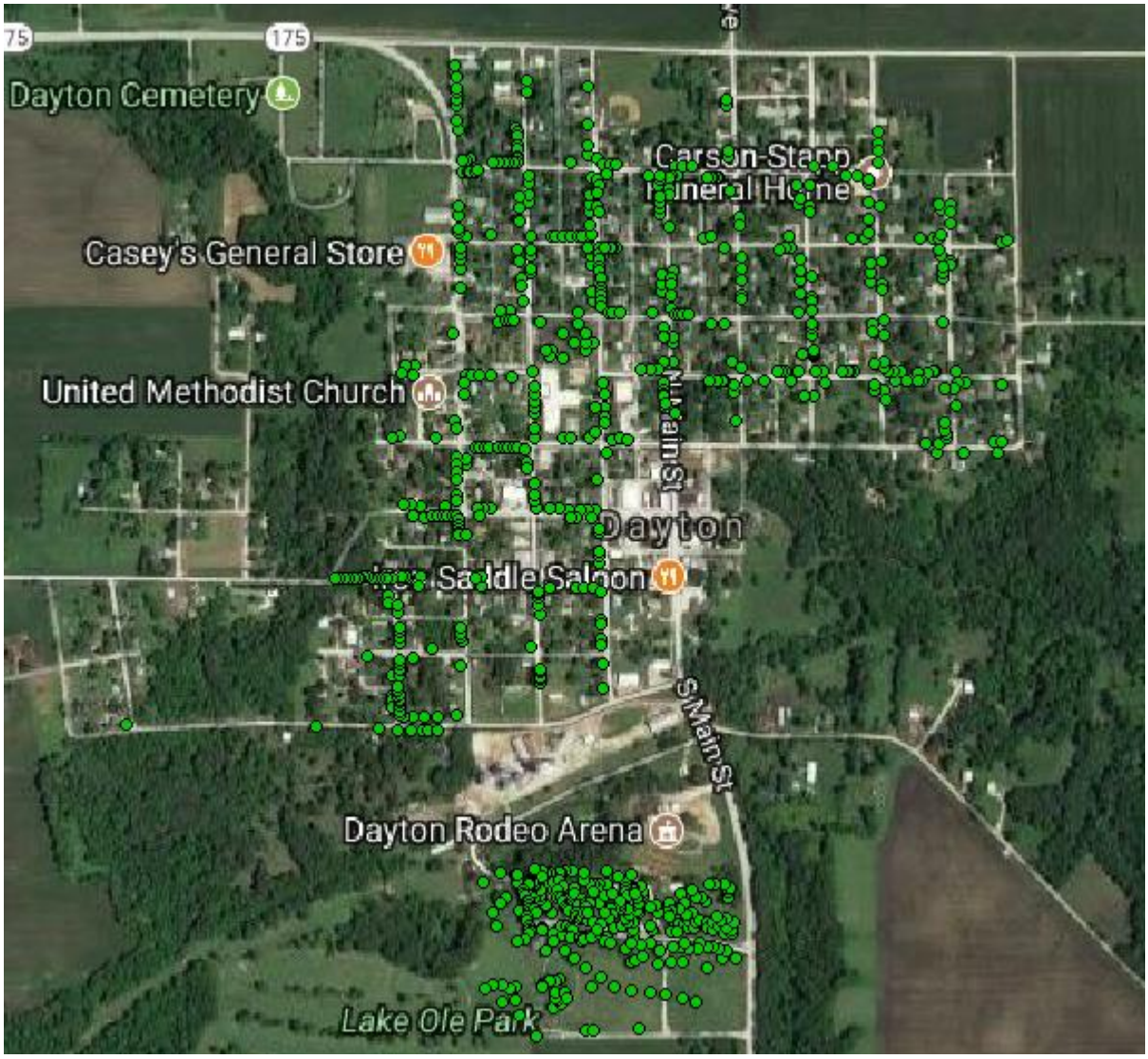
Community Tree Management Plan for Dayton, IA



2017 Urban Forest Management Plan
Prepared by ArborPro, Inc.
In Partnership with the Iowa DNR

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Executive Summary

Overview

This plan was developed to assist the City of Dayton 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 19.79% of Dayton's community, unless preventative treatment is used, will become infested and die once EAB becomes established in the community. 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 2017, 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 786 trees inventoried.

- Dayton's trees provide $169,899 of benefits annually, an average of $217 a tree
- There are over 44 species of trees
- The top three genera are: Maple 29.16%, Oak 20.57%, and Ash 19.79%
- 24% of trees need some type of management or mitigation.
- 26 trees are recommended for removal

Recommendations

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

- Of the 26 trees needing removal, 13 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- 31 of the 152 ash trees should be carefully examined, as they present with some of the 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, Bradford Pear, female Ginko, Chinese Elm, Scot's Pine, Austrian Pine, Willow or Black Walnut.
- Check ash trees with a visual survey yearly
- With the current budget it could take 24 years to remove ash – Suggestion: request a budget increase to $10,000 annually and apply for grants to plant replacement trees

Introduction

This plan was developed to assist Dayton 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 and replacement planting. With proper planning and management of the current canopy in Dayton, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Dayton'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, storm water 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 Dayton 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 Dayton's urban forestry goals.

Inventory

In 2017, a tree inventory was conducted that included 100% of the city owned street trees and park trees. The tree data was collected using a hand held 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 786 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban Forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Dayton's trees reduce energy related costs by approximately $44,515 annually (Appendix A, Table 1). These savings are both in Electricity (211 MWh) and in Natural Gas (29,025 Therms).

Annual Stormwater Benefits

Dayton's trees intercept about 2,408,693.14 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $65,276 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 Dayton it is estimated that trees remove 364.05 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 $7,802 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Dayton, trees sequester about 520,083 lbs of carbon a year with an associated value of $3,901 (Appendix A, Table 4). In addition, the trees store 9,359,219lbs of carbon, with a yearly benefit of $70,194 (Appendix A, Table 5).

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. Dayton receives $46,095 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STRATUM analysis, Dayton's trees provide $169,899 of benefits annually. Benefits of individual trees vary based on size, species, health and

location, but on average each of the 786 trees in Dayton provide approximately $217 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Dayton has over 44 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Green ash	151	19.66
Bur oak	148	19.27
Silver maple	70	9.11
Black walnut	59	7.68
Sugar maple	55	7.16
Northern hackberry	33	4.29
Red maple	29	3.77
Black maple	27	3.51
American basswood	12	1.5
American elm	11	1.43
Hickory	10	1.3
American sycamore	9	1.17
Northern red oak	8	1.04
Eastern cottonwood	3	0.39
Pin oak	2	0.26
Kentucky coffeetree	2	0.26
Catalpa	2	0.26
Maple	1	0.13
White ash	1	0.13
Oak	1	0.13
Norway maple	40	5.2
Littleleaf linden	19	2.47
Honeylocust	9	1.17
Siberian elm	8	1.04
Broadleaf Deciduous Medium	5	0.65
Boxelder	2	0.26
Ginkgo	1	0.13
Apple	8	1.04
Plum	4	0.52
Pear	3	0.39
Broadleaf Deciduous Small	3	0.39
Japanese tree lilac	2	0.26
Black cherry	2	0.26
Eastern redbud	2	0.26
Amur maple	2	0.26
White mulberry	2	0.26
Cherry plum	1	0.13
Conifer Evergreen Large	4	0.52
Eastern white pine	3	0.39
Norway spruce	3	0.39
Scotch pine	2	0.26
Spruce	1	0.13
Blue spruce	16	2.08
Eastern red cedar	6	0.78

Age Class

Well over one half (56.77%) of Dayton's trees are between 0 and 18 inches in diameter at 4.5 ft. (Appendix A, Figure 2). It is preferred that the highest number of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Dayton's size curve is on the upward side, indicating a mid to mature forest 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 Dayton indicate that 32.61% of the trees are in fair health, with 65.09% of the trees in good health, and only 1.79% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 63.55% of Dayton's trees are in fair health for wood condition, with 32.3% in good wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 4.22% of the population. This 4.22% 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).

Priority Tasks for All Trees by Zone (Stake/Train)			
Total	37 (N/A)	4.73	4.73
Priority Tasks for All Trees by Zone (Crown cleaning)			
Total	590 (N/A)	75.45	75.45
Priority Tasks for All Trees by Zone (Crown Raising)			
Total	92 (N/A)	11.76	11.76
Priority Tasks for All Trees by Zone (Crown reduction/thinning)			
Total	37 (N/A)	4.73	4.73
Priority Tasks for All Trees by Zone (Remove)			
Total	26 (N/A)	3.32	3.32

Canopy Cover

The total canopy with both private and public trees is 4.52%, 544 acres. The canopy cover included in the Dayton inventory includes approximately 25 acres (Appendix A, Figure 4). The City's Canopy goal is 30%, in 30 years. To achieve this goal, it is estimated that 40 trees need to be planted annually.

Land Use and Location

The majority of Dayton'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	480 (N/A)	61.38	61.38
Multi-family residential	2 (N/A)	0.26	0.26
Small commercial	5 (N/A)	0.64	0.64
Industrial/Large commercial	1 (N/A)	0.13	0.13
Park/vacant/other	294 (N/A)	37.60	37.60

Location			
Front yard	228 (N/A)	29.00	0.00
Planting strip	282 (N/A)	35.87	0.00
Other maintained locations	276 (N/A)	35.11	0.00

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

Dayton has 0 critical concern trees that need immediate removal. Trees marked as needing maintenance should be followed up on. There is a total of 756 trees with these needs.

Poor tree species

After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 26 removals, only 5 are ash trees. There is a total of 152 ash trees, and 32 of those have signs and symptoms that have been associated with EAB. In addition, there are 3 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

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

Planting

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

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 (29.16%) (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. All trees planted must meet the restrictions in city ordinance.

Continual Monitoring

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

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

Year 1

- Removal: 3 largest recommended removal trees
- Planting and Replacement: 9 trees to be planted in open locations
- Young Tree Pruning & Maintenance:
- Visual Survey for signs and symptoms of EAB

Year 2

- Removal: 2 critical concern trees and 4 additional ash trees with poor health
- *Or saving for ash tree treatment and/or future ash removal
- Planting and Replacement: 6 trees in open locations from year one removals
- Young Tree Pruning & Maintenance:
- Routine trimming: Contract to trim 1/3 of the city trees
- Visual Survey for signs and symptoms of EAB

Year 3

- Removal: 3 trees - removal of any new critical concern trees and ash in poor health
- *Or saving for ash tree treatment and/or future ash removal
- Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals

Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 4

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

Year 5

Removal: 3 trees - removal of any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 6

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

*Reduction of ash over 6 years: 17 ash trees removed (approximately 11.11% of ash). It will take approximately 24 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 to 15 years of its arrival.
** To remove all ash trees within 6 years, the budget would need to be increased to $19,500 a year. If the budget were increased to $10,000 a year all ash could be removed in 13 years.

Emerald Ash Borer Plan

Ash Tree Removal

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

Treatment of Ash Trees

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

EAB Quarantines

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

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

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

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

Wood Disposal

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

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance (Appendix C). The new plantings will be a diverse mix and will 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 they are not being treated. An example of City Code could state "If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property."

Budget

Current Budget
Total $9,570 over 6 years ($1,595/year)

FY 2018 Budget
Removal: $700
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Watering & Maintenance: $500

FY 2019 Budget
Removal: $700
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $300
Watering & Maintenance: $200

FY 2020 Budget
Removal: $700
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Watering & Maintenance: $500

FY 2021 Budget
Removal: $700
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $300
Watering & Maintenance: $200

FY 2022 Budget
Removal: $700
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Watering & Maintenance: $500

FY 2023 Budget
Removal: $700
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $300
Watering & Maintenance: $200

*Reduction of ash over 6 years: approximately 24 ash trees removed (approximately 11.11% of ash). **It will take approximately 24 years to remove all ash with the current budget.**

Purposed Budget Increase
EAB could potentially kill all ash trees in Dayton within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $19,500 a year. If the budget

were increased to $10,000 a year all ash could be removed within 13 years. Additionally, it is recommended that Dayton 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 Dayton 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 Dayton. 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

Dayton

3/30/2018

Annual Energy Benefits of All Trees by Species

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Green ash	43.38	3,292.83	5,967.60	5,848.25	9,141.08	(N/A)	19.31	20.53	60.54
Bur oak	43.64	3,312.64	6,076.93	5,955.39	9,268.03	(N/A)	18.93	20.82	62.62
Silver maple	25.65	1,946.71	3,369.23	3,301.85	5,248.56	(N/A)	8.95	11.79	74.98
Black walnut	15.95	1,210.63	2,192.11	2,148.26	3,358.89	(N/A)	7.54	7.55	56.93
Sugar maple	15.66	1,188.95	2,128.35	2,085.78	3,274.73	(N/A)	7.03	7.36	59.54
Norway maple	9.53	723.07	1,391.25	1,363.43	2,086.50	(N/A)	5.12	4.69	52.16
Northern hackberry	9.80	743.60	1,373.95	1,346.47	2,090.07	(N/A)	4.22	4.70	63.34
Red maple	4.64	351.88	604.91	592.81	944.70	(N/A)	3.71	2.12	32.58
Black maple	7.62	578.55	1,057.60	1,036.45	1,614.99	(N/A)	3.45	3.63	59.81
Littleleaf linden	4.07	309.25	568.53	557.16	866.42	(N/A)	2.43	1.95	45.60
Blue spruce	1.92	145.75	240.05	235.25	381.00	(N/A)	2.05	0.86	23.81
American basswood	3.09	234.61	438.61	429.84	664.45	(N/A)	1.53	1.49	55.37
American elm	4.21	319.56	531.93	521.29	840.86	(N/A)	1.41	1.89	76.44
Hickory	2.57	195.40	349.61	342.62	538.02	(N/A)	1.28	1.21	53.80
Honeylocust	2.95	223.64	389.33	381.55	605.19	(N/A)	1.15	1.36	67.24
American sycamore	3.47	263.50	480.06	470.46	733.96	(N/A)	1.15	1.65	81.55
Siberian elm	2.59	196.83	344.39	337.50	534.33	(N/A)	1.02	1.20	66.79
Northern red oak	1.44	109.45	205.73	201.61	311.07	(N/A)	1.02	0.70	38.88
Apple	0.84	63.41	120.33	117.92	181.33	(N/A)	1.02	0.41	22.67
Eastern red cedar	0.61	45.98	90.14	88.34	134.32	(N/A)	0.77	0.30	22.39
Broadleaf Deciduous Medi	0.02	1.63	3.96	3.88	5.51	(N/A)	0.64	0.01	1.10
Conifer Evergreen Large	0.66	50.44	88.62	86.85	137.29	(N/A)	0.51	0.31	34.32
Plum	0.07	5.30	12.01	11.77	17.07	(N/A)	0.51	0.04	4.27
Eastern cottonwood	0.98	74.53	128.21	125.64	200.18	(N/A)	0.38	0.45	66.73
Pear	0.07	5.05	11.39	11.16	16.21	(N/A)	0.38	0.04	5.40
Broadleaf Deciduous Small	0.15	11.49	26.29	25.76	37.25	(N/A)	0.38	0.08	12.42
Eastern white pine	0.39	29.49	53.81	52.73	82.22	(N/A)	0.38	0.18	27.41
Norway spruce	0.44	33.66	53.86	52.78	86.45	(N/A)	0.38	0.19	28.82
Boxelder	0.61	46.08	83.54	81.87	127.95	(N/A)	0.26	0.29	63.97
Catalpa	0.92	70.01	122.08	119.64	189.65	(N/A)	0.26	0.43	94.83
Japanese tree lilac	0.01	0.51	1.25	1.22	1.73	(N/A)	0.26	0.00	0.87
Amur maple	0.15	11.24	25.66	25.15	36.39	(N/A)	0.26	0.08	18.19
Pin oak	0.52	39.32	66.82	65.48	104.80	(N/A)	0.26	0.24	52.40
Black cherry	0.40	30.30	63.25	61.98	92.28	(N/A)	0.26	0.21	46.14
Eastern redbud	0.21	15.64	28.46	27.89	43.53	(N/A)	0.26	0.10	21.77
White mulberry	0.22	16.83	35.42	34.71	51.54	(N/A)	0.26	0.12	25.77
Kentucky coffeetree	0.87	66.20	116.79	114.45	180.65	(N/A)	0.26	0.41	90.32
Scotch pine	0.20	15.42	29.21	28.63	44.05	(N/A)	0.26	0.10	22.02
Maple	0.26	19.50	30.05	29.45	48.95	(N/A)	0.13	0.11	48.95
White ash	0.42	31.87	54.49	53.40	85.27	(N/A)	0.13	0.19	85.27
Ginkgo	0.00	0.17	0.41	0.40	0.57	(N/A)	0.13	0.00	0.57
Oak	0.39	29.41	53.68	52.60	82.02	(N/A)	0.13	0.18	82.02
Cherry plum	0.00	0.25	0.62	0.61	0.87	(N/A)	0.13	0.00	0.87
Spruce	0.13	9.80	14.63	14.34	24.14	(N/A)	0.13	0.05	24.14
Total	211.73	16,070.39	29,025.16	28,444.66	44,515.05	(N/A)	100.00	100.00	56.92

Table 2: Annual Storm Water Benefits

Dayton

3/30/2018

Annual Stormwater Benefits of All Trees by Species

Species	Total Rainfall Interception (Gal)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Green ash	490,933.54	13,304.30	(N/A)	19.31	20.38	88.11
Bur oak	487,425.08	13,209.22	(N/A)	18.93	20.24	89.25
Silver maple	401,511.76	10,880.97	(N/A)	8.95	16.67	155.44
Black walnut	166,088.24	4,500.99	(N/A)	7.54	6.90	76.29
Sugar maple	175,426.72	4,754.06	(N/A)	7.03	7.28	86.44
Norway maple	89,637.57	2,429.18	(N/A)	5.12	3.72	60.73
Northern hackberry	87,250.64	2,364.49	(N/A)	4.22	3.62	71.65
Red maple	33,616.95	911.02	(N/A)	3.71	1.40	31.41
Black maple	74,882.23	2,029.31	(N/A)	3.45	3.11	75.16
Littleleaf linden	41,953.02	1,136.93	(N/A)	2.43	1.74	59.84
Blue spruce	24,780.71	671.56	(N/A)	2.05	1.03	41.97
American basswood	31,683.82	858.63	(N/A)	1.53	1.32	71.55
American elm	35,649.09	966.09	(N/A)	1.41	1.48	87.83
Hickory	24,605.41	666.81	(N/A)	1.28	1.02	66.68
Honeylocust	34,546.25	936.20	(N/A)	1.15	1.43	104.02
American sycamore	49,816.38	1,350.02	(N/A)	1.15	2.07	150.00
Siberian elm	25,451.42	689.73	(N/A)	1.02	1.06	86.22
Northern red oak	15,236.39	412.91	(N/A)	1.02	0.63	51.61
Apple	3,460.47	93.78	(N/A)	1.02	0.14	11.72
Eastern red cedar	8,831.91	239.34	(N/A)	0.77	0.37	39.89
Broadleaf Deciduous Medi	61.02	1.65	(N/A)	0.64	0.00	0.33
Conifer Evergreen Large	15,147.68	410.50	(N/A)	0.51	0.63	102.63
Plum	213.42	5.78	(N/A)	0.51	0.01	1.45
Eastern cottonwood	11,295.15	306.10	(N/A)	0.38	0.47	102.03
Pear	205.97	5.58	(N/A)	0.38	0.01	1.86
Broadleaf Deciduous Small	536.43	14.54	(N/A)	0.38	0.02	4.85
Eastern white pine	8,169.36	221.39	(N/A)	0.38	0.34	73.80
Norway spruce	7,681.89	208.18	(N/A)	0.38	0.32	69.39
Boxelder	9,230.91	250.16	(N/A)	0.26	0.38	125.08
Catalpa	14,477.84	392.35	(N/A)	0.26	0.60	196.17
Japanese tree lilac	14.90	0.40	(N/A)	0.26	0.00	0.20
Amur maple	528.98	14.34	(N/A)	0.26	0.02	7.17
Pin oak	3,774.86	102.30	(N/A)	0.26	0.16	51.15
Black cherry	2,348.07	63.63	(N/A)	0.26	0.10	31.82
Eastern redbud	735.19	19.92	(N/A)	0.26	0.03	9.96
White mulberry	1,242.69	33.68	(N/A)	0.26	0.05	16.84
Kentucky coffeetree	12,729.45	344.97	(N/A)	0.26	0.53	172.48
Scotch pine	3,564.71	96.60	(N/A)	0.26	0.15	48.30
Maple	1,603.87	43.46	(N/A)	0.13	0.07	43.46
White ash	5,299.45	143.62	(N/A)	0.13	0.22	143.62
Ginkgo	7.11	0.19	(N/A)	0.13	0.00	0.19
Oak	5,490.53	148.79	(N/A)	0.13	0.23	148.79
Cherry plum	7.45	0.20	(N/A)	0.13	0.00	0.20
Spruce	1,538.62	41.70	(N/A)	0.13	0.06	41.70
Citywide total	2,408,693.14	65,275.58	(N/A)	100.00	100.00	83.47

Table 3: Annual Air Quality Benefits

Dayton

3/30/2018

Annual Air Quality Benefits of All Trees by Species

Species	Deposition O3 (lb)	Deposition NO2 (lb)	Deposition PM10 (lb)	Deposition SO2 (lb)	Total Deposition ($)	Avoided NO2 (lb)	Avoided PM10 (lb)	Avoided VOC (lb)	Avoided SO2 (lb)	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Tree Numbers	Avg. $/tree
Green ash	62.53	10.00	29.72	2.80	332.43	207.40	30.18	28.77	196.62	1,291.35	0.00	0.00	568.02	1,623.77	(N/A)	19.31	10.75
Bur oak	59.69	9.55	28.63	2.68	318.08	209.31	30.41	28.98	197.81	1,301.59	0.00	0.00	567.05	1,619.67	(N/A)	18.93	10.94
Silver maple	74.67	12.66	36.10	3.31	400.99	120.84	17.69	16.89	116.00	756.16	- 38.55	- 144.56	359.60	1,012.59	(N/A)	8.95	14.47
Black walnut	19.16	3.06	9.38	0.86	102.63	76.23	11.09	10.58	72.29	474.71	0.00	0.00	202.66	577.34	(N/A)	7.54	9.79
Sugar maple	23.12	3.94	11.55	1.02	125.30	74.56	10.87	10.37	70.95	464.93	- 18.16	- 68.09	188.22	522.14	(N/A)	7.03	9.49
Norway maple	18.25	3.15	8.98	0.81	98.63	46.34	6.69	6.36	43.22	286.68	- 4.28	- 16.07	129.52	369.24	(N/A)	5.12	9.23
Northern hackberry	13.42	2.32	6.94	0.60	73.55	47.15	6.84	6.52	44.44	292.87	0.00	0.00	128.23	366.41	(N/A)	4.22	11.10
Red maple	7.22	1.23	3.46	0.32	38.69	21.85	3.20	3.06	21.00	136.79	- 2.54	- 9.52	58.80	165.96	(N/A)	3.71	5.72
Black maple	19.37	3.30	8.88	0.86	102.72	36.47	5.30	5.05	34.52	226.93	- 6.30	- 23.64	107.46	306.01	(N/A)	3.45	11.33
Littleleaf linden	7.25	1.25	3.56	0.32	39.14	19.58	2.84	2.71	18.49	121.74	- 3.49	- 13.08	52.52	147.81	(N/A)	2.43	7.78
Blue spruce	3.27	0.65	2.73	0.40	21.65	8.94	1.32	1.26	8.69	56.23	- 8.98	- 33.67	18.28	44.22	(N/A)	2.05	2.76
American basswood	4.12	0.70	2.06	0.18	22.33	14.93	2.16	2.06	14.03	92.61	- 3.57	- 13.40	36.67	101.54	(N/A)	1.53	8.46
American elm	8.16	1.39	3.96	0.36	43.90	19.72	2.90	2.77	19.08	123.79	0.00	0.00	58.35	167.69	(N/A)	1.41	15.24
Hickory	2.63	0.42	1.33	0.12	14.22	12.27	1.79	1.71	11.67	76.48	0.00	0.00	31.93	90.70	(N/A)	1.28	9.07
Honeylocust	6.80	1.12	3.09	0.31	35.87	13.91	2.04	1.94	13.33	86.99	- 5.36	- 20.11	37.18	102.75	(N/A)	1.15	11.42
American sycamore	7.27	1.16	3.28	0.33	38.16	16.62	2.42	2.30	15.73	103.42	0.00	0.00	49.11	141.59	(N/A)	1.15	15.73
Siberian elm	3.98	0.68	1.97	0.18	21.51	12.28	1.79	1.71	11.75	76.74	0.00	0.00	34.34	98.25	(N/A)	1.02	12.28
Northern red oak	3.24	0.56	1.57	0.14	17.46	6.95	1.01	0.96	6.53	43.12	- 4.67	- 17.50	16.30	43.08	(N/A)	1.02	5.39
Apple	1.10	0.18	0.51	0.05	5.85	4.04	0.58	0.56	3.79	25.05	- 0.01	- 0.02	10.81	30.88	(N/A)	1.02	3.86
Eastern red cedar	1.78	0.35	1.41	0.22	11.58	2.95	0.42	0.40	2.74	18.21	- 4.87	- 18.25	5.41	11.55	(N/A)	0.77	1.92
Broadleaf Deciduous Medi	0.00	0.00	0.00	0.00	0.01	0.11	0.02	0.01	0.10	0.67	0.00	0.00	0.24	0.68	(N/A)	0.64	0.14
Conifer Evergreen Large	1.83	0.36	1.45	0.22	11.90	3.14	0.46	0.44	3.01	19.65	- 8.48	- 31.81	2.44	- 0.26	(N/A)	0.51	- 0.06
Plum	0.01	0.00	0.01	0.00	0.09	0.35	0.05	0.05	0.32	2.15	0.00	0.00	0.79	2.24	(N/A)	0.51	0.56
Eastern cottonwood	1.96	0.31	0.89	0.09	10.31	4.63	0.68	0.65	4.45	29.00	0.00	0.00	13.66	39.31	(N/A)	0.38	13.10
Pear	0.01	0.00	0.01	0.00	0.08	0.34	0.05	0.05	0.30	2.05	0.00	0.00	0.76	2.13	(N/A)	0.38	0.71
Broadleaf Deciduous Small	0.09	0.01	0.05	0.00	0.51	0.77	0.11	0.10	0.69	4.69	0.00	0.00	1.83	5.20	(N/A)	0.38	1.73
Eastern white pine	0.96	0.19	0.78	0.12	6.32	1.86	0.27	0.26	1.76	11.56	- 4.41	- 16.53	1.79	1.35	(N/A)	0.38	0.45
Norway spruce	0.91	0.18	0.74	0.11	5.96	2.05	0.30	0.29	2.01	12.94	- 3.96	- 14.83	2.64	4.06	(N/A)	0.38	1.35
Boxelder	1.42	0.23	0.63	0.06	7.42	2.90	0.42	0.40	2.75	18.05	- 0.35	- 1.32	8.46	24.15	(N/A)	0.26	12.08
Catalpa	2.74	0.44	1.20	0.12	14.29	4.37	0.64	0.61	4.18	27.30	0.00	0.00	14.30	41.58	(N/A)	0.26	20.79
Japanese tree lilac	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.03	0.21	0.00	0.00	0.08	0.21	(N/A)	0.26	0.11
Amur maple	0.09	0.01	0.05	0.00	0.51	0.75	0.11	0.10	0.67	4.58	0.00	0.00	1.79	5.09	(N/A)	0.26	2.55
Pin oak	0.49	0.09	0.28	0.02	2.78	2.44	0.36	0.34	2.35	15.26	- 1.00	- 3.76	5.36	14.28	(N/A)	0.26	7.14
Black cherry	0.87	0.14	0.39	0.04	4.57	1.98	0.28	0.27	1.81	12.15	0.00	- 0.02	5.77	16.69	(N/A)	0.26	8.35
Eastern redbud	0.21	0.03	0.10	0.01	1.13	0.99	0.14	0.14	0.93	6.14	0.00	0.00	2.56	7.27	(N/A)	0.26	3.63
White mulberry	0.44	0.07	0.20	0.02	2.31	1.10	0.16	0.15	1.00	6.76	0.00	- 0.01	3.14	9.06	(N/A)	0.26	4.53
Kentucky coffeetree	2.38	0.38	1.05	0.11	12.41	4.14	0.60	0.58	3.95	25.86	0.00	0.00	13.19	38.26	(N/A)	0.26	19.13
Scotch pine	0.40	0.08	0.33	0.05	2.63	0.98	0.14	0.14	0.92	6.08	- 1.54	- 5.79	1.49	2.92	(N/A)	0.26	1.46
Maple	0.32	0.05	0.16	0.01	1.73	1.18	0.18	0.17	1.16	7.47	- 0.12	- 0.45	3.12	8.75	(N/A)	0.13	8.75
White ash	0.92	0.15	0.42	0.04	4.82	1.97	0.29	0.28	1.90	12.37	0.00	0.00	5.96	17.19	(N/A)	0.13	17.19
Ginkgo	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.07	0.00	0.00	0.02	0.07	(N/A)	0.13	0.07
Oak	0.79	0.13	0.36	0.04	4.16	1.86	0.27	0.26	1.76	11.55	0.00	0.00	5.45	15.71	(N/A)	0.13	15.71
Cherry plum	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.11	0.00	0.00	0.04	0.11	(N/A)	0.13	0.11
Spruce	0.17	0.03	0.15	0.02	1.13	0.59	0.09	0.08	0.58	3.73	- 0.55	- 2.05	1.17	2.82	(N/A)	0.13	2.82
Citywide Total	364.05	60.58	178.38	16.97	1,959.80	1,010.89	147.17	140.31	959.36	6,296.76	- 121.19	- 454.46	2,756.51	7,802.10	(N/A)	100.00	9.98

Table 4: Annual Carbon Stored

Dayton

3/30/2018

Stored CO2 Benefits of All Trees by Species

Species	Total stored CO2 (lbs)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Green ash	2,050,407.86	15,378.06	(N/A)	19.31	21.91	101.84
Bur oak	1,931,900.33	14,489.25	(N/A)	18.93	20.64	97.90
Silver maple	1,767,115.24	13,253.36	(N/A)	8.95	18.88	189.33
Black walnut	618,102.76	4,635.77	(N/A)	7.54	6.60	78.57
Sugar maple	661,780.78	4,963.36	(N/A)	7.03	7.07	90.24
Norway maple	301,098.13	2,258.24	(N/A)	5.12	3.22	56.46
Northern hackberry	202,969.53	1,522.27	(N/A)	4.22	2.17	46.13
Red maple	80,788.15	605.91	(N/A)	3.71	0.86	20.89
Black maple	205,880.47	1,544.10	(N/A)	3.45	2.20	57.19
Littleleaf linden	154,292.72	1,157.20	(N/A)	2.43	1.65	60.91
Blue spruce	21,300.58	159.75	(N/A)	2.05	0.23	9.98
American basswood	150,756.93	1,130.68	(N/A)	1.53	1.61	94.22
American elm	170,563.05	1,279.22	(N/A)	1.41	1.82	116.29
Hickory	84,741.36	635.56	(N/A)	1.28	0.91	63.56
Honeylocust	87,862.38	658.97	(N/A)	1.15	0.94	73.22
American sycamore	239,778.33	1,798.34	(N/A)	1.15	2.56	199.82
Siberian elm	96,490.63	723.68	(N/A)	1.02	1.03	90.46
Northern red oak	71,235.59	534.27	(N/A)	1.02	0.76	66.78
Apple	16,803.45	126.03	(N/A)	1.02	0.18	15.75
Eastern red cedar	5,787.47	43.41	(N/A)	0.77	0.06	7.23
Broadleaf Deciduous Medi	84.19	0.63	(N/A)	0.64	0.00	0.13
Conifer Evergreen Large	21,666.09	162.50	(N/A)	0.51	0.23	40.62
Plum	547.16	4.10	(N/A)	0.51	0.01	1.03
Eastern cottonwood	68,111.50	510.84	(N/A)	0.38	0.73	170.28
Pear	533.37	4.00	(N/A)	0.38	0.01	1.33
Broadleaf Deciduous Small	1,829.60	13.72	(N/A)	0.38	0.02	4.57
Eastern white pine	11,089.73	83.17	(N/A)	0.38	0.12	27.72
Norway spruce	9,830.76	73.73	(N/A)	0.38	0.11	24.58
Boxelder	61,300.25	459.75	(N/A)	0.26	0.65	229.88
Catalpa	95,240.50	714.30	(N/A)	0.26	1.02	357.15
Japanese tree lilac	27.57	0.21	(N/A)	0.26	0.00	0.10
Amur maple	1,815.81	13.62	(N/A)	0.26	0.02	6.81
Pin oak	11,812.98	88.60	(N/A)	0.26	0.13	44.30
Black cherry	13,485.43	101.14	(N/A)	0.26	0.14	50.57
Eastern redbud	3,214.95	24.11	(N/A)	0.26	0.03	12.06
White mulberry	6,920.50	51.90	(N/A)	0.26	0.07	25.95
Kentucky coffeetree	81,925.14	614.44	(N/A)	0.26	0.88	307.22
Scotch pine	3,599.44	27.00	(N/A)	0.26	0.04	13.50
Maple	3,624.16	27.18	(N/A)	0.13	0.04	27.18
White ash	15,772.76	118.30	(N/A)	0.13	0.17	118.30
Ginkgo	4.55	0.03	(N/A)	0.13	0.00	0.03
Oak	25,943.15	194.57	(N/A)	0.13	0.28	194.57
Cherry plum	13.78	0.10	(N/A)	0.13	0.00	0.10
Spruce	1,170.23	8.78	(N/A)	0.13	0.01	8.78
Citywide total	9,359,219.36	70,194.15	(N/A)	100.00	100.00	89.76

Table 5: Annual Carbon Sequestered

Dayton

3/30/2018

Annual CO2 Benefits of All Trees by Species

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release(lb)	Maintenance Release (lb)	Total Release ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Green ash	101,801.33	763.51	- 9,841.96	- 456.11	- 77.24	72,770.75	545.78	164,274.02	1,232.06	(N/A)	19.31	19.84	8.16
Bur oak	106,475.60	798.57	- 9,273.12	- 456.30	- 72.97	73,208.45	549.06	169,954.63	1,274.66	(N/A)	18.93	20.52	8.61
Silver maple	119,684.50	897.63	- 8,482.91	- 297.18	- 65.85	43,021.71	322.66	153,926.13	1,154.45	(N/A)	8.95	18.59	16.49
Black walnut	38,485.42	288.64	- 2,966.89	- 163.61	- 23.48	26,754.54	200.66	62,109.47	465.82	(N/A)	7.54	7.50	7.90
Sugar maple	35,114.62	263.36	- 3,176.55	- 168.87	- 25.09	26,275.46	197.07	58,044.67	435.34	(N/A)	7.03	7.01	7.92
Norway maple	12,818.12	96.14	- 1,445.97	- 102.38	- 11.61	15,979.75	119.85	27,249.53	204.37	(N/A)	5.12	3.29	5.11
Northern hackberry	11,426.78	85.70	- 974.49	- 90.09	- 7.98	16,433.29	123.25	26,795.49	200.97	(N/A)	4.22	3.24	6.09
Red maple	7,482.63	56.12	- 388.05	- 42.12	- 3.23	7,776.51	58.32	14,828.97	111.22	(N/A)	3.71	1.79	3.84
Black maple	12,046.56	90.35	- 988.23	- 72.15	- 7.95	12,785.77	95.89	23,771.96	178.29	(N/A)	3.45	2.87	6.60
Littleleaf linden	12,700.75	95.26	- 741.24	- 47.97	- 5.92	6,834.42	51.26	18,745.95	140.59	(N/A)	2.43	2.26	7.40
Blue spruce	1,474.73	11.06	- 102.24	- 31.40	- 1.00	3,221.11	24.16	4,562.20	34.22	(N/A)	2.05	0.55	2.14
American basswood	9,149.00	68.62	- 723.67	- 34.91	- 5.69	5,184.85	38.89	13,575.27	101.81	(N/A)	1.53	1.64	8.48
American elm	4,848.66	36.36	- 818.70	- 38.61	- 6.43	7,062.28	52.97	11,053.63	82.90	(N/A)	1.41	1.33	7.54
Hickory	6,094.50	45.71	- 406.76	- 25.74	- 3.24	4,318.29	32.39	9,980.29	74.85	(N/A)	1.28	1.21	7.49
Honeylocust	8,017.34	60.13	- 421.74	- 23.01	- 3.34	4,942.38	37.07	12,514.97	93.86	(N/A)	1.15	1.51	10.43
American sycamore	8,335.93	62.52	- 1,150.94	- 38.61	- 8.92	5,823.31	43.67	12,969.70	97.27	(N/A)	1.15	1.57	10.81
Siberian elm	4,782.27	35.87	- 463.16	- 26.52	- 3.67	4,349.82	32.62	8,642.41	64.82	(N/A)	1.02	1.04	8.10
Northern red oak	1,421.29	10.66	- 341.97	- 19.31	- 2.71	2,418.89	18.14	3,478.91	26.09	(N/A)	1.02	0.42	3.26
Apple	1,421.30	10.66	- 80.79	- 10.34	- 0.68	1,401.24	10.51	2,731.41	20.49	(N/A)	1.02	0.33	2.56
Eastern red cedar	82.71	0.62	- 27.78	- 10.92	- 0.29	1,016.19	7.62	1,060.20	7.95	(N/A)	0.77	0.13	1.33
Broadleaf Deciduous Medi	27.10	0.20	- 0.67	- 0.98	- 0.01	35.95	0.27	61.40	0.46	(N/A)	0.64	0.01	0.09
Conifer Evergreen Large	630.80	4.73	- 104.00	- 13.26	- 0.88	1,114.68	8.36	1,628.23	12.21	(N/A)	0.51	0.20	3.05
Plum	122.50	0.92	- 2.67	- 1.95	- 0.03	117.18	0.88	235.07	1.76	(N/A)	0.51	0.03	0.44
Eastern cottonwood	1,583.89	11.88	- 326.94	- 10.53	- 2.53	1,647.19	12.35	2,893.62	21.70	(N/A)	0.38	0.35	7.23
Pear	113.82	0.85	- 2.56	- 1.76	- 0.03	111.57	0.84	221.07	1.66	(N/A)	0.38	0.03	0.55
Broadleaf Deciduous Small	236.43	1.77	- 8.83	- 2.54	- 0.09	253.92	1.90	478.99	3.59	(N/A)	0.38	0.06	1.20
Eastern white pine	496.05	3.72	- 53.23	- 7.41	- 0.45	651.75	4.89	1,087.16	8.15	(N/A)	0.38	0.13	2.72
Norway spruce	487.14	3.65	- 47.19	- 7.41	- 0.41	743.94	5.58	1,176.48	8.82	(N/A)	0.38	0.14	2.94
Boxelder	3,389.73	25.42	- 294.24	- 9.36	- 2.28	1,018.37	7.64	4,104.50	30.78	(N/A)	0.26	0.50	15.39
Catalpa	1,390.98	10.43	- 457.15	- 10.92	- 3.51	1,547.27	11.60	2,470.18	18.53	(N/A)	0.26	0.30	9.26
Japanese tree lilac	17.37	0.13	- 0.22	- 0.39	0.00	11.23	0.08	27.98	0.21	(N/A)	0.26	0.00	0.10
Amur maple	227.75	1.71	- 8.72	- 2.34	- 0.08	248.31	1.86	465.00	3.49	(N/A)	0.26	0.06	1.74
Pin oak	1,353.30	10.15	- 56.70	- 4.68	- 0.46	868.98	6.52	2,160.89	16.21	(N/A)	0.26	0.26	8.10
Black cherry	956.91	7.18	- 64.73	- 5.46	- 0.53	669.55	5.02	1,556.27	11.67	(N/A)	0.26	0.19	5.84
Eastern redbud	305.58	2.29	- 15.43	- 2.54	- 0.13	345.68	2.59	633.29	4.75	(N/A)	0.26	0.08	2.37
White mulberry	516.39	3.87	- 33.22	- 3.32	- 0.27	371.97	2.79	851.83	6.39	(N/A)	0.26	0.10	3.19
Kentucky coffeetree	1,438.45	10.79	- 393.24	- 10.14	- 3.03	1,462.97	10.97	2,498.04	18.74	(N/A)	0.26	0.30	9.37
Scotch pine	240.00	1.80	- 17.28	- 3.90	- 0.16	340.79	2.56	559.62	4.20	(N/A)	0.26	0.07	2.10
Maple	483.20	3.62	- 17.40	- 1.95	- 0.15	430.85	3.23	894.70	6.71	(N/A)	0.13	0.11	6.71
White ash	1,315.21	9.86	- 75.71	- 3.51	- 0.59	704.37	5.28	1,940.36	14.55	(N/A)	0.13	0.23	14.55
Ginkgo	2.20	0.02	- 0.04	- 0.20	0.00	3.70	0.03	5.67	0.04	(N/A)	0.13	0.00	0.04
Oak	959.59	7.20	- 124.53	- 4.29	- 0.97	650.03	4.88	1,480.80	11.11	(N/A)	0.13	0.18	11.11
Cherry plum	8.68	0.07	- 0.11	- 0.20	0.00	5.61	0.04	13.99	0.10	(N/A)	0.13	0.00	0.10
Spruce	115.55	0.87	- 5.62	- 1.95	- 0.06	216.49	1.62	324.47	2.43	(N/A)	0.13	0.04	2.43
Citywide Total	520,082.67	3,900.62	- 44,927.56	- 2,267.09	- 353.96	355,151.39	2,663.64	828,039.41	6,210.30	(N/A)	100.00	100.00	7.94

Table 6: Annual Social and Aesthetic Benefits

Dayton

3/30/2018

Average Annual Benefits of All Tree by Species ($/tree)

Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/ Other	Total	Standard Error
Green ash	60.54	8.16	10.75	88.11	55.21	222.76	(N/A)
Bur oak	62.62	8.61	10.94	89.25	58.48	229.91	(N/A)
Silver maple	74.98	16.49	14.47	155.44	124.89	386.27	(N/A)
Black walnut	56.93	7.90	9.79	76.29	55.14	206.04	(N/A)
Sugar maple	59.54	7.92	9.49	86.44	66.76	230.14	(N/A)
Norway maple	52.16	5.11	9.23	60.73	30.84	158.07	(N/A)
Northern hackberry	63.34	6.09	11.10	71.65	49.44	201.62	(N/A)
Red maple	32.58	3.84	5.72	31.41	35.93	109.48	(N/A)
Black maple	59.81	6.60	11.33	75.16	53.36	206.27	(N/A)
Littleleaf linden	45.60	7.40	7.78	59.84	67.44	188.06	(N/A)
Blue spruce	23.81	2.14	2.76	41.97	23.06	93.74	(N/A)
American basswood	55.37	8.48	8.46	71.55	56.28	200.15	(N/A)
American elm	76.44	7.54	15.24	87.83	60.26	247.31	(N/A)
Hickory	53.80	7.49	9.07	66.68	53.60	190.63	(N/A)
Honeylocust	67.24	10.43	11.42	104.02	219.59	412.70	(N/A)
American sycamore	81.55	10.81	15.73	150.00	64.54	322.63	(N/A)
Siberian elm	66.79	8.10	12.28	86.22	43.50	216.89	(N/A)
Northern red oak	38.88	3.26	5.39	51.61	13.65	112.79	(N/A)
Apple	22.67	2.56	3.86	11.72	10.22	51.03	(N/A)
Eastern red cedar	22.39	1.33	1.92	39.89	5.84	71.37	(N/A)
Broadleaf Deciduous Medi	1.10	0.09	0.14	0.33	2.74	4.40	(N/A)
Conifer Evergreen Large	34.32	3.05	- 0.06	102.63	30.10	170.04	(N/A)
Plum	4.27	0.44	0.56	1.45	1.55	8.27	(N/A)
Eastern cottonwood	66.73	7.23	13.10	102.03	44.04	233.13	(N/A)
Pear	5.40	0.55	0.71	1.86	2.06	10.58	(N/A)
Broadleaf Deciduous Small	12.42	1.20	1.73	4.85	4.28	24.47	(N/A)
Eastern white pine	27.41	2.72	0.45	73.80	29.59	133.96	(N/A)
Norway spruce	28.82	2.94	1.35	69.39	30.30	132.80	(N/A)
Boxelder	63.97	15.39	12.08	125.08	88.28	304.80	(N/A)
Catalpa	94.83	9.26	20.79	196.17	43.45	364.51	(N/A)
Japanese tree lilac	0.87	0.10	0.11	0.20	0.03	1.31	(N/A)
Amur maple	18.19	1.74	2.55	7.17	6.40	36.05	(N/A)
Pin oak	52.40	8.10	7.14	51.15	65.33	184.12	(N/A)
Black cherry	46.14	5.84	8.35	31.82	28.80	120.94	(N/A)
Eastern redbud	21.77	2.37	3.63	9.96	8.77	46.51	(N/A)
White mulberry	25.77	3.19	4.53	16.84	15.43	65.76	(N/A)
Kentucky coffeetree	90.32	9.37	19.13	172.48	47.59	338.89	(N/A)
Scotch pine	22.02	2.10	1.46	48.30	31.25	105.14	(N/A)
Maple	48.95	6.71	8.75	43.46	65.89	173.77	(N/A)
White ash	85.27	14.55	17.19	143.62	126.36	386.99	(N/A)
Ginkgo	0.57	0.04	0.07	0.19	0.37	1.25	(N/A)
Oak	82.02	11.11	15.71	148.79	66.60	324.23	(N/A)
Cherry plum	0.87	0.10	0.11	0.20	0.03	1.31	(N/A)
Spruce	24.14	2.43	2.82	41.70	32.32	103.40	(N/A)
Citywide Total	56.92	7.94	9.98	83.47	58.95	217.26	(N/A)

Table 7: Summary of Benefits in Dollars

Average Annual Benefits of All Trees by Species

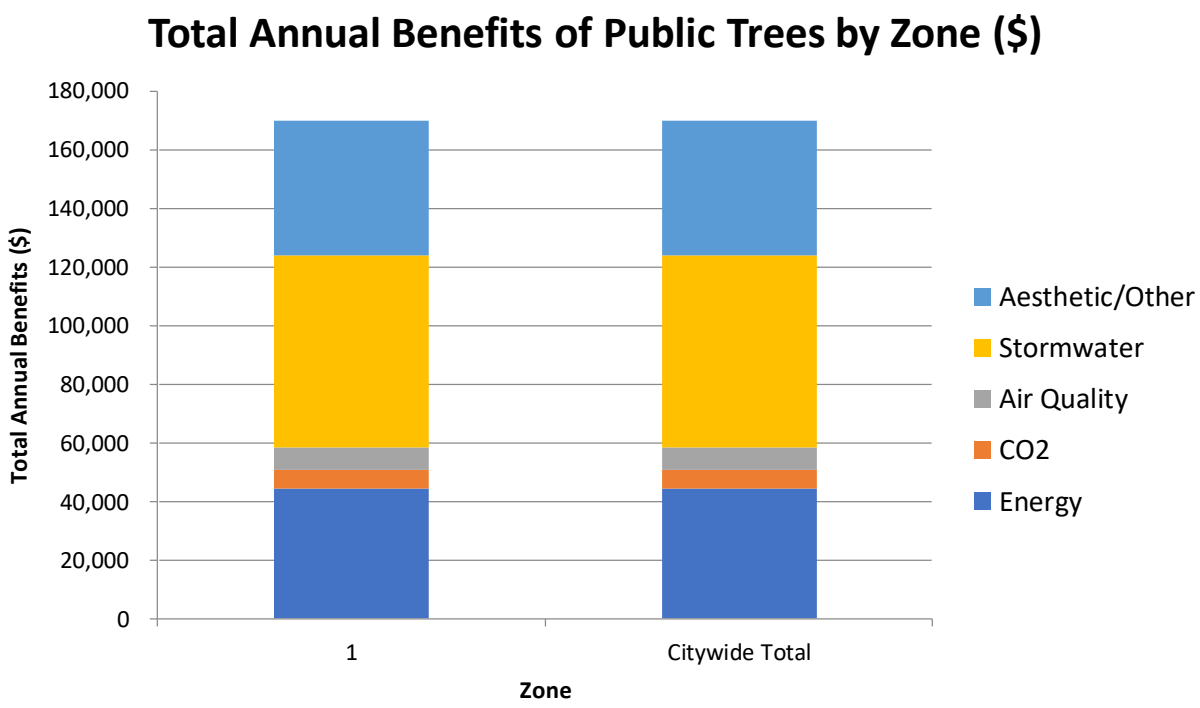
Species	Energy	CO2	Air Quality	Stormwater	Aesthetic/ Other	Total ($)	Standard Error	% of Total $
Green ash	9,141.08	1,232.06	1,623.77	13,304.30	8,336.19	33,637.40	(N/A)	19.80
Bur oak	9,268.03	1,274.66	1,619.67	13,209.22	8,654.77	34,026.35	(N/A)	20.03
Silver maple	5,248.56	1,154.45	1,012.59	10,880.97	8,742.63	27,039.19	(N/A)	15.91
Black walnut	3,358.89	465.82	577.34	4,500.99	3,253.50	12,156.55	(N/A)	7.16
Sugar maple	3,274.73	435.34	522.14	4,754.06	3,671.68	12,657.94	(N/A)	7.45
Norway maple	2,086.50	204.37	369.24	2,429.18	1,233.63	6,322.93	(N/A)	3.72
Northern hackberry	2,090.07	200.97	366.41	2,364.49	1,631.47	6,653.41	(N/A)	3.92
Red maple	944.70	111.22	165.96	911.02	1,042.04	3,174.94	(N/A)	1.87
Black maple	1,614.99	178.29	306.01	2,029.31	1,440.71	5,569.31	(N/A)	3.28
Littleleaf linden	866.42	140.59	147.81	1,136.93	1,281.37	3,573.11	(N/A)	2.10
Blue spruce	381.00	34.22	44.22	671.56	368.91	1,499.90	(N/A)	0.88
American basswood	664.45	101.81	101.54	858.63	675.41	2,401.85	(N/A)	1.41
American elm	840.86	82.90	167.69	966.09	662.81	2,720.36	(N/A)	1.60
Hickory	538.02	74.85	90.70	666.81	535.96	1,906.34	(N/A)	1.12
Honeylocust	605.19	93.86	102.75	936.20	1,976.29	3,714.29	(N/A)	2.19
American sycamore	733.96	97.27	141.59	1,350.02	580.86	2,903.70	(N/A)	1.71
Siberian elm	534.33	64.82	98.25	689.73	347.98	1,735.11	(N/A)	1.02
Northern red oak	311.07	26.09	43.08	412.91	109.18	902.33	(N/A)	0.53
Apple	181.33	20.49	30.88	93.78	81.75	408.22	(N/A)	0.24
Eastern red cedar	134.32	7.95	11.55	239.34	35.03	428.20	(N/A)	0.25
Broadleaf Deciduous Medi	5.51	0.46	0.68	1.65	13.68	21.99	(N/A)	0.01
Conifer Evergreen Large	137.29	12.21	- 0.26	410.50	120.42	680.16	(N/A)	0.40
Plum	17.07	1.76	2.24	5.78	6.21	33.07	(N/A)	0.02
Eastern cottonwood	200.18	21.70	39.31	306.10	132.11	699.40	(N/A)	0.41
Pear	16.21	1.66	2.13	5.58	6.17	31.75	(N/A)	0.02
Broadleaf Deciduous Small	37.25	3.59	5.20	14.54	12.84	73.42	(N/A)	0.04
Eastern white pine	82.22	8.15	1.35	221.39	88.76	401.87	(N/A)	0.24
Norway spruce	86.45	8.82	4.06	208.18	90.89	398.40	(N/A)	0.23
Boxelder	127.95	30.78	24.15	250.16	176.56	609.60	(N/A)	0.36
Catalpa	189.65	18.53	41.58	392.35	86.91	729.02	(N/A)	0.43
Japanese tree lilac	1.73	0.21	0.21	0.40	0.07	2.63	(N/A)	0.00
Amur maple	36.39	3.49	5.09	14.34	12.80	72.10	(N/A)	0.04
Pin oak	104.80	16.21	14.28	102.30	130.66	368.25	(N/A)	0.22
Black cherry	92.28	11.67	16.69	63.63	57.60	241.88	(N/A)	0.14
Eastern redbud	43.53	4.75	7.27	19.92	17.54	93.01	(N/A)	0.05
White mulberry	51.54	6.39	9.06	33.68	30.86	131.52	(N/A)	0.08
Kentucky coffeetree	180.65	18.74	38.26	344.97	95.17	677.78	(N/A)	0.40
Scotch pine	44.05	4.20	2.92	96.60	62.50	210.28	(N/A)	0.12
Maple	48.95	6.71	8.75	43.46	65.89	173.77	(N/A)	0.10
White ash	85.27	14.55	17.19	143.62	126.36	386.99	(N/A)	0.23
Ginkgo	0.57	0.04	0.07	0.19	0.37	1.25	(N/A)	0.00
Oak	82.02	11.11	15.71	148.79	66.60	324.23	(N/A)	0.19
Cherry plum	0.87	0.10	0.11	0.20	0.03	1.31	(N/A)	0.00
Spruce	24.14	2.43	2.82	41.70	32.32	103.40	(N/A)	0.06

Dayton

3/30/2018

Annual Aesthetic/Other Benefit of All Trees by Species

Species	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/tree
Green ash	8,336.19	(N/A)	19.31	18.08	55.21
Bur oak	8,654.77	(N/A)	18.93	18.78	58.48
Silver maple	8,742.63	(N/A)	8.95	18.97	124.89
Black walnut	3,253.50	(N/A)	7.54	7.06	55.14
Sugar maple	3,671.68	(N/A)	7.03	7.97	66.76
Norway maple	1,233.63	(N/A)	5.12	2.68	30.84
Northern hackberry	1,631.47	(N/A)	4.22	3.54	49.44
Red maple	1,042.04	(N/A)	3.71	2.26	35.93
Black maple	1,440.71	(N/A)	3.45	3.13	53.36
Littleleaf linden	1,281.37	(N/A)	2.43	2.78	67.44
Blue spruce	368.91	(N/A)	2.05	0.80	23.06
American basswood	675.41	(N/A)	1.53	1.47	56.28
American elm	662.81	(N/A)	1.41	1.44	60.26
Hickory	535.96	(N/A)	1.28	1.16	53.60
Honeylocust	1,976.29	(N/A)	1.15	4.29	219.59
American sycamore	580.86	(N/A)	1.15	1.26	64.54
Siberian elm	347.98	(N/A)	1.02	0.75	43.50
Northern red oak	109.18	(N/A)	1.02	0.24	13.65
Apple	81.75	(N/A)	1.02	0.18	10.22
Eastern red cedar	35.03	(N/A)	0.77	0.08	5.84
Broadleaf Deciduous Medi	13.68	(N/A)	0.64	0.03	2.74
Conifer Evergreen Large	120.42	(N/A)	0.51	0.26	30.10
Plum	6.21	(N/A)	0.51	0.01	1.55
Eastern cottonwood	132.11	(N/A)	0.38	0.29	44.04
Pear	6.17	(N/A)	0.38	0.01	2.06
Broadleaf Deciduous Small	12.84	(N/A)	0.38	0.03	4.28
Eastern white pine	88.76	(N/A)	0.38	0.19	29.59
Norway spruce	90.89	(N/A)	0.38	0.20	30.30
Boxelder	176.56	(N/A)	0.26	0.38	88.28
Catalpa	86.91	(N/A)	0.26	0.19	43.45
Japanese tree lilac	0.07	(N/A)	0.26	0.00	0.03
Amur maple	12.80	(N/A)	0.26	0.03	6.40
Pin oak	130.66	(N/A)	0.26	0.28	65.33
Black cherry	57.60	(N/A)	0.26	0.12	28.80
Eastern redbud	17.54	(N/A)	0.26	0.04	8.77
White mulberry	30.86	(N/A)	0.26	0.07	15.43
Kentucky coffeetree	95.17	(N/A)	0.26	0.21	47.59
Scotch pine	62.50	(N/A)	0.26	0.14	31.25
Maple	65.89	(N/A)	0.13	0.14	65.89
White ash	126.36	(N/A)	0.13	0.27	126.36
Ginkgo	0.37	(N/A)	0.13	0.00	0.37
Oak	66.60	(N/A)	0.13	0.14	66.60
Cherry plum	0.03	(N/A)	0.13	0.00	0.03
Spruce	32.32	(N/A)	0.13	0.07	32.32
Citywide Total	46,095.49	(N/A)	100.00	100.00	58.95


Total Annual Benefits of Public Trees by Zone ($)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Total Annual Benefits ($)
1
Citywide Total
Zone
Aesthetic/Other
Stormwater
Air Quality
CO2
Energy

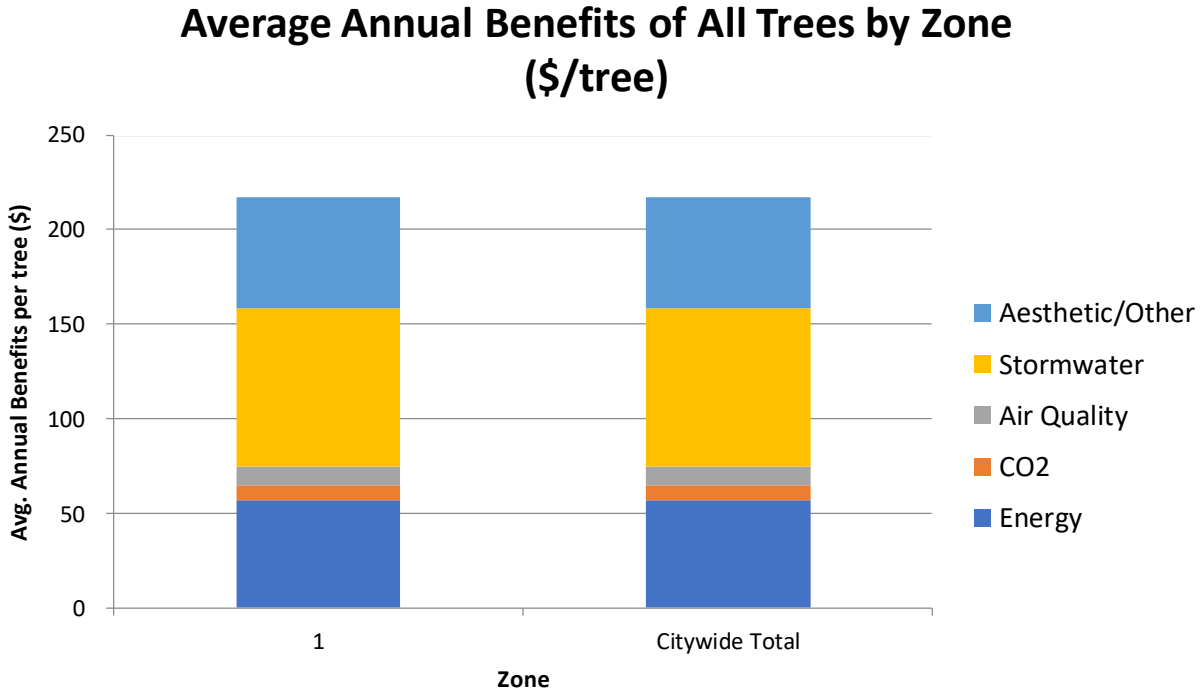

Average Annual Benefits of All Trees by Zone ($/tree)
250
200
150
100
50
0
Avg. Annual Benefits per tree ($)
1
Citywide Total
Zone
Aesthetic/Other
Stormwater
Air Quality
CO2
Energy

Figure 1: Species Distribution

Dayton
Species Distribution of All Trees
3/30/2018

Species	Percent
Green ash	19.31
Bur oak	18.93
Silver maple	8.95
Black walnut	7.54
Sugar maple	7.03
Norway maple	5.12
Northern hackberry	4.22
Red maple	3.71
Black maple	3.45
Littleleaf linden	2.43
Other Species	19.31

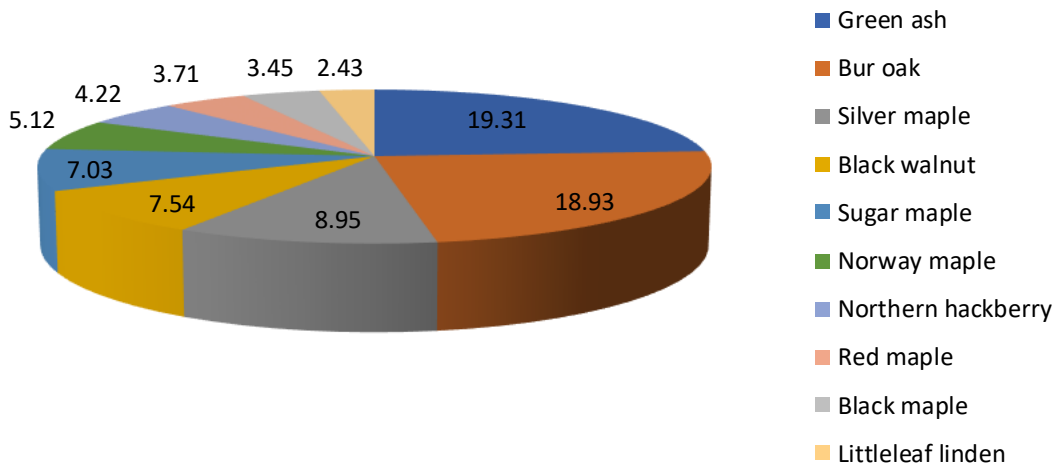
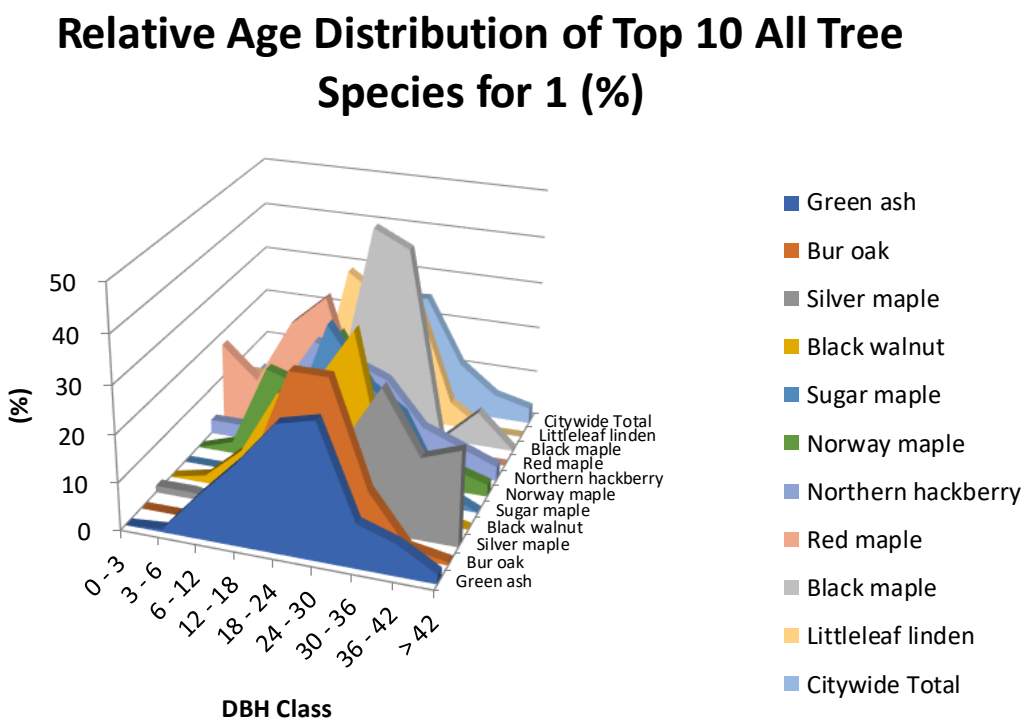


Figure 2: Relative Age Distribution



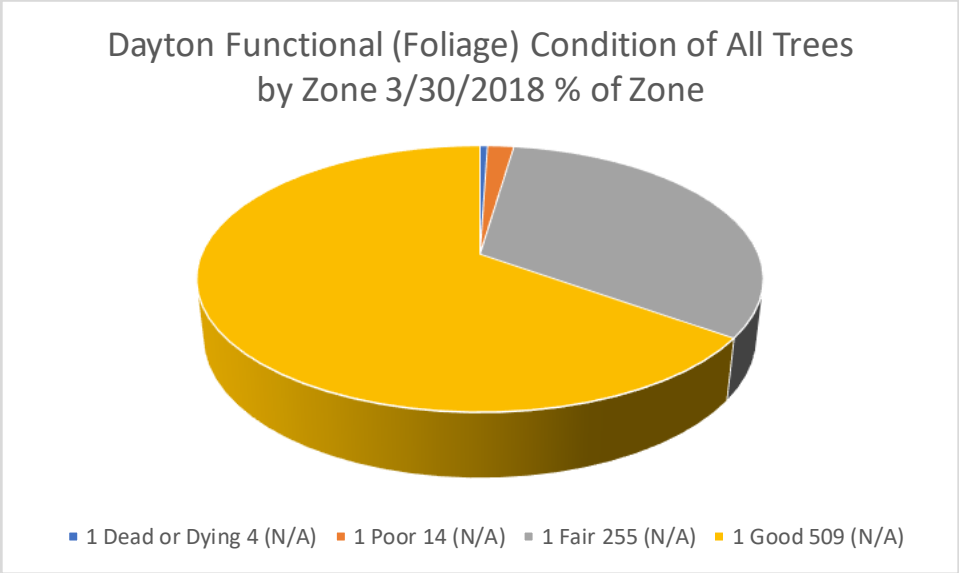
Relative Age Distribution of Top 10 All Tree Species for 1 (%)

DBH class (in)

Species	0 - 3	3 - 6	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	> 42
Green ash	0.00	0.66	9.27	17.22	26.49	28.48	9.27	6.62	1.99
Bur oak	0.00	0.00	4.05	13.51	33.78	33.78	12.16	2.03	0.68
Silver maple	1.43	1.43	0.00	5.71	7.14	17.14	30.00	17.14	20.00
Black walnut	0.00	1.69	8.47	22.03	25.42	37.29	3.39	1.69	0.00
Sugar maple	0.00	0.00	7.27	12.73	34.55	23.64	18.18	3.64	0.00
Norway maple	0.00	2.50	20.00	17.50	30.00	17.50	5.00	5.00	2.50
Northern hackberry	3.03	3.03	12.12	24.24	21.21	18.18	9.09	6.06	3.03
Red maple	17.24	10.34	24.14	31.03	6.90	10.34	0.00	0.00	0.00
Black maple	0.00	0.00	0.00	7.41	44.44	40.74	0.00	7.41	0.00
Littleleaf linden	5.26	5.26	0.00	31.58	26.32	26.32	5.26	0.00	0.00
Citywide Total	3.07	2.30	7.80	17.52	24.55	25.06	11.13	5.24	3.32

Figure 2: Relative Age Class

Figure 3: Functional Condition of all Trees

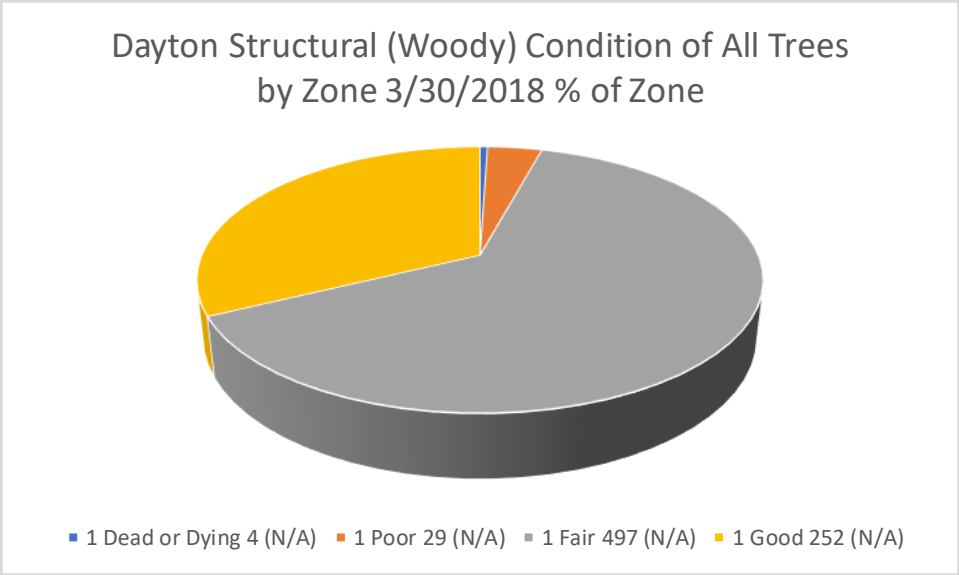


Dayton
Functional (Foliage) Condition of All Trees by Zone
3/30/2018

Zone	Condition	Tree Count	Standard Error	% of Zone	% of All Trees
1	Dead or Dying	4	(N/A)	0.51	0.51
	Poor	14	(N/A)	1.79	1.79
	Fair	255	(N/A)	32.61	32.61
	Good	509	(N/A)	65.09	65.09
	Total	782	(N/A)	100.00	100.00

Figure 3: Foliage Condition

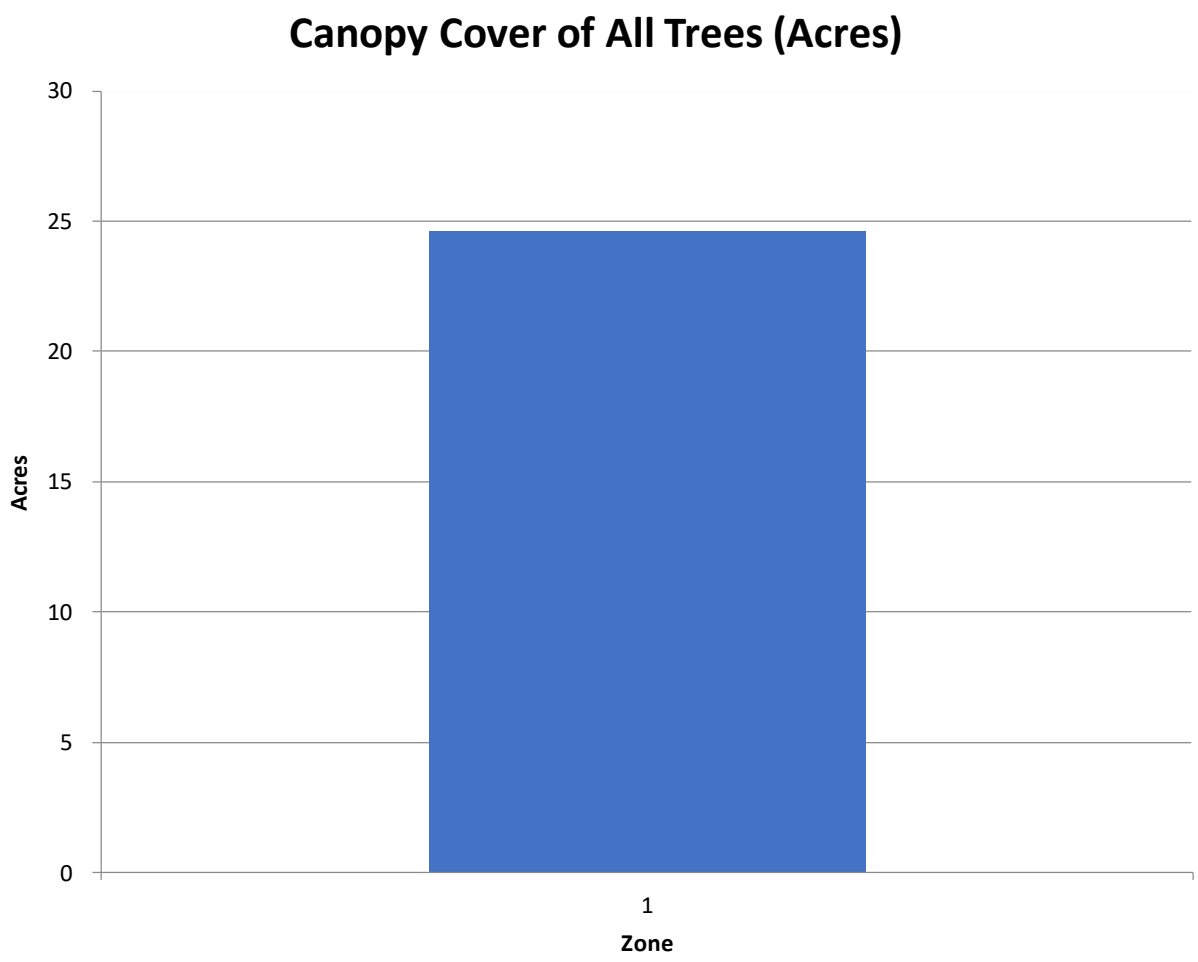
Figure 4: Structural Condition of all Trees



Dayton
Structural (Woody) Condition of All Trees by Zone
3/30/2018

Zone	Condition	Tree Count	Standard Error	% of Zone	% of All Trees
1	Dead or Dying	4	(N/A)	0.51	0.51
	Poor	29	(N/A)	3.71	3.71
	Fair	497	(N/A)	63.55	63.55
	Good	252	(N/A)	32.23	32.23
	Total	782	(N/A)	100.00	100.00

Figure 4: Wood Condition


Canopy Cover of All Trees (Acres)
30
25
20
15
10
5
0
Acres
1
Zone

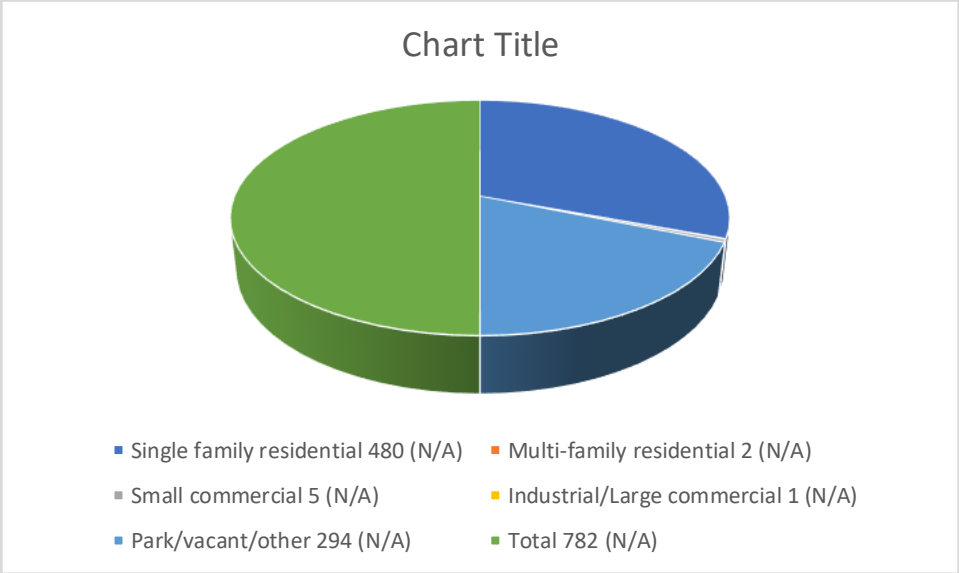
Dayton
Canopy Cover of All Trees (Acres)
3/30/2018

Zone	Acres	% of Total Canopy
1	24.59	100.00
Citywide Total	24.59	100.00

	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	544.00	21.21	24.59	4.52	115.94

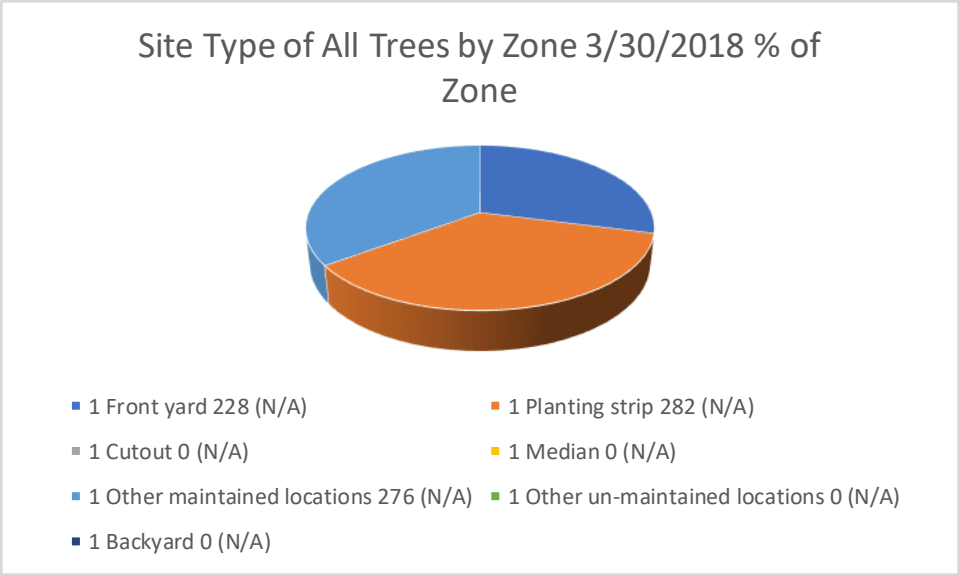
Figure 5: Canopy Cover in Acres

Figure 6: Land Use of city/park trees



Dayton
Land Use of All Trees by Zone
3/30/2018

Zone	Land Use	Tree Count	Standard Error	% of Zone	% of All Trees
1	Single family residential	480	(N/A)	61.38	61.38
	Multi-family residential	2	(N/A)	0.26	0.26
	Small commercial	5	(N/A)	0.64	0.64
	Industrial/Large commercial	1	(N/A)	0.13	0.13
	Park/vacant/other	294	(N/A)	37.60	37.60
	Total	782	(N/A)	100.00	100.00



Site Type of All Trees by Zone
3/30/2018

Zone	Site Type	Tree Count	Standard Error	% of Zone	% of All Trees
1	Front yard	228	(N/A)	29.00	0.00
	Planting strip	282	(N/A)	35.87	0.00
	Cutout	0	(N/A)	0.00	0.00
	Median	0	(N/A)	0.00	0.00
	Other maintained locations	276	(N/A)	35.11	0.00
	Other un-maintained locations	0	(N/A)	0.00	0.00
	Backyard	0	(N/A)	0.00	0.00

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

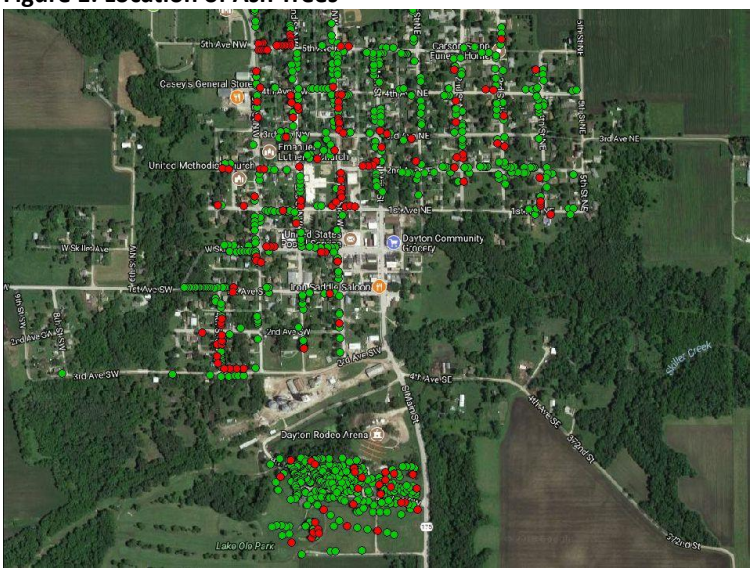


Figure 2: Location of EAB symptoms

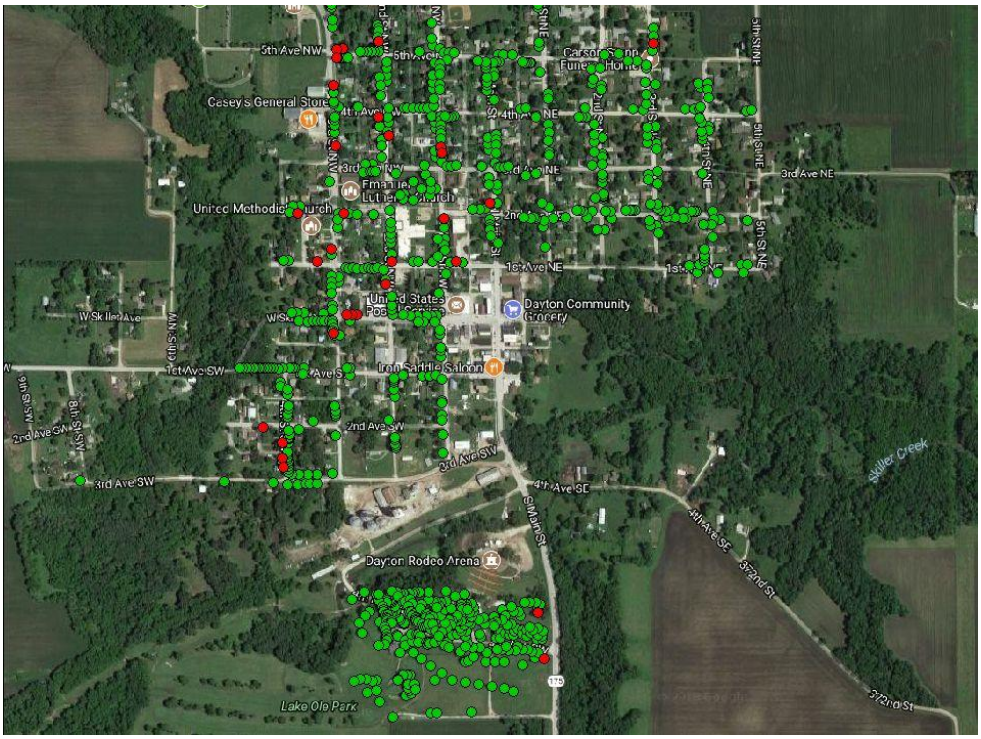


Figure 3: Location of Poor Condition Trees

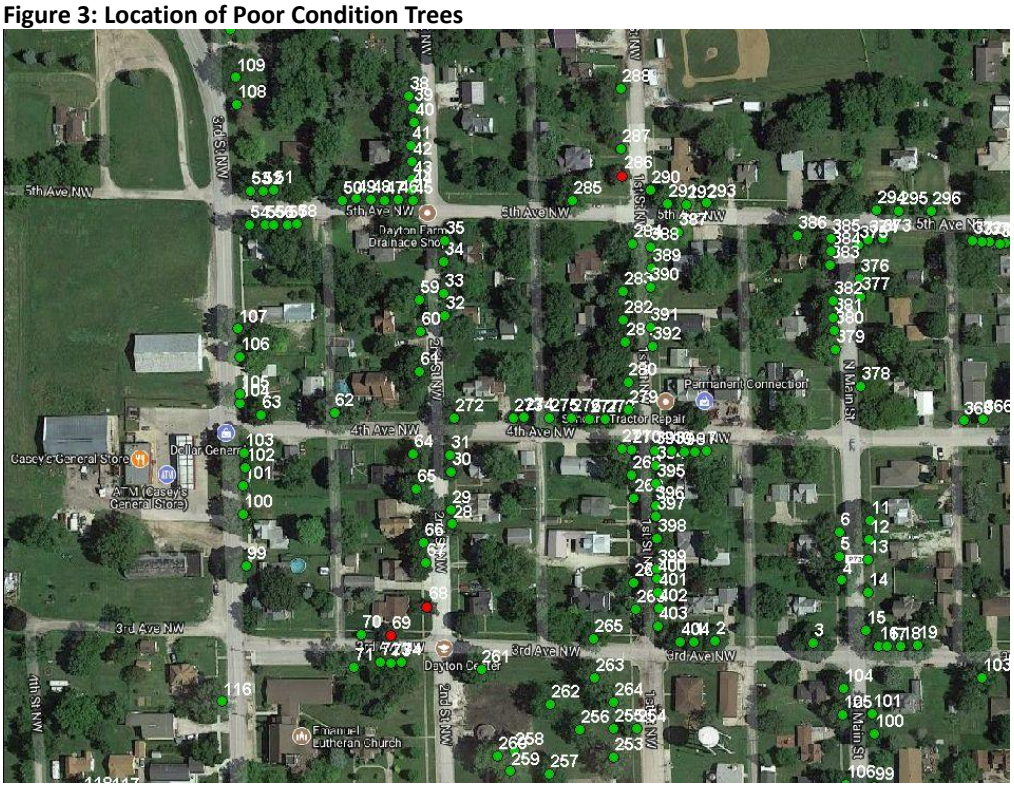


Figure 4: Location of Trees with Recommended Maintenance

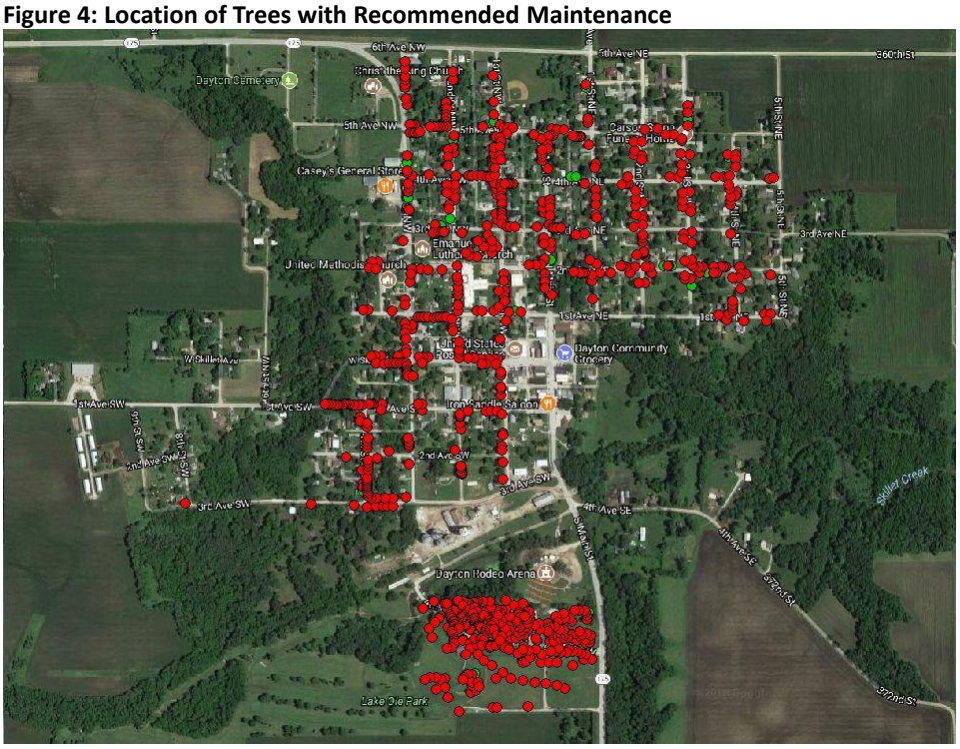


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Dayton Tree Ordinances

URBAN FORESTRY ORDINANCE

CHAPTER 13 TREE, SHRUB, BUSH, AND OTHER VEGETATION REGULATIONS

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6-13-1 PURPOSE. The purpose of this Chapter is to beautify and preserve the appearance of the City by regulating and providing for the planting, care and removal of trees, shrubs, bushes, and other vegetation.

6-13-2 DEFINITIONS. As used in this chapter, the following terms have these meanings.

1. Parking. That part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.
2. Superintendent. The Superintendent of Streets or such person as may be designated by the Council.

6-13-3 PLANTING RESTRICTIONS. No tree, shrub, bush, or other vegetative plant exceeding 24 inches in height, or vegetative plant less than 24 inches in height if deemed a safety hazard by the City Council shall be planted in any street or parking except in accordance with the following:

1. Alignment. All trees, shrubs and bushes hereafter planted in any street shall be planted in the parking midway between the outer line of the sidewalk and curb. In the event a curb line is not established, trees shall be planted to a line ten (10) feet from the property line.
2. Spacing. Trees, shrubs and buses shall not be planted on any parking which is less than nine (9) feet in width, or contains less than eighty one (81) square feet of exposed soil surface per tree, shrub or bush. Trees, shrubs and bushes shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible, trees, shrubs and

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bushes should be planted inside the property lines and not between the sidewalk and curb.

3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, chinese elm, or evergreens.

6-13-4 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks.
6-13-5 ASSESSMENT. If the abutting property owner fails to trim the trees as required in this chapter, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.
6-13-6 TRIMMING TREES TO BE SUPERVISED. It shall be unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.
6-13-7 REMOVAL OF TREES. The Superintendent shall remove, on order of the Council, any tree on the streets of the City which, interferes with the making of improvements or with travel thereon. The Superintendent shall additionally remove any trees on the street, not on private property, which have become diseased, or which constitute a danger to the public, or which may otherwise be declared a nuisance