

West Okoboji, IA



2019 URBAN FOREST MANAGEMENT PLAN

IOWA DEPARTMENT OF NATURAL RESOURCES



Prepared By
Andrew Larson
JEO Consulting Group, Inc.

Table of Contents

Executive Summary.....	1
Overview	1
Inventory and Results	1
Recommendations	1
Introduction	2
Inventory.....	2
Inventory Results	3
Annual Benefits.....	3
Annual Energy Benefits.....	3
Annual Stormwater Benefits.....	3
Annual Air Quality Benefits.....	3
Annual Carbon Benefits	3
Annual Aesthetics Benefits	3
Financial Summary of all Benefits.....	3
Forest Structure	4
Species Distribution	4
Age Class	4
Condition: Wood and Foliage	4
Management Needs.....	4
Land Use and Location.....	5
Recommendations.....	5
Risk Management	5
Pruning Cycle.....	5
Planting	6
Continual Monitoring.....	6
Emerald Ash Borer Plan	6
Ash Tree Removal	6
Treatment of Ash Trees	6
EAB Quarantines	6
Wood Disposal	7
Canopy Replacement	7
Postponed Work	7
Monitoring	7
Private Ash Trees	7
Proposed Work Schedule and Budget	8
Proposed Work Schedule with Increased Budget	9
Works Cited.....	11
Appendix A: i-Tree Data	12
Table 1: Annual Energy Benefits.....	12
Table 2: Annual Stormwater Benefits.....	12
Table 3: Annual Air Quality Benefits	13
Table 4: Annual Carbon Stored	13
Table 5: Annual Carbon Sequestered	14
Table 6: Annual Social and Aesthetic Benefits.....	14

Table 7: Summary of Benefits in Dollars.....	15
Figure 1: Species Distribution	16
Figure 2: Relative Age Class	17
Figure 3: Foliage Condition	18
Figure 4: Wood Condition.....	18
Figure 5: Canopy Cover in Acres	19
Figure 6: Land Use of city/park trees.....	20
Appendix B: ArcGIS Mapping	21
Figure 1: Location of Ash Trees.....	21
Figure 2: Location of EAB symptoms	22
Figure 3: Location of Poor Condition Trees	23
Figure 4: Location of Trees with Recommended Maintenance *City ownership of the trees recommended for removal should be verified prior to any removal*	24
Appendix C: West Okoboji Tree Ordinances.....	25

Executive Summary

Overview

This plan was developed to assist the City of West Okoboji 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 9% of West Okoboji'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 136 trees inventoried.

- West Okoboji's trees provide \$32,478 of benefits annually, an average of \$238.81 per tree
- There are over 11 species of trees
- The top three genera are: Oak 62.5%, Ash 9%, and Pine 9%
- 13% of trees need some type of management
- 1 tree 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 1 tree needing removal, there are none over 24 inches in diameter at 4.5 ft, however if a tree over 24 inches poses a risk these must be addressed immediately. [*City ownership of the trees recommended for removal should be verified prior to any removal*](#)
- 3 of the 12 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 14.5 years to remove ash. We suggest that city officials request a budget increase to \$1,500 annually and apply for grants to plant replacement trees.

Introduction

This plan was developed to assist West Okoboji 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 West Okoboji, 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 West Okoboji'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 West Okoboji 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 West Okoboji'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 136 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. West Okoboji's trees reduce energy-related costs by approximately \$8,470 annually (Appendix A, Table 1). These savings are both in electricity (40.1 MWh) and in natural gas (5,538.9 Therms).

Annual Stormwater Benefits

West Okoboji's trees intercept about 549,396 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides \$14,889 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 West Okoboji, it is estimated that trees remove 560.4 lbs of air pollution (ozone (O₃), particulate matter less than 10 microns (PM₁₀), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$1,609 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In West Okoboji, trees sequester about 86,151 lbs of carbon per year with an associated value of \$646 (Appendix A, Table 5). In addition, the trees store 2,721,396 lbs of carbon, with a yearly benefit of \$20,410 (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. West Okoboji receives \$6,461 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STREETS analysis, West Okoboji's trees provide \$32,478 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 136 trees in West Okoboji provide approximately \$238.81 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

West Okoboji has over 11 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Oak	85	62.5%
Ash	12	9%
Pine	12	9%
Pear	6	4%
Spruce	5	3.5%
Maple	4	3%
Linden/Basswood	3	2%
Mulberry	3	2%
Locust	2	1%
Birch	1	<1%
Hackberry	1	<1%

Age Class

Most of West Okoboji's trees (41%) are between 30 and 42 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. West Okoboji's size curve is on the larger side, indicating an older 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 West Okoboji indicate that 73.5% 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, 58% of West Okoboji's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Six percent of the tree population's wood condition is in poor health, dead, or dying. This 6% 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	0	0%
Crown Raising	14	10%
Tree Staking	0	0%
Tree Removal	1	<1%
Crown Reduction	3	2%

Land Use and Location

The majority of West Okoboji'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.

<u>Land Use</u>	
Single family residential	10%
Park/vacant/other	0%
Industrial/Large commercial	90%
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

West Okoboji has 1 tree that needs immediate removal. These trees along with other trees needing maintenance can be seen on the Location of Trees with Recommended Maintenance Map (Appendix B, Figure 4). We recommend starting with the large-diameter, critical concern trees first. There are no trees over 24 inches in diameter at 4.5 ft that should be addressed immediately at this time. Please refer to the Proposed 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 are a total of 18 trees with maintenance needs.

Poor tree species

After removing the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 1 removal, none are ash trees. There are a total of 12 ash trees, and 3 of those have signs and symptoms that have been associated with EAB. In addition, there are no trees that are currently 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 Six Year Maintenance Plan 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 West Okoboji.

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 oak (62.5%) (Appendix A, Figure 1). The city should be hesitant to plant more oak 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 species 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 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 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

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 151.05 states "The City has the right to cause the removal of any dead or diseased trees on private property within the City when such trees constitute a hazard to life and property, or harbor insects or diseases which constitute a potential threat to other trees within the City. The City Administrator or Public Works Director will notify in writing the owners of such trees. Removal shall be done by said owners at their own expense

within 45 days after the date of service of notice. In the event of failure of owners to comply with such provisions, the City shall have the authority to remove such trees and charge the cost of removal on the owner’s property tax notice.”

Proposed Work Schedule and Budget

Budget Allowance of \$578/Year – (Based off \$2/Capita Calculation Due to no City Reporting)

YEAR 1

ESTIMATED COSTS

Remove 1 tree recommended for immediate removal	\$700
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Plant 3 trees in open locations	\$450
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 1 ash tree (prioritize largest diameter)	\$700
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Plant 3 trees in open locations	\$450
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 1 ash tree (prioritize largest diameter)	\$700
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Plant 3 trees in open locations	\$450
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 \$1,400 a year. If the budget were increased to \$1,500 a year all ash could be removed in 5.5 years.

Proposed Work Schedule with Increased Budget

Budget Allowance of \$1,500/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1

ESTIMATED COSTS

Remove 1 tree recommended for immediate removal	\$700
Remove 1 ash tree (prioritize largest diameter)	\$700
Visual Survey of EAB Signs/Symptoms	

YEAR 2

Plant 5 trees in open locations	\$750
Prune 1/3 of City Owned Trees	\$675
Visual Survey of EAB Signs/Symptoms	

YEAR 3

Remove 2 ash trees (prioritize largest diameter)	\$1,400
Visual Survey of EAB Signs/Symptoms	

YEAR 4

Plant 5 trees in open locations	\$750
Prune 1/3 of City Owned Trees	\$675
Visual Survey of EAB Signs/Symptoms	

YEAR 5

Remove 2 ash trees (prioritize largest diameter)	\$1,400
Visual Survey of EAB Signs/Symptoms	

YEAR 6

Plant 5 trees in open locations	\$750
Prune 1/3 of City Owned Trees	\$675
Visual Survey of EAB Signs/Symptoms	

Purposed Budget Increase

EAB could potentially kill all ash trees in West Okoboji within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to \$1,400 a year. If the budget were increased to \$1,500 per year all ash could be removed within 5.5 years. Additionally, we recommend that West Okoboji 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 West Okoboji would still need to find \$2,800 for removal. Alternatively, if there are 2 treatable trees, it would cost approximately \$600 a year for treatment and leave \$900 for removal with the proposed budget figure. 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 West Okoboji. We suggest considering an increased budget to plan for this.

Works Cited

Census Bureau. 2010. <http://censtats.census.gov/data/IA/1601964290.pdf> (April, 2013)

USDA Forest Service, et al. 2006. i-Tree Software Suite v1.0 User's Manual. Pp. 27-40.

McPherson EG, Simpson JR, Peper PJ, Gardner SL, Vargas KE, Ho J, Maco S, Xiao Q. 2005b. City of Charleston, South Carolina, municipal forest resource analysis. Internal Tech Rep. Davis, CA: U.S. Department of Agriculture, Center for Urban Forest Research. p. 57

Nowak, DJ and JF Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

Peper, Paula J; McPherson, E Gregory; Simpson, James R; Vargas, Kelaine E; Xiao, Qingfu 2009. Lower Midwest community tree guide: benefits, costs, and strategic planting. Gen. Tech. Rep. PSW-GTR-219. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. p.115

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees									
4/22/2020									
Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Bur oak	31.7	2,406	4,338.6	4,252	6,658	(N/A)	61.8	78.6	79.26
Green ash	3.5	264	479.4	470	734	(N/A)	8.1	8.7	66.70
Red pine	0.3	26	59.4	58	85	(N/A)	5.9	1.0	10.59
Pear	0.2	14	31.8	31	45	(N/A)	4.4	0.5	7.53
Eastern white pine	0.4	28	48.3	47	75	(N/A)	2.9	0.9	18.86
Blue spruce	0.4	30	56.2	55	85	(N/A)	2.9	1.0	21.21
Honeylocust	0.3	20	40.5	40	60	(N/A)	1.5	0.7	29.94
Norway maple	0.6	42	76.9	75	118	(N/A)	1.5	1.4	58.81
Mulberry	0.1	7	16.6	16	24	(N/A)	1.5	0.3	11.80
Sugar maple	0.3	22	41.3	40	63	(N/A)	1.5	0.7	31.39
American basswood	0.8	57	108.2	106	163	(N/A)	1.5	1.9	81.70
Northern hackberry	0.3	23	45.0	44	67	(N/A)	0.7	0.8	67.04
White ash	0.1	7	13.3	13	20	(N/A)	0.7	0.2	20.10
Black spruce	0.1	5	10.2	10	15	(N/A)	0.7	0.2	14.80
White oak	0.3	25	46.9	46	71	(N/A)	0.7	0.8	70.91
White mulberry	0.1	6	12.8	13	18	(N/A)	0.7	0.2	18.19
Silver maple	0.3	21	38.3	37	58	(N/A)	0.7	0.7	58.27
Birch	0.1	8	16.9	17	24	(N/A)	0.7	0.3	24.47
Littleleaf linden	0.3	22	41.9	41	63	(N/A)	0.7	0.7	62.69
Red maple	0.1	8	16.5	16	25	(N/A)	0.7	0.3	24.58
Total	40.1	3,042	5,538.9	5,428	8,470	(N/A)	100.0	100.0	62.28

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees						
4/22/2020						
Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Bur oak	453,606	12,293	(N/A)	61.8	82.6	146.34
Green ash	44,939	1,218	(N/A)	8.1	8.2	110.71
Red pine	3,616	98	(N/A)	5.9	0.7	12.25
Pear	608	16	(N/A)	4.4	0.1	2.75
Eastern white pine	4,268	116	(N/A)	2.9	0.8	28.92
Blue spruce	6,362	172	(N/A)	2.9	1.2	43.10
Honeylocust	1,254	34	(N/A)	1.5	0.2	17.00
Norway maple	5,173	140	(N/A)	1.5	0.9	70.10
Mulberry	333	9	(N/A)	1.5	0.1	4.51
Sugar maple	2,607	71	(N/A)	1.5	0.5	35.32
American basswood	10,705	290	(N/A)	1.5	1.9	145.06
Northern hackberry	2,432	66	(N/A)	0.7	0.4	65.89
White ash	614	17	(N/A)	0.7	0.1	16.63
Black spruce	755	20	(N/A)	0.7	0.1	20.47
White oak	3,943	107	(N/A)	0.7	0.7	106.85
White mulberry	264	7	(N/A)	0.7	0.0	7.17
Silver maple	2,961	80	(N/A)	0.7	0.5	80.24
Birch	586	16	(N/A)	0.7	0.1	15.88
Littleleaf linden	3,744	101	(N/A)	0.7	0.7	101.46
Red maple	625	17	(N/A)	0.7	0.1	16.95
Citywide total	549,396	14,889	(N/A)	100.0	100.0	109.48

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees																	
4/22/2020																	
Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total (\$)	Standard Error	% of Total Trees	Avg. \$/tree
	O ₃	NO ₂	PM ₁₀	SO ₂		NO ₂	PM ₁₀	VOC	SO ₂								
Bur oak	70.4	11.3	31.6	3.2	369	151.4	22.0	21.0	143.6	943	0.0	0	454.4	1,312 (N/A)	61.8	15.62	
Green ash	6.2	1.0	2.9	0.3	33	16.6	2.4	2.3	15.8	104	0.0	0	47.4	136 (N/A)	8.1	12.38	
Red pine	0.3	0.1	0.3	0.0	2	1.8	0.2	0.2	1.6	11	-1.0	-4	3.5	9 (N/A)	5.9	1.13	
Pear	0.1	0.0	0.0	0.0	0	0.9	0.1	0.1	0.8	6	0.0	0	2.2	6 (N/A)	4.4	1.02	
Eastern white pine	0.4	0.1	0.4	0.1	3	1.7	0.3	0.2	1.7	11	-1.4	-5	3.5	9 (N/A)	2.9	2.15	
Blue spruce	1.1	0.2	0.9	0.1	7	1.9	0.3	0.3	1.8	12	-2.4	-9	4.1	10 (N/A)	2.9	2.46	
Honeylocust	0.1	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	-0.1	0	3.1	9 (N/A)	1.5	4.28	
Norway maple	1.1	0.2	0.5	0.0	6	2.7	0.4	0.4	2.5	17	-0.3	-1	7.5	21 (N/A)	1.5	10.75	
Mulberry	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)	1.5	1.63	
Sugar maple	0.3	0.0	0.2	0.0	2	1.4	0.2	0.2	1.3	9	-0.2	-1	3.4	9 (N/A)	1.5	4.74	
American basswood	1.7	0.3	0.8	0.1	9	3.7	0.5	0.5	3.4	23	-1.3	-5	9.6	26 (N/A)	1.5	13.23	
Northern hackberry	0.3	0.1	0.2	0.0	2	1.5	0.2	0.2	1.4	9	0.0	0	3.8	11 (N/A)	0.7	10.85	
White ash	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	3	0.0	0	1.0	3 (N/A)	0.7	2.91	
Black spruce	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2 (N/A)	0.7	1.53	
White oak	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)	0.7	12.48	
White 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)	0.7	2.55	
Silver maple	0.4	0.1	0.2	0.0	2	1.3	0.2	0.2	1.2	8	-0.2	-1	3.3	9 (N/A)	0.7	9.36	
Birch	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)	0.7	3.47	
Littleleaf linden	0.7	0.1	0.3	0.0	4	1.4	0.2	0.2	1.3	9	-0.3	-1	4.0	11 (N/A)	0.7	11.21	
Red maple	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.3	4 (N/A)	0.7	3.64	
Citywide total	83.8	13.5	38.8	3.9	443	191.8	27.9	26.6	181.6	1,194	-7.6	-29	560.4	1,609 (N/A)	100.0	11.83	

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees						
4/22/2020						
Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Bur oak	2,361,067	17,708	(N/A)	61.8	86.8	210.81
Green ash	205,344	1,540	(N/A)	8.1	7.5	140.01
Red pine	1,398	10	(N/A)	5.9	0.1	1.31
Pear	1,797	13	(N/A)	4.4	0.1	2.25
Eastern white pine	2,854	21	(N/A)	2.9	0.1	5.35
Blue spruce	9,873	74	(N/A)	2.9	0.4	18.51
Honeylocust	1,816	14	(N/A)	1.5	0.1	6.81
Norway maple	17,904	134	(N/A)	1.5	0.7	67.14
Mulberry	1,086	8	(N/A)	1.5	0.0	4.07
Sugar maple	8,164	61	(N/A)	1.5	0.3	30.61
American basswood	62,568	469	(N/A)	1.5	2.3	234.63
Northern hackberry	4,142	31	(N/A)	0.7	0.2	31.07
White ash	1,035	8	(N/A)	0.7	0.0	7.76
Black spruce	284	2	(N/A)	0.7	0.0	2.13
White oak	15,773	118	(N/A)	0.7	0.6	118.30
White mulberry	908	7	(N/A)	0.7	0.0	6.81
Silver maple	7,945	60	(N/A)	0.7	0.3	59.59
Birch	1,101	8	(N/A)	0.7	0.0	8.26
Littleleaf linden	15,239	114	(N/A)	0.7	0.6	114.29
Red maple	1,101	8	(N/A)	0.7	0.0	8.26
Citywide total	2,721,396	20,410	(N/A)	100.0	100.0	150.08

Table 5: Annual Carbon Sequestered

Annual CO₂ Benefits of Public Trees													
4/22/2020													
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
Bur oak	68,928	517	-11,333	-356	-88	53,174	399	110,412	828	(N/A)	61.8	78.9	9.86
Green ash	8,043	60	-986	-38	-8	5,833	44	12,853	96	(N/A)	8.1	9.2	8.76
Red pine	317	2	-7	-8	0	585	4	888	7	(N/A)	5.9	0.6	0.83
Pear	304	2	-9	-4	0	310	2	601	5	(N/A)	4.4	0.4	0.75
Eastern white pine	336	3	-14	-6	0	622	5	938	7	(N/A)	2.9	0.7	1.76
Blue spruce	213	2	-47	-8	0	657	5	814	6	(N/A)	2.9	0.6	1.53
Honeylocust	403	3	-9	-2	0	447	3	838	6	(N/A)	1.5	0.6	3.14
Norway maple	756	6	-86	-5	-1	934	7	1,598	12	(N/A)	1.5	1.1	5.99
Mulberry	152	1	-5	-2	0	161	1	306	2	(N/A)	1.5	0.2	1.15
Sugar maple	579	4	-40	-3	0	493	4	1,029	8	(N/A)	1.5	0.7	3.86
American basswood	3,305	25	-300	-9	-2	1,268	10	4,263	32	(N/A)	1.5	3.0	15.99
Northern hackberry	354	3	-20	-3	0	507	4	838	6	(N/A)	0.7	0.6	6.29
White ash	182	1	-5	-1	0	156	1	331	2	(N/A)	0.7	0.2	2.49
Black spruce	39	0	-1	-1	0	106	1	142	1	(N/A)	0.7	0.1	1.07
White oak	857	6	-76	-4	-1	552	4	1,330	10	(N/A)	0.7	1.0	9.97
White mulberry	114	1	-4	-1	0	124	1	232	2	(N/A)	0.7	0.2	1.74
Silver maple	881	7	-38	-3	0	459	3	1,299	10	(N/A)	0.7	0.9	9.74
Birch	224	2	-5	-1	0	176	1	393	3	(N/A)	0.7	0.3	2.95
Littleleaf linden	0	0	-73	-4	-1	478	4	400	3	(N/A)	0.7	0.3	3.00
Red maple	165	1	-5	-1	0	186	1	344	3	(N/A)	0.7	0.2	2.58
Citywide total	86,151	646	-13,063	-461	-101	67,226	504	139,853	1,049	(N/A)	100.0	100.0	7.71

Table 6: Annual Social and Aesthetic Benefits

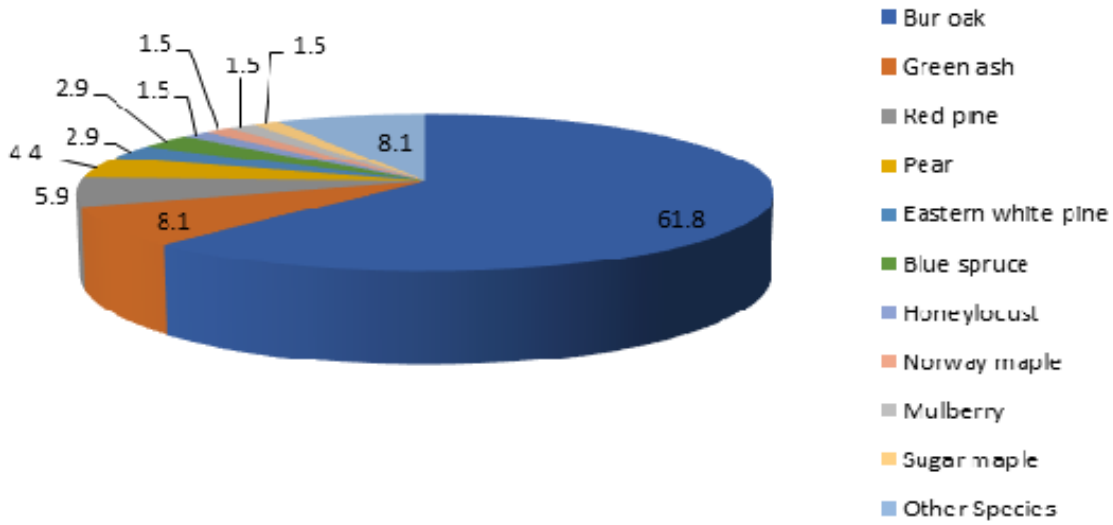
Annual Aesthetic/Other Benefits of Public Trees					
4/22/2020					
Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Bur oak	4,859	(N/A)	61.8	75.2	57.84
Green ash	620	(N/A)	8.1	9.6	56.39
Red pine	98	(N/A)	5.9	1.5	12.20
Pear	17	(N/A)	4.4	0.3	2.78
Eastern white pine	95	(N/A)	2.9	1.5	23.87
Blue spruce	37	(N/A)	2.9	0.6	9.36
Honeylocust	63	(N/A)	1.5	1.0	31.49
Norway maple	71	(N/A)	1.5	1.1	35.31
Mulberry	8	(N/A)	1.5	0.1	4.23
Sugar maple	66	(N/A)	1.5	1.0	32.94
American basswood	214	(N/A)	1.5	3.3	106.78
Northern hackberry	52	(N/A)	0.7	0.8	52.26
White ash	33	(N/A)	0.7	0.5	33.42
Black spruce	21	(N/A)	0.7	0.3	21.08
White oak	66	(N/A)	0.7	1.0	65.59
White mulberry	6	(N/A)	0.7	0.1	6.40
Silver maple	79	(N/A)	0.7	1.2	78.67
Birch	26	(N/A)	0.7	0.4	26.22
Littleleaf linden	0	(N/A)	0.7	0.0	0.00
Red maple	30	(N/A)	0.7	0.5	29.84
Citywide total	6,461	(N/A)	100.0	100.0	47.51

Table 7: Summary of Benefits in Dollars

Annual Benefits of Public Trees by Species (\$/tree)							
4/22/2020							
Species	Energy	CO ₂	Air Quality	Stomwater	Aesthetic/Other	Total (\$)	Standard Error
Bur oak	79.26	9.86	15.62	146.34	57.84	308.92	(N/A)
Green ash	66.70	8.76	12.38	110.71	56.39	254.95	(N/A)
Red pine	10.59	0.83	1.13	12.25	12.20	37.00	(N/A)
Pear	7.53	0.75	1.02	2.75	2.78	14.83	(N/A)
Eastern white pine	18.86	1.76	2.15	28.92	23.87	75.55	(N/A)
Blue spruce	21.21	1.53	2.46	43.10	9.36	77.65	(N/A)
Honeylocust	29.94	3.14	4.28	17.00	31.49	85.86	(N/A)
Norway maple	58.81	5.99	10.75	70.10	35.31	180.96	(N/A)
Mulberry	11.80	1.15	1.63	4.51	4.23	23.32	(N/A)
Sugar maple	31.39	3.86	4.74	35.32	32.94	108.25	(N/A)
American basswood	81.70	15.99	13.23	145.06	106.78	362.74	(N/A)
Northern hackberry	67.04	6.29	10.85	65.89	52.26	202.32	(N/A)
White ash	20.10	2.49	2.91	16.63	33.42	75.55	(N/A)
Black spruce	14.80	1.07	1.53	20.47	21.08	58.96	(N/A)
White oak	70.91	9.97	12.48	106.85	65.59	265.81	(N/A)
White mulberry	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Silver maple	58.27	9.74	9.36	80.24	78.67	236.28	(N/A)
Birch	24.47	2.95	3.47	15.88	26.22	72.99	(N/A)
Littleleaf linden	62.69	3.00	11.21	101.46	0.00	178.36	(N/A)
Red maple	24.58	2.58	3.64	16.95	29.84	77.58	(N/A)
Citywide Total	62.28	7.71	11.83	109.48	47.51	238.81	(N/A)

Species Distribution of Public Trees

4/22/2020

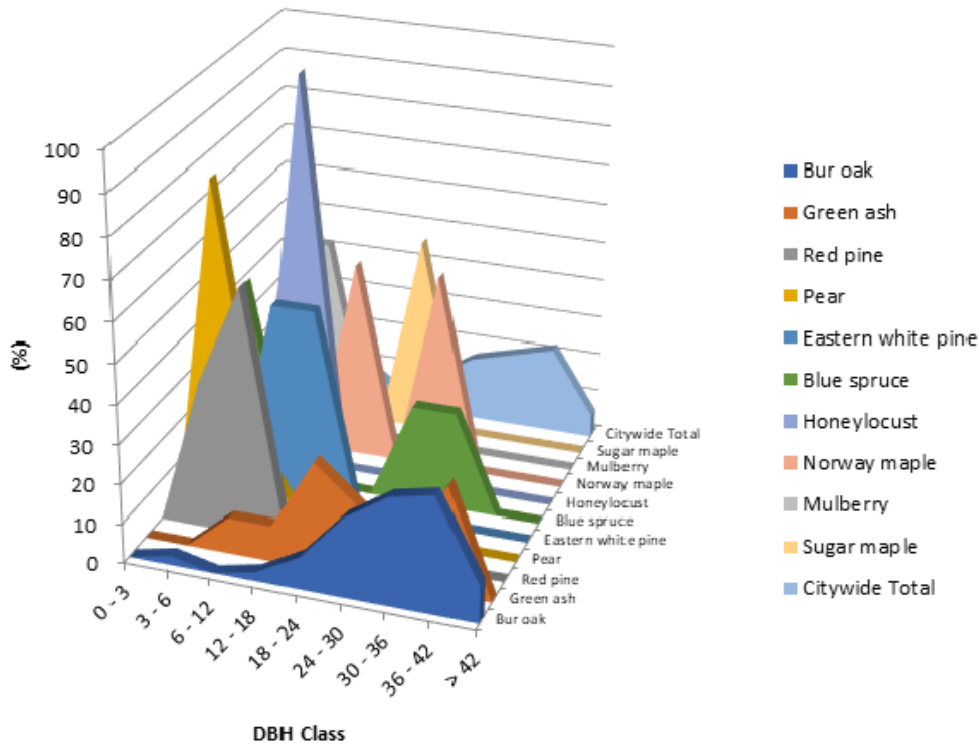


Species	Percent
Bur oak	61.8
Green ash	8.1
Red pine	5.9
Pear	4.4
Eastern white pine	2.9
Blue spruce	2.9
Honeylocust	1.5
Norway maple	1.5
Mulberry	1.5
Sugar maple	1.5
Other Species	8.1
Total	100.0

Figure 1: Species Distribution

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

4/22/2020



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Bur oak	0.00	2.38	0.00	2.38	8.33	20.24	27.38	29.76	9.52
Green ash	0.00	0.00	9.09	9.09	27.27	18.18	9.09	27.27	0.00
Red pine	0.00	37.50	62.50	0.00	0.00	0.00	0.00	0.00	0.00
Pear	0.00	83.33	16.67	0.00	0.00	0.00	0.00	0.00	0.00
Eastern white pine	0.00	0.00	50.00	50.00	0.00	0.00	0.00	0.00	0.00
Blue spruce	0.00	50.00	0.00	0.00	0.00	25.00	25.00	0.00	0.00
Honeylocust	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Norway maple	0.00	0.00	0.00	50.00	0.00	50.00	0.00	0.00	0.00
Mulberry	0.00	50.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00
Sugar maple	0.00	50.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00
Citywide Total	0.00	10.29	12.50	4.41	9.56	16.18	19.12	22.06	5.88

Figure 2: Relative Age Class

Functional (Foliage) Condition of Public Trees by %

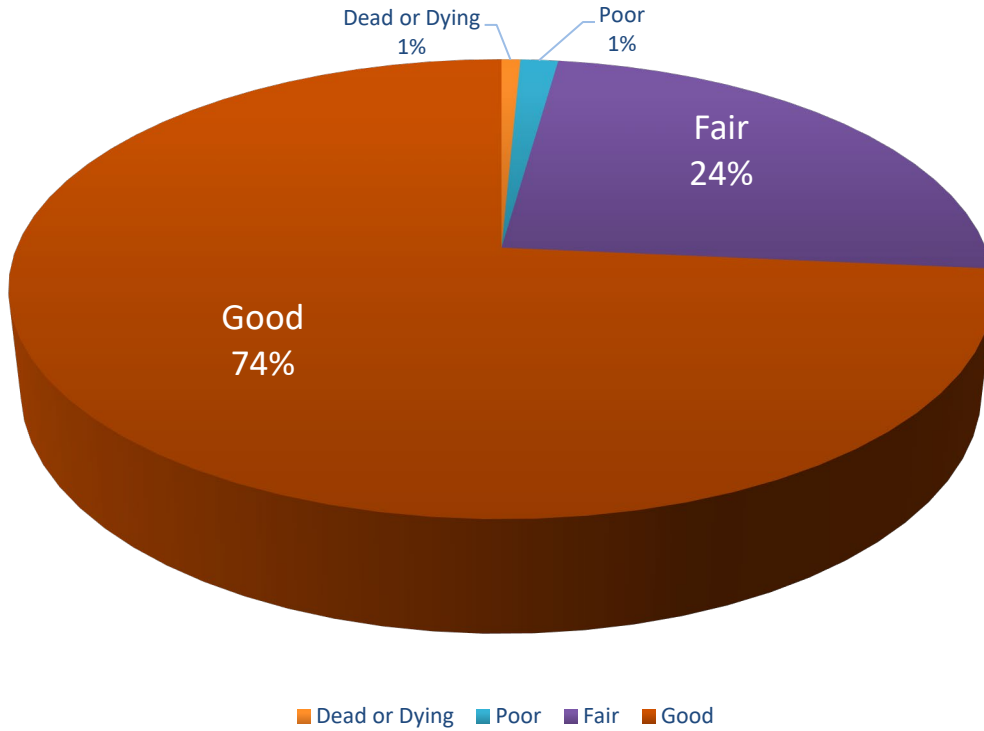


Figure 3: Foliage Condition

Structural (Woody) Condition of Public Trees by %

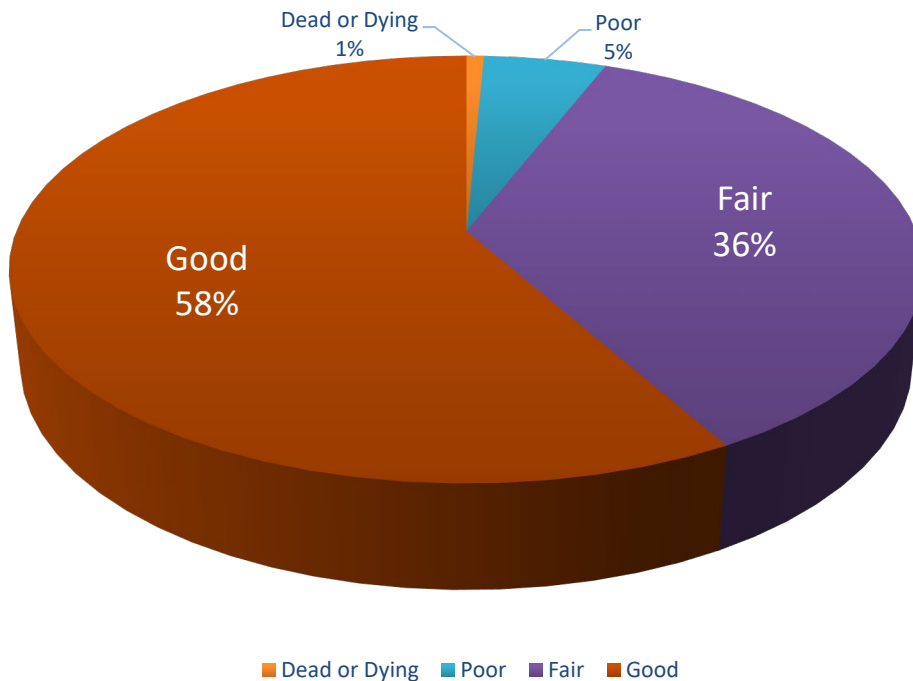
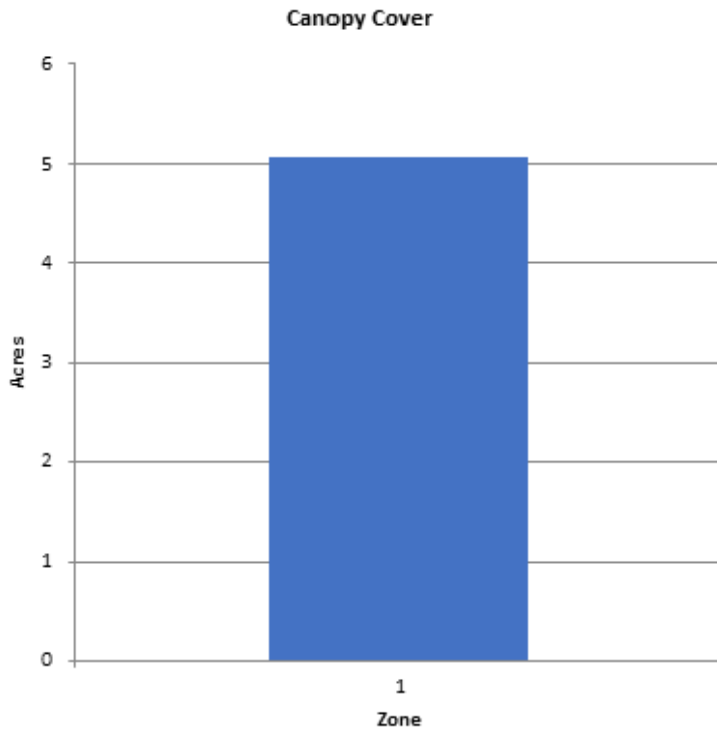


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

4/22/2020



Zone	Acres	% of Total Canopy Cover
1	5	100.0
Citywide total	5	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	5	0.00	0.00

Figure 5: Canopy Cover in Acres

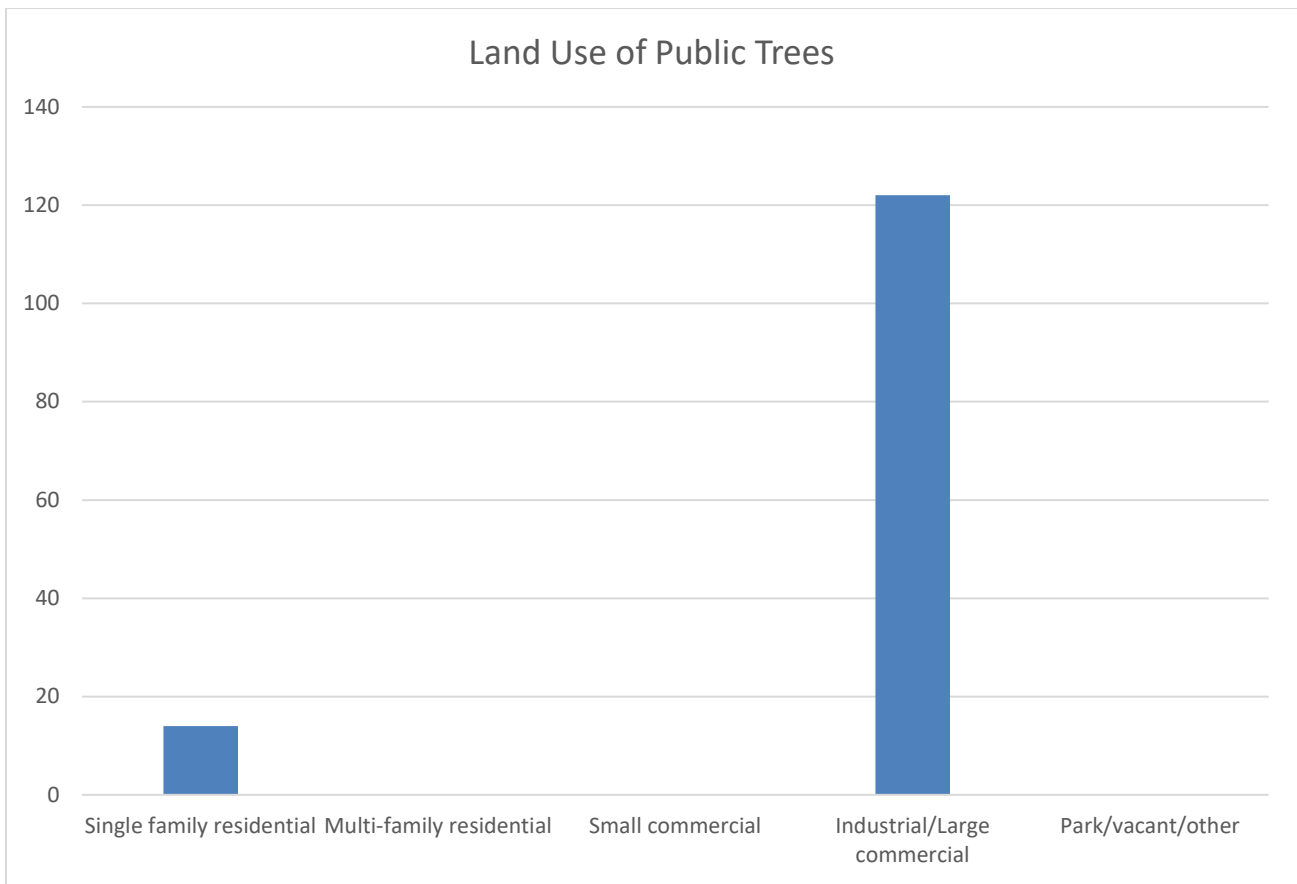


Figure 6: Land Use of city/park trees

Appendix B: ArcGIS Mapping



Figure 1: Location of Ash Trees



Figure 2: Location of EAB symptoms



Figure 3: Location of Poor Condition Trees

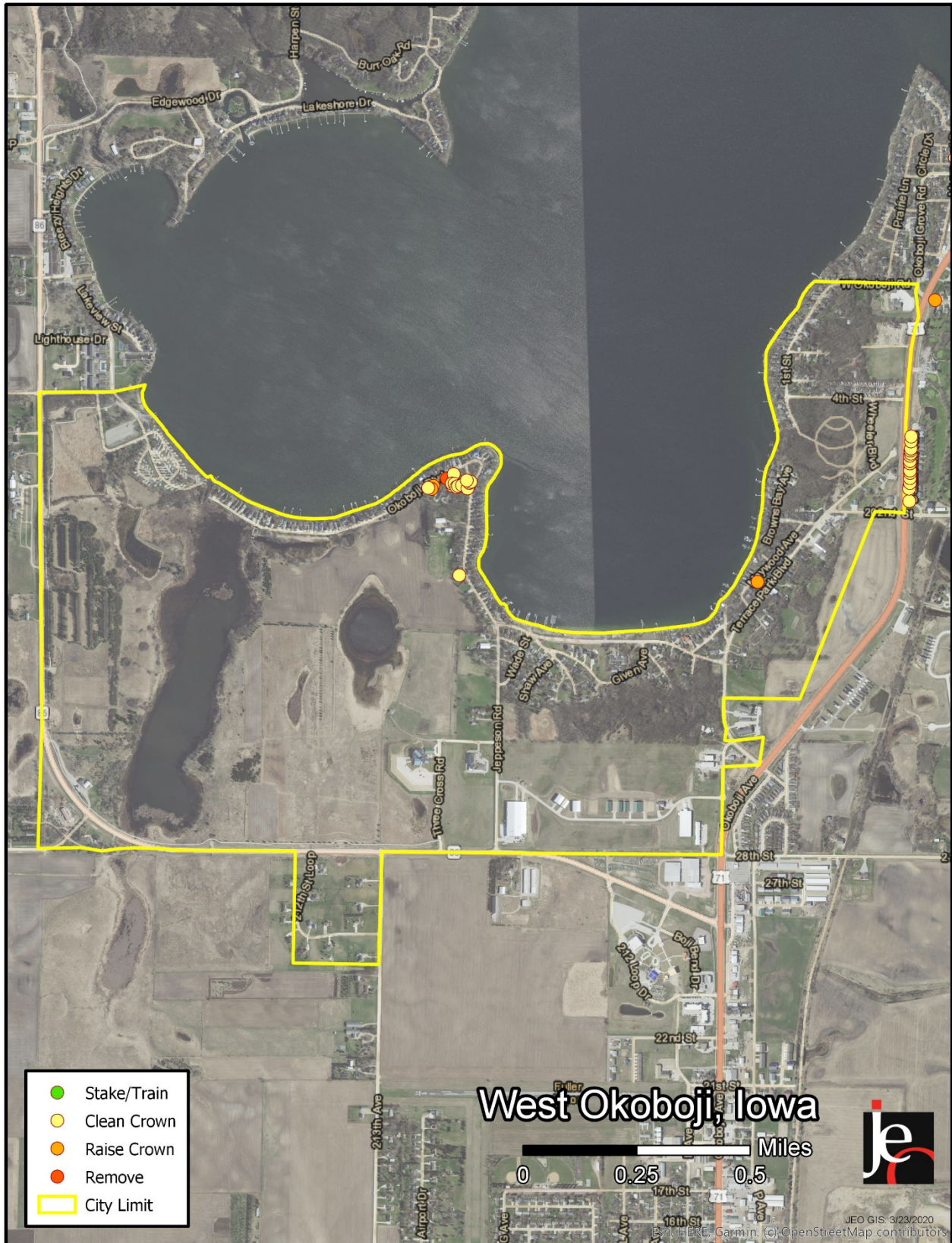


Figure 4: Location of Trees with Recommended Maintenance *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: West Okoboji Tree Ordinances

CHAPTER 150 TREES

150.01 PURPOSE.

The purpose of this chapter is to beautify and preserve the appearance of the City.

150.02 DEFINITIONS.

For use in this chapter, the following definitions are given.

1. "Park trees" means trees, shrubs, bushes, and all other woody vegetation in public parks and other areas owned by the City to which the public has free access as a park.
2. "Street trees" means trees, shrubs, bushes, and all other woody vegetation on land owned by the City and lying between property lines on either side of all streets, avenues, or ways, within the City.

150.03 LOCATION.

No tree shall be planted less than twenty (20) feet from the street edge, intersection of a street, or alley.

150.04 REMOVAL OF TREES PROHIBITED.

Any tree currently existing on publicly owned right-of-way shall not be removed by an adjoining property owner, or anyone else, without first obtaining permission from the Council.

150.05 REMOVAL OF DEAD OR DISEASED TREES.

The City has the right to cause the removal of any dead or diseased trees on private property within the City when such trees constitute a hazard to life and property, or harbor insects or diseases which constitute a potential threat to other trees within the City. The City Administrator or Public Works Director will notify in writing the owners of such trees. Removal shall be done by said owners at their own expense within 45 days after the date of service of notice. In the event of failure of owners to comply with such provisions, the City shall have the authority to remove such trees and charge the cost of removal on the owner's property tax notice.

150.06 REMOVAL OF STUMPS.

All stumps of street and park trees shall be removed below the surface of the ground so that the top of the stump does not project above the surface of the ground. When the City causes a tree on City property to be removed, the City shall remove the stump to six inches below ground level.

150.07 PUBLIC TREE CARE.

The City has the right to plant, prune, maintain, and remove trees, plants, and shrubs within the lines of all streets, alleys, avenues, lanes, squares, and public grounds, as may be necessary to insure public safety or to preserve or enhance the symmetry and beauty of such public grounds. The City may remove or cause or order to be removed any tree or part thereof which is in an unsafe condition or which by reason of its nature is injurious to sewers, electric power lines, gas lines, water lines, or other public improvements, or is affected with any injurious fungus, insect, or other pest; provided, however, such removal shall be conducted in accordance with tree removal policies of the tree plan. This section

does not prohibit the planting of street trees by adjacent property owners providing that the selection and location of said trees is in accordance with this chapter.

150.08 TOPPING PROHIBITED.

Topping, also referred to as heading, stubbing, rounding, tipping, dehorning, or the drastic removal of large branches, is defined as the severe cutting back of limbs to stubs larger than three inches in diameter within the tree’s crown to such a degree so as to remove the normal canopy and disfigure the tree. It is unlawful as a normal practice for any person or firm to top any street tree, park tree, or other tree on City property. Proper early trimming, selective branch thinning, or entire tree removal are acceptable tree maintenance alternatives to topping. Allowable natural shape branch thinning techniques include drop-crotch, under pruning, side pruning, and through pruning. It is under the supervision of the Public Works Director to determine which alternatives to use in such instances.

150.09 DUTY TO TRIM TREES.

The owner or agent of the abutting property shall keep the trees on public or private property trimmed so that all branches will be at least 15 feet above the traveled roadway and to a minimum of eight feet above a sidewalk. 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 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. Except as allowed in this section, it is unlawful for any property owner to trim or cut any tree in a street or public place. (Code of Iowa, Sec. 364.12[2c, d, & e])

150.10 SPECIAL PENALTY.

In the event any trees are removed or altered in violation of this chapter, the person shall replace said trees within 45 days of the violation. The Council will determine age and type of tree to be planted in such event.

150.11 ALTERNATIVE REMEDY.

In addition to or in lieu of the special penalty provided by this chapter, the Zoning Enforcement Officer may enforce these provisions by issuing the offender a municipal infraction.

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.