Arnolds Park, IA

2019 URBAN FOREST MANAGEMENT PLAN

IOWA DEPARTMENT OF NATURAL RESOURCES

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Executive Summary

Overview

This plan was developed to assist the City of Arnolds Park 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 14% of Arnolds Park'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.

Inventory and Results

In 2019, 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 364 trees inventoried.

- Arnolds Park's trees provide $38,622 of benefits annually, an average of $106.10 per tree
- There are over 27 species of trees
- The top three genera are: Spruce 24%, Pear 24%, and Ash 14%
- 28% of trees need some type of management
- 5 trees should be removed

Recommendations

We detail our core recommendations in the Recommendations Section. In the Emerald Ash Borer Plan, we include management recommendations. Below are some key recommendations.

- Out of the 5 trees needing removal, 1 tree is 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*
- 3 of the 50 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 could take 15.5 years to remove all ash. We suggest that city officials request a budget increase to $5,000 annually and apply for grants to plant replacement trees.

Introduction

This plan was developed to assist Arnolds Park 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 Arnolds Park, 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 Arnolds Park'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 Bedford 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 Arnolds Park's urban forestry goals.

Inventory

In 2019, JEO conducted a tree inventory that included 100% 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 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 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 ft, 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 364 city trees into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. Below are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Arnolds Park trees reduce energy-related costs by approximately $11,071 annually (Appendix A, Table 1). These savings are both in electricity (51.6 MWh) and in natural gas (7,300.2 Therms).

Annual Stormwater Benefits

Arnolds Park's trees intercept about 545,651 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $14,787 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 Arnolds Park, it is estimated that trees remove 671.3 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $1,900 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Arnolds Park, trees sequester about 103,239 lbs of carbon per year with an associated value of $774 (Appendix A, Table 5). In addition, the trees store 2,108,570 lbs of carbon, with a yearly benefit of $15,814 (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. Arnolds Park receives $9,521 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, Arnolds Park's trees provide $38,622of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 364 trees in Arnolds Park provide approximately $106.10 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Arnolds Park has over 27 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Spruce	87	24%
Pear	87	24%
Ash	50	14%
Maple	38	10%
Linden/Basswood	30	8%
Oak	13	4%
Hackberry	11	3%
Broadleaf Deciduous	10	3%
Birch	8	2%
Locust	7	2%
Elm	5	1%
Mulberry	4	1%
Walnut	4	1%
Boxelder	3	<1%
Eastern red cedar	3	<1%
Cottonwood	2	<1%
Pine	2	<1%

Age Class

Most of Arnolds Park's trees (55%) are between 3 and 12 inches in diameter at 4.5 ft (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. Arnolds Park 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 urban forest's overall health. The foliage condition results for Arnolds Park indicate that 92% of the trees are in good health, with only 2% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 91% of Arnolds Park's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). One percent of the tree population's wood condition is in poor health, dead, or dying. This 1% 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	57	16%
Crown Raising	0	0%
Tree Staking	3	<1%
Tree Removal	5	1%
Crown Reduction	35	10%

Land Use and Location

The majority of Arnolds Park'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	5%
Park/vacant/other	0%
Industrial/Large commercial	67.5%
Small commercial	27.5%
Multifamily residential	0%

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

Arnolds Park has no critical concern trees that need immediate removal. These trees would be accessed on the Location of Trees with Recommended Maintenance Map (Appendix B, Figure 4). In general, we recommend starting with the large-diameter, critical concern trees first. There are 4 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the Six-Year Maintenance Plan at the end of this section. After all the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 100 trees with maintenance needs.

Poor tree species

Since there are no critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 5 removals, 2 are ash trees. There are a total of 50 ash trees, and 3 of those have signs and symptoms that have been associated with EAB. In addition, there are 2 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 Proposed Work 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 Arnolds Park.

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 spruce and pear (24%) (Appendix A, Figure 1). Spruce and Pear 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. 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 prohibited trees like cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

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

Monitoring
It is recommended that ash trees be checked with a visual survey every year for tree death and for 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 151.06 states, "Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (14) days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property. (Code of Iowa, Sec. 364.12[3b & h])"

Proposed Work Schedule and Budget

Budget Allowance of $2,252/Year – (Calculated at $2/Capita, No Budget Provided)

YEAR 1	**ESTIMATED COSTS**
Remove 1 tree > 24" recommended for immediate removal	$700
Remove 1 ash tree in poor condition	$700
Plant 5 trees in open locations	$750
Visual Survey of EAB Signs/Symptoms	

YEAR 2	
Remove 2 trees recommended for immediate removal	$1,400
Remove 1 ash tree in poor condition	$700
Plant 1 tree in open locations	$150
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 3 ash trees (Prioritize Dead/Dying or Poor Condition)	$2,100
Plant 1 trees in open locations	$150
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 2 ash trees (Prioritize Dead/Dying or Poor Condition)	$1,400
Plant 5 trees in open locations	$750
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 3 ash trees (Prioritize Dead/Dying or Poor Condition)	$2,100
Plant 1 trees in open locations	$150
Visual Survey of EAB Signs/Symptom	

YEAR 6

Remove 2 ash trees (Prioritize Dead/Dying or Poor Condition)	$1,400
Plant 5 trees in open locations	$750
Visual Survey of EAB Signs/Symptoms	

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

**To remove all ash trees within 6 years alone, the budget would need to be $5,850 a year. If the budget were increased to $10,000 a year all ash could be removed in 3.5 years.

Proposed Work Schedule with Increased Budget

Budget Allowance of $5,000/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	**ESTIMATED COSTS**
Remove 3 trees recommended for immediate removal	$2,100
Remove 2 ash trees recommended for immediate removal	$1,400
Plant 10 trees in open locations	$1,500
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Remove 4 ash trees (Prioritize Dead/Dying or Poor Condition)	$2,800
Plant 2 trees in open locations	$300
Prune 1/3 of City Owned Trees	$1,830
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 5 ash trees (Prioritize Dead/Dying or Poor Condition)	$3,500
Plant 10 trees in open locations	$1,500
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 4 ash trees (Prioritize Dead/Dying or Poor Condition)	$2,800
Plant 2 trees in open locations	$300
Prune 1/3 of City Owned Trees	$1,830
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 5 ash trees (Prioritize Dead/Dying or Poor Condition)	$3,500
Plant 10 trees in open locations	$1,500
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 4 ash trees (Prioritize Dead/Dying or Poor Condition)	$2,800
Plant 2 trees in open locations	$300
Prune 1/3 of City Owned Trees	$1,830
Visual Survey of EAB Signs/Symptoms	

Proposed Budget Increase

EAB could potentially kill all ash trees in Arnolds Park within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to $5,850 a year. If the budget were increased to $4,000 per year all ash could be removed within 9 years. Additionally, we recommend that Arnolds Park 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 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 4 trees could be treated per year (every other year treatment). Eight trees would be selected for treatment, and Arnolds Park would still need to find $29,400 for removal of the remaining 42 ash trees. Alternatively, if there are 15 treatable trees, it would cost approximately $2,250 a year for treatment and leave no money for removal. These are alternatives to straight removal of ash trees. However, whether the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Arnolds Park. We suggest considering an increased budget to plan for this.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees

3/31/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Pear	5.8	437	918.9	901	1,338	(N/A)	23.9	12.1	15.37
Spruce	1.1	82	190.8	187	269	(N/A)	14.6	2.4	5.08
Green ash	12.9	981	1,726.6	1,692	2,673	(N/A)	12.1	24.1	60.75
Littleleaf linden	4.8	364	718.6	704	1,068	(N/A)	8.2	9.7	35.61
Norway spruce	0.9	67	150.4	147	214	(N/A)	6.0	1.9	9.74
Maple	2.9	222	408.4	400	622	(N/A)	5.2	5.6	32.75
Northern hackberry	4.8	365	670.9	658	1,022	(N/A)	3.0	9.2	92.93
Sugar maple	1.5	112	179.8	176	288	(N/A)	2.5	2.6	32.03
Silver maple	3.4	260	454.5	445	706	(N/A)	2.5	6.4	78.41
Blue spruce	0.6	45	91.4	90	135	(N/A)	2.5	1.2	15.01
Birch	1.1	83	160.1	157	240	(N/A)	2.2	2.2	30.05
Bur oak	3.0	228	405.2	397	625	(N/A)	1.9	5.6	89.34
Honeylocust	0.6	45	72.7	71	116	(N/A)	1.9	1.0	16.56
Broadleaf Deciduous Sm	0.4	30	62.3	61	92	(N/A)	1.9	0.8	13.08
Northern red oak	0.8	62	103.7	102	164	(N/A)	1.6	1.5	27.27
Ash	1.0	74	144.6	142	216	(N/A)	1.6	1.9	35.97
Mulberry	0.5	39	75.0	73	113	(N/A)	1.1	1.0	28.16
Black walnut	1.5	113	206.4	202	315	(N/A)	1.1	2.8	78.72
Broadleaf Deciduous Me	0.4	34	63.2	62	96	(N/A)	0.8	0.9	31.91
Black spruce	0.2	12	25.2	25	37	(N/A)	0.8	0.3	12.18
Eastern red cedar	0.1	11	23.8	23	34	(N/A)	0.8	0.3	11.47
Elm	1.2	88	161.0	158	246	(N/A)	0.8	2.2	82.02
Boxelder	0.8	58	102.0	100	158	(N/A)	0.8	1.4	52.73
Eastern white pine	0.4	28	49.2	48	76	(N/A)	0.5	0.7	38.17
Cottonwood	0.8	63	112.7	110	173	(N/A)	0.5	1.6	86.52
Chinese elm	0.1	9	17.4	17	26	(N/A)	0.5	0.2	13.23
Red maple	0.0	3	5.2	5	8	(N/A)	0.3	0.1	7.85
Total	51.6	3,916	7,300.2	7,154	11,071	(N/A)	100.0	100.0	30.41

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

3/31/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Pear	21,237	576	(N/A)	23.9	3.9	6.62
Spruce	10,292	279	(N/A)	14.6	1.9	5.26
Green ash	147,960	4,010	(N/A)	12.1	27.1	91.13
Littleleaf linden	52,850	1,432	(N/A)	8.2	9.7	47.74
Norway spruce	9,110	247	(N/A)	6.0	1.7	11.22
Maple	26,623	721	(N/A)	5.2	4.9	37.97
Northern hackberry	56,912	1,542	(N/A)	3.0	10.4	140.21
Sugar maple	8,486	230	(N/A)	2.5	1.6	25.55
Silver maple	54,615	1,480	(N/A)	2.5	10.0	164.45
Blue spruce	7,089	192	(N/A)	2.5	1.3	21.35
Birch	6,334	172	(N/A)	2.2	1.2	21.46
Bur oak	45,427	1,231	(N/A)	1.9	8.3	175.87
Honeylocust	3,211	87	(N/A)	1.9	0.6	12.43
Broadleaf Deciduous Small	1,409	38	(N/A)	1.9	0.3	5.45
Northern red oak	4,805	130	(N/A)	1.6	0.9	21.70
Ash	11,330	307	(N/A)	1.6	2.1	51.17
Mulberry	1,862	50	(N/A)	1.1	0.3	12.62
Black walnut	20,615	559	(N/A)	1.1	3.8	139.67
Broadleaf Deciduous Medi	2,581	70	(N/A)	0.8	0.5	23.32
Black spruce	1,767	48	(N/A)	0.8	0.3	15.96
Eastern red cedar	1,978	54	(N/A)	0.8	0.4	17.86
Elm	16,472	446	(N/A)	0.8	3.0	148.79
Boxelder	9,831	266	(N/A)	0.8	1.8	88.80
Eastern white pine	9,209	250	(N/A)	0.5	1.7	124.79
Cottonwood	12,729	345	(N/A)	0.5	2.3	172.48
Chinese elm	779	21	(N/A)	0.5	0.1	10.56
Red maple	137	4	(N/A)	0.3	0.0	3.72
Citywide total	545,651	14,787	(N/A)	100.0	100.0	40.62

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

3/31/2020

Species	Deposition (lb) O_3	NO_2	PM_{10}	SO_2	Total Depos. ($)	Avoided (lb) NO_2	PM_{10}	VOC	SO_2	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
Pear	4.8	0.8	2.5	0.2	26	28.6	4.1	3.9	26.1	176	0.0	0	71.0	202	(N/A)	23.9	2.32
Spruce	0.4	0.1	0.6	0.0	3	5.5	0.8	0.7	4.9	34	-2.8	-10	10.3	26	(N/A)	14.6	0.50
Green ash	19.1	3.1	9.0	0.9	101	61.3	9.0	8.5	58.6	383	0.0	0	169.5	484	(N/A)	12.1	11.01
Littleleaf linden	9.3	1.6	4.6	0.4	50	23.5	3.4	3.2	21.8	145	-4.4	-17	63.3	179	(N/A)	8.2	5.95
Norway spruce	0.7	0.1	0.8	0.1	5	4.5	0.6	0.6	4.0	27	-2.5	-9	8.8	23	(N/A)	6.0	1.04
Maple	6.6	1.1	3.0	0.3	35	14.0	2.0	1.9	13.2	87	-2.2	-8	40.1	114	(N/A)	5.2	5.99
Northern hackberry	10.5	1.8	5.1	0.5	57	23.1	3.4	3.2	21.8	144	0.0	0	69.4	200	(N/A)	3.0	18.22
Sugar maple	0.7	0.1	0.5	0.0	4	6.8	1.0	1.0	6.7	43	-0.7	-2	16.2	45	(N/A)	2.5	4.98
Silver maple	10.2	1.7	4.9	0.5	55	16.2	2.4	2.3	15.5	101	-5.3	-20	48.4	136	(N/A)	2.5	15.14
Blue spruce	0.7	0.1	0.7	0.1	5	2.9	0.4	0.4	2.7	18	-2.3	-9	5.8	14	(N/A)	2.5	1.60
Birch	0.8	0.1	0.5	0.0	4	5.3	0.8	0.7	5.0	33	-0.2	-1	13.0	37	(N/A)	2.2	4.58
Bur oak	7.9	1.3	3.5	0.4	41	14.3	2.1	2.0	13.6	89	0.0	0	45.0	130	(N/A)	1.9	18.62
Honeylocust	0.5	0.1	0.3	0.0	3	2.7	0.4	0.4	2.7	17	-0.3	-1	6.8	19	(N/A)	1.9	2.69
Broadleaf Deciduous Smal	0.3	0.1	0.2	0.0	2	2.0	0.3	0.3	1.8	12	0.0	0	4.9	14	(N/A)	1.9	1.98
Northern red oak	0.8	0.1	0.4	0.0	4	3.8	0.6	0.5	3.7	24	-1.1	-4	8.9	24	(N/A)	1.6	4.05
Ash	2.6	0.4	1.2	0.1	14	4.8	0.7	0.7	4.4	29	-0.6	-2	14.3	41	(N/A)	1.6	6.86
Mulberry	0.5	0.1	0.2	0.0	3	2.5	0.4	0.3	2.3	15	0.0	0	6.4	18	(N/A)	1.1	4.55
Black walnut	2.9	0.5	1.3	0.1	15	7.1	1.0	1.0	6.7	44	0.0	0	20.7	60	(N/A)	1.1	14.92
Broadleaf Deciduous Medi	0.3	0.1	0.2	0.0	2	2.2	0.3	0.3	2.0	13	-0.1	0	5.3	15	(N/A)	0.8	4.95
Black spruce	0.2	0.0	0.2	0.0	1	0.8	0.1	0.1	0.7	5	-0.5	-2	1.5	4	(N/A)	0.8	1.27
Eastern red cedar	0.2	0.0	0.2	0.0	1	0.7	0.1	0.1	0.7	4	-1.0	-4	1.0	2	(N/A)	0.8	0.62
Elm	2.4	0.4	1.1	0.1	12	5.6	0.8	0.8	5.3	35	0.0	0	16.4	47	(N/A)	0.8	15.71
Boxelder	1.4	0.2	0.6	0.1	7	3.6	0.5	0.5	3.5	23	-0.4	-1	10.1	29	(N/A)	0.8	9.59
Eastern white pine	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)	0.5	-1.58
Cottonwood	2.0	0.3	0.9	0.1	10	3.9	0.6	0.5	3.7	25	0.0	0	12.0	35	(N/A)	0.5	17.37
Chinese elm	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.4	4	(N/A)	0.5	1.93
Red maple	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)	0.3	1.12
Citywide total	86.8	14.5	43.3	4.1	470	248.4	36.0	34.3	233.8	1,542	-30.1	-113	671.3	1,900	(N/A)	100.0	5.22

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

3/31/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Pear	83,952	630	(N/A)	23.9	4.0	7.24
Spruce	1,809	14	(N/A)	14.6	0.1	0.26
Green ash	630,256	4,727	(N/A)	12.1	29.9	107.43
Littleleaf linden	200,473	1,504	(N/A)	8.2	9.5	50.12
Norway spruce	3,426	26	(N/A)	6.0	0.2	1.17
Maple	70,808	531	(N/A)	5.2	3.4	27.95
Northern hackberry	170,186	1,276	(N/A)	3.0	8.1	116.04
Sugar maple	21,440	161	(N/A)	2.5	1.0	17.87
Silver maple	243,506	1,826	(N/A)	2.5	11.5	202.92
Blue spruce	3,150	24	(N/A)	2.5	0.1	2.63
Birch	13,852	104	(N/A)	2.2	0.7	12.99
Bur oak	268,310	2,012	(N/A)	1.9	12.7	287.48
Honeylocust	6,143	46	(N/A)	1.9	0.3	6.58
Broadleaf Deciduo	5,400	41	(N/A)	1.9	0.3	5.79
Northern red oak	13,021	98	(N/A)	1.6	0.6	16.28
Ash	42,891	322	(N/A)	1.6	2.0	53.61
Mulberry	7,890	59	(N/A)	1.1	0.4	14.79
Black walnut	96,747	726	(N/A)	1.1	4.6	181.40
Broadleaf Deciduo	5,825	44	(N/A)	0.8	0.3	14.56
Black spruce	611	5	(N/A)	0.8	0.0	1.53
Eastern red cedar	831	6	(N/A)	0.8	0.0	2.08
Elm	77,829	584	(N/A)	0.8	3.7	194.57
Boxelder	58,590	439	(N/A)	0.8	2.8	146.47
Eastern white pine	14,981	112	(N/A)	0.5	0.7	56.18
Cottonwood	65,202	489	(N/A)	0.5	3.1	244.51
Chinese elm	1,220	9	(N/A)	0.5	0.1	4.57
Red maple	218	2	(N/A)	0.3	0.0	1.64
Citywide total	2,108,570	15,814	(N/A)	100.0	100.0	43.45

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees

3/31/2020

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($) Error	Standard	% of Total Trees	% of Total $	Avg. $/tree
Pear	9,189	69	-403	-89	-4	9,659	72	18,356	138	(N/A)	23.9	10.3	1.58
Spruce	867	7	-9	-29	0	1,813	14	2,643	20	(N/A)	14.6	1.5	0.37
Green ash	29,430	221	-3,025	-134	-24	21,680	163	47,951	360	(N/A)	12.1	26.8	8.17
Littleleaf linden	8,328	62	-963	-69	-8	8,048	60	15,344	115	(N/A)	8.2	8.6	3.84
Norway spruce	797	6	-16	-20	0	1,479	11	2,240	17	(N/A)	6.0	1.3	0.76
Maple	3,805	29	-340	-29	-3	4,904	37	8,340	63	(N/A)	5.2	4.7	3.29
Northern hackberry	6,812	51	-817	-49	-6	8,060	60	14,007	105	(N/A)	3.0	7.8	9.55
Sugar maple	2,061	15	-103	-13	-1	2,475	19	4,419	33	(N/A)	2.5	2.5	3.68
Silver maple	16,303	122	-1,169	-40	-9	5,751	43	20,845	156	(N/A)	2.5	11.6	17.37
Blue spruce	373	3	-15	-11	0	1,005	8	1,352	10	(N/A)	2.5	0.8	1.13
Birch	2,116	16	-66	-11	-1	1,845	14	3,883	29	(N/A)	2.2	2.2	3.64
Bur oak	5,661	42	-1,288	-35	-10	5,045	38	9,383	70	(N/A)	1.9	5.2	10.05
Honeylocust	1,002	8	-30	-5	0	986	7	1,954	15	(N/A)	1.9	1.1	2.09
Broadleaf Deciduous St	618	5	-26	-6	0	674	5	1,260	9	(N/A)	1.9	0.7	1.35
Northern red oak	1,194	9	-63	-9	-1	1,370	10	2,492	19	(N/A)	1.6	1.4	3.12
Ash	756	6	-206	-12	-2	1,637	12	2,176	16	(N/A)	1.6	1.2	2.72
Mulberry	763	6	-38	-6	0	865	6	1,584	12	(N/A)	1.1	0.9	2.97
Black walnut	3,585	27	-464	-16	-4	2,489	19	5,594	42	(N/A)	1.1	3.1	10.49
Broadleaf Deciduous M	834	6	-28	-4	0	747	6	1,548	12	(N/A)	0.8	0.9	3.87
Black spruce	89	1	-3	-3	0	261	2	344	3	(N/A)	0.8	0.2	0.86
Eastern red cedar	120	1	-4	-4	0	246	2	358	3	(N/A)	0.8	0.2	0.89
Elm	2,879	22	-374	-13	-3	1,950	15	4,442	33	(N/A)	0.8	2.5	11.11
Boxelder	3,464	26	-281	-11	-2	1,288	10	4,460	33	(N/A)	0.8	2.5	11.15
Eastern white pine	0	0	-72	-9	-1	622	5	541	4	(N/A)	0.5	0.3	2.03
Cottonwood	1,872	14	-313	-9	-2	1,384	10	2,934	22	(N/A)	0.5	1.6	11.00
Chinese elm	283	2	-6	-2	0	207	2	483	4	(N/A)	0.5	0.3	1.81
Red maple	39	0	-1	-1	0	60	0	97	1	(N/A)	0.3	0.1	0.73
Citywide total	103,239	774	-10,123	-636	-81	86,551	649	179,031	1,343	(N/A)	100.0	100.0	3.69

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

3/31/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Pear	520	(N/A)	23.9	5.5	5.97
Spruce	356	(N/A)	14.6	3.7	6.71
Green ash	2,392	(N/A)	12.1	25.1	54.36
Littleleaf linden	965	(N/A)	8.2	10.1	32.17
Norway spruce	252	(N/A)	6.0	2.7	11.47
Maple	490	(N/A)	5.2	5.1	25.80
Northern hackberry	794	(N/A)	3.0	8.3	72.22
Sugar maple	262	(N/A)	2.5	2.8	29.13
Silver maple	1,183	(N/A)	2.5	12.4	131.46
Blue spruce	185	(N/A)	2.5	1.9	20.57
Birch	236	(N/A)	2.2	2.5	29.46
Bur oak	374	(N/A)	1.9	3.9	53.37
Honeylocust	207	(N/A)	1.9	2.2	29.62
Broadleaf Deciduous Smal	34	(N/A)	1.9	0.4	4.93
Northern red oak	112	(N/A)	1.6	1.2	18.66
Ash	71	(N/A)	1.6	0.7	11.85
Mulberry	44	(N/A)	1.1	0.5	10.94
Black walnut	256	(N/A)	1.1	2.7	64.03
Broadleaf Deciduous Medi	92	(N/A)	0.8	1.0	30.53
Black spruce	54	(N/A)	0.8	0.6	18.16
Eastern red cedar	64	(N/A)	0.8	0.7	21.34
Elm	200	(N/A)	0.8	2.1	66.60
Boxelder	202	(N/A)	0.8	2.1	67.37
Eastern white pine	0	(N/A)	0.5	0.0	0.00
Cottonwood	125	(N/A)	0.5	1.3	62.47
Chinese elm	43	(N/A)	0.5	0.5	21.64
Red maple	7	(N/A)	0.3	0.1	7.28
Citywide total	9,521	(N/A)	100.0	100.0	26.16

Table 7: Summary of Benefits in Dollars

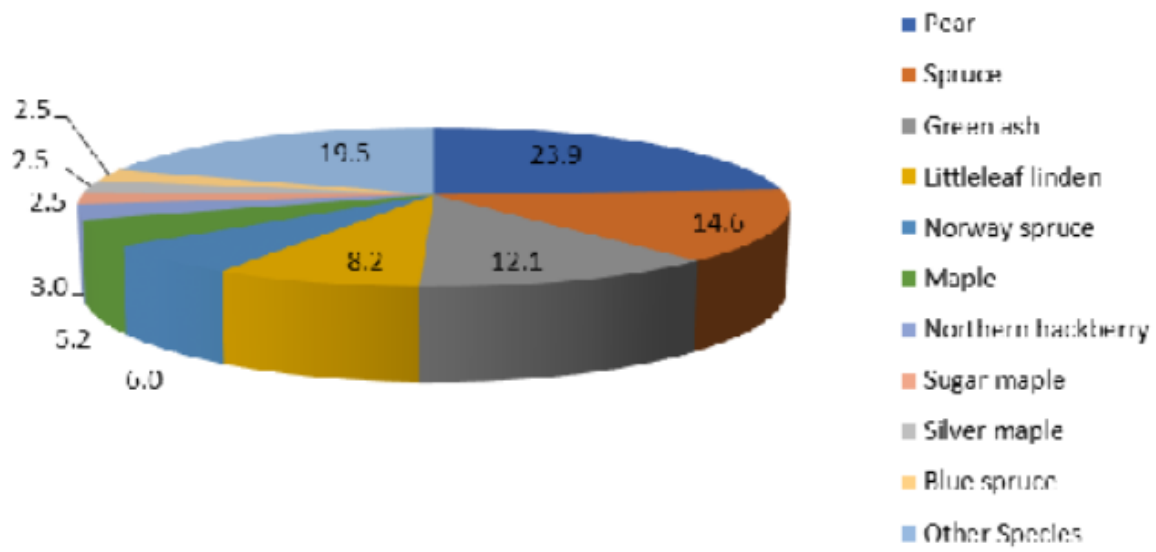
Annual Benefits of Public Trees by Species ($/tree)

3/31/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error
Pear	15.37	1.58	2.32	6.62	5.97	31.86	(N/A)
Spruce	5.08	0.37	0.50	5.26	6.71	17.92	(N/A)
Green ash	60.75	8.17	11.01	91.13	54.36	225.43	(N/A)
Littleleaf linden	35.61	3.84	5.95	47.74	32.17	125.31	(N/A)
Norway spruce	9.74	0.76	1.04	11.22	11.47	34.23	(N/A)
Maple	32.75	3.29	5.99	37.97	25.80	105.80	(N/A)
Northern hackberry	92.93	9.55	18.22	140.21	72.22	333.13	(N/A)
Sugar maple	32.03	3.68	4.98	25.55	29.13	95.37	(N/A)
Silver maple	78.41	17.37	15.14	164.45	131.46	406.83	(N/A)
Blue spruce	15.01	1.13	1.60	21.35	20.57	59.65	(N/A)
Birch	30.05	3.64	4.58	21.46	29.46	89.18	(N/A)
Bur oak	89.34	10.05	18.62	175.87	53.37	347.25	(N/A)
Honeylocust	16.56	2.09	2.69	12.43	29.62	63.39	(N/A)
Broadleaf Deciduou	13.08	1.35	1.98	5.45	4.93	26.80	(N/A)
Northern red oak	27.27	3.12	4.05	21.70	18.66	74.80	(N/A)
Ash	35.97	2.72	6.86	51.17	11.85	108.58	(N/A)
Mulberry	28.16	2.97	4.55	12.62	10.94	59.24	(N/A)
Black walnut	78.72	10.49	14.92	139.67	64.03	307.83	(N/A)
Broadleaf Deciduou	31.91	3.87	4.95	23.32	30.53	94.58	(N/A)
Black spruce	12.18	0.86	1.27	15.96	18.16	48.44	(N/A)
Eastern red cedar	11.47	0.89	0.62	17.86	21.34	52.19	(N/A)
Elm	82.02	11.11	15.71	148.79	66.60	324.23	(N/A)
Boxelder	52.73	11.15	9.59	88.80	67.37	229.64	(N/A)
Eastern white pine	38.17	2.03	-1.58	124.79	0.00	163.42	(N/A)
Cottonwood	86.52	11.00	17.37	172.48	62.47	349.85	(N/A)
Chinese elm	13.23	1.81	1.93	10.56	21.64	49.18	(N/A)
Red maple	7.85	0.73	1.12	3.72	7.28	20.71	(N/A)
Citywide Total	30.41	3.69	5.22	40.62	26.16	106.10	(N/A)

Species Distribution of Public Trees

3/31/2020

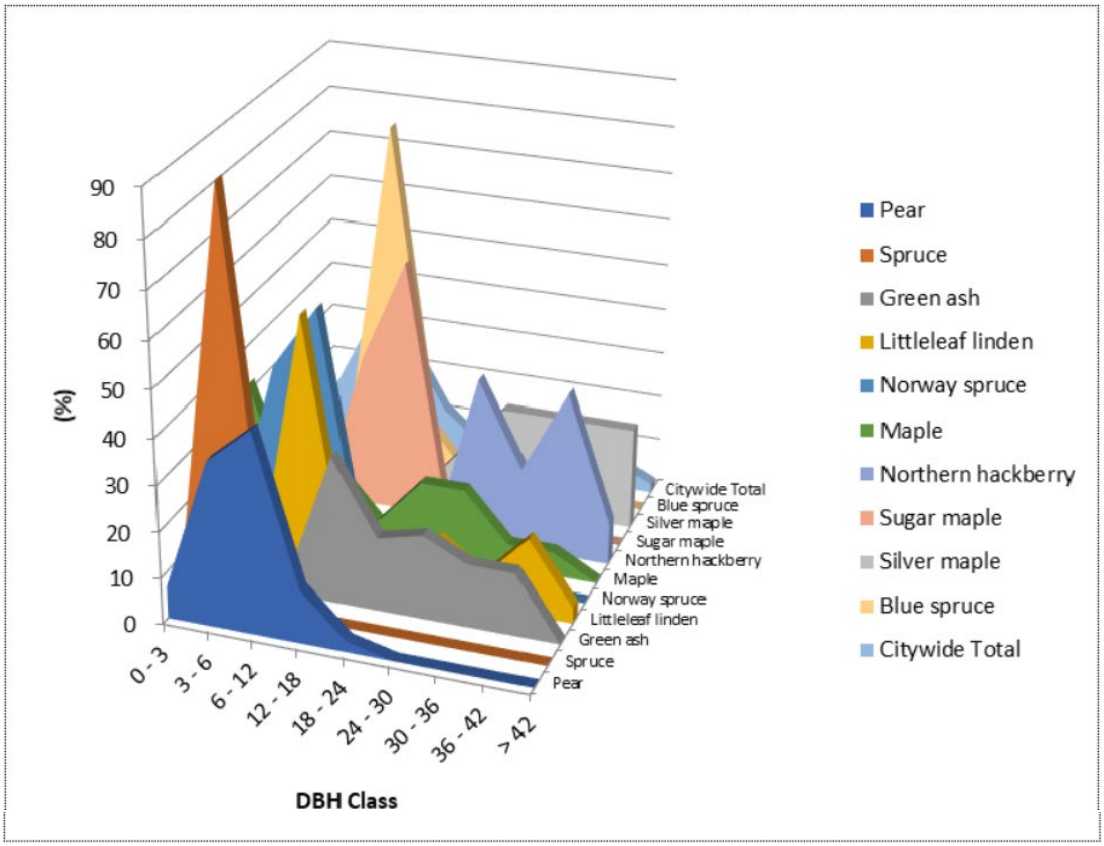


Species	Percent
Pear	23.9
Spruce	14.6
Green ash	12.1
Littleleaf linden	8.2
Norway spruce	6.0
Maple	5.2
Northern hackberry	3.0
Sugar maple	2.5
Silver maple	2.5
Blue spruce	2.5
Other Species	19.5
Total	100.0

Figure 1: Species Distribution

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

3/31/2020



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Pear	6.90	35.63	43.68	11.49	2.30	0.00	0.00	0.00	0.00
Spruce	11.32	88.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Green ash	0.00	2.27	4.55	31.82	15.91	18.18	13.64	13.64	0.00
Littleleaf linden	0.00	3.33	56.67	0.00	0.00	13.33	6.67	16.67	3.33
Norway spruce	4.55	40.91	54.55	0.00	0.00	0.00	0.00	0.00	0.00
Maple	31.58	5.26	15.79	5.26	15.79	15.79	5.26	5.26	0.00
Northern hackberry	0.00	0.00	0.00	0.00	0.00	36.36	18.18	36.36	9.09
Sugar maple	11.11	0.00	33.33	55.56	0.00	0.00	0.00	0.00	0.00
Silver maple	0.00	0.00	0.00	0.00	11.11	22.22	22.22	22.22	22.22
Blue spruce	0.00	11.11	77.78	11.11	0.00	0.00	0.00	0.00	0.00
Citywide Total	7.97	26.92	28.02	11.81	3.85	6.87	6.32	6.32	1.92

Figure 2: Relative Age Class

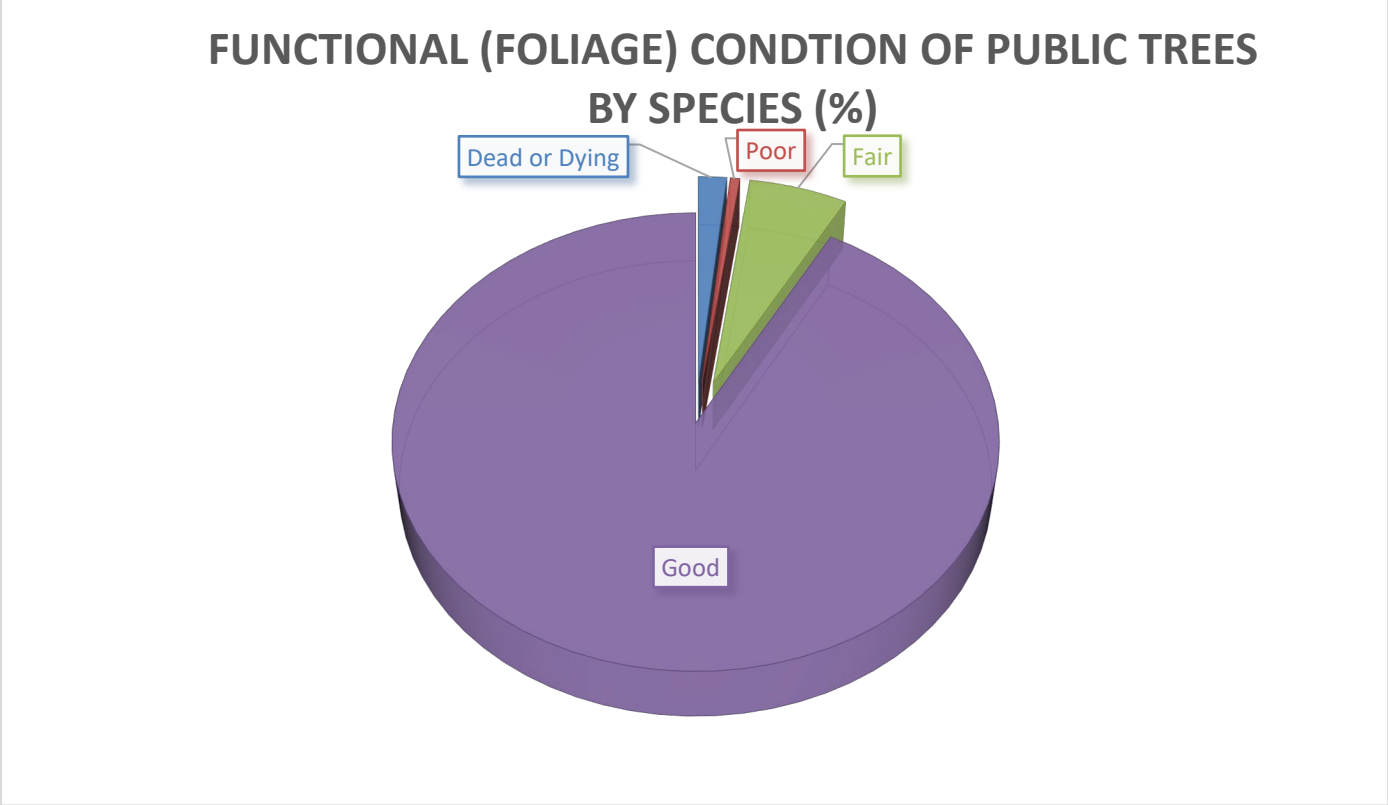


Figure 3: Foliage Condition

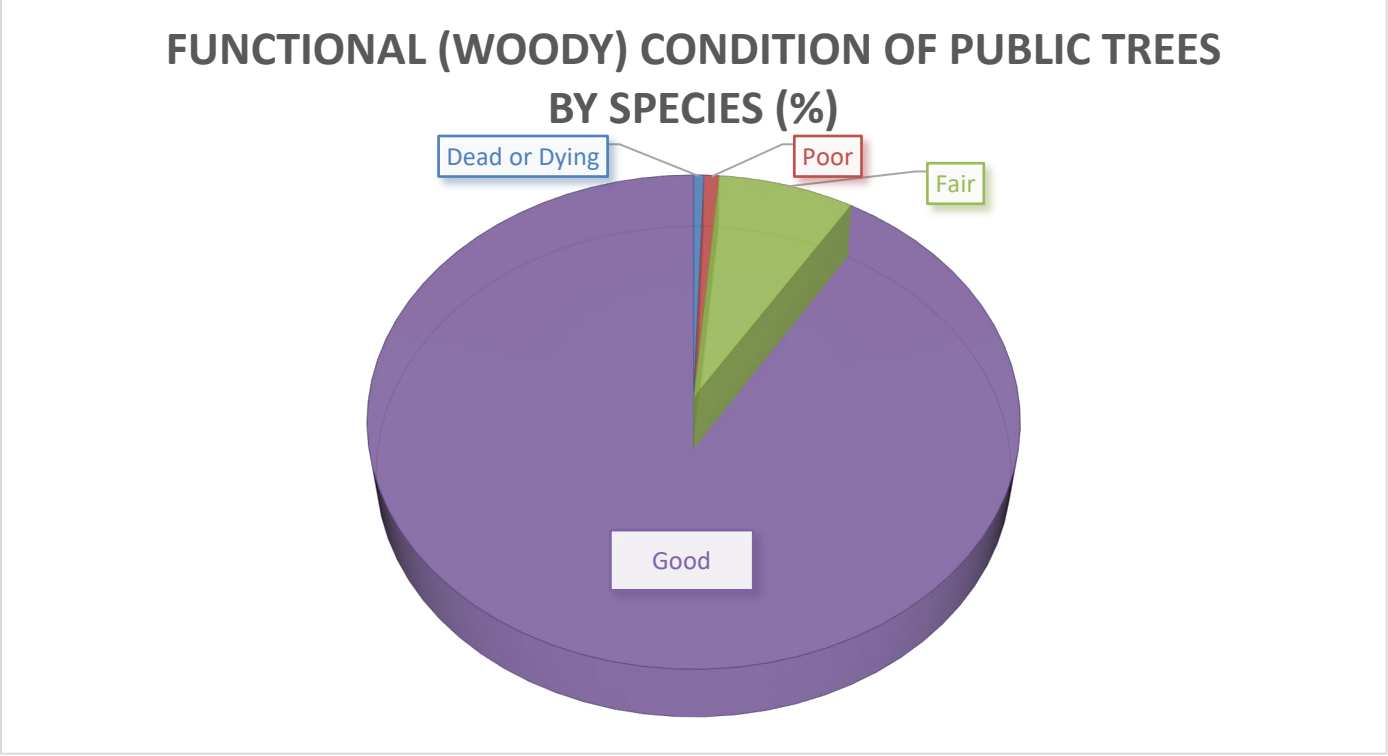
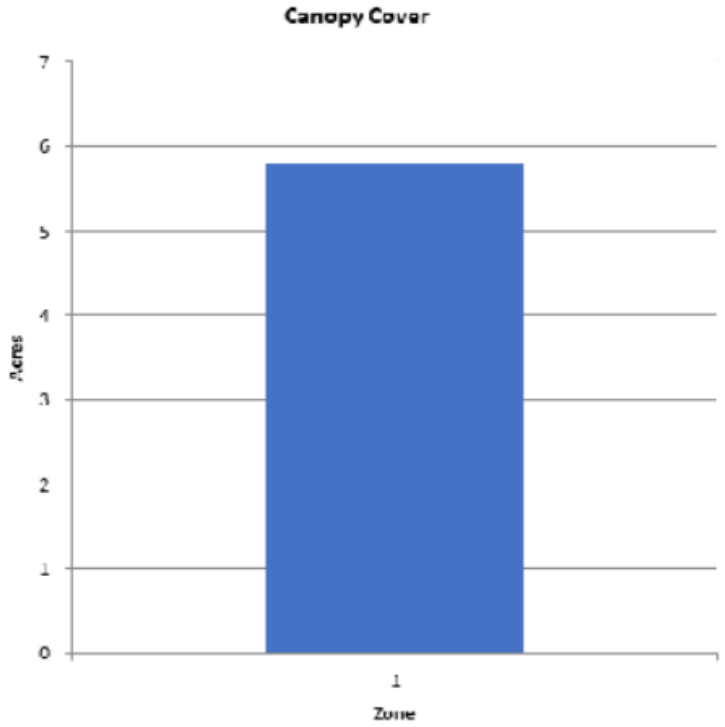


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

3/31/2020



Zone	Acres	% of Total Canopy Cover
1	6	100.0
Citywide total	6	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	6	0.00	0.00

Figure 5: Canopy Cover in Acres

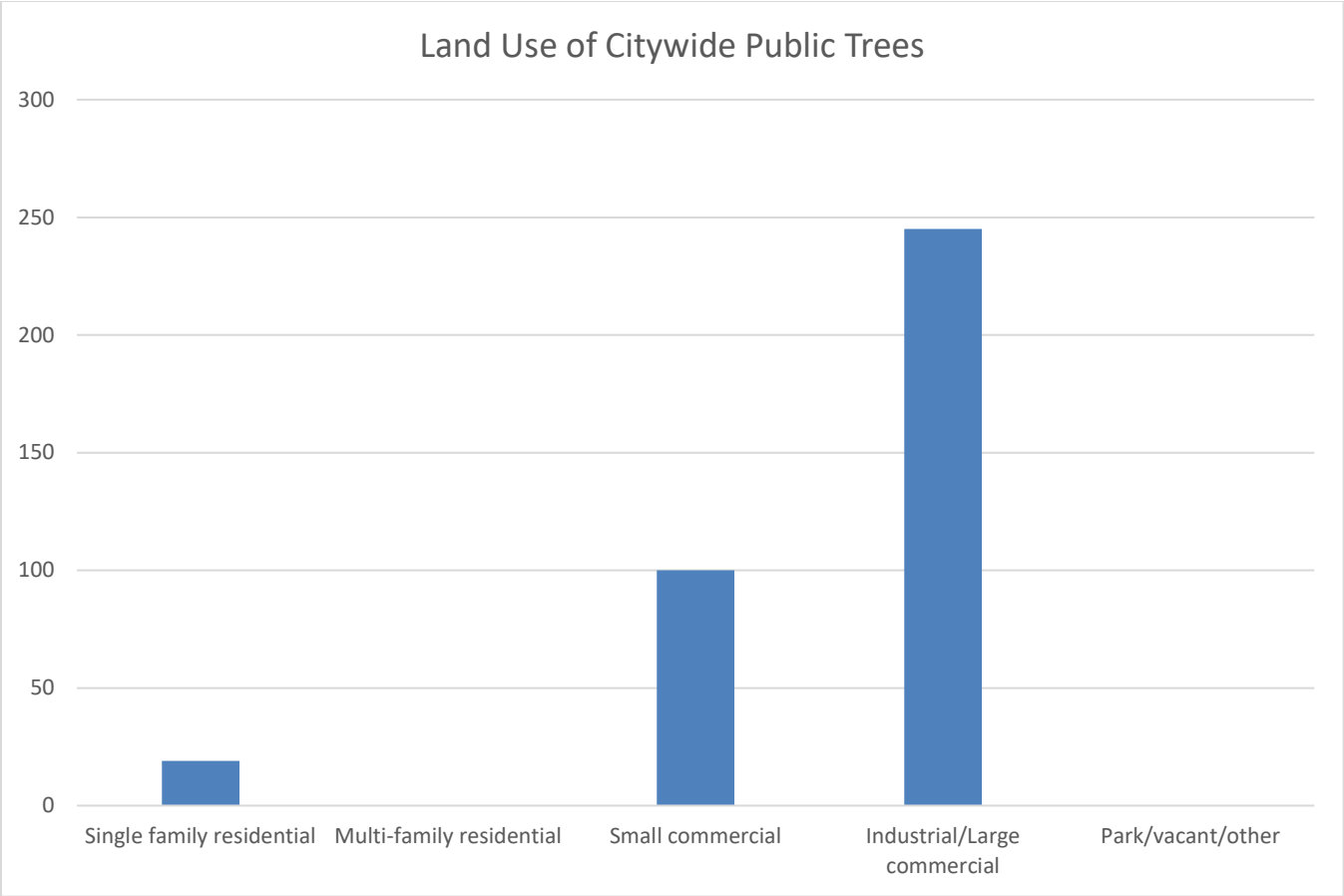


Figure 6: Land Use of city/park trees

Appendix B: ArcGIS Mapping

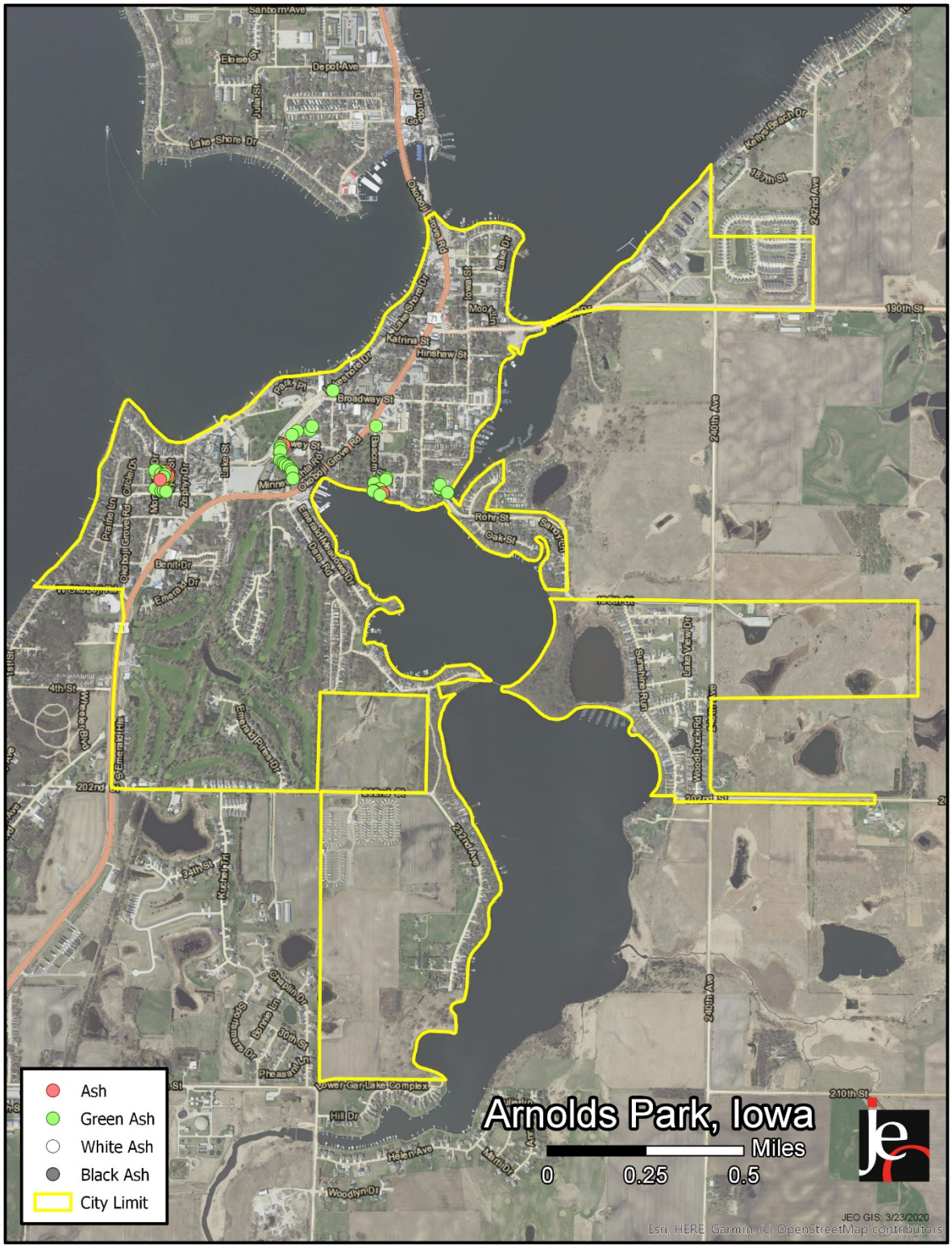


Figure 1: Location of Ash Trees

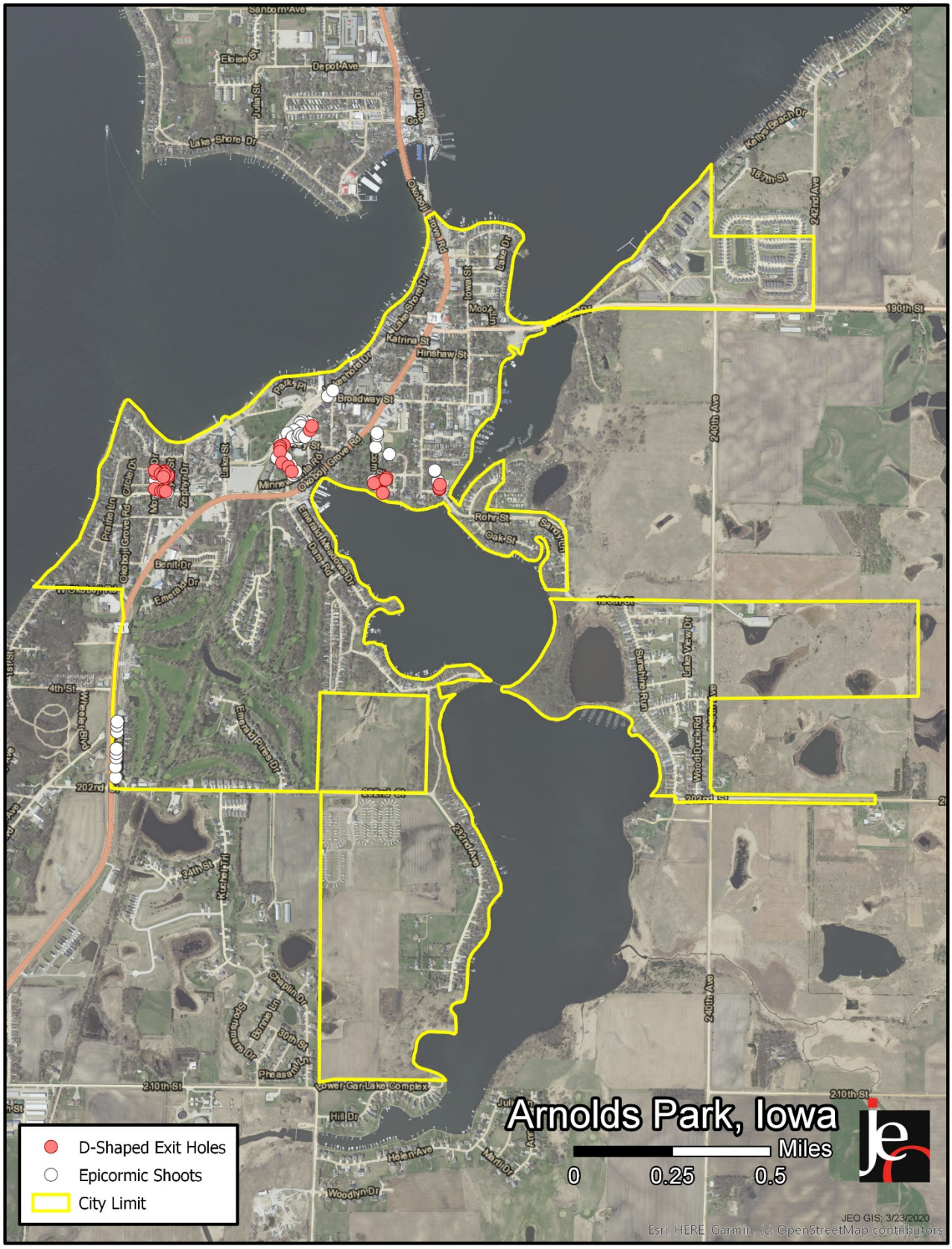


Figure 2: Location of EAB symptoms

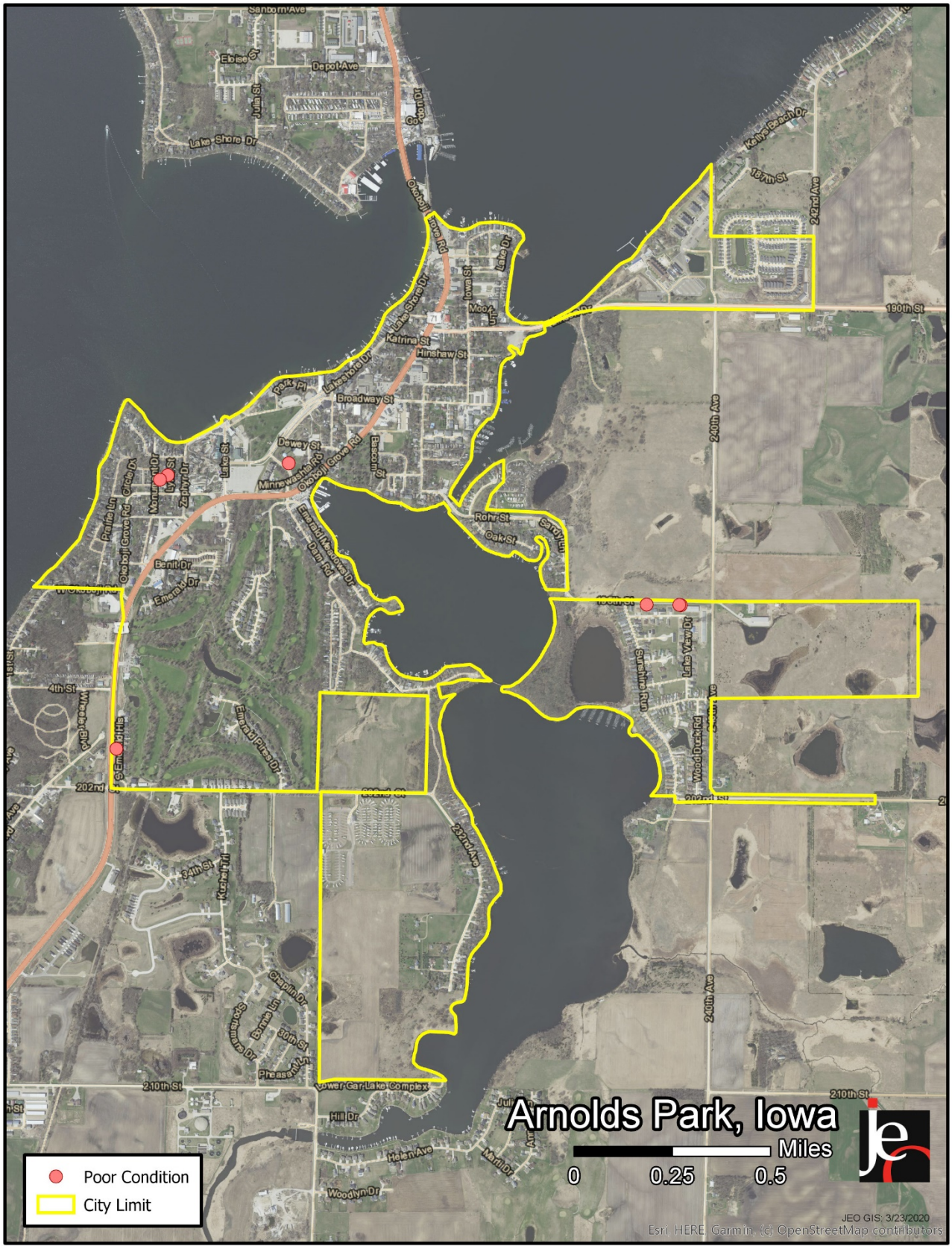


Figure 3: Location of Poor Condition Trees

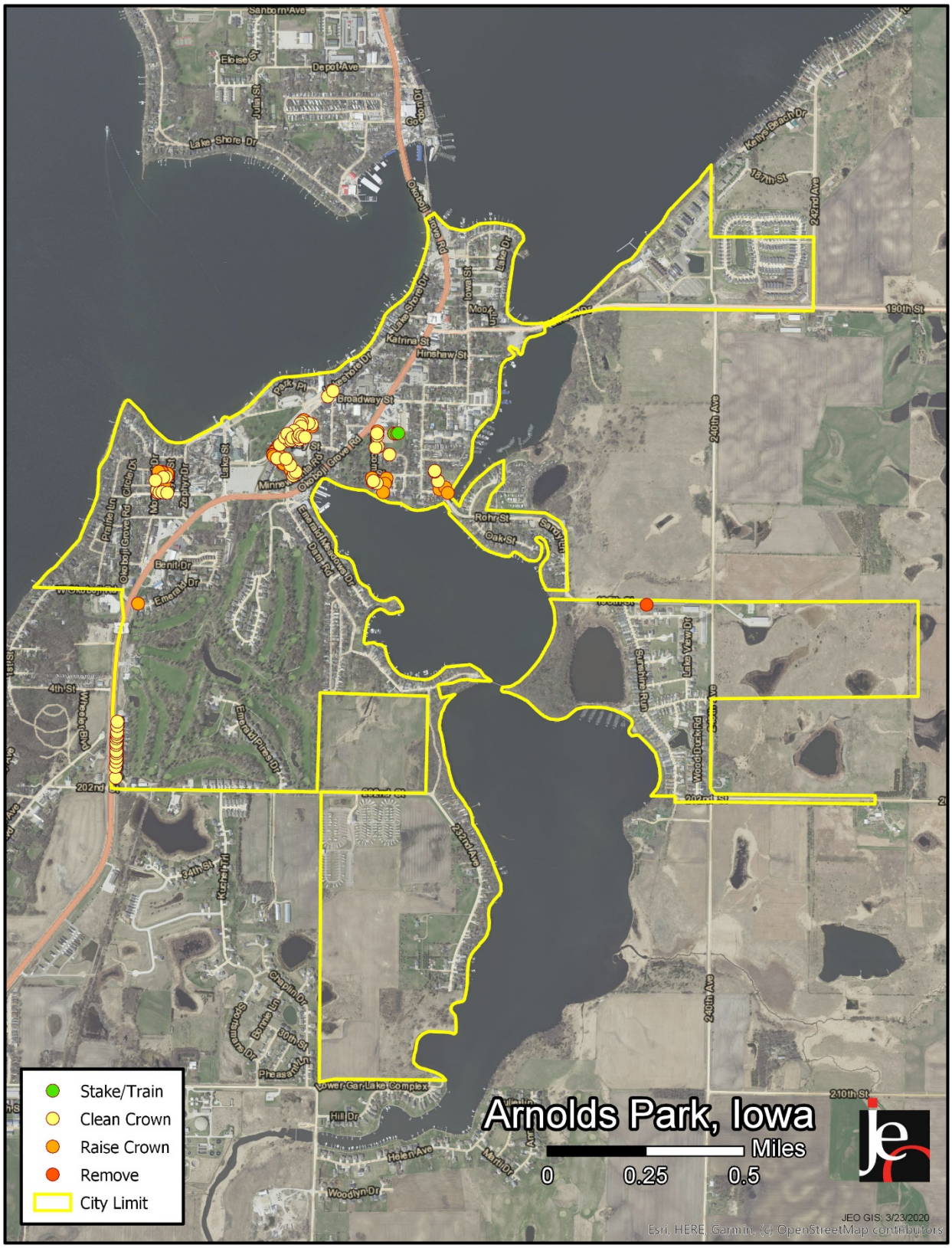


Figure 4: Location of Trees with Recommended Maintenance

City ownership of the trees recommended for removal should be verified prior to any removal

Appendix C: Arnolds Park Tree Ordinances

CHAPTER 151 TREES

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

151.02 PLANTING RESTRICTIONS.
No tree shall be planted in any parking or street without the permission of the City and except in accordance with the following:
1. Alignment. All trees planted in any street shall be planted in the parking 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 (10) feet from the property line.
2. Spacing. Trees shall not be planted on any parking which is less than nine (9) feet 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 (20) feet from street intersections (property lines extended) and ten (10) feet from 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 plant in any street any fruit bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

151.03 DUTY TO TRIM TREES.
The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax. (Code of Iowa, Sec. 364.12[2c, d & e])

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

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

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

1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (14) days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property. (Code of Iowa, Sec. 364.12[3b & h])

151.07 TREE COMMITTEE.
There is hereby created and established a City Tree Committee under the City's Park Commission, whose membership is composed of members of the Arnolds Park Beautification Committee. This committee shall report to the Park Commission at least annually concerning its activities. Members of the committee receive no compensation from the City. The committee chooses its own officers, makes rules and regulations and keeps a journal of its proceedings. A majority of the members shall be a quorum for the transaction of business. The committee shall have the following responsibilities:
1. Study, investigate, counsel, and develop a written plan for the care, preservation, trimming, planting, replanting, removal or disposition of trees in City public areas.
2. Promote and educate the citizens of the City on the values and care of public trees within the City.
3. Pursue grant opportunities and other sources of funding to enhance tree planting and maintenance within the City.
4. When requested by the Park Commission, consider, investigate, make findings, report and recommend upon any special matter or question within the scope of its work.

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.