Belmond, 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 Belmond 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% of Belmond'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 742 trees inventoried.

- Belmond's trees provide $111,141 of benefits annually, an average of $150 a tree
- There are over 48 species of trees
- The top three genera are: Maple 25%, Ash 18%, and Oak 7%
- 27% of trees need some type of management
- 0 trees are recommended for removal

Recommendations

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

- There are no trees needing removal at this time, and no trees 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*
- Twenty-two of the 130 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 tree care provided, it could take 16 years to remove all ash trees alone including both Emerald Ash borer infested and non-infested trees. Time is calculated only considering the removal of ash trees, and does not include replacement, trimming, or other care. We suggest that city officials request a budget increase to at least $12,000 annually and apply for grants to plant replacement trees

Introduction

This plan was developed to assist Belmond 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 Belmond, 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 Belmond'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 Belmond 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 Belmond'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 noted signs and symptoms associated with EAB including canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

The data collected for the 742 city trees were 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. Belmond's trees reduce energy related costs by approximately $33,107 annually (Appendix A, Table 1). These savings are both in electricity (155.6 MWh) and in natural gas (21,731.4 Therms).

Annual Stormwater Benefits

Belmond's trees intercept about 1,325,886 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $35,932 in 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 lessens emissions of volatile organic matter (ozone). In Belmond, it is estimated that trees remove 1,945.1 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $5,481 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Belmond, trees sequester about 285,022 lbs of carbon per year with an associated value of $2,138 (Appendix A, Table 5). In addition, the trees store 3,693,533 lbs of carbon, with a yearly benefit of $27,702 (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. Belmond receives $32,671 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, Belmond's trees provide $111,141 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 742 trees in Belmond provide approximately $146.79 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Belmond has over 48 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	205	25%
Ash	130	18%
Hackberry	109	15%
Oak	50	7%
Apple	59	8%
Linden/Basswood	40	5%
Walnut	21	3%
Locust	21	3%
Spruce	16	2%
Elm	16	2%
Pear	11	1%
Birch	10	1%
Catalpa	9	1%
White Pine	6	<1%
Kentucky Coffeetree	3	<1%
Hickory	3	<1%
Willow	2	<1%
Boxelder	2	<1%
Aspen	1	<1%
Poplar	1	<1%
Sycamore	1	<1%
Other Evergreen	15	2%
Other Deciduous	4	<1%

Age Class

Most of Belmond's trees (52%) are between six and 18 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. Belmond'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 urban forest's overall health. The foliage condition results for Belmond indicate that 72% of the trees are in good health, with only 4% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 53% of Belmond's trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Five percent of the tree population's wood condition is in poor health, dead or dying. This 8% is an estimate of trees that need management follow up.

Management Needs

The following outlines the specific management needs of the street and park trees by number of trees and percent of canopy (Appendix B, Figure 3).

Crown Cleaning	126	17%
Crown Raising	0	0%
Tree Staking	2	<1%
Tree Removal	2	<1%
Crown Reduction	3	<1%

Land Use and Location

The majority of Belmond'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	58%
Industrial/Large commercial	42%
Park/Vacant/other	0%
Small commercial	0%
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

Belmond has 0 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 0 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the Work Schedule and Budget 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 is a total of 3 trees with maintenance 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). All 22 of the initial removals are ash trees. There is a total of 130 ash trees, and 22 of those have signs and symptoms that have been associated with EAB. In addition, there are 12 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 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 Belmond.

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 (25%) (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. While the city currently has no existing City Code in reference to tree planting restrictions, we encourage the city to work with the Iowa Department of Natural Resources to develop a plan moving forward.

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 annually 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, and hazardous trees (Appendix B, Figure 4). Next will be all ash in poor condition that display 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 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 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 outlined by the Iowa Department of Natural Resources. While the city currently has no existing City Code in reference to tree species restrictions, we encourage the city to work with the Iowa Department of Natural Resources to develop a plan moving forward. We encourage the new plantings to be a diverse mix and not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

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

Monitoring
We recommend that ash trees be checked with a visual survey every year for tree death and 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. While there is no existing City Code in reference to private tree care and removal, we encourage the city to work with the Iowa Department of Natural Resources to develop a plan moving forward.

Proposed Work Schedule and Budget

Budget Allowance of $5,000/Year – (Based off Reported Yearly Tree Budget)

YEAR 1	**ESTIMATED COSTS**
Remove 5 ash trees suspected to have EAB Signs/Symptoms	$3,125
Plant 12 trees in open locations	$1,800
Visual Survey of EAB Signs/Symptoms	

YEAR 2	
Remove 2 ash trees suspected to have EAB Signs/Symptoms	$1,250
Prune 1/3 of city-owned trees	$3,720
Visual Survey of EAB Signs/Symptoms	

YEAR 3	
Remove 6 ash trees suspected to have EAB Signs/Symptoms	$3,750
Plant 8 trees in open locations	$1,200
Visual Survey of EAB Signs/Symptoms	

YEAR 4	
Remove 2 ash trees suspected to have EAB Signs/Symptoms	$1,250
Prune 1/3 of city-owned trees	$3,720
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 5 ash trees suspected to have EAB Signs/Symptoms	$3,125
Plant 12 trees in open locations	$1,800
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 2 ash trees suspected to have EAB Signs/Symptoms	$1,250
Prune 1/3 of city-owned trees	$3,720
Visual Survey of EAB Signs/Symptoms	

Estimated costs based on average costs of $625/tree for removal, $150/tree for planting and maintenance, and $15/tree for pruning.

**To remove all ash trees alone within 6 years, the budget would need to be increased to $13,500 a year. If the budget were increased to $8,125 per year, all ash could be removed in 10 years.

Proposed Work Schedule with Increased Budget

Budget Allowance of $12,000/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	**ESTIMATED COSTS**
Remove 15 ash trees suspected to have EAB Signs/Symptoms	$9,375
Plant 17 trees in open locations	$2,550
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Remove 10 ash trees suspected to have EAB Signs/Symptoms	$6,250
Plant 13 trees in open locations	$1,950
Prune 1/3 of city-owned trees	$3,720
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 15 ash trees suspected to have EAB Signs/Symptoms	$9,375
Plant 17 trees in open locations	$2,550
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Remove 10 ash trees suspected to have EAB Signs/Symptoms	$6,250
Plant 13 trees in open locations	$1,950
Prune 1/3 of city-owned trees	$3,720
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 15 ash trees suspected to have EAB Signs/Symptoms	$9,375
Plant 17 trees in open locations	$2,550
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Remove 10 ash trees suspected to have EAB Signs/Symptoms	$6,250
Plant 13 trees in open locations	$1,950
Prune 1/3 of city-owned trees	$3,720
Visual Survey of EAB Signs/Symptoms	

Proposed Budget Increase

EAB could potentially kill all ash trees in Belmond within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $13,500 a year. If the budget were increased to $10,000 a year all ash could be removed within 9 years. Additionally, it is recommended that Belmond apply for grants to fund replacement trees. Utility Company grants are usually between $500 and $10,000 for community-based, tree-planting projects that include parks, gateways, cemeteries, nature trails, libraries, nursing homes, and schools.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For instance, in this treatment scenario, the average ash diameter is 20 inches and at $15 per inch, about 4 trees could be treated per year (every other year treatment). This would be 8 trees selected for treatment, and Belmond would still need to find $8,000 for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $2,250 a year for treatment and leave $1,800 for removal. 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 if EAB is found in Belmond. 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 Public Trees

3/12/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	31.3	2,372	4,408.7	4,321	6,693	(N/A)	17.0	20.2	53.12
Northern hackberry	31.8	2,412	4,466.8	4,377	6,789	(N/A)	14.7	20.5	62.29
Norway maple	23.1	1,753	3,314.5	3,248	5,001	(N/A)	13.3	15.1	50.52
Silver maple	16.4	1,246	2,208.5	2,164	3,410	(N/A)	8.1	10.3	56.84
Apple	4.2	321	695.6	682	1,002	(N/A)	8.0	3.0	16.99
American basswood	4.4	330	614.4	602	933	(N/A)	3.5	2.8	35.87
Black walnut	4.9	370	675.8	662	1,032	(N/A)	2.8	3.1	49.13
Honeylocust	6.1	460	793.1	777	1,237	(N/A)	2.7	3.7	61.87
Red maple	3.3	253	433.4	425	677	(N/A)	2.7	2.0	33.87
Sugar maple	4.1	312	553.7	543	855	(N/A)	2.7	2.6	42.74
Northern red oak	2.6	200	363.4	356	556	(N/A)	2.7	1.7	27.82
Pin oak	3.1	236	412.7	404	640	(N/A)	2.0	1.9	42.67
Black maple	2.3	177	318.5	312	489	(N/A)	1.9	1.5	34.96
Littleleaf linden	2.5	186	338.6	332	518	(N/A)	1.9	1.6	37.02
American elm	2.2	170	307.9	302	471	(N/A)	1.8	1.4	36.26
River birch	2.0	153	263.7	258	412	(N/A)	1.3	1.2	41.17
Bur oak	0.8	60	106.7	105	165	(N/A)	1.2	0.5	18.32
Spruce	0.7	55	100.9	99	154	(N/A)	1.2	0.5	17.10
Blue spruce	0.7	53	91.3	90	142	(N/A)	0.9	0.4	20.35
Conifer Evergreen Mediu	0.3	26	55.8	55	81	(N/A)	0.8	0.2	13.49
Eastern white pine	0.5	41	71.9	71	112	(N/A)	0.8	0.3	18.58
Amur maple	0.5	38	79.8	78	116	(N/A)	0.8	0.4	19.38
Pear	0.4	28	64.8	63	92	(N/A)	0.8	0.3	15.31
Swamp white oak	0.8	60	109.5	107	167	(N/A)	0.7	0.5	33.39
Callery pear	0.3	25	52.3	51	76	(N/A)	0.7	0.2	15.18
Catalpa	0.8	64	121.2	119	183	(N/A)	0.5	0.6	45.77
White ash	0.7	51	84.7	83	134	(N/A)	0.4	0.4	44.61
Kentucky coffeetree	0.2	17	31.1	31	47	(N/A)	0.4	0.1	15.70
Chinese elm	0.7	50	87.6	86	136	(N/A)	0.4	0.4	45.26
Willow	0.5	36	59.0	58	94	(N/A)	0.3	0.3	46.78
Scotch pine	0.3	20	29.3	29	48	(N/A)	0.3	0.1	24.14
Red pine	0.3	20	29.3	29	48	(N/A)	0.3	0.1	24.14
Boxelder	0.4	32	54.7	54	85	(N/A)	0.3	0.3	42.69
Norway spruce	0.2	15	29.2	29	44	(N/A)	0.3	0.1	22.02
Black locust	0.1	8	16.9	17	24	(N/A)	0.1	0.1	24.47
Cottonwood	0.2	18	27.0	26	44	(N/A)	0.1	0.1	44.23
Black spruce	0.1	10	15.2	15	25	(N/A)	0.1	0.1	24.51
Conifer Evergreen Large	0.1	11	19.7	19	30	(N/A)	0.1	0.1	30.47
American sycamore	0.1	7	13.7	13	21	(N/A)	0.1	0.1	20.64
Mulberry	0.1	6	12.8	13	18	(N/A)	0.1	0.1	18.19
Ohio buckeye	0.1	8	16.9	17	24	(N/A)	0.1	0.1	24.47
Quaking aspen	0.2	18	27.0	26	44	(N/A)	0.1	0.1	44.23
Green ash	0.3	25	46.9	46	71	(N/A)	0.1	0.2	70.91
Black poplar	0.4	29	53.7	53	82	(N/A)	0.1	0.2	82.02
Hickory	0.1	7	13.7	13	21	(N/A)	0.1	0.1	20.64
Broadleaf Deciduous Me	0.1	8	16.9	17	24	(N/A)	0.1	0.1	24.47
White oak	0.0	2	3.7	4	6	(N/A)	0.1	0.0	5.82
Ginkgo	0.2	13	18.9	19	31	(N/A)	0.1	0.1	31.46
Total	155.6	11,810	21,731.4	21,297	33,107	(N/A)	100.0	100.0	44.62

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

3/12/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	272,643	7,389	(N/A)	17.0	20.6	58.64
Northern hackberry	247,679	6,712	(N/A)	14.7	18.7	61.58
Norway maple	195,939	5,310	(N/A)	13.3	14.8	53.64
Silver maple	187,055	5,069	(N/A)	8.1	14.1	84.49
Apple	15,008	407	(N/A)	8.0	1.1	6.89
American basswood	32,540	882	(N/A)	3.5	2.5	33.92
Black walnut	44,677	1,211	(N/A)	2.8	3.4	57.65
Honeylocust	59,264	1,606	(N/A)	2.7	4.5	80.30
Red maple	22,250	603	(N/A)	2.7	1.7	30.15
Sugar maple	32,312	876	(N/A)	2.7	2.4	43.78
Northern red oak	19,023	516	(N/A)	2.7	1.4	25.78
Pin oak	24,191	656	(N/A)	2.0	1.8	43.71
Black maple	16,173	438	(N/A)	1.9	1.2	31.31
Littleleaf linden	19,972	541	(N/A)	1.9	1.5	38.66
American elm	22,486	609	(N/A)	1.8	1.7	46.87
River birch	12,941	351	(N/A)	1.3	1.0	35.07
Bur oak	5,020	136	(N/A)	1.2	0.4	15.12
Spruce	8,189	222	(N/A)	1.2	0.6	24.66
Blue spruce	8,444	229	(N/A)	0.9	0.6	32.69
Conifer Evergreen Medium	4,034	109	(N/A)	0.8	0.3	18.22
Eastern white pine	7,450	202	(N/A)	0.8	0.6	33.65
Amur maple	1,793	49	(N/A)	0.8	0.1	8.10
Pear	1,330	36	(N/A)	0.8	0.1	6.01
Swamp white oak	4,576	124	(N/A)	0.7	0.3	24.80
Callery pear	1,660	45	(N/A)	0.7	0.1	9.00
Catalpa	9,102	247	(N/A)	0.5	0.7	61.66
White ash	5,501	149	(N/A)	0.4	0.4	49.70
Kentucky coffeetree	1,387	38	(N/A)	0.4	0.1	12.53
Chinese elm	6,016	163	(N/A)	0.4	0.5	54.35
Willow	2,818	76	(N/A)	0.3	0.2	38.19
Scotch pine	3,077	83	(N/A)	0.3	0.2	41.70
Red pine	3,077	83	(N/A)	0.3	0.2	41.70
Boxelder	3,689	100	(N/A)	0.3	0.3	49.99
Norway spruce	3,565	97	(N/A)	0.3	0.3	48.30
Black locust	586	16	(N/A)	0.1	0.0	15.88
Cottonwood	1,466	40	(N/A)	0.1	0.1	39.72
Black spruce	1,544	42	(N/A)	0.1	0.1	41.85
Conifer Evergreen Large	2,969	80	(N/A)	0.1	0.2	80.46
American sycamore	608	16	(N/A)	0.1	0.0	16.47
Mulberry	264	7	(N/A)	0.1	0.0	7.17
Ohio buckeye	586	16	(N/A)	0.1	0.0	15.88
Quaking aspen	1,466	40	(N/A)	0.1	0.1	39.72
Green ash	3,943	107	(N/A)	0.1	0.3	106.85
Black poplar	5,491	149	(N/A)	0.1	0.4	148.79
Hickory	608	16	(N/A)	0.1	0.0	16.47
Broadleaf Deciduous Medi	586	16	(N/A)	0.1	0.0	15.88
White oak	172	5	(N/A)	0.1	0.0	4.65
Ginkgo	718	19	(N/A)	0.1	0.1	19.45
Citywide total	1,325,886	35,932	(N/A)	100.0	100.0	48.43

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

3/12/2020

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
Ash	33.8	9.3	26.7	2.4	292	150.7	21.8	20.8	141.8	935	-12.8	-48	414.6	1,179 (N/A)	17.0	9.36
Northern hackberry	33.1	5.7	18.0	1.5	184	153.0	22.2	21.1	144.1	950	0.0	0	398.7	1,134 (N/A)	14.7	10.40
Norway maple	37.4	6.4	18.7	1.7	203	111.8	16.2	15.4	104.8	693	-9.0	-34	303.4	862 (N/A)	13.3	8.71
Silver maple	25.9	4.4	13.5	1.2	142	77.9	11.4	10.8	74.3	486	-14.8	-56	204.6	573 (N/A)	8.1	9.54
Apple	3.0	0.5	1.6	0.1	16	21.2	3.0	2.9	19.1	129	0.0	0	51.4	146 (N/A)	8.0	2.47
American basswood	3.3	0.6	1.9	0.1	19	21.0	3.0	2.9	19.8	130	-3.2	-12	49.4	137 (N/A)	3.5	5.26
Black walnut	4.4	0.7	2.3	0.2	24	23.3	3.4	3.2	22.1	145	0.0	0	59.7	169 (N/A)	2.8	8.06
Honeylocust	11.3	1.9	5.2	0.5	60	28.6	4.2	4.0	27.5	179	-8.5	-32	74.6	207 (N/A)	2.7	10.34
Red maple	4.4	0.7	2.2	0.2	24	15.7	2.3	2.2	15.1	98	-1.6	-6	41.1	116 (N/A)	2.7	5.79
Sugar maple	3.4	0.6	1.9	0.2	19	19.5	2.8	2.7	18.6	122	-2.8	-11	46.9	130 (N/A)	2.7	6.51
Northern red oak	3.4	0.6	1.8	0.1	19	12.6	1.8	1.7	12.0	78	-4.8	-18	29.2	79 (N/A)	2.7	3.95
Pin oak	3.3	0.6	1.9	0.1	19	14.7	2.1	2.1	14.1	92	-6.6	-25	32.2	86 (N/A)	2.0	5.70
Black maple	3.2	0.5	1.6	0.1	17	11.1	1.6	1.5	10.6	69	-1.2	-4	29.1	82 (N/A)	1.9	5.86
Littleleaf linden	2.9	0.5	1.5	0.1	16	11.8	1.7	1.6	11.1	73	-1.5	-6	29.8	83 (N/A)	1.9	5.96
American elm	3.3	0.6	1.7	0.1	18	10.7	1.6	1.5	10.1	67	0.0	0	29.5	84 (N/A)	1.8	6.49
River birch	2.1	0.4	1.1	0.1	11	9.6	1.4	1.3	9.2	60	-0.5	-2	24.5	69 (N/A)	1.3	6.92
Bur oak	0.2	0.0	0.2	0.0	1	3.8	0.6	0.5	3.6	24	0.0	0	8.9	25 (N/A)	1.2	2.78
Spruce	0.8	0.2	0.8	0.1	6	3.5	0.5	0.5	3.3	22	-2.6	-10	6.9	17 (N/A)	1.2	1.92
Blue spruce	1.0	0.2	0.9	0.1	7	3.3	0.5	0.5	3.2	21	-2.9	-11	6.6	16 (N/A)	0.9	2.31
Conifer Evergreen Medium	0.4	0.1	0.4	0.0	3	1.7	0.2	0.2	1.6	11	-1.2	-5	3.4	8 (N/A)	0.8	1.40
Eastern white pine	0.8	0.2	0.7	0.1	5	2.6	0.4	0.4	2.4	16	-2.9	-11	4.6	11 (N/A)	0.8	1.77
Amur maple	0.4	0.1	0.2	0.0	2	2.5	0.4	0.3	2.3	15	0.0	0	6.1	17 (N/A)	0.8	2.91
Pear	0.2	0.0	0.1	0.0	1	1.9	0.3	0.3	1.7	12	0.0	0	4.5	13 (N/A)	0.8	2.14
Swamp white oak	0.6	0.1	0.3	0.0	3	3.8	0.5	0.5	3.6	23	-0.2	-1	9.3	26 (N/A)	0.7	5.25
Callery pear	0.1	0.0	0.1	0.0	1	1.6	0.2	0.2	1.5	10	-0.1	0	3.8	11 (N/A)	0.7	2.11
Catalpa	1.0	0.2	0.5	0.0	6	4.1	0.6	0.6	3.8	25	0.0	0	10.8	31 (N/A)	0.5	7.73
White ash	0.5	0.1	0.3	0.0	3	3.1	0.5	0.4	3.0	20	0.0	0	7.9	22 (N/A)	0.4	7.47
Kentucky coffeetree	0.1	0.0	0.0	0.0	0	1.1	0.2	0.1	1.0	7	0.0	0	2.4	7 (N/A)	0.4	2.29
Chinese elm	0.6	0.1	0.3	0.0	3	3.1	0.5	0.4	3.0	19	0.0	0	8.1	23 (N/A)	0.4	7.63
Willow	0.4	0.1	0.2	0.0	2	2.2	0.3	0.3	2.1	14	-0.1	0	5.6	16 (N/A)	0.3	7.92
Scotch pine	0.3	0.1	0.3	0.0	2	1.2	0.2	0.2	1.2	7	-1.1	-4	2.3	6 (N/A)	0.3	2.82
Red pine	0.3	0.1	0.3	0.0	2	1.2	0.2	0.2	1.2	7	-1.1	-4	2.3	6 (N/A)	0.3	2.82
Boxelder	0.4	0.1	0.2	0.0	2	2.0	0.3	0.3	1.9	12	-0.2	-1	5.0	14 (N/A)	0.3	6.96
Norway spruce	0.4	0.1	0.3	0.0	3	1.0	0.1	0.1	0.9	6	-1.5	-6	1.5	3 (N/A)	0.3	1.46
Black locust	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3 (N/A)	0.1	3.47
Cottonwood	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.1	7.42
Black spruce	0.2	0.0	0.2	0.0	1	0.6	0.1	0.1	0.6	4	-0.6	-2	1.2	3 (N/A)	0.1	2.89
Conifer Evergreen Large	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
American sycamore	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3 (N/A)	0.1	2.99
Mulberry	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3 (N/A)	0.1	2.55
Ohio buckeye	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3 (N/A)	0.1	3.47
Quaking aspen	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.1	7.42
Green ash	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
Black poplar	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16 (N/A)	0.1	15.71
Hickory	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3 (N/A)	0.1	2.99
Broadleaf Deciduous Medi	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3 (N/A)	0.1	3.47
White oak	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
Ginkgo	0.1	0.0	0.1	0.0	1	0.8	0.1	0.1	0.8	5	0.0	0	1.9	5 (N/A)	0.1	5.44
Citywide total	209.2	35.9	109.0	9.7	1,148	747.2	108.5	103.4	705.5	4,645	-83.2	-312	1,945.1	5,481 (N/A)	100.0	7.39

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

3/12/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	887,031	6,653	(N/A)	17.0	24.0	52.80
Northern hackberry	465,967	3,495	(N/A)	14.7	12.6	32.06
Norway maple	613,713	4,603	(N/A)	13.3	16.6	46.49
Silver maple	549,750	4,123	(N/A)	8.1	14.9	68.72
Apple	54,557	409	(N/A)	8.0	1.5	6.94
American basswood	123,546	927	(N/A)	3.5	3.3	35.64
Black walnut	143,405	1,076	(N/A)	2.8	3.9	51.22
Honeylocust	143,172	1,074	(N/A)	2.7	3.9	53.69
Red maple	50,519	379	(N/A)	2.7	1.4	18.94
Sugar maple	96,232	722	(N/A)	2.7	2.6	36.09
Northern red oak	64,720	485	(N/A)	2.7	1.8	24.27
Pin oak	81,003	608	(N/A)	2.0	2.2	40.50
Black maple	36,669	275	(N/A)	1.9	1.0	19.64
Littleleaf linden	63,163	474	(N/A)	1.9	1.7	33.84
American elm	74,987	562	(N/A)	1.8	2.0	43.26
River birch	34,432	258	(N/A)	1.3	0.9	25.82
Bur oak	9,401	71	(N/A)	1.2	0.3	7.83
Spruce	5,051	38	(N/A)	1.2	0.1	4.21
Blue spruce	5,325	40	(N/A)	0.9	0.1	5.71
Conifer Evergreen M	1,464	11	(N/A)	0.8	0.0	1.83
Eastern white pine	6,235	47	(N/A)	0.8	0.2	7.79
Amur maple	6,847	51	(N/A)	0.8	0.2	8.56
Pear	4,553	34	(N/A)	0.8	0.1	5.69
Swamp white oak	10,550	79	(N/A)	0.7	0.3	15.83
Callery pear	2,857	21	(N/A)	0.7	0.1	4.29
Catalpa	33,615	252	(N/A)	0.5	0.9	63.03
White ash	13,164	99	(N/A)	0.4	0.4	32.91
Kentucky coffeetree	2,255	17	(N/A)	0.4	0.1	5.64
Chinese elm	20,479	154	(N/A)	0.4	0.6	51.20
Willow	7,248	54	(N/A)	0.3	0.2	27.18
Scotch pine	2,340	18	(N/A)	0.3	0.1	8.78
Red pine	2,340	18	(N/A)	0.3	0.1	8.78
Boxelder	11,569	87	(N/A)	0.3	0.3	43.39
Norway spruce	3,599	27	(N/A)	0.3	0.1	13.50
Black locust	1,101	8	(N/A)	0.1	0.0	8.26
Cottonwood	3,672	28	(N/A)	0.1	0.1	27.54
Black spruce	1,118	8	(N/A)	0.1	0.0	8.39
Conifer Evergreen I	3,343	25	(N/A)	0.1	0.1	25.07
American sycamore	1,035	8	(N/A)	0.1	0.0	7.76
Mulberry	908	7	(N/A)	0.1	0.0	6.81
Ohio buckeye	1,101	8	(N/A)	0.1	0.0	8.26
Quaking aspen	3,672	28	(N/A)	0.1	0.1	27.54
Green ash	15,773	118	(N/A)	0.1	0.4	118.30
Black poplar	25,943	195	(N/A)	0.1	0.7	194.57
Hickory	1,035	8	(N/A)	0.1	0.0	7.76
Broadleaf Deciduou	1,101	8	(N/A)	0.1	0.0	8.26
White oak	185	1	(N/A)	0.1	0.0	1.39
Ginkgo	1,787	13	(N/A)	0.1	0.0	13.40
Citywide total	3,693,533	27,702	(N/A)	100.0	100.0	37.33

Table 5: Annual Carbon Sequestered

Annual CO_2 Benefits of Public Trees

3/12/2020

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
Ash	47,871	359	-4,258	-309	-34	52,429	393	95,733	718	(N/A)	17.0	18.2	5.70
Northern hackberry	34,423	258	-2,237	-277	-19	53,297	400	85,206	639	(N/A)	14.7	16.2	5.86
Norway maple	38,308	287	-2,947	-230	-24	38,739	291	73,871	554	(N/A)	13.3	14.0	5.60
Silver maple	54,471	409	-2,640	-165	-21	27,533	206	79,198	594	(N/A)	8.1	15.0	9.90
Apple	6,471	49	-262	-65	-2	7,085	53	13,229	99	(N/A)	8.0	2.5	1.68
American basswood	9,090	68	-593	-49	-5	7,303	55	15,751	118	(N/A)	3.5	3.0	4.54
Black walnut	11,587	87	-688	-50	-6	8,166	61	19,015	143	(N/A)	2.8	3.6	6.79
Honeylocust	18,793	141	-687	-48	-6	10,171	76	28,229	212	(N/A)	2.7	5.4	10.59
Red maple	6,631	50	-243	-30	-2	5,582	42	11,941	90	(N/A)	2.7	2.3	4.48
Sugar maple	7,195	54	-462	-41	-4	6,897	52	13,588	102	(N/A)	2.7	2.6	5.10
Northern red oak	3,978	30	-311	-32	-3	4,426	33	8,061	60	(N/A)	2.7	1.5	3.02
Pin oak	8,949	67	-389	-30	-3	5,208	39	13,737	103	(N/A)	2.0	2.6	6.87
Black maple	3,860	29	-176	-22	-1	3,917	29	7,579	57	(N/A)	1.9	1.4	4.06
Littleleaf linden	7,411	56	-303	-28	-2	4,118	31	11,198	84	(N/A)	1.9	2.1	6.00
American elm	2,828	21	-363	-24	-3	3,748	28	6,189	46	(N/A)	1.8	1.2	3.57
River birch	3,401	26	-165	-18	-1	3,388	25	6,606	50	(N/A)	1.3	1.3	4.95
Bur oak	1,712	13	-45	-10	0	1,333	10	2,990	22	(N/A)	1.2	0.6	2.49
Spruce	662	5	-24	-13	0	1,216	9	1,841	14	(N/A)	1.2	0.3	1.53
Blue spruce	479	4	-26	-11	0	1,170	9	1,612	12	(N/A)	0.9	0.3	1.73
Conifer Evergreen Medi	205	2	-7	-6	0	579	4	771	6	(N/A)	0.8	0.1	0.96
Eastern white pine	542	4	-30	-10	0	906	7	1,408	11	(N/A)	0.8	0.3	1.76
Amur maple	761	6	-33	-7	0	842	6	1,563	12	(N/A)	0.8	0.3	1.95
Pear	578	4	-22	-6	0	626	5	1,176	9	(N/A)	0.8	0.2	1.47
Swamp white oak	1,444	11	-51	-7	0	1,318	10	2,703	20	(N/A)	0.7	0.5	4.05
Callery pear	735	6	-16	-4	0	545	4	1,260	9	(N/A)	0.7	0.2	1.89
Catalpa	2,131	16	-161	-9	-1	1,422	11	3,383	25	(N/A)	0.5	0.6	6.34
White ash	1,521	11	-63	-6	-1	1,123	8	2,574	19	(N/A)	0.4	0.5	6.44
Kentucky coffeetree	492	4	-11	-3	0	366	3	844	6	(N/A)	0.4	0.2	2.11
Chinese elm	1,511	11	-98	-7	-1	1,104	8	2,510	19	(N/A)	0.4	0.5	6.27
Willow	772	6	-35	-4	0	790	6	1,523	11	(N/A)	0.3	0.3	5.71
Scotch pine	231	2	-11	-4	0	433	3	649	5	(N/A)	0.3	0.1	2.43
Red pine	231	2	-11	-4	0	433	3	649	5	(N/A)	0.3	0.1	2.43
Boxelder	1,113	8	-56	-5	0	702	5	1,755	13	(N/A)	0.3	0.3	6.58
Norway spruce	240	2	-17	-4	0	341	3	560	4	(N/A)	0.3	0.1	2.10
Black locust	224	2	-5	-1	0	176	1	393	3	(N/A)	0.1	0.1	2.95
Cottonwood	445	3	-18	-2	0	393	3	819	6	(N/A)	0.1	0.2	6.14
Black spruce	91	1	-5	-2	0	213	2	296	2	(N/A)	0.1	0.1	2.22
Conifer Evergreen Large	187	1	-16	-3	0	246	2	415	3	(N/A)	0.1	0.1	3.11
American sycamore	209	2	-5	-1	0	159	1	361	3	(N/A)	0.1	0.1	2.71
Mulberry	114	1	-4	-1	0	124	1	232	2	(N/A)	0.1	0.0	1.74
Ohio buckeye	224	2	-5	-1	0	176	1	393	3	(N/A)	0.1	0.1	2.95
Quaking aspen	445	3	-18	-2	0	393	3	819	6	(N/A)	0.1	0.2	6.14
Green ash	857	6	-76	-4	-1	552	4	1,330	10	(N/A)	0.1	0.3	9.97
Black poplar	960	7	-125	-4	-1	650	5	1,481	11	(N/A)	0.1	0.3	11.11
Hickory	209	2	-5	-1	0	159	1	361	3	(N/A)	0.1	0.1	2.71
Broadleaf Deciduous M	224	2	-5	-1	0	176	1	393	3	(N/A)	0.1	0.1	2.95
White oak	74	1	-1	-1	0	49	0	121	1	(N/A)	0.1	0.0	0.91
Ginkgo	134	1	-9	-2	0	285	2	409	3	(N/A)	0.1	0.1	3.07
Citywide total	285,022	2,138	-17,737	-1,561	-145	261,005	1,958	526,728	3,950	(N/A)	100.0	100.0	5.32

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

3/12/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Ash	4,578	(N/A)	17.0	14.0	36.33
Northern hackberry	5,265	(N/A)	14.7	16.1	48.31
Norway maple	3,691	(N/A)	13.3	11.3	37.28
Silver maple	4,779	(N/A)	8.1	14.6	79.65
Apple	365	(N/A)	8.0	1.1	6.18
American basswood	754	(N/A)	3.5	2.3	28.99
Black walnut	1,063	(N/A)	2.8	3.3	50.64
Honeylocust	4,466	(N/A)	2.7	13.7	223.32
Red maple	933	(N/A)	2.7	2.9	46.63
Sugar maple	853	(N/A)	2.7	2.6	42.64
Northern red oak	365	(N/A)	2.7	1.1	18.23
Pin oak	833	(N/A)	2.0	2.6	55.57
Black maple	575	(N/A)	1.9	1.8	41.09
Littleleaf linden	808	(N/A)	1.9	2.5	57.69
American elm	395	(N/A)	1.8	1.2	30.36
River birch	346	(N/A)	1.3	1.1	34.61
Bur oak	233	(N/A)	1.2	0.7	25.87
Spruce	189	(N/A)	1.2	0.6	21.05
Blue spruce	164	(N/A)	0.9	0.5	23.45
Conifer Evergreen Medium	118	(N/A)	0.8	0.4	19.62
Eastern white pine	149	(N/A)	0.8	0.5	24.90
Amur maple	43	(N/A)	0.8	0.1	7.19
Pear	32	(N/A)	0.8	0.1	5.34
Swamp white oak	157	(N/A)	0.7	0.5	31.40
Callery pear	91	(N/A)	0.7	0.3	18.22
Catalpa	188	(N/A)	0.5	0.6	47.07
White ash	199	(N/A)	0.4	0.6	66.17
Kentucky coffeetree	72	(N/A)	0.4	0.2	23.95
Chinese elm	140	(N/A)	0.4	0.4	46.67
Willow	78	(N/A)	0.3	0.2	39.16
Scotch pine	65	(N/A)	0.3	0.2	32.32
Red pine	65	(N/A)	0.3	0.2	32.32
Boxelder	91	(N/A)	0.3	0.3	45.50
Norway spruce	63	(N/A)	0.3	0.2	31.25
Black locust	26	(N/A)	0.1	0.1	26.22
Cottonwood	46	(N/A)	0.1	0.1	45.86
Black spruce	25	(N/A)	0.1	0.1	25.23
Conifer Evergreen Large	47	(N/A)	0.1	0.1	47.08
American sycamore	29	(N/A)	0.1	0.1	28.56
Mulberry	6	(N/A)	0.1	0.0	6.40
Ohio buckeye	26	(N/A)	0.1	0.1	26.22
Quaking aspen	46	(N/A)	0.1	0.1	45.86
Green ash	66	(N/A)	0.1	0.2	65.59
Black poplar	67	(N/A)	0.1	0.2	66.60
Hickory	29	(N/A)	0.1	0.1	28.56
Broadleaf Deciduous Medi	26	(N/A)	0.1	0.1	26.22
White oak	15	(N/A)	0.1	0.0	14.73
Ginkgo	12	(N/A)	0.1	0.0	12.07
Citywide total	32,671	(N/A)	100.0	100.0	44.03

Table 7: Summary of Benefits in Dollars

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

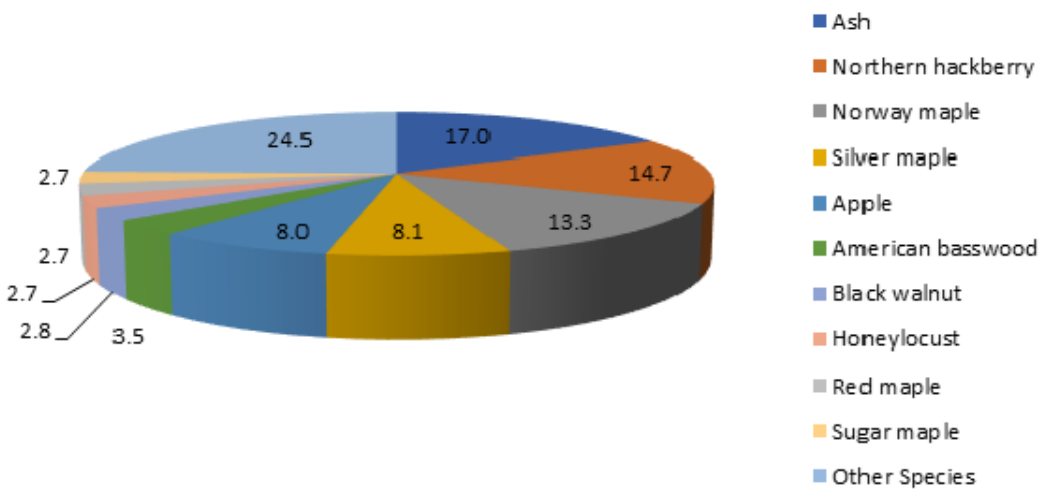
3/12/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error
Ash	53.12	5.70	9.36	58.64	36.33	163.15	(N/A)
Northern hackberry	62.29	5.86	10.40	61.58	48.31	188.44	(N/A)
Norway maple	50.52	5.60	8.71	53.64	37.28	155.74	(N/A)
Silver maple	56.84	9.90	9.54	84.49	79.65	240.42	(N/A)
Apple	16.99	1.68	2.47	6.89	6.18	34.21	(N/A)
American basswood	35.87	4.54	5.26	33.92	28.99	108.58	(N/A)
Black walnut	49.13	6.79	8.06	57.65	50.64	172.28	(N/A)
Honeylocust	61.87	10.59	10.34	80.30	223.32	386.42	(N/A)
Red maple	33.87	4.48	5.79	30.15	46.63	120.92	(N/A)
Sugar maple	42.74	5.10	6.51	43.78	42.64	140.77	(N/A)
Northern red oak	27.82	3.02	3.95	25.78	18.23	78.80	(N/A)
Pin oak	42.67	6.87	5.70	43.71	55.57	154.52	(N/A)
Black maple	34.96	4.06	5.86	31.31	41.09	117.28	(N/A)
Littleleaf linden	37.02	6.00	5.96	38.66	57.69	145.33	(N/A)
American elm	36.26	3.57	6.49	46.87	30.36	123.55	(N/A)
River birch	41.17	4.95	6.92	35.07	34.61	122.73	(N/A)
Bur oak	18.32	2.49	2.78	15.12	25.87	64.57	(N/A)
Spruce	17.10	1.53	1.92	24.66	21.05	66.27	(N/A)
Blue spruce	20.35	1.73	2.31	32.69	23.45	80.53	(N/A)
Conifer Evergreen M	13.49	0.96	1.40	18.22	19.62	53.70	(N/A)
Eastern white pine	18.58	1.76	1.77	33.65	24.90	80.66	(N/A)
Amur maple	19.38	1.95	2.91	8.10	7.19	39.54	(N/A)
Pear	15.31	1.47	2.14	6.01	5.34	30.26	(N/A)
Swamp white oak	33.39	4.05	5.25	24.80	31.40	98.90	(N/A)
Callery pear	15.18	1.89	2.11	9.00	18.22	46.40	(N/A)
Catalpa	45.77	6.34	7.73	61.66	47.07	168.59	(N/A)
White ash	44.61	6.44	7.47	49.70	66.17	174.38	(N/A)
Kentucky coffeetree	15.70	2.11	2.29	12.53	23.95	56.57	(N/A)
Chinese elm	45.26	6.27	7.63	54.35	46.67	160.18	(N/A)
Willow	46.78	5.71	7.92	38.19	39.16	137.75	(N/A)
Scotch pine	24.14	2.43	2.82	41.70	32.32	103.40	(N/A)
Red pine	24.14	2.43	2.82	41.70	32.32	103.40	(N/A)
Boxelder	42.69	6.58	6.96	49.99	45.50	151.71	(N/A)
Norway spruce	22.02	2.10	1.46	48.30	31.25	105.14	(N/A)
Black locust	24.47	2.95	3.47	15.88	26.22	72.99	(N/A)
Cottonwood	44.23	6.14	7.42	39.72	45.86	143.36	(N/A)
Black spruce	24.51	2.22	2.89	41.85	25.23	96.70	(N/A)
Conifer Evergreen L	30.47	3.11	1.45	80.46	47.08	162.58	(N/A)
American sycamore	20.64	2.71	2.99	16.47	28.56	71.37	(N/A)
Mulberry	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Ohio buckeye	24.47	2.95	3.47	15.88	26.22	72.99	(N/A)
Quaking aspen	44.23	6.14	7.42	39.72	45.86	143.36	(N/A)
Green ash	70.91	9.97	12.48	106.85	65.59	265.81	(N/A)
Black poplar	82.02	11.11	15.71	148.79	66.60	324.23	(N/A)
Hickory	20.64	2.71	2.99	16.47	28.56	71.37	(N/A)
Broadleaf Deciduou	24.47	2.95	3.47	15.88	26.22	72.99	(N/A)
White oak	5.82	0.91	0.87	4.65	14.73	26.98	(N/A)
Ginkgo	31.46	3.07	5.44	19.45	12.07	71.49	(N/A)
Citywide Total	44.62	5.32	7.39	48.43	44.03	149.79	(N/A)

Belmond

Species Distribution of Public Trees

3/12/2020

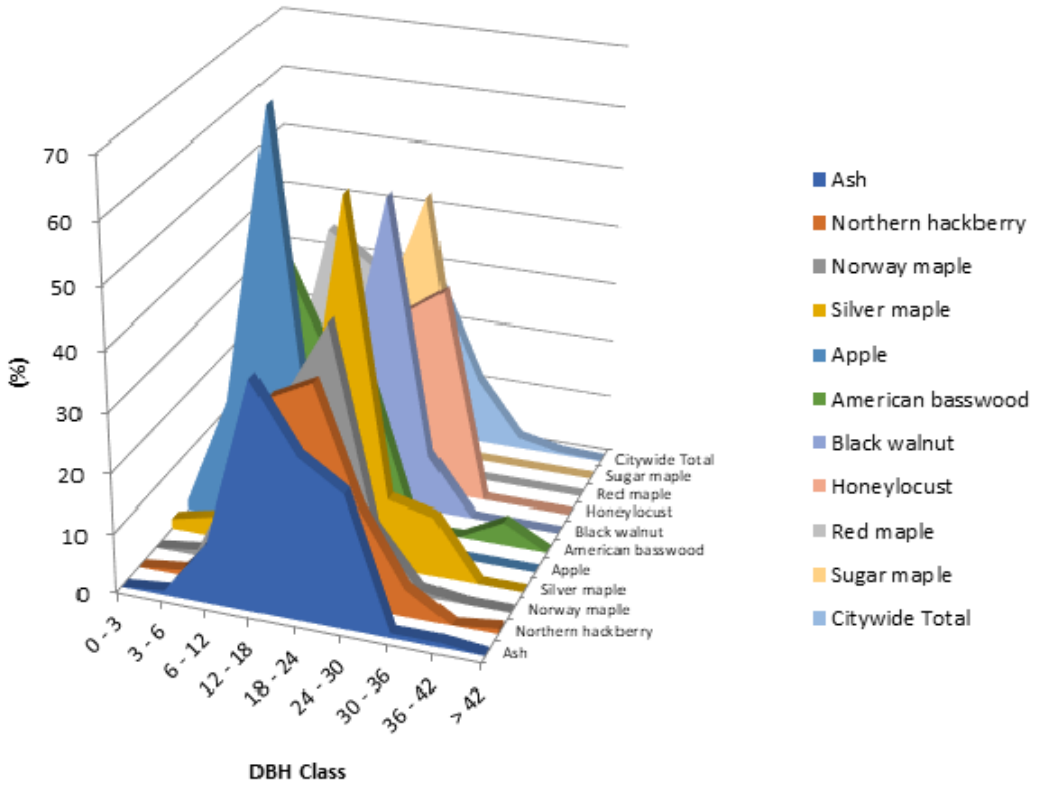


Species	Percent
Ash	17.0
Northern hackberry	14.7
Norway maple	13.3
Silver maple	8.1
Apple	8.0
American basswood	3.5
Black walnut	2.8
Honeylocust	2.7
Red maple	2.7
Sugar maple	2.7
Other Species	24.5
Total	100.0

Figure 1: Species Distribution

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

3/12/2020



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Ash	0.00	0.79	10.32	38.10	26.98	22.22	0.79	0.79	0.00
Northern hackberry	0.00	0.92	9.17	32.11	35.78	16.51	4.59	0.00	0.92
Norway maple	0.00	1.01	16.16	29.29	42.42	10.10	1.01	0.00	0.00
Silver maple	1.67	3.33	1.67	11.67	60.00	11.67	10.00	0.00	0.00
Apple	1.69	20.34	69.49	8.47	0.00	0.00	0.00	0.00	0.00
American basswood	0.00	3.85	42.31	26.92	23.08	0.00	0.00	3.85	0.00
Black walnut	0.00	0.00	19.05	19.05	52.38	9.52	0.00	0.00	0.00
Honeylocust	0.00	0.00	10.00	25.00	30.00	35.00	0.00	0.00	0.00
Red maple	5.00	10.00	40.00	35.00	10.00	0.00	0.00	0.00	0.00
Sugar maple	0.00	0.00	30.00	25.00	45.00	0.00	0.00	0.00	0.00
Citywide Total	1.08	5.26	25.34	27.09	27.63	11.19	1.89	0.40	0.13

Figure 2: Relative Age Class

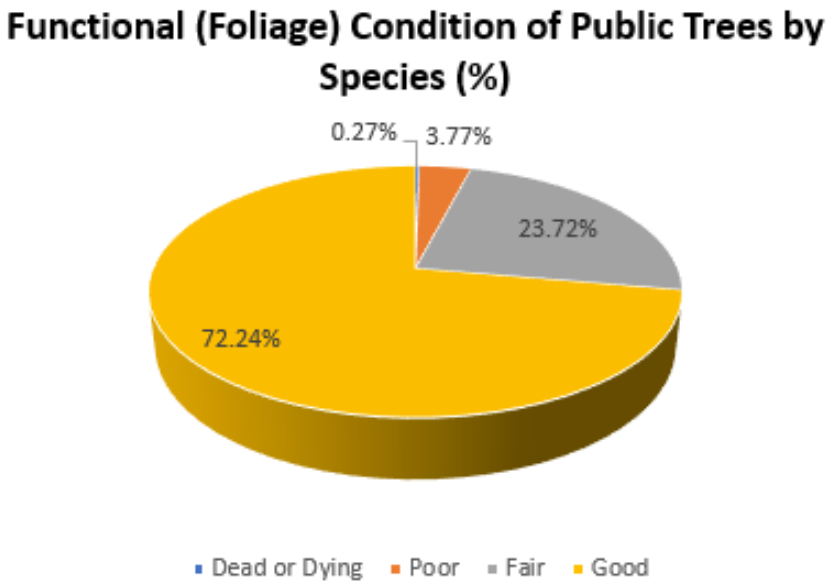


Figure 3: Foliage Condition

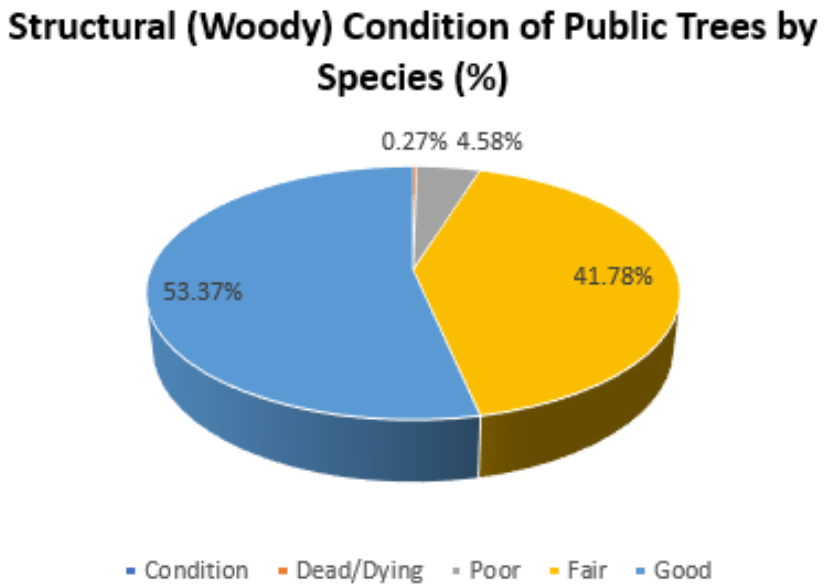
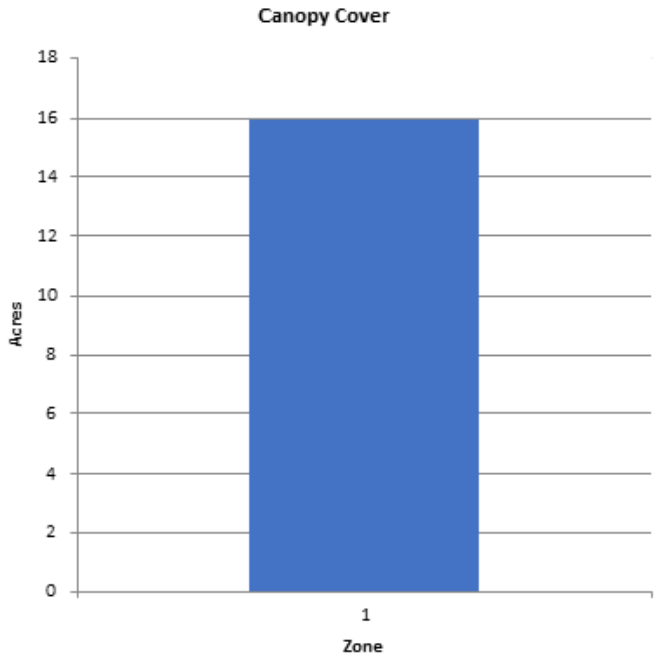


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

3/12/2020



Zone	Acres	% of Total Canopy Cover
1	16	100.0
Citywide total	16	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	16	0.00	0.00

Figure 5: Canopy Cover in Acres

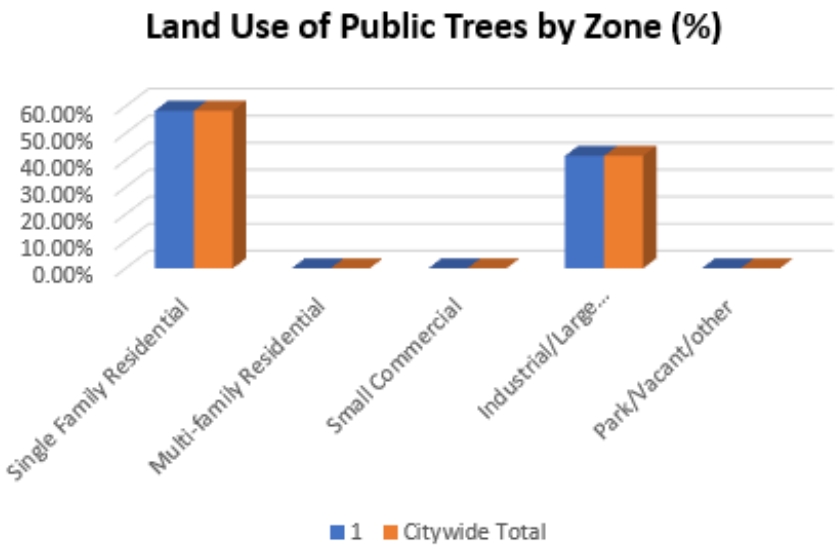


Figure 6: Land Use of city/park trees

Appendix B: ArcGIS Mapping

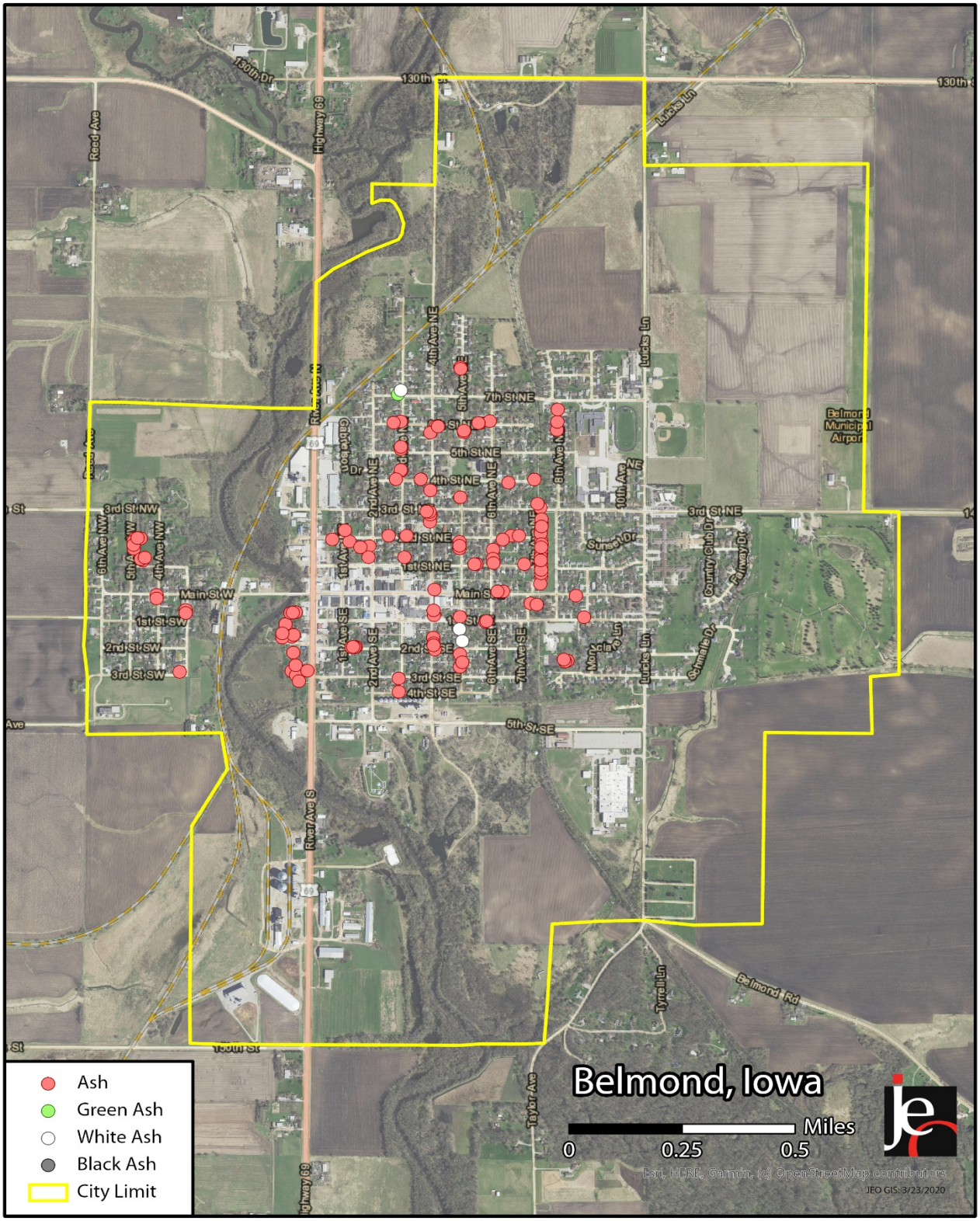


Figure 1: Location of Ash Trees

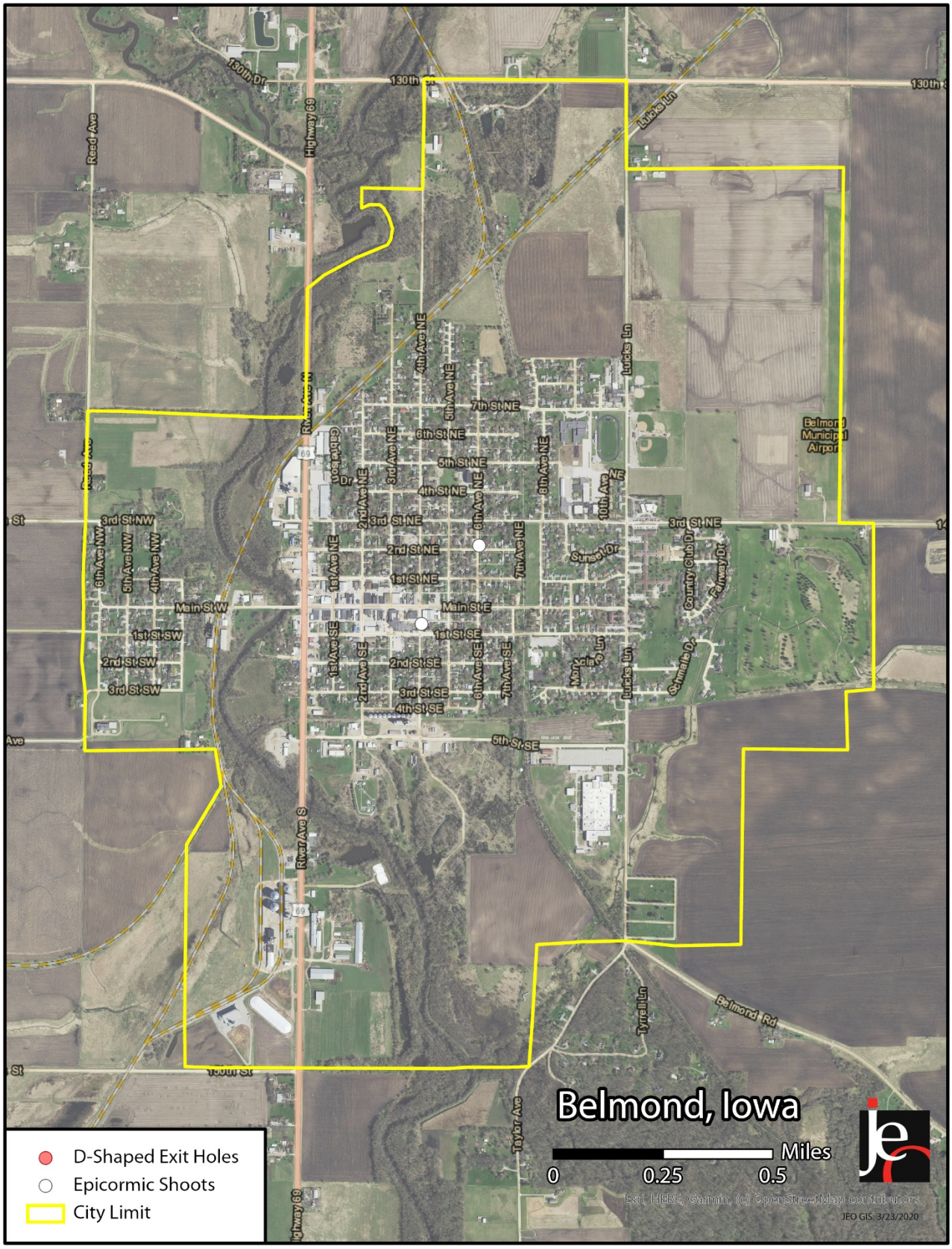


Figure 2: Location of EAB symptoms

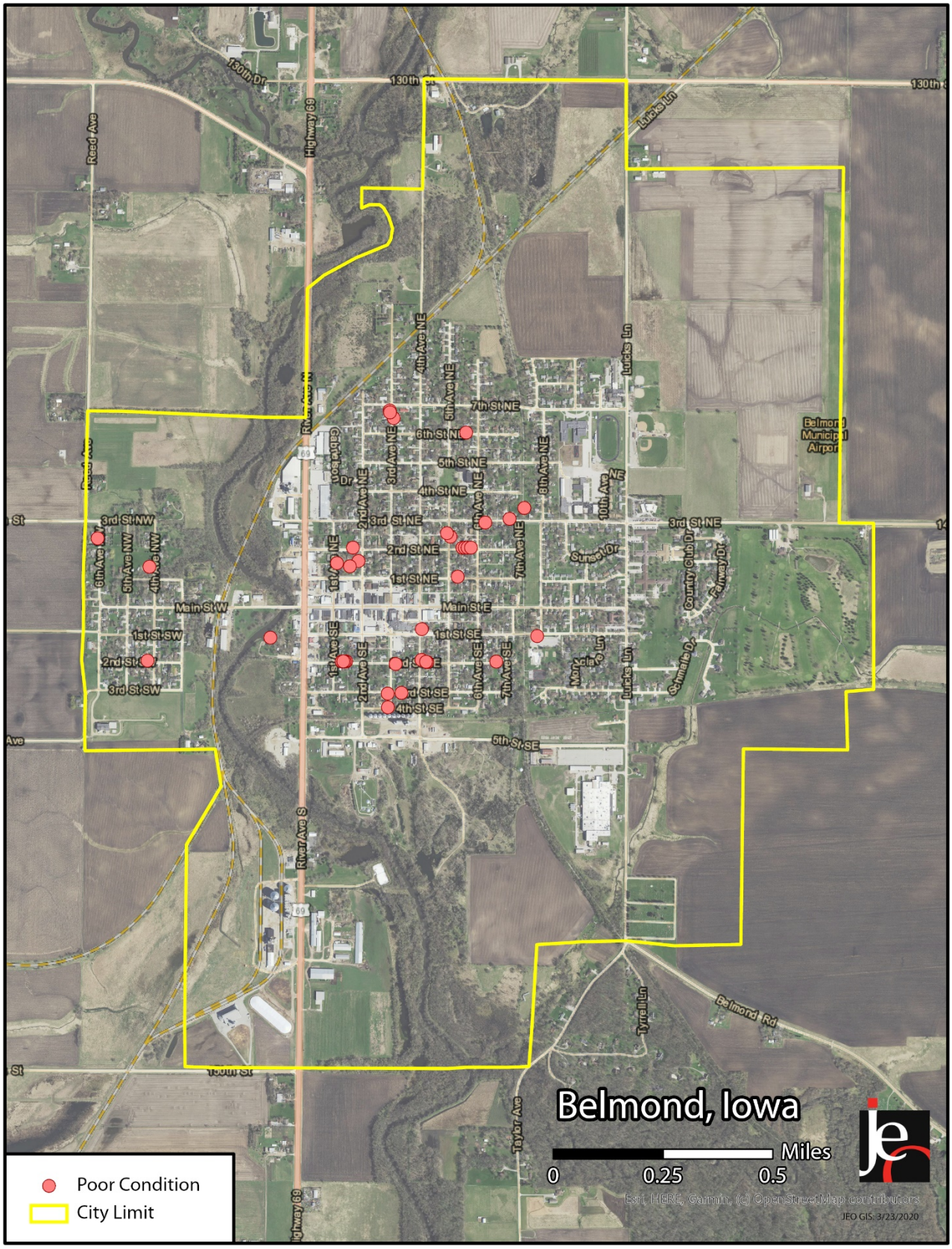


Figure 3: Location of Poor Condition Trees

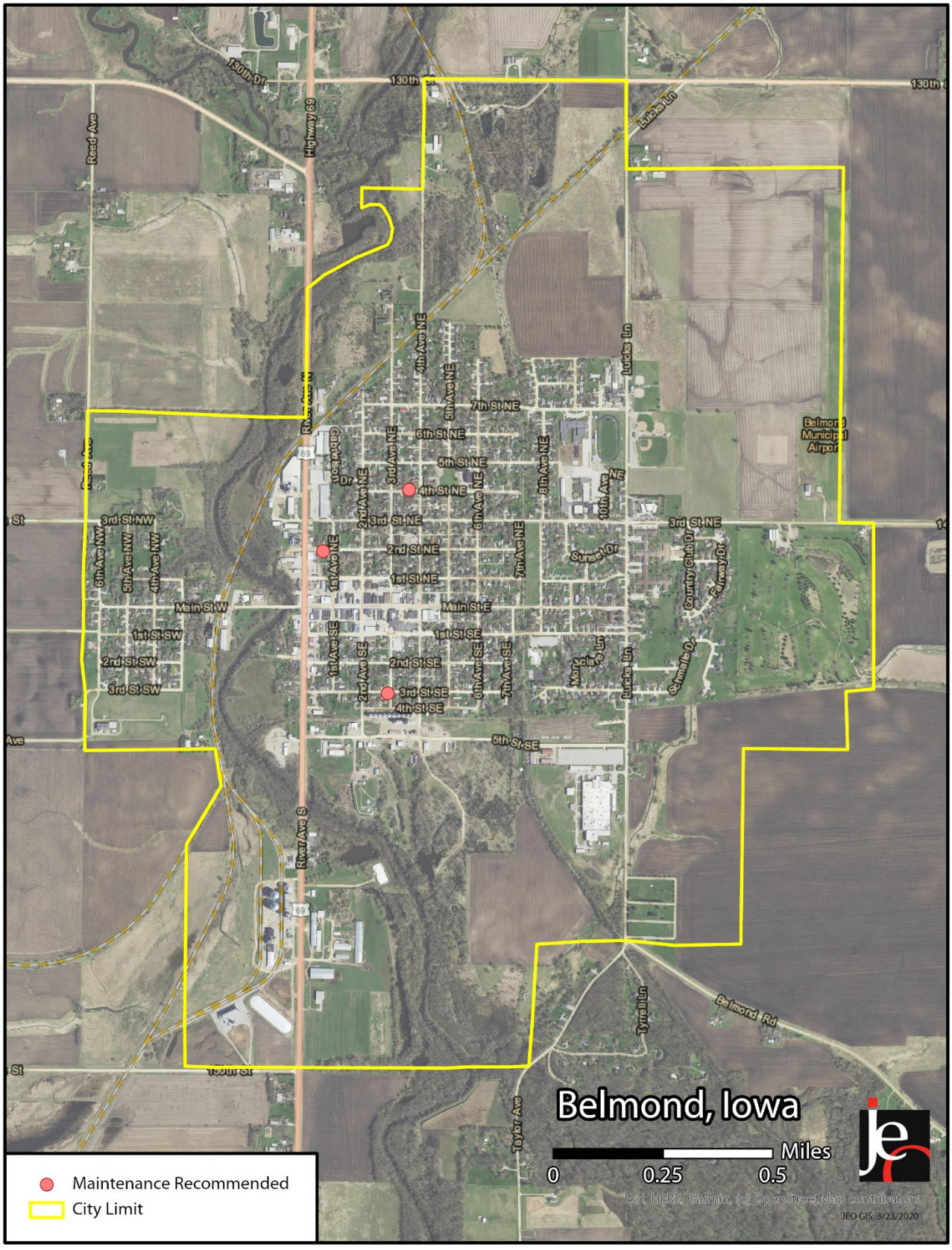


Figure 4: Location of Trees with Recommended Maintenance

Appendix C: Belmond Tree Ordinances

No specific Tree Care Ordinances, only Chapter 135 under Streets and Sidewalks mentions tree removal

135.10 PROPERTY OWNER'S RESPONSIBILITY FOR MAINTENANCE. The abutting property owner shall maintain all property outside the lot and property lines and inside the curb lines upon public streets and shall keep such area in a safe condition, free from nuisances, obstructions, and hazards. In the absence of a curb, such property shall extend from the property line to that portion of the public street used or improved for vehicular purposes. The abutting property owner shall not be required to remove diseased trees or dead wood on the publicly owned property or right-of-way. Maintenance includes timely mowing, trimming trees and shrubs, picking up litter and keeping the area for a vertical distance of seven feet above the sidewalk free and clear of brush, tree branches and other obstructions and hazards. The abutting property owner may be liable for damages caused by failure to maintain the publicly owned property or right-of-way.†

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