

Bancroft, IA



2020 Urban Forest Management Plan
Prepared by Vince Grube
Iowa Department of Natural Resources



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Executive Summary

Overview

This plan was developed to assist the City of Bancroft with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 26% of Bancroft's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2018, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 595 trees inventoried.

- Bancroft's trees provide \$93,836 of benefits annually, an average of \$157.71 a tree
- There were 32 species of trees inventoried.
- The top three genus are: Maple 38%, Ash 26%, and Spruce 10%
- Due to a bad contract agreement, it is unclear exactly how many trees in Bancroft need maintenance or removal.

Recommendations

The core recommendations are detailed in the Recommendations Section. The Emerald Ash Borer Plan includes management recommendations as well. Below are some key recommendations.

- EAB was not recorded when the inventory was conducted. There are 154 ash trees within Bancroft and it is likely that many are currently displaying symptoms and it is recommended that a visual inspection of all ash trees be conducted annually.
- All trees should be pruned on a routine schedule – one sixth of the city every year.
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow, or black walnut.
- Due to the prevalence of EAB, it is likely that many of Bancroft's ash trees will die over the next ten years.

Introduction

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

Trees are an important component of Bancroft's infrastructure and one of the greatest assets to the community. The benefits of trees are immense. Trees provide the community with improved air quality, stormwater runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and create a desirable place to live, to name just a few benefits. It is essential that these benefits be maintained for the people of Bancroft and future generations through good urban forestry management.

Good urban forestry management involves setting goals and developing management strategies to achieve these goals. An essential part of developing management strategies is a comprehensive public tree inventory. The inventory supplies information that will be used for maintenance, removal schedules, tree planting and budgeting. Basing actions on this information will help meet Bancroft's urban forestry goals.

Inventory

In 2018, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms associated with EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

The data collected for the 595 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Bancroft’s trees reduce energy related costs by approximately \$16,843 annually (Appendix A, Table 1). These savings are both in Electricity (124.9 MWh) and in Natural Gas (17,186.7 Therms).

Annual Stormwater Benefits

Bancroft’s trees intercept about 1,318,551 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$35,733 of benefits to the city.

Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and emitting volatile organic matter (ozone). In Bancroft, it is estimated that trees remove 1618.5 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 \$4,580 (Appendix A, Table 3).

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Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Bancroft, trees sequester about 262,291 lbs of carbon a year with an associated value of \$3,351 (Appendix A, Table 5). In addition, the trees store 4,937,472 lbs of carbon, with a yearly benefit of \$37,031 (Appendix A, Table 4).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Bancroft receives \$23,847 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, Bancroft’s trees provide \$93,836 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 595 trees in Bancroft provide approximately \$157.71 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Bancroft has 21 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Genus	Count	Percent
Maple	227	38
Ash	154	26
Spruce	60	10

Apple	36	6
Basswood	29	5
Oak	24	4
Honeylocust	16	3
Cottonwood	12	2
Broadleaf, Lg	6	1
Pear	6	1
Hackberry	4	1
Acer	3	1
Pine	2	<1
Walnut	2	<1
Boxelder	2	<1
CA	2	<1
Redbud	2	<1
Ginco	2	<1
Lilac	2	<1
Catalpa	2	<1
Birch	2	<1

Age Class

Most of Bancroft’s trees (47.73%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Bancroft’s size curve is on the smaller side, indicating a younger than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Bancroft indicate that 63% of the trees are in good health, with only 3% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 63% of Bancroft’s trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 3% of the population. This 3% figure is the estimate of trees that need management follow up.

Management Needs

There were no specific management needs recorded for Bancroft trees. It is recommended that the trees that were listed as in need of immediate maintenance be prioritized.

Canopy Cover

The total canopy with both private and public trees is 15%, or 52.95 acres. The canopy cover included in the Bancroft inventory includes approximately 13.72 acres (Appendix A, Figure 4). The City’s Canopy goal is to increase canopy by 3%, in 30 years. To achieve this goal, it is estimated that 26 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Bancroft’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	70.25%
Park/vacant/other	29.75%

<u>Location</u>	
Planting strip	67%
Other maintained locations	30%
Front yard	3%
Back yard	<1%

Recommendations

Risk Management

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

Hazardous trees

Detailed information was not collected on which trees are potentially hazardous or where they might be located.

Poor tree species

The data collectors did not collect appropriate data on this, however it was noted that 154 of the trees present within Bancroft are ash trees. While the collectors did not gather data on EAB, it is common though out the region and very likely affecting many of the ash trees in Bancroft. Visual inspections of ash trees should be conducted annually in order track their conditions. Treatment for EAB is an effective preventative measure that can be taken to prevent the death of healthy ash trees. It is not recommended to be used on ash trees already displaying two or more symptoms of EAB. Since data for EAB was not collected, we will present two separate scenarios regarding ash management versus removal. If all 154 ash trees in Bancroft are healthy and could be treated, it would cost an estimated \$51,270 every two years, which is an average of \$332.92 per tree. If all 154 ash trees in Bancroft are suffering from EAB, it would cost an estimated \$123,200 to remove, which is an average of \$800 per tree. These scenarios represent two different extremes and while it is likely that many ash trees within Bancroft are displaying signs of EAB, it is also likely that many are not and would therefore be eligible for treatment. It is recommended that Bancroft treat many of its larger, healthier ash trees and begin removing dead or dying ash trees, as well as those found to be displaying 2 or more symptoms of EAB.

Pruning Cycle

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

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. 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 Bancroft.

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 (38%) (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.

Continual Monitoring

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended that ash trees be checked with a visual survey every year for tree decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Emerald Ash Borer Plan

Ash Tree Removal

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

Treatment of Ash Trees

Chemical treatment can be effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit <http://extension.entm.purdue.edu/treecomputer/>

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:

- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

In addition, any other article, product or means of conveyance not listed above may be designated as a regulated article if a USDA inspector determines that it presents a risk of spreading EAB once a quarantine is in effect for your county.

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. The new plantings will be a diverse mix and should 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 the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Bancroft

Annual Energy Benefits of Public Trees

12/10/2019

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total Standard Error (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	40.4	3,069	5,519.7	5,409	8,479 (N/A)	23.2	32.2	61.44
Norway maple	22.6	1,713	3,229.3	3,165	4,877 (N/A)	18.0	18.5	45.58
Silver maple	17.6	1,333	2,285.0	2,239	3,573 (N/A)	11.9	13.6	50.32
Norway spruce	2.6	199	399.6	392	591 (N/A)	6.7	2.2	14.76
Apple	3.0	227	475.6	466	693 (N/A)	6.1	2.6	19.26
Black maple	8.1	618	1,117.7	1,095	1,713 (N/A)	4.9	6.5	59.07
Blue spruce	1.8	135	233.4	229	364 (N/A)	3.0	1.4	20.19
White ash	2.3	172	302.8	297	469 (N/A)	2.7	1.8	29.29
Northern red oak	1.6	122	227.5	223	345 (N/A)	2.7	1.3	21.58
Honeylocust	1.6	124	214.6	210	334 (N/A)	2.7	1.3	20.87
Littleleaf linden	3.0	225	360.1	353	578 (N/A)	2.7	2.2	36.15
American basswood	3.3	252	498.1	488	740 (N/A)	2.2	2.8	56.92
Eastern cottonwood	5.0	383	684.2	671	1,053 (N/A)	2.0	4.0	87.79
Sugar maple	2.3	175	304.2	298	473 (N/A)	1.5	1.8	52.55
Red maple	0.9	70	121.6	119	189 (N/A)	1.5	0.7	21.04
Broadleaf Deciduous Large	2.2	168	295.9	290	458 (N/A)	1.5	1.7	50.84
Pear	1.1	86	161.9	159	245 (N/A)	1.0	0.9	40.80
White oak	0.6	44	81.7	80	124 (N/A)	0.8	0.5	24.76
Northern hackberry	0.8	59	104.9	103	162 (N/A)	0.7	0.6	40.39
Swamp white oak	0.3	24	50.6	50	73 (N/A)	0.5	0.3	24.47
Black walnut	0.9	66	118.0	116	182 (N/A)	0.3	0.7	91.02
River birch	0.5	36	59.0	58	94 (N/A)	0.3	0.4	46.78
Austrian pine	0.3	25	46.5	46	71 (N/A)	0.3	0.3	35.47
Amur maple	0.1	11	25.7	25	36 (N/A)	0.3	0.1	18.19
Japanese tree lilac	0.0	3	7.6	7	11 (N/A)	0.3	0.0	5.40
Conifer Evergreen Large	0.1	9	19.0	19	27 (N/A)	0.3	0.1	13.58
Eastern redbud	0.0	3	7.6	7	11 (N/A)	0.3	0.0	5.40
Northern catalpa	1.0	74	126.2	124	197 (N/A)	0.3	0.7	98.63
Boxelder	0.4	33	61.6	60	94 (N/A)	0.3	0.4	46.76
Ginkgo	0.1	10	19.8	19	29 (N/A)	0.3	0.1	14.72
Catalpa	0.2	14	27.5	27	41 (N/A)	0.3	0.2	20.64
Total	124.9	9,482	17,186.7	16,843	26,325 (N/A)	100.0	100.0	44.24

Table 2: Annual Stormwater Benefits

Bancroft

Annual Stormwater Benefits of Public Trees

12/10/2019

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	453,927	12,301	(N/A)	23.2	34.4	89.14
Norway maple	201,690	5,466	(N/A)	18.0	15.3	51.08
Silver maple	237,027	6,423	(N/A)	11.9	18.0	90.47
Norway spruce	28,714	778	(N/A)	6.7	2.2	19.45
Apple	10,698	290	(N/A)	6.1	0.8	8.05
Black maple	78,090	2,116	(N/A)	4.9	5.9	72.97
Blue spruce	21,487	582	(N/A)	3.0	1.6	32.35
White ash	17,139	464	(N/A)	2.7	1.3	29.03
Northern red oak	9,066	246	(N/A)	2.7	0.7	15.35
Honeylocust	13,684	371	(N/A)	2.7	1.0	23.18
Littleleaf linden	18,556	503	(N/A)	2.7	1.4	31.43
American basswood	31,182	845	(N/A)	2.2	2.4	65.00
Eastern cottonwood	76,377	2,070	(N/A)	2.0	5.8	172.48
Sugar maple	31,884	864	(N/A)	1.5	2.4	96.01
Red maple	5,382	146	(N/A)	1.5	0.4	16.20
Broadleaf Deciduous Large	21,384	580	(N/A)	1.5	1.6	64.39
Pear	5,014	136	(N/A)	1.0	0.4	22.65
White oak	5,502	149	(N/A)	0.8	0.4	29.82
Northern hackberry	4,087	111	(N/A)	0.7	0.3	27.69
Swamp white oak	1,758	48	(N/A)	0.5	0.1	15.88
Black walnut	14,478	392	(N/A)	0.3	1.1	196.17
River birch	2,818	76	(N/A)	0.3	0.2	38.19
Austrian pine	5,849	159	(N/A)	0.3	0.4	79.26
Amur maple	529	14	(N/A)	0.3	0.0	7.17
Japanese tree lilac	137	4	(N/A)	0.3	0.0	1.86
Conifer Evergreen Large	1,191	32	(N/A)	0.3	0.1	16.14
Eastern redbud	137	4	(N/A)	0.3	0.0	1.86
Northern catalpa	14,478	392	(N/A)	0.3	1.1	196.17
Boxelder	4,466	121	(N/A)	0.3	0.3	60.52
Ginkgo	603	16	(N/A)	0.3	0.0	8.17
Catalpa	1,216	33	(N/A)	0.3	0.1	16.47
Citywide total	1,318,551	35,733	(N/A)	100.0	100.0	60.05

Table 3: Annual Air Quality Benefits

Bancroft

Annual Air Quality Benefits of Public Trees

12/10/2019

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							
Green ash	38.3	9.3	27.7	2.6	310	193.0	28.1	26.8	183.3	1,202	0.0	0	529.1	1,512 (N/A)	23.2	10.96
Norway maple	40.3	6.9	19.9	1.8	218	109.2	15.8	15.0	102.4	677	-9.5	-36	301.8	859 (N/A)	18.0	8.03
Silver maple	38.6	6.5	19.2	1.7	209	\$2.6	12.1	11.6	79.5	517	-20.6	-77	231.2	649 (N/A)	11.9	9.14
Norway spruce	2.7	0.5	2.6	0.3	19	12.9	1.8	1.8	11.9	79	-8.7	-33	25.8	65 (N/A)	6.7	1.63
Apple	2.4	0.4	1.2	0.1	13	14.9	2.1	2.0	13.6	91	0.0	0	36.7	104 (N/A)	6.1	2.89
Black maple	20.0	3.4	9.2	0.9	106	38.8	5.7	5.4	36.9	242	-6.5	-25	113.7	324 (N/A)	4.9	11.16
Blue spruce	2.5	0.5	2.2	0.3	17	8.4	1.2	1.2	8.0	52	-7.4	-28	16.8	41 (N/A)	3.0	2.29
White ash	1.2	0.2	0.7	0.1	7	10.7	1.6	1.5	10.3	67	0.0	0	26.2	74 (N/A)	2.7	4.62
Northern red oak	1.3	0.2	0.7	0.1	7	7.7	1.1	1.1	7.3	48	-1.8	-7	17.7	49 (N/A)	2.7	3.04
Honeylocust	2.4	0.4	1.2	0.1	13	7.7	1.1	1.1	7.4	48	-1.9	-7	19.5	54 (N/A)	2.7	3.39
Littleleaf linden	2.3	0.4	1.3	0.1	13	13.8	2.0	2.0	13.5	87	-1.3	-5	34.1	95 (N/A)	2.7	5.94
American basswood	3.6	0.6	1.9	0.2	20	16.3	2.3	2.2	15.1	100	-3.3	-12	38.9	108 (N/A)	2.2	8.29
Eastern cottonwood	12.6	2.0	5.6	0.6	66	24.0	3.5	3.3	22.9	150	0.0	0	74.5	216 (N/A)	2.0	17.96
Sugar maple	4.7	0.8	2.3	0.2	25	10.9	1.6	1.5	10.4	68	-3.7	-14	28.7	80 (N/A)	1.5	8.84
Red maple	0.9	0.2	0.5	0.0	5	4.4	0.6	0.6	4.2	27	-0.3	-1	11.0	31 (N/A)	1.5	3.44
Broadleaf/Deciduous Large	2.4	0.4	1.2	0.1	13	10.5	1.5	1.5	10.0	65	0.0	0	27.5	78 (N/A)	1.5	8.68
Pear	1.7	0.3	0.8	0.1	9	5.5	0.8	0.8	5.1	34	0.0	0	15.0	43 (N/A)	1.0	7.15
White oak	0.5	0.1	0.3	0.0	3	2.8	0.4	0.4	2.6	17	0.0	0	7.1	20 (N/A)	0.8	4.04
Northern hackberry	0.3	0.1	0.2	0.0	2	3.7	0.5	0.5	3.5	23	0.0	0	8.9	25 (N/A)	0.7	6.25
Swamp white oak	0.2	0.0	0.1	0.0	1	1.6	0.2	0.2	1.4	10	-0.1	0	3.7	10 (N/A)	0.5	3.47
Black walnut	2.3	0.4	1.0	0.1	12	4.2	0.6	0.6	4.0	26	0.0	0	13.1	38 (N/A)	0.3	19.04
River birch	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
Austrian pine	1.1	0.2	0.8	0.1	7	1.6	0.2	0.2	1.5	10	-2.3	-9	3.5	8 (N/A)	0.3	4.16
Amur maple	0.1	0.0	0.1	0.0	1	0.8	0.1	0.1	0.7	5	0.0	0	1.8	5 (N/A)	0.3	2.55
Japanese tree lilac	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1 (N/A)	0.3	0.71
Conifer Evergreen Large	0.1	0.0	0.1	0.0	1	0.6	0.1	0.1	0.5	3	-0.3	-1	1.1	3 (N/A)	0.3	1.48
Eastern redbud	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1 (N/A)	0.3	0.71
Northern catalpa	3.2	0.5	1.4	0.1	16	4.6	0.7	0.6	4.4	29	0.0	0	15.5	45 (N/A)	0.3	22.55
Bowlder	0.6	0.1	0.3	0.0	3	2.1	0.3	0.3	2.0	13	-0.2	-1	5.4	15 (N/A)	0.3	7.54
Ginkgo	0.1	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.5	4 (N/A)	0.3	2.12
Catalpa	0.0	0.0	0.0	0.0	0	0.9	0.1	0.1	0.9	6	0.0	0	2.1	6 (N/A)	0.3	2.99
Citywide total	206.6	34.6	102.7	9.7	1,117	597.1	86.9	82.8	566.2	3,718	-68.1	-255	1,618.5	4,580 (N/A)	100.0	7.70

Table 4: Annual Carbon Stored

Bancroft

Stored CO2 Benefits of Public Trees

12/10/2019

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	1,912,173	14,341	(N/A)	23.2	38.7	103.92
Norway maple	666,694	5,000	(N/A)	18.0	13.5	46.73
Silver maple	871,870	6,539	(N/A)	11.9	17.7	92.10
Norway spruce	15,312	115	(N/A)	6.7	0.3	2.87
Apple	40,915	307	(N/A)	6.1	0.8	8.52
Black maple	213,129	1,598	(N/A)	4.9	4.3	55.12
Blue spruce	13,456	101	(N/A)	3.0	0.3	5.61
White ash	36,673	275	(N/A)	2.7	0.7	17.19
Northern red oak	19,859	149	(N/A)	2.7	0.4	9.31
Honeylocust	31,713	238	(N/A)	2.7	0.6	14.87
Littleleaf linden	52,379	393	(N/A)	2.7	1.1	24.55
American basswood	127,897	959	(N/A)	2.2	2.6	73.79
Eastern cottonwood	424,657	3,185	(N/A)	2.0	8.6	265.41
Sugar maple	142,724	1,070	(N/A)	1.5	2.9	118.94
Red maple	11,021	83	(N/A)	1.5	0.2	9.18
Broadleaf Deciduous	76,176	571	(N/A)	1.5	1.5	63.48
Pear	25,634	192	(N/A)	1.0	0.5	32.04
White oak	18,213	137	(N/A)	0.8	0.4	27.32
Northern hackberry	4,210	32	(N/A)	0.7	0.1	7.89
Swamp white oak	3,302	25	(N/A)	0.5	0.1	8.26
Black walnut	78,517	589	(N/A)	0.3	1.6	294.44
River birch	7,248	54	(N/A)	0.3	0.1	27.18
Austrian pine	9,787	73	(N/A)	0.3	0.2	36.70
Amur maple	1,816	14	(N/A)	0.3	0.0	6.81
Japanese tree lilac	356	3	(N/A)	0.3	0.0	1.33
Conifer Evergreen La	513	4	(N/A)	0.3	0.0	1.93
Eastern redbud	356	3	(N/A)	0.3	0.0	1.33
Northern catalpa	111,964	840	(N/A)	0.3	2.3	419.86
Boxelder	15,891	119	(N/A)	0.3	0.3	59.59
Ginkgo	948	7	(N/A)	0.3	0.0	3.56
Catalpa	2,069	16	(N/A)	0.3	0.0	7.76
Citywide total	4,937,472	37,031	(N/A)	100.0	100.0	62.24

Table 5: Annual Carbon Sequestered

Bancroft

Annual CO₂ Benefits of Public Trees

12/10/2019

Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Avoided (lb)	Avoided (\$)	Net Total (lb)	Total Standard (\$)	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	94,213	707	-9,178	-422	-72	67,834	509	152,447	1,143 (N/A)	23.2	34.1	8.29
Norway maple	28,578	214	-3,205	-242	-26	37,847	284	62,978	472 (N/A)	18.0	14.1	4.41
Silver maple	68,454	513	-4,192	-192	-33	29,465	221	93,534	702 (N/A)	11.9	20.9	9.88
Norway spruce	2,413	18	-73	-50	-1	4,396	33	6,685	50 (N/A)	6.7	1.5	1.25
Apple	4,537	34	-196	-43	-2	5,022	38	9,320	70 (N/A)	6.1	2.1	1.94
Black maple	4,703	35	-1,023	-76	-8	13,647	102	17,251	129 (N/A)	4.9	3.9	4.46
Blue spruce	1,216	9	-65	-29	-1	2,978	22	4,101	31 (N/A)	3.0	0.9	1.71
White ash	4,862	36	-176	-23	-1	3,801	29	8,464	63 (N/A)	2.7	1.9	3.97
Northern red oak	2,441	18	-95	-19	-1	2,704	20	5,031	38 (N/A)	2.7	1.1	2.36
Honeylocust	1,281	10	-156	-14	-1	2,734	21	3,845	29 (N/A)	2.7	0.9	1.80
Littleleaf linden	7,646	57	-251	-30	-2	4,983	37	12,348	93 (N/A)	2.7	2.8	5.79
American basswood	8,745	66	-614	-38	-5	5,566	42	13,660	102 (N/A)	2.2	3.1	7.88
Eastern cottonwood	10,364	78	-2,038	-58	-16	8,463	63	16,731	125 (N/A)	2.0	3.7	10.46
Sugar maple	6,052	45	-685	-27	-5	3,863	29	9,203	69 (N/A)	1.5	2.1	7.67
Red maple	1,545	12	-53	-9	0	1,553	12	3,036	23 (N/A)	1.5	0.7	2.53
Broadleaf Deciduous Large	5,181	39	-366	-22	-3	3,705	28	8,498	64 (N/A)	1.5	1.9	7.08
Pear	1,071	8	-123	-15	-1	1,904	14	2,836	21 (N/A)	1.0	0.6	3.55
White oak	1,423	11	-87	-7	-1	967	7	2,295	17 (N/A)	0.8	0.5	3.44
Northern hackberry	556	4	-20	-6	0	1,298	10	1,828	14 (N/A)	0.7	0.4	3.43
Swamp white oak	672	5	-16	-4	0	528	4	1,180	9 (N/A)	0.5	0.3	2.95
Black walnut	1,824	14	-377	-10	-3	1,469	11	2,906	22 (N/A)	0.3	0.7	10.90
River birch	772	6	-35	-4	0	790	6	1,523	11 (N/A)	0.3	0.3	5.71
Austrian pine	377	3	-47	-7	0	560	4	883	7 (N/A)	0.3	0.2	3.31
Amur maple	228	2	-9	-2	0	248	2	465	3 (N/A)	0.3	0.1	1.74
Japanese tree lilac	76	1	-2	-1	0	74	1	147	1 (N/A)	0.3	0.0	0.55
Conifer Evergreen Large	105	1	-2	-2	0	189	1	289	2 (N/A)	0.3	0.1	1.08
Eastern redbud	76	1	-2	-1	0	74	1	147	1 (N/A)	0.3	0.0	0.55
Northern catalpa	958	7	-537	-12	-4	1,626	12	2,034	15 (N/A)	0.3	0.5	7.63
Bovelder	1,389	10	-76	-5	-1	732	5	2,039	15 (N/A)	0.3	0.5	7.65
Ginkgo	115	1	-5	-2	0	223	2	331	2 (N/A)	0.3	0.1	1.24
Catalpa	418	3	-10	-2	0	318	2	723	5 (N/A)	0.3	0.2	2.71
Citywide total	262,291	1,967	-23,715	-1,376	-188	209,560	1,572	446,760	3,351 (N/A)	100.0	100.0	5.63

Table 6: Annual Social and Aesthetic Benefits

Bancroft

Annual Aesthetic/Other Benefits of Public Trees					
12/10/2019					
Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Green ash	7,682	(N/A)	23.2	32.2	55.67
Norway maple	2,846	(N/A)	18.0	11.9	26.60
Silver maple	5,692	(N/A)	11.9	23.9	80.17
Norway spruce	701	(N/A)	6.7	2.9	17.53
Apple	257	(N/A)	6.1	1.1	7.14
Black maple	591	(N/A)	4.9	2.5	20.37
Blue spruce	421	(N/A)	3.0	1.8	23.39
White ash	731	(N/A)	2.7	3.1	45.70
Northern red oak	257	(N/A)	2.7	1.1	16.09
Honeylocust	253	(N/A)	2.7	1.1	15.84
Littleleaf linden	834	(N/A)	2.7	3.5	52.11
American basswood	685	(N/A)	2.2	2.9	52.66
Eastern cottonwood	690	(N/A)	2.0	2.9	57.51
Sugar maple	590	(N/A)	1.5	2.5	65.56
Red maple	236	(N/A)	1.5	1.0	26.21
Broadleaf Deciduous Large	457	(N/A)	1.5	1.9	50.78
Pear	62	(N/A)	1.0	0.3	10.32
White oak	152	(N/A)	0.8	0.6	30.43
Northern hackberry	128	(N/A)	0.7	0.5	31.91
Swamp white oak	79	(N/A)	0.5	0.3	26.22
Black walnut	117	(N/A)	0.3	0.5	58.34
River birch	78	(N/A)	0.3	0.3	39.16
Austrian pine	26	(N/A)	0.3	0.1	12.81
American maple	13	(N/A)	0.3	0.1	6.40
Japanese tree lilac	4	(N/A)	0.3	0.0	2.06
Conifer Evergreen Large	31	(N/A)	0.3	0.1	15.42
Eastern redbud	4	(N/A)	0.3	0.0	2.06
Northern catalpa	57	(N/A)	0.3	0.2	28.57
Bowelder	103	(N/A)	0.3	0.4	51.63
Ginkgo	14	(N/A)	0.3	0.1	6.77
Catalpa	57	(N/A)	0.3	0.2	28.56
Citywide total	23,847	(N/A)	100.0	100.0	40.08

Table 7: Summary of Benefits in Dollars

Bancroft

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

12/10/2019

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard I
Green ash	61.44	8.29	10.96	89.14	55.67	225.49 (N/A)
Norway maple	45.58	4.41	8.03	51.08	26.60	135.71 (N/A)
Silver maple	50.32	9.88	9.14	90.47	80.17	239.97 (N/A)
Norway spruce	14.76	1.25	1.63	19.45	17.53	54.63 (N/A)
Apple	19.26	1.94	2.89	8.05	7.14	39.28 (N/A)
Black maple	59.07	4.46	11.16	72.97	20.37	168.03 (N/A)
Blue spruce	20.19	1.71	2.29	32.35	23.39	79.93 (N/A)
White ash	29.29	3.97	4.62	29.03	45.70	112.61 (N/A)
Northern red oak	21.58	2.36	3.04	15.35	16.09	58.42 (N/A)
Honeylocust	20.87	1.80	3.39	23.18	15.84	65.08 (N/A)
Littleleaf linden	36.15	5.79	5.94	31.43	52.11	131.41 (N/A)
American basswood	56.92	7.88	8.29	65.00	52.66	190.76 (N/A)
Eastern cottonwood	87.79	10.46	17.96	172.48	57.51	346.20 (N/A)
Sugar maple	52.55	7.67	8.84	96.01	65.56	230.63 (N/A)
Red maple	21.04	2.53	3.44	16.20	26.21	69.43 (N/A)
Broadleaf Deciduous I	50.84	7.08	8.68	64.39	50.78	181.78 (N/A)
Pear	40.80	3.55	7.15	22.65	10.32	84.47 (N/A)
White oak	24.76	3.44	4.04	29.82	30.43	92.50 (N/A)
Northern hackberry	40.39	3.43	6.25	27.69	31.91	109.68 (N/A)
Swamp white oak	24.47	2.95	3.47	15.88	26.22	72.99 (N/A)
Black walnut	91.02	10.90	19.04	196.17	58.34	375.47 (N/A)
River birch	46.78	5.71	7.92	38.19	39.16	137.75 (N/A)
Austrian pine	35.47	3.31	4.16	79.26	12.81	135.00 (N/A)
Amur maple	18.19	1.74	2.55	7.17	6.40	36.05 (N/A)
Japanese tree lilac	5.40	0.55	0.71	1.86	2.06	10.58 (N/A)
Conifer Evergreen Lar	13.58	1.08	1.48	16.14	15.42	47.70 (N/A)
Eastern redbud	5.40	0.55	0.71	1.86	2.06	10.58 (N/A)
Northern catalpa	98.63	7.63	22.55	196.17	28.57	353.55 (N/A)
Bowelder	46.76	7.65	7.54	60.52	51.63	174.10 (N/A)
Ginkgo	14.72	1.24	2.12	8.17	6.77	33.03 (N/A)
Catalpa	20.64	2.71	2.99	16.47	28.56	71.37 (N/A)
Citywide Total	44.24	5.63	7.70	60.05	40.08	157.71 (N/A)

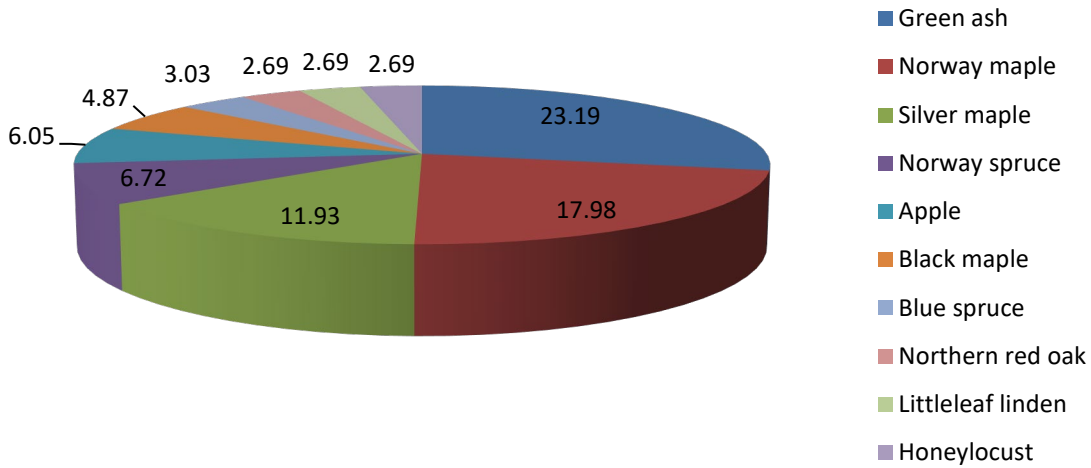


Figure 1: Species Distribution

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

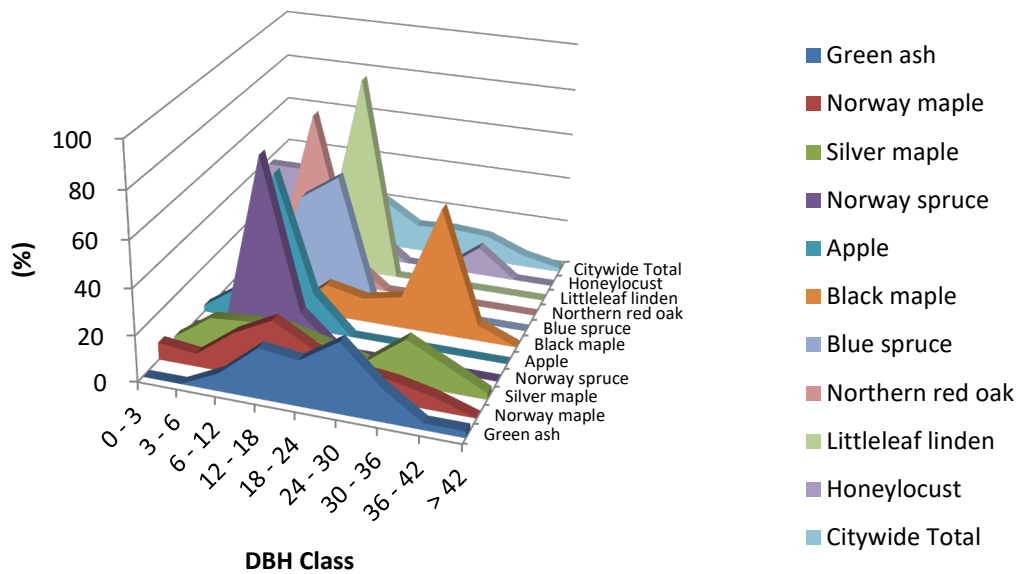


Figure 2: Relative Age Class

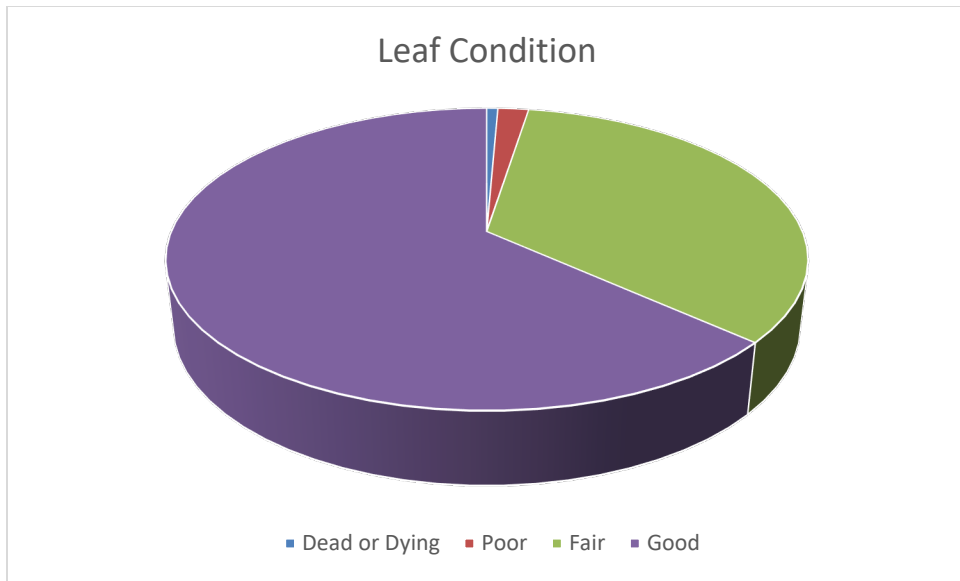


Figure 3: Foliage Condition

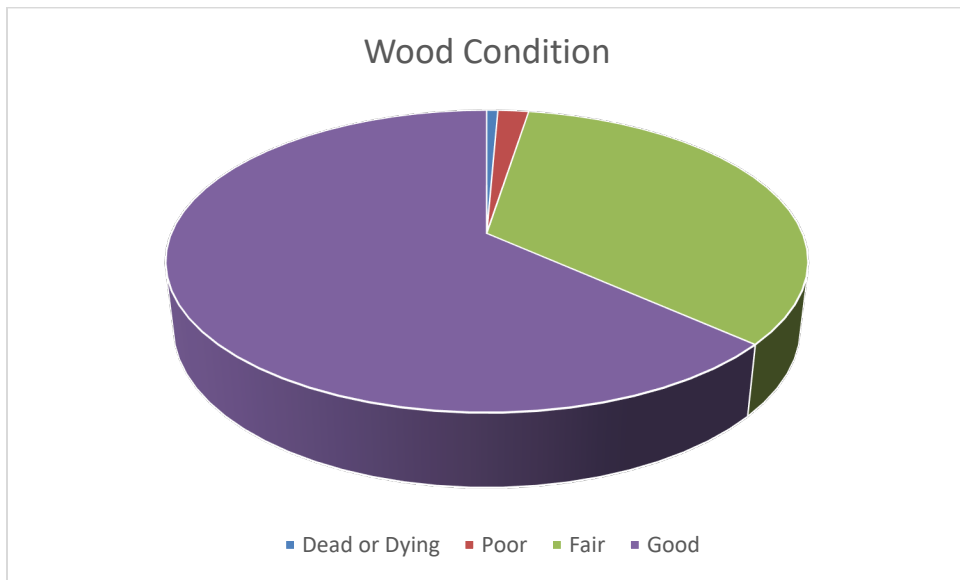


Figure 4: Wood Condition

Canopy Cover of Public Trees (Acres)

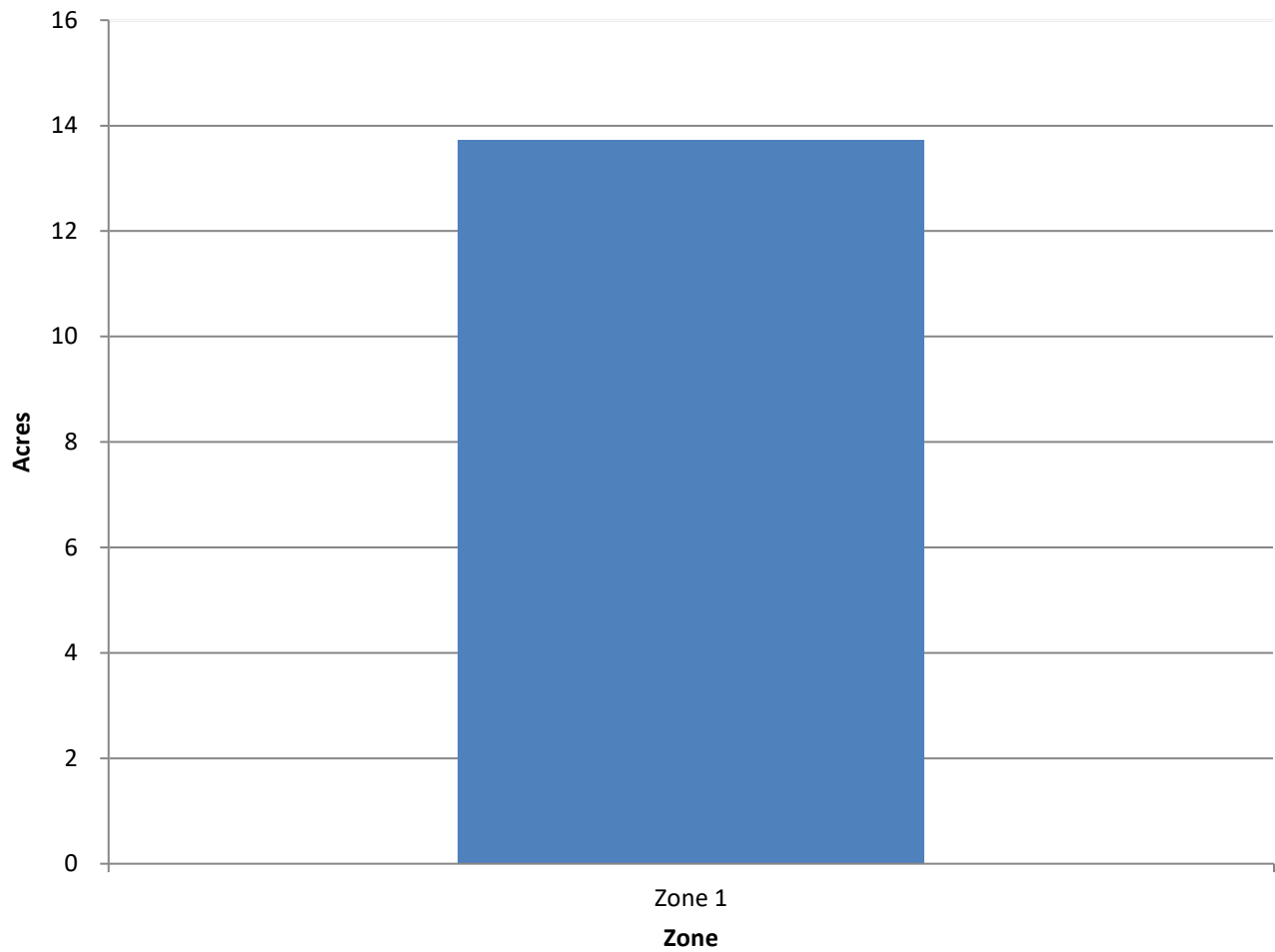


Figure 5: Canopy Cover in Acres

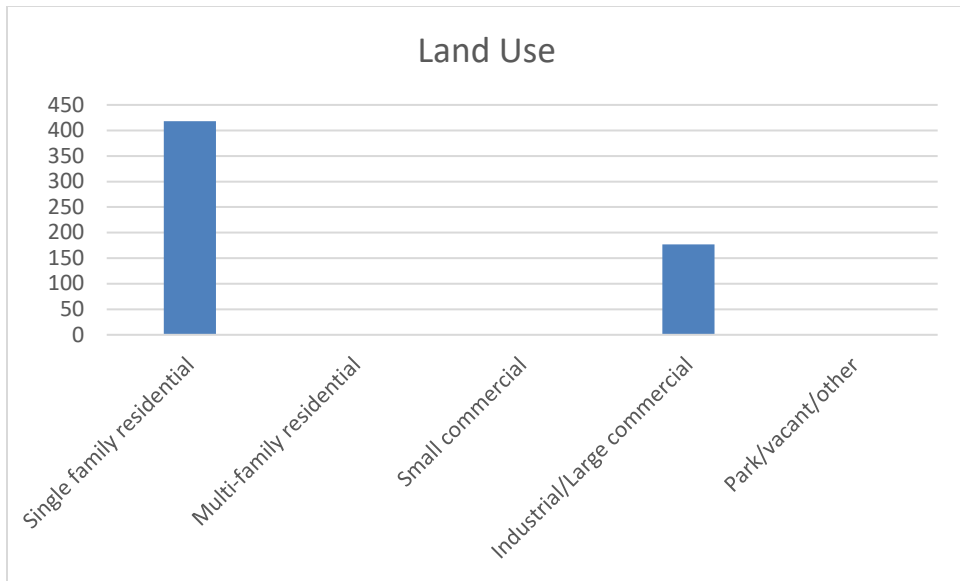


Figure 6: Land Use of city/park trees

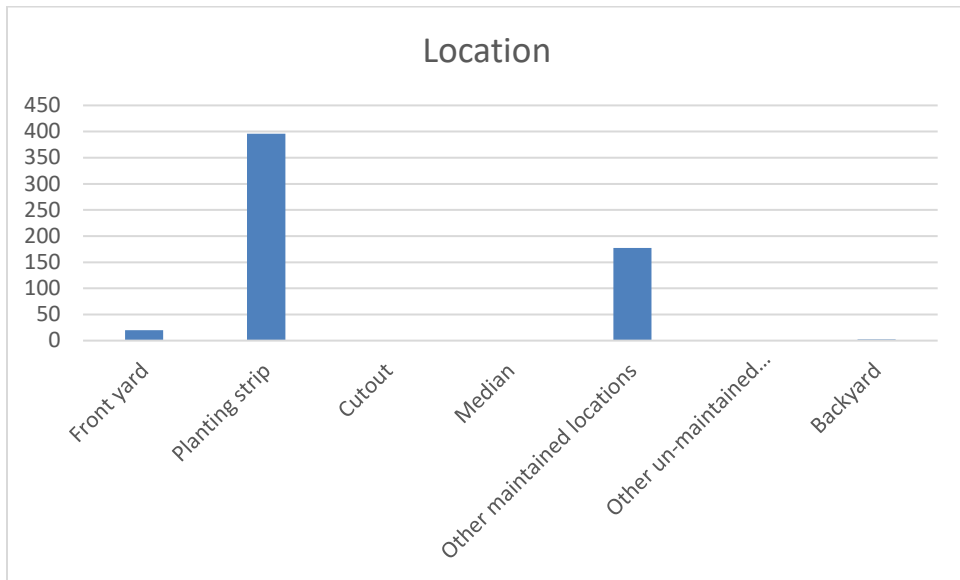


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping



Figure 1: Location of Ash Trees

NO DATA COLLECTED

Figure 2: Location of EAB symptoms



Figure 3: Location of Poor Condition Trees

NO DATA COLLECTED

Figure 4: Location of Trees with Recommended Maintenance

NO DATA COLLECTED

Figure 5: Maintenance Tasks

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