire provide approximately $147 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Le Claire has over 20 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	40	23%
Oak	31	18%
Pear	29	16.5%
Ash	28	16%
Gingko	11	6%
Walnut	8	4.5%
Spruce	8	4.5%
Hackberry	3	1.7%
Apple	3	1.7%
Cherry	3	1.7%
Others	12	6.8%

Age Class

Most of Le Claire's trees (64%) are less than 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Le Claire'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 Le Claire indicate that 87% of the trees are in fair to good health, with 13% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 86% of Le Claire's trees are in fair to 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 14% of the population. This 14% 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	27	15.34%
Crown Raising	4	2.27%
Tree Staking	1	.57%
Tree Removal	30	17.5%
Crown Reduction	3	1.7%
Treat	7	3.98%

Canopy Cover

The total canopy with both private and public trees is 24%, 741 acres. The canopy cover included in the Le Claire inventory includes approximately 4.07 acres (Appendix A, Figure 4). The City's Canopy goal is to increase canopy by 3%, in 30 years. To achieve this goal it is estimated that 227 trees need to be planted annually.

Land Use and Location

The majority of Le Claire'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	21%
Park/vacant/other	46.6%
Industrial/Large commercial	0.0%
Small commercial	32.4%
Multifamily residential	0.0%

Location	
Planting strip	66%
Other maintained locations	8%
Cutout (surrounded by pavement)	25%
Front yard	1%

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

Le Claire has 7 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 7 trees over 30 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 45 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 30 removals, 21 are ash trees. There are a total of 28 ash trees, and 26 of those have signs and symptoms that have been associated with EAB. In

addition, there are 9 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Le Claire.

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 (23%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut, 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. 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.

Six Year Maintenance Plan with <u>No Additional Funding</u>

Year 1

Removal: 5 largest critical concern trees
Planting and Replacement: 7 trees to be planted in open locations
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 2 critical concern trees and 3 additional ash trees with poor health

*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 2 trees in open locations from year one removals
Young Tree Pruning & Maintenance:
Routine trimming: Contract to trim 1/3 of the city trees
Visual Survey for signs and symptoms of EAB

Year 3
Removal: 5 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 4
Removal: 5 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 5
Removal: 5 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 6
Removal: 5 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 7 trees in open locations from previous removals
Routine trimming: Contract to trim 1/3 of the city trees
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: Approximately 23 ash trees removed (approximately 82% of ash). It will take approximately 7 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 to 15 years of its arrival.
**To remove all ash trees within 6 years, the budget would need to be increased to $4,600 a year. If the budget were increased to $10,000 a year all ash could be removed in 2 years.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). *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 151.02 (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen.

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. City Code 151.06 states:

> **151.06 REMOVAL OF TREES.** The City shall remove any trees on the public right-of-ways of the City which interfere with the making of improvements or with travel thereon. The City shall additionally remove any trees on public places which have become diseased, or which constitute a danger to the public, or which may otherwise be declared a nuisance.

Budget

<u>Current Budget</u>
Total $24,000 over 6 years ($4,000/year)

FY 2019 Budget
Removal: $3000
*Or saving for ash tree treatment and/or future ash removal
Planting: $700
Watering & Maintenance: $300

FY 2020 Budget
Removal: $3000
*Or saving for ash tree treatment and/or future ash removal
Planting: $200
Routine trimming: $500
Watering & Maintenance: $300

FY 2021 Budget
Removal: $3000
*Or saving for ash tree treatment and/or future ash removal
Planting: $700

Watering & Maintenance: $300

FY 2022 Budget

Removal: $3000
*Or saving for ash tree treatment and/or future ash removal
Planting: $200
Routine trimming: $500
Watering & Maintenance: $300

FY 2023 Budget

Removal: $3000
*Or saving for ash tree treatment and/or future ash removal
Planting: $700
Watering & Maintenance: $300

FY 2024 Budget

Removal: $3000
*Or saving for ash tree treatment and/or future ash removal
Planting: $200
Routine trimming: $500
Watering & Maintenance: $300

*Reduction of ash over 6 years: approximately 23 ash trees removed (approximately 82% of ash). **It will take approximately 7 years to remove all ash with the current budget.**

<u>Purposed Budget Increase</u>

EAB could potentially kill all ash trees in Le Claire within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $4,500 a year. If the budget were increased to $10,000 a year all ash could be removed within 2 years. Additionally, it is recommended that Le Claire apply for grants to fund replacement trees. Utility Company grants are usually between $500 and $10,000 for community-based, tree-planting projects that include parks, gateways, cemeteries, nature trails, libraries, nursing homes, and schools.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For instance, in this treatment scenario, the average ash diameter is 20 inches and at $12 per inch, about 4 trees could be treated ($960) per year (1/2 treatable ash every other year treatment). This would be 7 total trees selected for treatment, and Le Claire would still need to find $3000 for removal. Alternatively, if there are 29 treated trees every other year, it would cost approximately $1,920 every 2 years for treatment and leave $1,080 for removal and $0 for planting. These are 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 when EAB is found in Le Claire. 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

Annual Energy Benefits of All Trees by Species				12/14/2018					
Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	6.42	486.93	810.07	793.87	1,280.80	(N/A)	15.91	17.88	45.74
Callery pear	2.45	185.94	393.79	385.92	571.86	(N/A)	13.64	7.98	23.83
Sugar maple	2.42	184.02	322.10	315.66	499.68	(N/A)	12.50	6.98	22.71
White oak	8.77	665.96	1,175.13	1,151.63	1,817.59	(N/A)	11.36	25.38	90.88
Ginkgo	0.02	1.84	4.52	4.43	6.28	(N/A)	6.25	0.09	0.57
Silver maple	1.36	103.13	183.68	180.00	283.13	(N/A)	5.11	3.95	31.46
Black walnut	2.93	222.03	408.97	400.79	622.83	(N/A)	4.55	8.70	77.85
Bur oak	1.75	132.63	235.30	230.59	363.23	(N/A)	3.41	5.07	60.54
Red maple	0.52	39.30	75.13	73.63	112.92	(N/A)	3.41	1.58	18.82
Blue spruce	0.44	33.66	66.17	64.85	98.51	(N/A)	3.41	1.38	16.42
Pear	0.30	22.73	51.95	50.91	73.64	(N/A)	2.84	1.03	14.73
Northern hackberry	1.10	83.81	159.77	156.58	240.38	(N/A)	1.70	3.36	80.13
Norway maple	0.46	35.25	70.46	69.05	104.30	(N/A)	1.70	1.46	34.77
Apple	0.40	30.55	63.87	62.59	93.15	(N/A)	1.70	1.30	31.05
Black cherry	0.60	45.45	94.87	92.97	138.42	(N/A)	1.70	1.93	46.14
American sycamore	0.97	73.57	126.21	123.69	197.26	(N/A)	1.14	2.75	98.63
Kentucky coffeetree	0.53	39.94	76.22	74.70	114.64	(N/A)	1.14	1.60	57.32
Oak	0.29	22.17	41.80	40.97	63.14	(N/A)	1.14	0.88	31.57
Eastern red cedar	0.16	12.16	24.37	23.88	36.04	(N/A)	1.14	0.50	18.02
Northern red oak	0.52	39.11	72.80	71.34	110.45	(N/A)	1.14	1.54	55.22
Others	1.65	124.90	213.15	208.88	333.78		5.11	4.66	37.09
Total	34.06	2,585.08	4,670.34	4,576.93	7,162.01	(N/A)	100.00	100.00	40.69

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of All Trees by Species				12/14/2018		
Species	Total Rainfall Interception (Gal)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	56,482.36	1,530.67	(N/A)	15.91	14.30	54.67
Callery pear	13,639.78	369.64	(N/A)	13.64	3.45	15.40
Sugar maple	25,500.71	691.07	(N/A)	12.50	6.46	31.41
White oak	134,488.86	3,644.65	(N/A)	11.36	34.06	182.23
Ginkgo	78.17	2.12	(N/A)	6.25	0.02	0.19
Silver maple	19,623.97	531.81	(N/A)	5.11	4.97	59.09
Black walnut	39,281.49	1,064.53	(N/A)	4.55	9.95	133.07
Bur oak	26,002.98	704.68	(N/A)	3.41	6.58	117.45
Red maple	4,152.60	112.54	(N/A)	3.41	1.05	18.76
Blue spruce	5,321.46	144.21	(N/A)	3.41	1.35	24.04
Pear	1,065.41	28.87	(N/A)	2.84	0.27	5.77
Northern hackberry	11,035.55	299.06	(N/A)	1.70	2.79	99.69
Norway maple	4,513.01	122.30	(N/A)	1.70	1.14	40.77
Apple	2,355.52	63.83	(N/A)	1.70	0.60	21.28
Black cherry	3,522.10	95.45	(N/A)	1.70	0.89	31.82
American sycamore	14,477.84	392.35	(N/A)	1.14	3.67	196.17
Kentucky coffeetree	5,181.36	140.41	(N/A)	1.14	1.31	70.21
Oak	2,762.32	74.86	(N/A)	1.14	0.70	37.43
Eastern red cedar	2,293.75	62.16	(N/A)	1.14	0.58	31.08
Northern red oak	6,060.58	164.24	(N/A)	1.14	1.53	82.12
Others	17,058.51	462.29		5.11	4.32	51.37
Citywide total	394,898.33	10,701.74	(N/A)	100.00	100.00	60.81

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of All Trees by Species					12/14/2018												
Species	Deposition O3 (lb)	Deposition NO2 (lb)	Deposition PM10 (lb)	Deposition SO2 (lb)	Total Deposition ($)	Avoided NO2 (lb)	Avoided PM10 (lb)	Avoided VOC (lb)	Avoided SO2 (lb)	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Stand. Error	% of Total Trees	Avg. $/tree
Green ash	6.53	1.05	3.27	0.29	35.22	30.02	4.42	4.22	29.08	188.55	0.00	0.00	78.89	223.77	(N/A)	15.91	7.99
Callery pear	1.30	0.22	0.88	0.06	7.70	12.24	1.74	1.65	11.12	74.94	- 0.45	- 1.68	28.77	80.96	(N/A)	13.64	3.37
Sugar maple	3.34	0.57	1.69	0.15	18.15	11.47	1.68	1.60	10.98	71.69	- 2.65	- 9.93	28.83	79.92	(N/A)	12.50	3.63
White oak	24.04	3.84	10.57	1.08	125.34	41.67	6.08	5.80	39.76	260.11	0.00	0.00	132.83	385.46	(N/A)	11.36	19.27
Ginkgo	0.00	0.00	0.00	0.00	0.01	0.13	0.02	0.02	0.11	0.76	0.00	0.00	0.27	0.77	(N/A)	6.25	0.07
Silver maple	3.52	0.60	1.72	0.16	18.97	6.45	0.94	0.90	6.15	40.23	- 1.92	- 7.19	18.51	52.02	(N/A)	5.11	5.78
Black walnut	5.45	0.87	2.49	0.24	28.69	14.05	2.04	1.94	13.26	87.30	0.00	0.00	40.34	115.99	(N/A)	4.55	14.50
Bur oak	4.40	0.70	1.95	0.20	23.00	8.31	1.21	1.16	7.92	51.84	0.00	0.00	25.85	74.84	(N/A)	3.41	12.47
Red maple	0.91	0.15	0.44	0.04	4.86	2.51	0.36	0.34	2.35	15.52	- 0.31	- 1.18	6.78	19.21	(N/A)	3.41	3.20
Blue spruce	0.54	0.11	0.50	0.07	3.72	2.16	0.31	0.30	2.01	13.34	- 1.73	- 6.50	4.26	10.56	(N/A)	3.41	1.76
Pear	0.18	0.03	0.11	0.01	1.03	1.53	0.22	0.20	1.36	9.27	0.00	0.00	3.63	10.29	(N/A)	2.84	2.06
Northern hackberry	1.73	0.30	0.88	0.08	9.43	5.36	0.77	0.74	5.01	33.17	0.00	0.00	14.86	42.60	(N/A)	1.70	14.20
Norway maple	0.93	0.16	0.46	0.04	5.01	2.28	0.33	0.31	2.11	14.06	- 0.22	- 0.82	6.40	18.26	(N/A)	1.70	6.09
Apple	0.87	0.14	0.39	0.04	4.57	2.00	0.29	0.27	1.82	12.25	0.00	- 0.02	5.81	16.80	(N/A)	1.70	5.60
Black cherry	1.30	0.21	0.59	0.06	6.85	2.97	0.42	0.40	2.71	18.22	- 0.01	- 0.03	8.66	25.04	(N/A)	1.70	8.35
American sycamore	3.17	0.51	1.38	0.14	16.48	4.57	0.67	0.64	4.39	28.62	0.00	0.00	15.47	45.10	(N/A)	1.14	22.55
Kentucky coffeetree	0.53	0.08	0.27	0.02	2.89	2.55	0.37	0.35	2.39	15.79	0.00	0.00	6.57	18.68	(N/A)	1.14	9.34
Oak	0.27	0.04	0.14	0.01	1.47	1.41	0.20	0.19	1.32	8.74	0.00	0.00	3.60	10.21	(N/A)	1.14	5.11
Eastern red cedar	0.41	0.08	0.33	0.05	2.66	0.78	0.11	0.11	0.73	4.83	- 1.25	- 4.70	1.34	2.80	(N/A)	1.14	1.40
Northern red oak	1.35	0.23	0.64	0.06	7.21	2.48	0.36	0.34	2.33	15.38	- 1.95	- 7.30	5.84	15.30	(N/A)	1.14	7.65
Others	4.40	0.76	2.23	0.23	24.08	7.75	1.14	1.08	7.46	48.53	- 1.45	- 5.45	23.60	67.15		5.11	7.46
Citywide Total	65.16	10.67	30.94	3.02	347.34	162.67	23.68	22.57	154.34	1,013.16	- 11.94	- 44.78	461.11	1,315.73	(N/A)	100.00	7.48

Table 4: Annual Carbon Stored

Stored CO2 Benefits of All Trees by Species				12/14/2018		
Species	Total stored CO2 (lbs)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	220,361.09	1,652.71	(N/A)	15.91	11.40	59.03
Callery pear	25,533.84	191.50	(N/A)	13.64	1.32	7.98
Sugar maple	99,210.19	744.08	(N/A)	12.50	5.13	33.82
White oak	825,487.42	6,191.16	(N/A)	11.36	42.72	309.56
Ginkgo	50.05	0.38	(N/A)	6.25	0.00	0.03
Silver maple	85,694.17	642.71	(N/A)	5.11	4.43	71.41
Black walnut	177,034.06	1,327.76	(N/A)	4.55	9.16	165.97
Bur oak	150,642.70	1,129.82	(N/A)	3.41	7.80	188.30
Red maple	10,197.14	76.48	(N/A)	3.41	0.53	12.75
Blue spruce	2,539.12	19.04	(N/A)	3.41	0.13	3.17
Pear	3,645.41	27.34	(N/A)	2.84	0.19	5.47
Northern hackberry	25,696.68	192.73	(N/A)	1.70	1.33	64.24
Norway maple	15,599.28	116.99	(N/A)	1.70	0.81	39.00
Apple	13,499.21	101.24	(N/A)	1.70	0.70	33.75
Black cherry	20,228.14	151.71	(N/A)	1.70	1.05	50.57
American sycamore	111,963.97	839.73	(N/A)	1.14	5.79	419.86
Kentucky coffeetree	16,915.36	126.87	(N/A)	1.14	0.88	63.43
Oak	8,643.14	64.82	(N/A)	1.14	0.45	32.41
Eastern red cedar	1,379.19	10.34	(N/A)	1.14	0.07	5.17
Northern red oak	30,477.89	228.58	(N/A)	1.14	1.58	114.29
Others	87,534.12	656.51		5.11	4.53	72.95
Citywide total	1,932,332.18	14,492.49	(N/A)	100.00	100.00	82.34

Table 5: Annual Carbon Sequestered

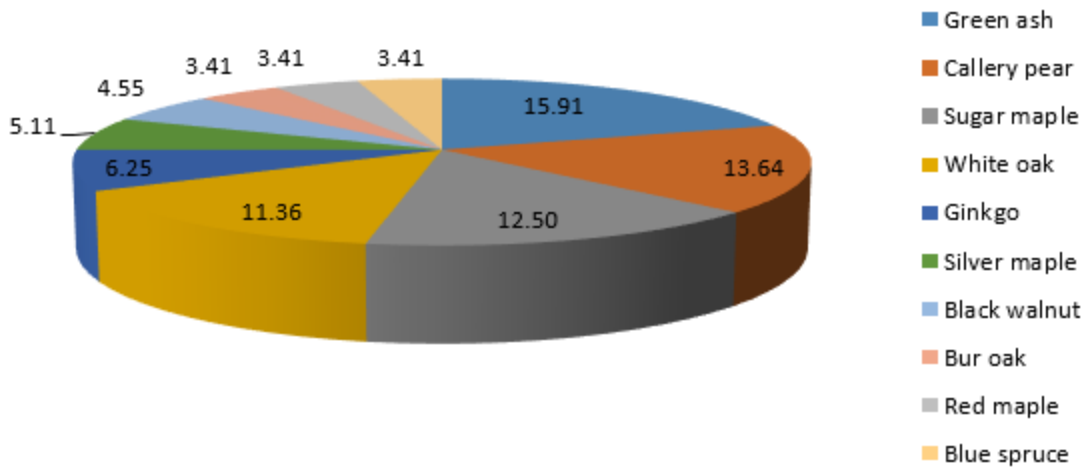
Annual CO2 Benefits of All Trees by Species					12/14/2018								
Species	Sequestered (lb)	Sequestered ($)	Decomposition Release(lb)	Maintenance Release (lb)	Total Release ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Stand. Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	13,015.81	97.62	- 1,057.73	- 62.40	- 8.40	10,760.96	80.71	22,656.64	169.92	(N/A)	15.91	19.96	6.07
Callery pear	5,246.41	39.35	- 123.26	- 27.50	- 1.13	4,109.23	30.82	9,204.88	69.04	(N/A)	13.64	8.11	2.88
Sugar maple	5,350.98	40.13	- 480.78	- 28.67	- 3.82	4,066.75	30.50	8,908.28	66.81	(N/A)	12.50	7.85	3.04
White oak	15,344.24	115.08	- 3,962.34	- 102.18	- 30.48	14,717.58	110.38	25,997.30	194.98	(N/A)	11.36	22.90	9.75
Ginkgo	24.23	0.18	- 0.40	- 2.15	- 0.02	40.73	0.31	62.41	0.47	(N/A)	6.25	0.05	0.04
Silver maple	6,033.00	45.25	- 412.89	- 16.58	- 3.22	2,279.20	17.09	7,882.73	59.12	(N/A)	5.11	6.94	6.57
Black walnut	7,368.57	55.26	- 849.76	- 31.98	- 6.61	4,906.91	36.80	11,393.74	85.45	(N/A)	4.55	10.04	10.68
Bur oak	3,308.34	24.81	- 723.08	- 20.67	- 5.58	2,931.14	21.98	5,495.72	41.22	(N/A)	3.41	4.84	6.87
Red maple	338.97	2.54	- 49.11	- 5.66	- 0.41	868.48	6.51	1,152.69	8.65	(N/A)	3.41	1.02	1.44
Blue spruce	283.77	2.13	- 12.19	- 7.80	- 0.15	743.86	5.58	1,007.65	7.56	(N/A)	3.41	0.89	1.26
Pear	464.18	3.48	- 17.54	- 4.88	- 0.17	502.23	3.77	943.99	7.08	(N/A)	2.84	0.83	1.42
Northern hackberry	1,469.80	11.02	- 123.34	- 10.53	- 1.00	1,852.07	13.89	3,187.99	23.91	(N/A)	1.70	2.81	7.97
Norway maple	319.56	2.40	- 75.58	- 6.05	- 0.61	778.97	5.84	1,016.91	7.63	(N/A)	1.70	0.90	2.54
Apple	965.59	7.24	- 64.84	- 5.66	- 0.53	675.17	5.06	1,570.26	11.78	(N/A)	1.70	1.38	3.93
Black cherry	956.91	7.18	- 97.10	- 8.97	- 0.80	1,004.33	7.53	1,855.17	13.91	(N/A)	1.70	1.63	4.64
American sycamore	957.73	7.18	- 537.43	- 11.70	- 4.12	1,625.88	12.19	2,034.48	15.26	(N/A)	1.14	1.79	7.63
Kentucky coffeetree	1,319.38	9.90	- 81.19	- 5.46	- 0.65	882.77	6.62	2,115.50	15.87	(N/A)	1.14	1.86	7.93
Oak	733.87	5.50	- 41.49	- 3.32	- 0.34	490.02	3.68	1,179.10	8.84	(N/A)	1.14	1.04	4.42
Eastern red cedar	82.71	0.62	- 6.62	- 3.12	- 0.07	268.79	2.02	341.76	2.56	(N/A)	1.14	0.30	1.28
Northern red oak	0.00	0.00	- 146.29	- 7.02	- 1.15	864.21	6.48	710.90	5.33	(N/A)	1.14	0.63	2.67
Others	2,476.59	18.57	- 420.86	- 20.87	- 3.31	2,760.24	20.70	4,795.11	35.96		5.11	4.22	4.00
Citywide Total	66,060.64	495.45	- 9,283.83	- 393.12	- 72.58	57,129.52	428.47	113,513.20	851.35	(N/A)	100.00	100.00	4.84

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefit of All Trees by Species				12/14/2018	
Species	Total ($)	Stand. Error	% of Total Trees	% of Total $	$/tree
Green ash	1,239.38	(N/A)	15.91	21.27	44.26
Callery pear	615.99	(N/A)	13.64	10.57	25.67
Sugar maple	559.21	(N/A)	12.50	9.60	25.42
White oak	998.69	(N/A)	11.36	17.14	49.93
Ginkgo	4.09	(N/A)	6.25	0.07	0.37
Silver maple	513.17	(N/A)	5.11	8.81	57.02
Black walnut	529.77	(N/A)	4.55	9.09	66.22
Bur oak	240.31	(N/A)	3.41	4.12	40.05
Red maple	59.79	(N/A)	3.41	1.03	9.96
Blue spruce	130.65	(N/A)	3.41	2.24	21.77
Pear	25.64	(N/A)	2.84	0.44	5.13
Northern hackberry	188.48	(N/A)	1.70	3.24	62.83
Norway maple	39.11	(N/A)	1.70	0.67	13.04
Apple	57.63	(N/A)	1.70	0.99	19.21
Black cherry	57.60	(N/A)	1.70	0.99	19.20
American sycamore	57.14	(N/A)	1.14	0.98	28.57
Kentucky coffeetree	115.37	(N/A)	1.14	1.98	57.69
Oak	72.42	(N/A)	1.14	1.24	36.21
Eastern red cedar	35.02	(N/A)	1.14	0.60	17.51
Northern red oak	0.00	(N/A)	1.14	0.00	0.00
Others	286.68		5.11	4.92	31.85
Citywide Total	5,826.16	(N/A)	100.00	100.00	33.10

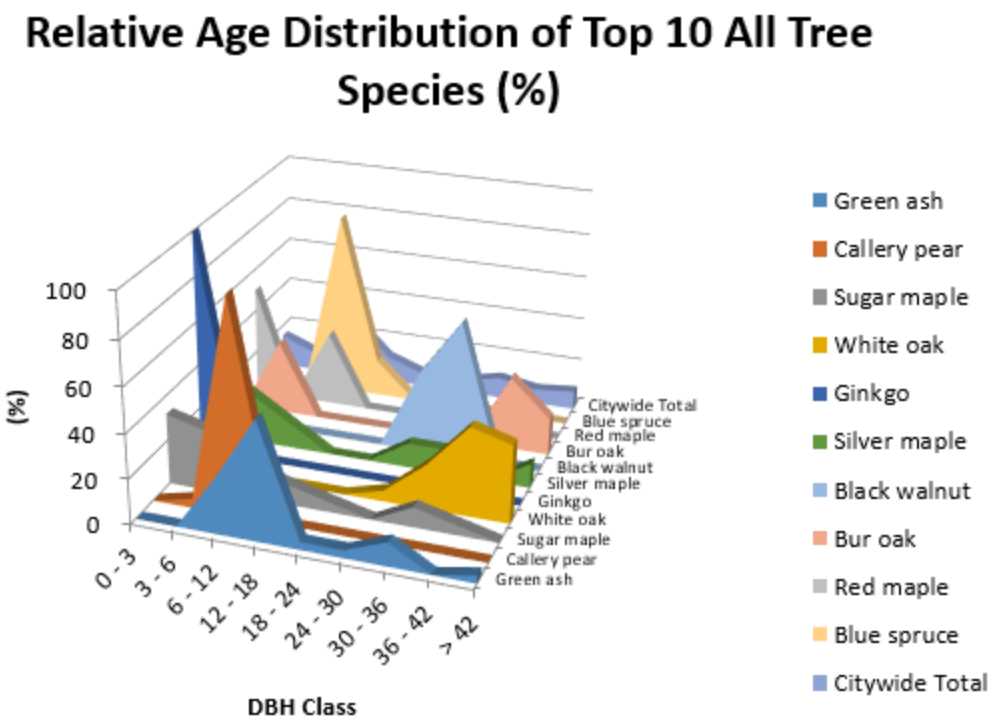
Table 7: Summary of Benefits in Dollars

Average Annual Benefits of All Trees by Species					43448			
Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Stand. Error	% of Total $
Green ash	1,280.80	169.92	223.77	1,530.67	1,239.38	4,444.54	(N/A)	17.19
Callery pear	571.86	69.04	80.96	369.64	615.99	1,707.48	(N/A)	6.60
Sugar maple	499.68	66.81	79.92	691.07	559.21	1,896.69	(N/A)	7.34
White oak	1,817.59	194.98	385.46	3,644.65	998.69	7,041.36	(N/A)	27.23
Ginkgo	6.28	0.47	0.77	2.12	4.09	13.72	(N/A)	0.05
Silver maple	283.13	59.12	52.02	531.81	513.17	1,439.26	(N/A)	5.57
Black walnut	622.83	85.45	115.99	1,064.53	529.77	2,418.57	(N/A)	9.35
Bur oak	363.23	41.22	74.84	704.68	240.31	1,424.27	(N/A)	5.51
Red maple	112.92	8.65	19.21	112.54	59.79	313.10	(N/A)	1.21
Blue spruce	98.51	7.56	10.56	144.21	130.65	391.49	(N/A)	1.51
Pear	73.64	7.08	10.29	28.87	25.64	145.52	(N/A)	0.56
Northern hackberry	240.38	23.91	42.60	299.06	188.48	794.44	(N/A)	3.07
Norway maple	104.30	7.63	18.26	122.30	39.11	291.60	(N/A)	1.13
Apple	93.15	11.78	16.80	63.83	57.63	243.19	(N/A)	0.94
Black cherry	138.42	13.91	25.04	95.45	57.60	330.43	(N/A)	1.28
American sycamore	197.26	15.26	45.10	392.35	57.14	707.11	(N/A)	2.73
Kentucky coffeetree	114.64	15.87	18.68	140.41	115.37	404.98	(N/A)	1.57
Oak	63.14	8.84	10.21	74.86	72.42	229.47	(N/A)	0.89
Eastern red cedar	36.04	2.56	2.80	62.16	35.02	138.59	(N/A)	0.54
Northern red oak	110.45	5.33	15.30	164.24	0.00	295.32	(N/A)	1.14
Others	333.78	35.96	67.15	462.29	286.68	1,185.87		0.51
Citywide Total	7,162.01	851.35	1,315.73	10,701.74	5,826.16	25,856.99	(N/A)	100.00



Species Distribution of All Trees for 1	
12/14/2018	
Species	Percent
Green ash	15.91
Callery pear	13.64
Sugar maple	12.50
White oak	11.36
Ginkgo	6.25
Silver maple	5.11
Black walnut	4.55
Bur oak	3.41
Red maple	3.41
Blue spruce	3.41
Other Species	20.45

Figure 1: Species Distribution



Relative Age Distribution of Top 10 All Tree Species (%)	DBH class (in)					12/14/2018			
Species	0 - 3	3 - 6	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	> 42
Green ash	0.00	0.00	25.00	53.57	3.57	3.57	10.71	0.00	3.57
Callery pear	0.00	4.17	95.83	0.00	0.00	0.00	0.00	0.00	0.00
Sugar maple	31.82	27.27	13.64	9.09	4.55	0.00	9.09	4.55	0.00
White oak	0.00	0.00	0.00	0.00	0.00	5.00	20.00	40.00	35.00
Ginkgo	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Silver maple	33.33	22.22	11.11	0.00	0.00	11.11	11.11	0.00	11.11
Black walnut	0.00	0.00	0.00	0.00	0.00	37.50	62.50	0.00	0.00
Bur oak	0.00	33.33	0.00	0.00	0.00	16.67	0.00	33.33	16.67
Red maple	50.00	0.00	33.33	0.00	0.00	16.67	0.00	0.00	0.00
Blue spruce	0.00	0.00	83.33	16.67	0.00	0.00	0.00	0.00	0.00
Citywide Total	14.77	7.95	28.98	11.93	5.68	5.68	9.66	6.82	8.52

Figure 2: Relative Age Class

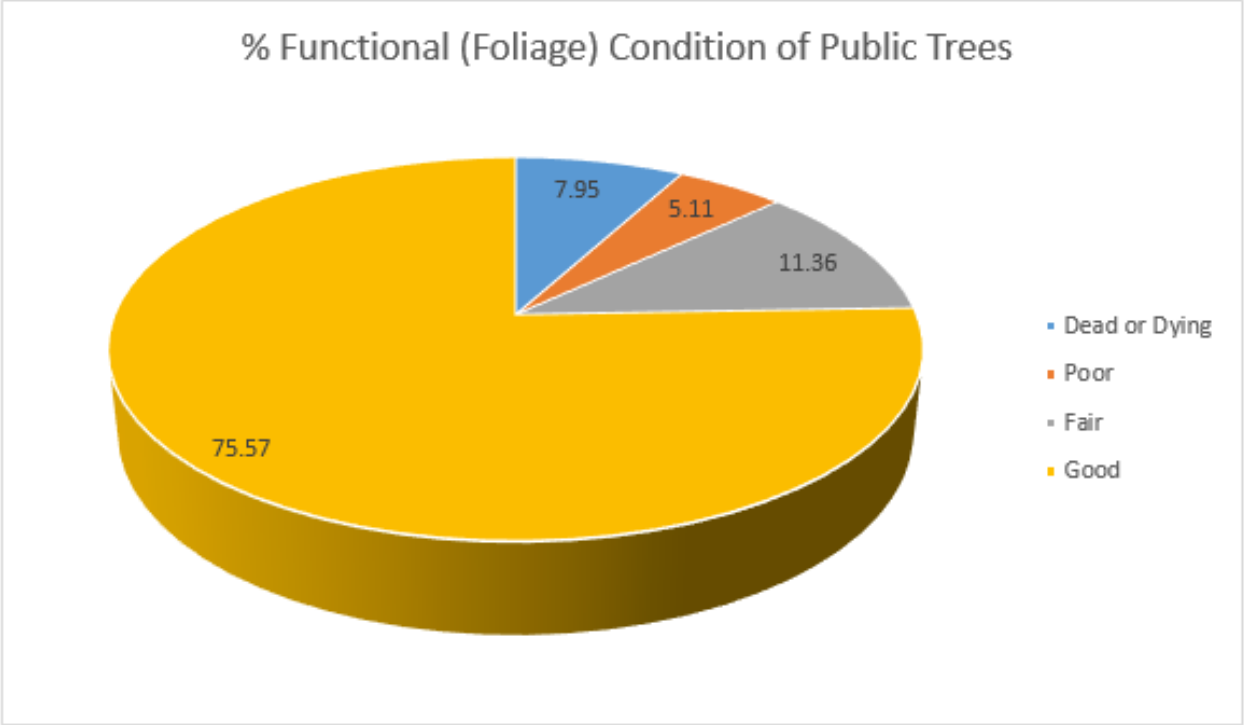


Figure 3: Foliage Condition

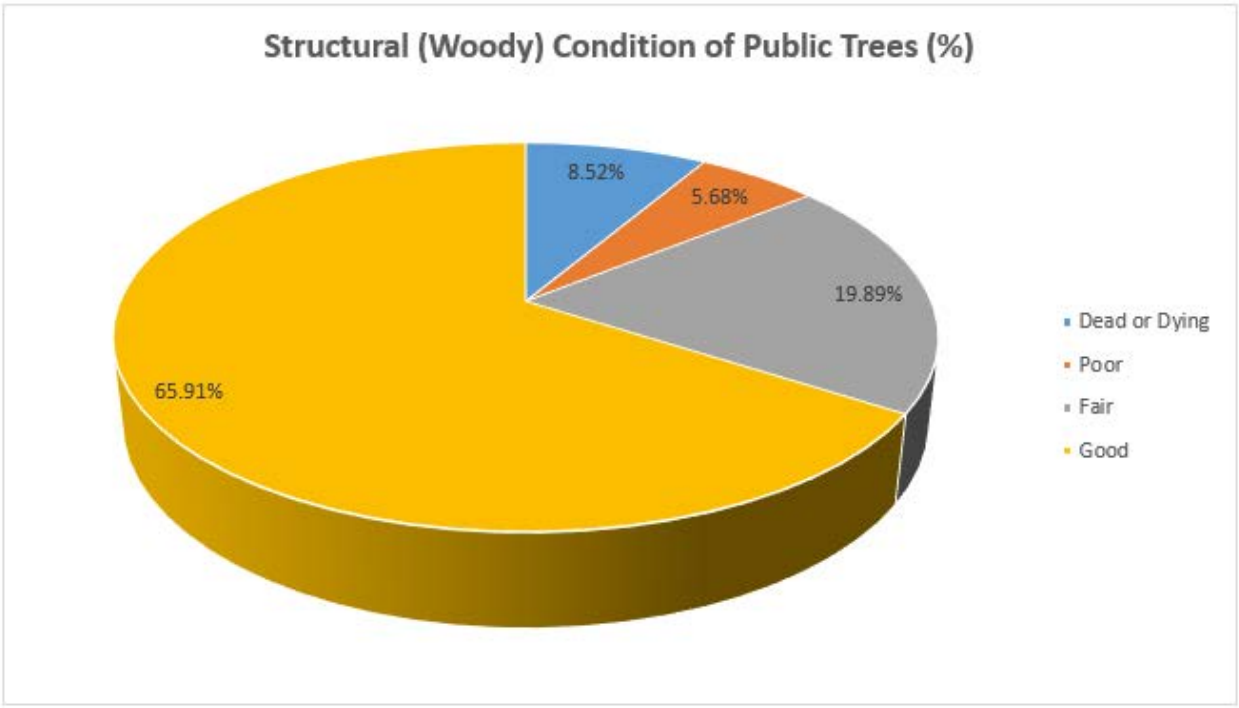
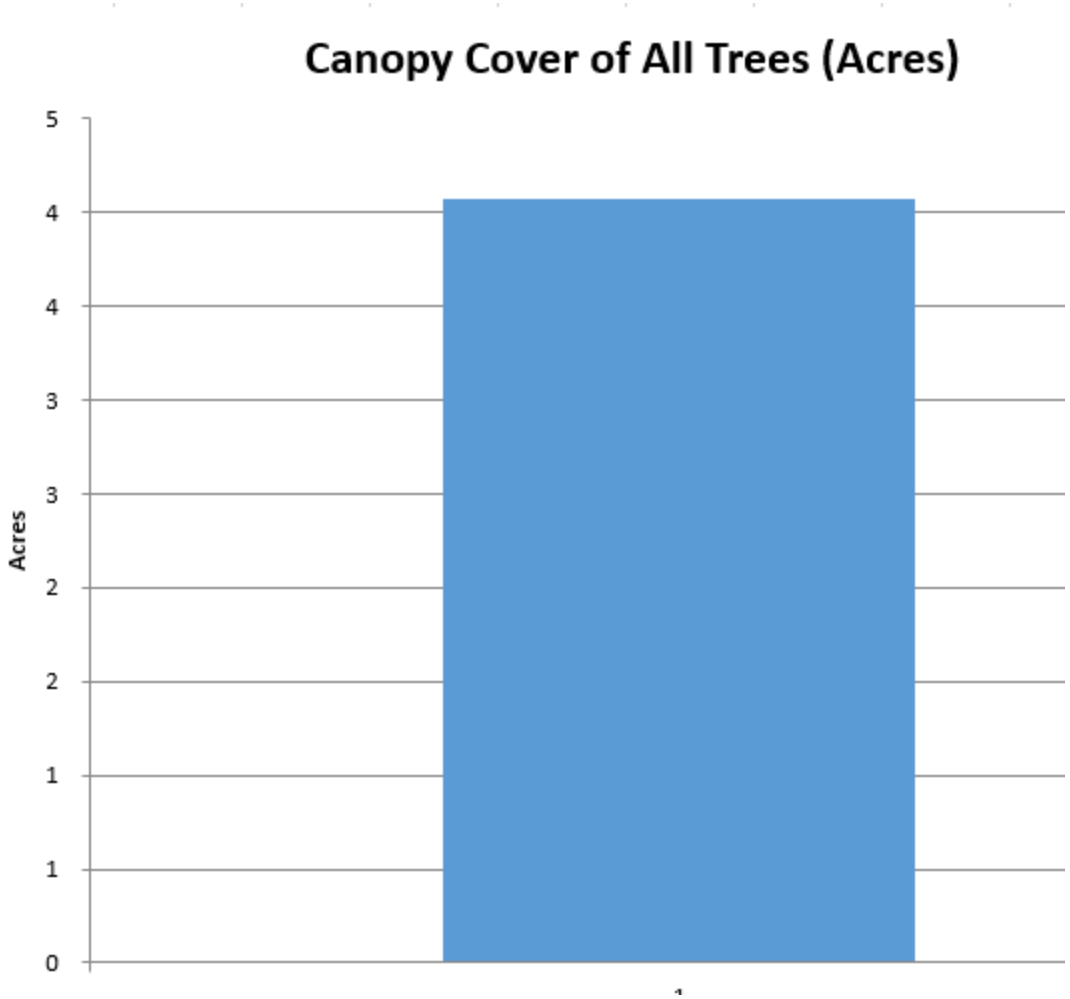


Figure 4: Wood Condition

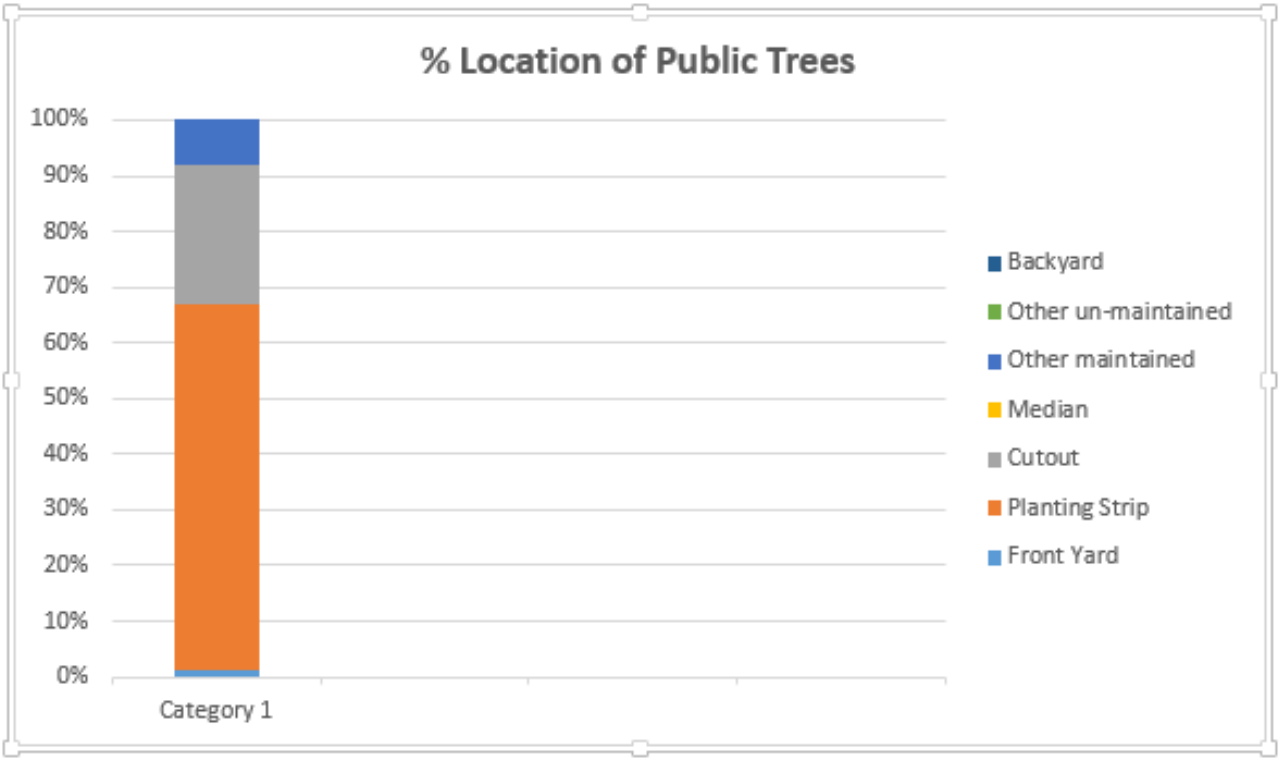


Canopy Cover of All Trees (Acres)		12/14/2018
Zone	Acres	% of Total Canopy
1	4.07	0.55
Citywide Total	741.00	100.00

Figure 5: Canopy Cover in Acres

Land Use of All Trees by Zone					
Zone	**Land Use**	**Tree Count**	**Standard Error**	**% of Zone**	**% of All Trees**
1	Single family residential	37	(N/A)	21.02	21.02
	Multi-family residential	0	(N/A)	0.00	0.00
	Industrial/Large commercial	0	(N/A)	0.00	0.00
	Park/vacant/other	82	(N/A)	46.59	46.59
	Small commercial	57	(N/A)	32.39	32.39
	Total	176	(N/A)	100.00	100.00

Figure 6: Land Use of city/park trees



Site Type of All Trees by Zone

Zone	Site Type	Tree Count	Standard Error	% of Zone	% of All Trees
1	Front yard	2	(N/A)	1.14	1.14
	Planting strip	116	(N/A)	65.91	65.91
	Cutout	44	(N/A)	25.00	25.00
	Median	0	(N/A)	0.00	0.00
	Other maintained locations	14	(N/A)	8.00	8.00
	Other un-maintained locations	0	(N/A)	0.00	0.00
	Backyard	0	(N/A)	0.00	0.00
	Total	176	(N/A)	100.00	100.00

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1:

Location of Ash Trees
2018 Community Tree Inventory
Le Claire, IA

Figure 2:

Location of EAB Symptoms
2018 Community Tree Inventory
Le Claire, IA

Figure 3:

Location of Poor Condition Trees
2018 Community Tree Inventory
Le Claire, IA

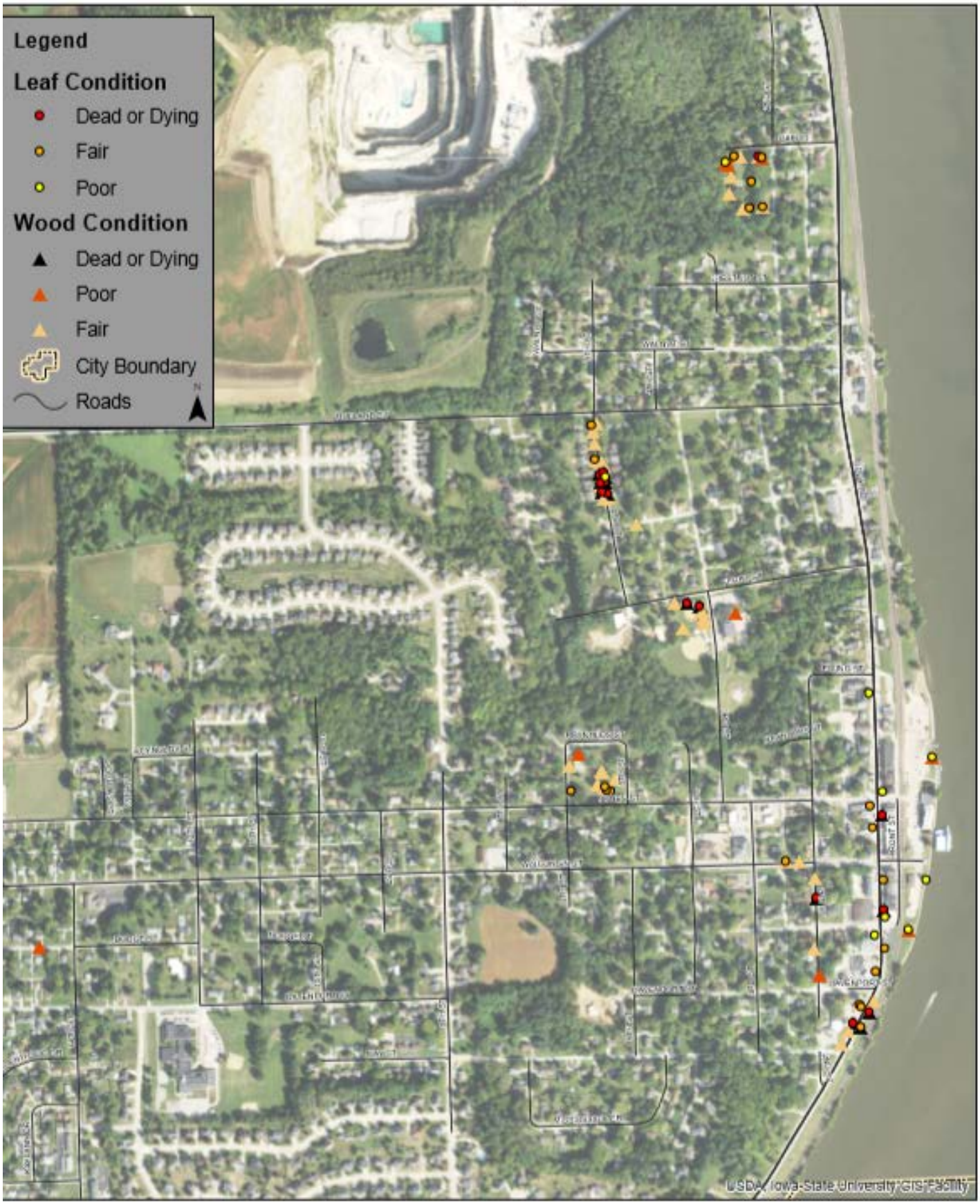


Figure 4:

Location of Trees with Recommended Maintenance
2018 Community Tree Inventory
Le Claire, IA

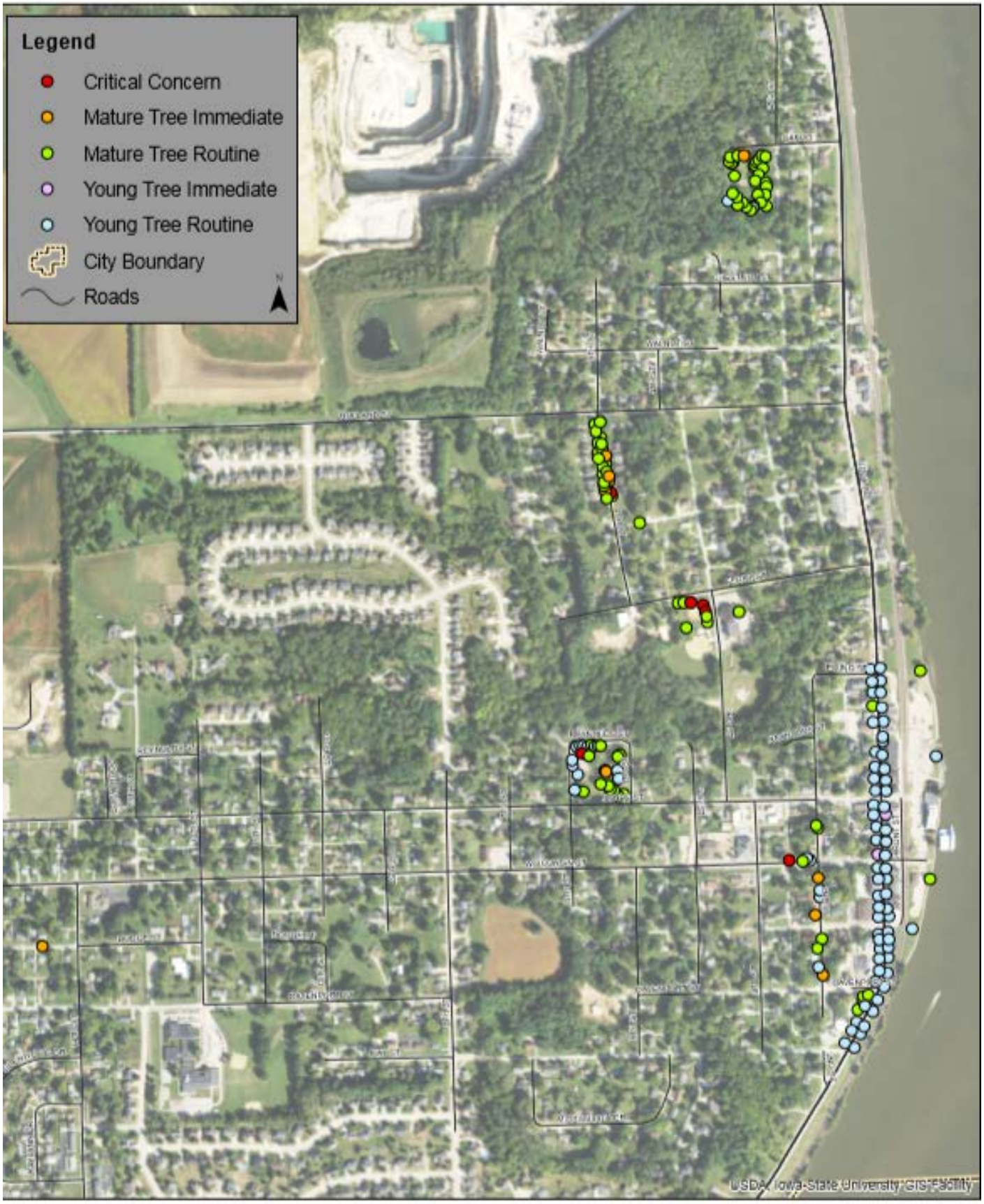


Figure 5:

Maintenance Tasks
2018 Community Tree Inventory
Le Claire, IA

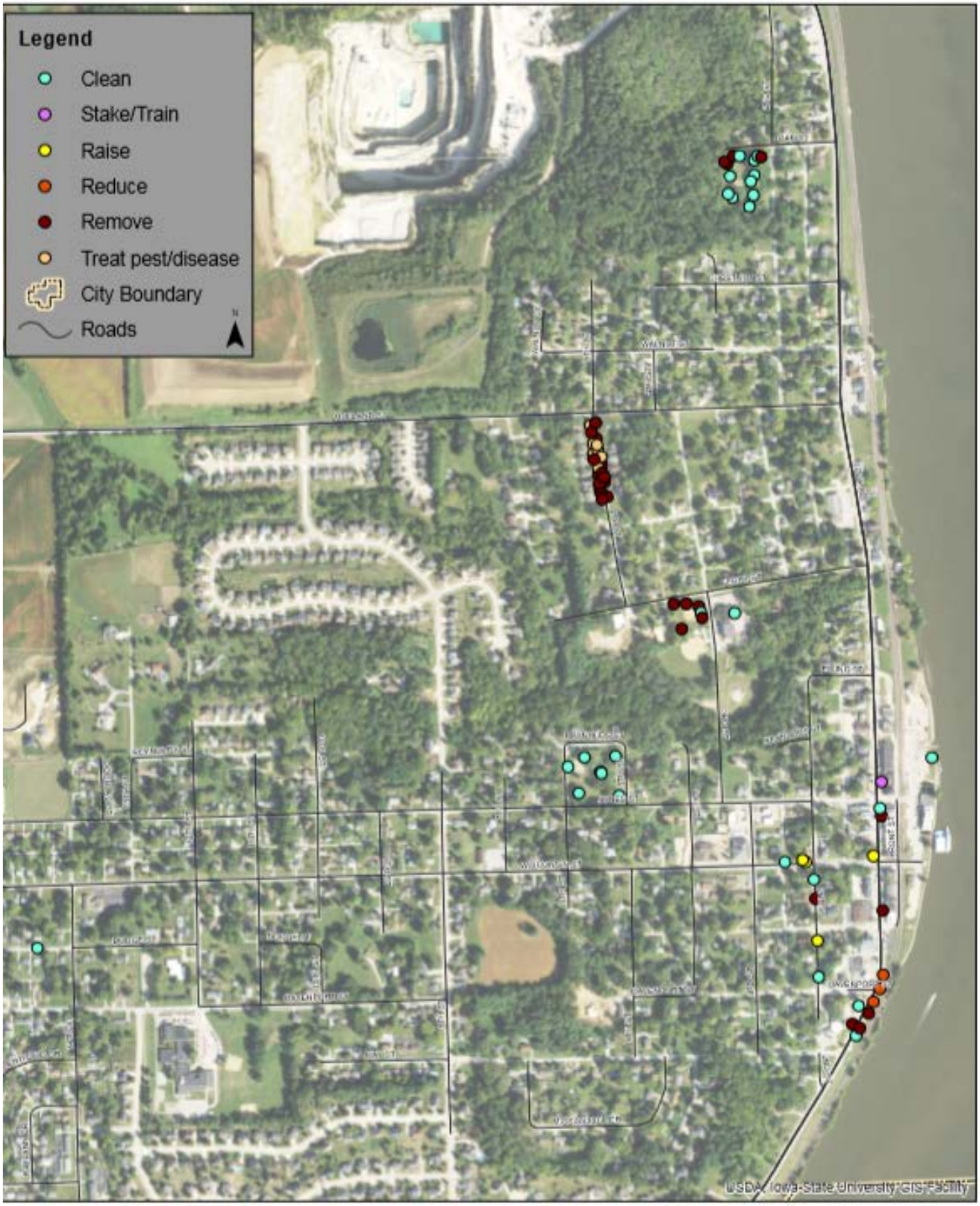


Figure 6:

Location of Treatable Ash Trees
2018 Community Tree Inventory
Le Claire, IA

Figure 7:

Removed Trees
2018 Community Tree Inventory
Le Claire, IA

Appendix C: Le Claire Tree Ordinances

TREES

151.01 PURPOSE. The purpose of this chapter is to beautify and preserve the appearance of the City by regulating and providing for the planting, care and removal of trees on or overhanging any public right-of-way or on any public property.

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

"Public right-of-way" means any property dedicated to the public which is intended to be used for vehicular or pedestrian traffic and for the placement of utilities.

"Public place" means any property dedicated to the public which is intended to be used for any public purpose.

A. **PLANTING RESTRICTIONS.** No tree shall be planted in any public right-of-way except in accordance with the following:

1. Alignment. All trees planted in any public right-of-way shall be planted in the non-paved area midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten feet (10') from the property line.

2. Spacing. Trees shall not be planted on the above-referenced non-paved area if it is less than nine feet (9') in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty feet (20') to street intersections (property lines extended) and ten feet (10') to driveways. If it is at all possible, trees should be planted inside the property lines and not between the sidewalk and the curb.

3. Prohibited Trees. No person shall hereinafter plant on any public right-of-way any fruit bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, or evergreens.

151.04 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees overhanging any public right-of-way trimmed so that all branches will be at least fifteen feet (15') above the surface of the street and eight feet (8') above the sidewalks. If the abutting property owner fails to trim the trees as required in this chapter, the City will cause to have the trees trimmed and the costs will be assessed against the property as provided for in Section 155.07.

151.05 TRIMMING TREES TO BE SUPERVISED. It is unlawful for any person to trim or cut any tree in any public place unless the work is done pursuant to the consent of the City.

151.06 REMOVAL OF TREES. The City shall remove any trees on the public right-of-ways of the City which interfere with the making of improvements or with travel thereon. The City shall additionally remove any trees on public places which have become diseased, or which constitute a danger to the public, or which may otherwise be declared a nuisance.

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

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

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