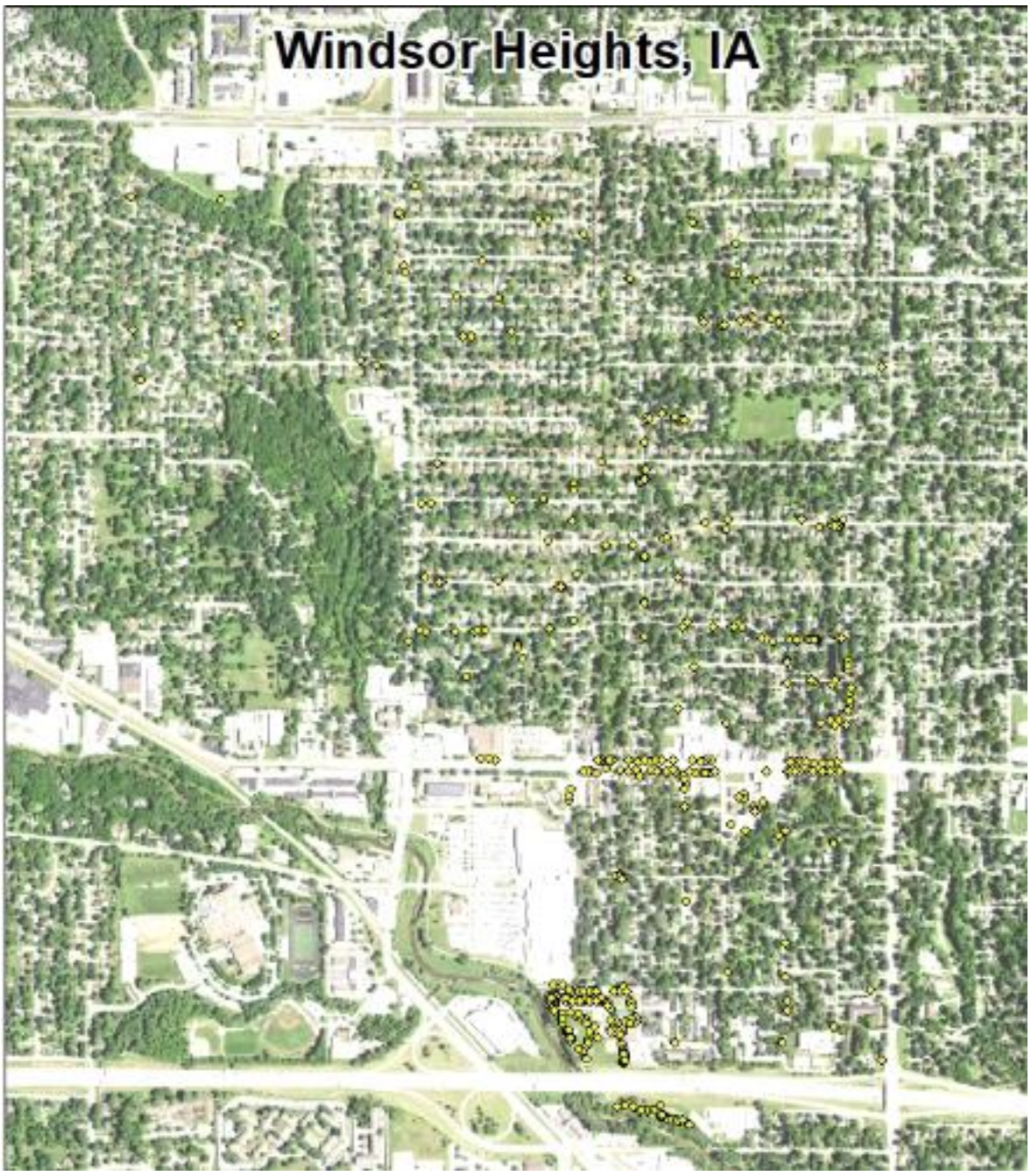
Windsor Heights, IA



2020 Urban Forest Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Windsor Heights 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 9% of Windsor Heights'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 2019, 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 430 trees inventoried.

- Windsor Heights's trees provide $13,779 of benefits annually, an average of $32 a tree
- There are over 53 species of trees
- The top three genera are: Small deciduous trees/shrubs 10.2%, Ash 9%, and Callery Pear 7.4%
- 54% of trees are in need of some type of management
- 25 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 25 trees needing removal, 6 trees are over 18 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*
- 25 of the 49 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With the current budget it could take 16 years to remove ash – Suggestion: request a budget increase to $30,000 annually and apply for grants to plant replacement trees

Introduction

This plan was developed to assist Windsor Heights 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 Windsor Heights, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Windsor Heights' 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 Windsor Heights 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 Windsor Heights's urban forestry goals.

Inventory

In 2019, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. This did not include trees along the Walnut or North Walnut Creek Trails. 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 woodpecker damage.

Inventory Results

The data collected for the 431 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. Windsor Heights's trees reduce energy related costs by approximately $13,779 annually (Appendix A, Table 1). These savings are both in Electricity (66 MWh) and in Natural Gas (8,950.2 Therms).

Annual Stormwater Benefits

Windsor Heights's trees intercept about 630,275 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $17,080 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 Windsor Heights, it is estimated that trees remove 811 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 $2,268 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Windsor Heights, trees sequester about 140,126 lbs of carbon a year with an associated value of $1,051 (Appendix A, Table 5). In addition, the trees store 2,388,777 lbs of carbon, with a yearly benefit of $17,916 (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. Windsor Heights receives $13,375 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, Windsor Heights's trees provide $48,292 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 431 trees in Windsor Heights provide approximately $100 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Windsor Heights has over 53 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genera is as follows:

Broadleaf Deciduous Small	44	10%
Green ash	39	9%
Pear	32	7%
Cottonwood	26	6%
Apple	25	6%
Honeylocust	22	5%
Lilac	17	4%
Sugar maple	17	4%
Eastern white pine	17	4%
Silver maple	16	4%
Other Species	220	41%

Age Class

Most of Windsor Heights's trees (49%) 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. Windsor Heights'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 Windsor Heights indicate that 88% 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, 56% of Windsor Heights'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 6% of the population. This 6% is an estimate of trees that need management follow up.

Management Needs

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

Crown Cleaning	119	28%
Crown Raising	7	2%
Tree Staking	8	2%
Tree Removal	25	6%
Crown Reduction	38	9%

Canopy Cover

The total canopy with both private and public trees is 31%, 283 acres. The canopy cover included in the Windsor Heights inventory includes approximately 7 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 66 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Windsor Heights's city and park trees are in front yards 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	61%
Park/vacant/other	31%
Small commercial	6%
Industrial/Large commercial	2%
Multifamily residential	<1%

Location	
Front Yard	81%
Planting Strip	12%
Median	6%
Cutout	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 a motorist's vision of pedestrians, vehicles, traffic signs and signals, etc should be removed.

Hazardous trees

Windsor Heights has 2 trees labeled critical concern trees and 5 trees labeled immediate maintenance that need to be removed. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 4 trees over 18 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing immediate maintenance. There are a total of 17 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 25 removals, 13 are ash trees.

There are a total of 49 ash trees, and 25 of those have signs and symptoms that have been associated with EAB. In addition, there is 1 tree that is 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 Windsor Heights.

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 two most common genuses represented are ash(11%) and then maple (10%). (Appendix A, Figure 1). These percentages don't exactly match up with the figure in the appendix because I combined green ash and white ash for the ash category and silver maple, sugar maple, and norway maple for the maple category. These numbers suggest that these species are not over represented. I believe, however, that this percentage for maple should not go up by much and ash trees have not been recommended since 2002, due to the threat of EAB. Other species some communities like to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut. There is no species restriction outlined in the city ordinance. Chapter 50.02(37) forbids planting of cottonwood trees. There must be a permit to plant a tree on city property.

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 woodpecker damage.

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

Year 1

Removal: 2 critical concern trees and 1 tree labeled for immediate removal
Planting and Replacement: 4 trees to be planted in open locations
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 2

Removal: 2 trees labeled for immediate removal
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 3 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 labeled for immediate removal
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 4 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: 2 trees labeled for removal and any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 3 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 labeled for removal or any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 4 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: 2 trees labeled for removal or any new critical concern trees and ash in poor health
*Or saving for ash tree treatment and/or future ash removal
Planting and Replacement: 3 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: Approximately 13 ash trees removed (approximately 27% of ash). It will take approximately 16 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 $33,000 a year. If the budget were increased to $15,000 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 an 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. All trees will meet the restrictions in city ordinance 151.13 (Appendix C). 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 woodpecker damage.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used. City Code 151.21.3 states "Removal of Trees, Shrubs, and Plants. The Superintendent may remove or cause to be removed all trees, shrubs, plants or parts thereof upon the public streets or highways or other City property within the City when removal shall be beneficial to the public peace, health, and safety, or for public improvements or if such trees, shrubs, or plants constitute a public nuisance or are dead or diseased, or detrimental to the growth of adjacent trees, plants, or shrubs growing in the public streets or other City property."

Budget

Current Budget

Total $75,000 over 6 years ($12,500/year based on previous 2 year average)
*Keep in mind that grant funds are available for tree planting.

FY 2021 Budget

Removal: $12,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Watering & Maintenance: $500

FY 2022 Budget

Removal: $8,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $450
Routine trimming: $4,000
Watering & Maintenance: $500

FY 2023 Budget

Removal: $12,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Watering & Maintenance: $500

FY 2024 Budget

Removal: $8,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $450
Routine trimming: $4,000
Watering & Maintenance: $500

FY 2025 Budget

Removal: $12,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $600
Watering & Maintenance: $500

FY 2026 Budget

Removal: $8,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $450
Routine trimming: $4,000
Watering & Maintenance: $500

*Reduction of ash over 6 years: approximately 13 ash trees removed (approximately 27% of ash). **It will take approximately 16 years to remove all ash with the current budget.**

<u>Proposed Budget Increase</u>

EAB could potentially kill all ash trees in Windsor Heights within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $33,000 a year. If the budget were increased to $15,000 a year all ash could be removed within 13 years. Additionally, it is recommended that Windsor Heights 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 15 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 Windsor Heights would still need to find $11,500 per year for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $3,375 a year for treatment and leave $9,125 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 Windsor Heights. 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

Windsor Heights

Annual Energy Benefits of Public Trees

3/31/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Broadleaf Deciduous Small	1.3	99	217.8	213	313	(N/A)	10.2	2.3	7.11
Green ash	9.8	744	1,310.9	1,285	2,029	(N/A)	9.0	14.7	52.01
Pear	2.2	170	367.0	360	530	(N/A)	7.4	3.8	16.56
Cottonwood	7.6	574	943.2	924	1,498	(N/A)	6.0	10.9	57.62
Apple	2.0	148	290.6	285	433	(N/A)	5.8	3.1	17.31
Honeylocust	4.4	332	581.9	570	902	(N/A)	5.1	6.5	41.01
Lilac	0.5	35	76.0	75	109	(N/A)	3.9	0.8	6.42
Sugar maple	2.3	176	302.3	296	472	(N/A)	3.9	3.4	27.77
Eastern white pine	1.0	77	165.5	162	239	(N/A)	3.9	1.7	14.09
Silver maple	5.4	408	706.7	693	1,100	(N/A)	3.7	8.0	68.76
Eastern redbud	0.7	52	103.4	101	153	(N/A)	3.2	1.1	10.93
Pin oak	4.4	333	589.9	578	911	(N/A)	3.0	6.6	70.10
Spruce	1.1	82	132.2	130	212	(N/A)	2.8	1.5	17.63
White ash	2.2	170	240.3	236	405	(N/A)	2.1	2.9	45.00
Northern red oak	1.2	93	163.0	160	253	(N/A)	1.9	1.8	31.60
Cherry plum	0.2	16	29.0	28	44	(N/A)	1.9	0.3	5.52
Blue spruce	0.4	33	65.7	64	98	(N/A)	1.6	0.7	13.94
Swamp white oak	0.8	58	113.8	111	169	(N/A)	1.4	1.2	28.19
Norway maple	0.9	65	112.3	110	175	(N/A)	1.4	1.3	29.15
Eastern cottonwood	1.8	133	239.9	235	368	(N/A)	1.4	2.7	61.37
Callery pear	0.4	32	68.2	67	99	(N/A)	1.2	0.7	19.80
Siberian elm	1.4	106	198.3	194	301	(N/A)	1.2	2.2	60.14
Black cherry	0.8	63	118.5	116	179	(N/A)	1.2	1.3	35.75
Ginkgo	0.2	15	30.5	30	45	(N/A)	1.2	0.3	9.06
Northern hackberry	1.9	145	265.0	260	405	(N/A)	1.2	2.9	80.99
Elm	1.8	135	238.4	234	369	(N/A)	1.2	2.7	73.70
Maple	0.4	31	60.0	59	89	(N/A)	1.2	0.6	17.89
Bur oak	1.1	83	146.6	144	227	(N/A)	0.9	1.6	56.70
Black maple	0.7	56	93.1	91	147	(N/A)	0.9	1.1	36.76
American elm	1.0	78	122.0	120	197	(N/A)	0.7	1.4	65.78
Mulberry	0.5	35	69.1	68	102	(N/A)	0.7	0.7	34.15
Eastern red cedar	0.0	3	5.6	5	8	(N/A)	0.7	0.1	2.72
Norway spruce	0.5	39	68.9	68	107	(N/A)	0.7	0.8	35.61
Austrian pine	0.4	29	45.6	45	74	(N/A)	0.7	0.5	24.51
Broadleaf Deciduous Mediu	0.5	35	70.5	69	104	(N/A)	0.7	0.8	34.77
Conifer Evergreen Large	0.4	34	53.9	53	86	(N/A)	0.7	0.6	28.82
River birch	1.0	73	142.2	139	213	(N/A)	0.7	1.5	70.84
Black walnut	0.6	43	73.8	72	115	(N/A)	0.5	0.8	57.57
White oak	0.4	32	57.4	56	88	(N/A)	0.5	0.6	43.92
American sycamore	0.8	59	107.4	105	164	(N/A)	0.5	1.2	82.02
Oak	0.1	9	17.4	17	26	(N/A)	0.5	0.2	13.23
Eastern hemlock	0.1	4	9.5	9	14	(N/A)	0.2	0.1	13.58
Littleleaf linden	0.2	17	33.8	33	50	(N/A)	0.2	0.4	50.34
Ash	0.0	3	6.2	6	9	(N/A)	0.2	0.1	8.99
Boxelder	0.1	8	14.9	15	22	(N/A)	0.2	0.2	22.45
Scotch pine	0.1	10	14.6	14	24	(N/A)	0.2	0.2	24.14
Birch	0.0	0	0.8	1	1	(N/A)	0.2	0.0	1.10
Paper birch	0.1	7	13.7	13	21	(N/A)	0.2	0.1	20.64
Broadleaf Evergreen Small	0.0	1	1.5	1	2	(N/A)	0.2	0.0	2.12
Conifer Evergreen Medium	0.1	10	15.2	15	25	(N/A)	0.2	0.2	24.51
Amur maple	0.2	15	31.6	31	46	(N/A)	0.2	0.3	46.14
Plum	0.0	2	3.8	4	5	(N/A)	0.2	0.0	5.40
Red maple	0.0	0	0.7	1	1	(N/A)	0.2	0.0	1.03
Total	66.0	5,008	8,950.2	8,771	13,779	(N/A)	100.0	100.0	31.97

Table 2: Annual Stormwater Benefits

Windsor Heights

Annual Stormwater Benefits of Public Trees

3/31/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Broadleaf Deciduous Small	4,956	134	(N/A)	10.2	0.8	3.05
Green ash	94,622	2,564	(N/A)	9.0	15.0	65.75
Pear	7,993	217	(N/A)	7.4	1.3	6.77
Cottonwood	76,614	2,076	(N/A)	6.0	12.2	79.86
Apple	8,784	238	(N/A)	5.8	1.4	9.52
Honeylocust	29,645	803	(N/A)	5.1	4.7	36.52
Lilac	1,979	54	(N/A)	3.9	0.3	3.15
Sugar maple	12,987	352	(N/A)	3.9	2.1	20.70
Eastern white pine	13,368	362	(N/A)	3.9	2.1	21.31
Silver maple	84,988	2,303	(N/A)	3.7	13.5	143.95
Eastern redbud	2,365	64	(N/A)	3.2	0.4	4.58
Pin oak	53,381	1,447	(N/A)	3.0	8.5	111.28
Spruce	12,654	343	(N/A)	2.8	2.0	28.58
White ash	13,914	377	(N/A)	2.1	2.2	41.90
Northern red oak	8,725	236	(N/A)	1.9	1.4	29.56
Cherry plum	719	19	(N/A)	1.9	0.1	2.43
Blue spruce	5,079	138	(N/A)	1.6	0.8	19.66
Swamp white oak	4,339	118	(N/A)	1.4	0.7	19.60
Norway maple	4,988	135	(N/A)	1.4	0.8	22.53
Eastern cottonwood	21,136	573	(N/A)	1.4	3.4	95.46
Callery pear	2,356	64	(N/A)	1.2	0.4	12.77
Siberian elm	12,520	339	(N/A)	1.2	2.0	67.86
Black cherry	3,438	93	(N/A)	1.2	0.5	18.63
Ginkgo	918	25	(N/A)	1.2	0.1	4.98
Northern hackberry	18,778	509	(N/A)	1.2	3.0	101.78
Elm	27,379	742	(N/A)	1.2	4.3	148.39
Maple	2,150	58	(N/A)	1.2	0.3	11.66
Bur oak	13,255	359	(N/A)	0.9	2.1	89.80
Black maple	4,458	121	(N/A)	0.9	0.7	30.21
American elm	7,333	199	(N/A)	0.7	1.2	66.24
Oak	779	21	(N/A)	0.5	0.1	10.56
Eastern hemlock	596	16	(N/A)	0.2	0.1	16.14
Littleleaf linden	2,366	64	(N/A)	0.2	0.4	64.13
Ash	163	4	(N/A)	0.2	0.0	4.41
Boxelder	720	20	(N/A)	0.2	0.1	19.51
Scotch pine	1,539	42	(N/A)	0.2	0.2	41.70
Birch	12	0	(N/A)	0.2	0.0	0.33
Paper birch	608	16	(N/A)	0.2	0.1	16.47
Broadleaf Evergreen Small	24	1	(N/A)	0.2	0.0	0.64
Conifer Evergreen Medium	1,544	42	(N/A)	0.2	0.2	41.85
Amur maple	1,174	32	(N/A)	0.2	0.2	31.82
Plum	69	2	(N/A)	0.2	0.0	1.86
Red maple	12	0	(N/A)	0.2	0.0	0.32
Citywide total	630,275	17,080	(N/A)	100.0	100.0	39.63

Table 3: Annual Air Quality Benefits

Windsor Heights

Annual Air Quality Benefits of Public Trees

3/31/2020

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($) Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2							
Broadleaf Deciduous Small	1.1	0.2	0.6	0.0	6	6.6	0.9	0.9	5.9	40	0.0	0	16.2	46 (N/A)	10.2	1.05
Green ash	10.9	1.7	5.4	0.5	59	46.5	6.8	6.5	44.4	290	0.0	0	122.8	349 (N/A)	9.0	8.95
Pear	1.6	0.3	0.9	0.1	9	11.2	1.6	1.5	10.2	69	0.0	0	27.4	78 (N/A)	7.4	2.43
Cottonwood	11.9	1.9	5.5	0.5	63	35.3	5.2	5.0	34.3	222	0.0	0	99.6	285 (N/A)	6.0	10.95
Apple	2.9	0.5	1.3	0.1	15	9.5	1.4	1.3	8.8	59	0.0	0	25.8	74 (N/A)	5.8	2.96
Honeylocust	4.9	0.8	2.4	0.2	26	20.7	3.0	2.9	19.8	129	-3.4	-13	51.4	143 (N/A)	5.1	6.51
Lilac	0.5	0.1	0.3	0.0	3	2.3	0.3	0.3	2.1	14	0.0	0	5.9	17 (N/A)	3.9	0.98
Sugar maple	1.0	0.2	0.7	0.0	6	10.9	1.6	1.5	10.5	68	-0.9	-4	25.5	71 (N/A)	3.9	4.16
Eastern white pine	1.3	0.3	1.2	0.2	9	5.1	0.7	0.7	4.6	31	-5.3	-20	8.7	20 (N/A)	3.9	1.19
Silver maple	15.3	2.6	7.4	0.7	82	25.3	3.7	3.5	24.3	158	-7.7	-29	75.2	212 (N/A)	3.7	13.24
Eastern redbud	0.5	0.1	0.3	0.0	3	3.3	0.5	0.5	3.1	21	0.0	0	8.3	23 (N/A)	3.2	1.68
Pin oak	9.9	1.7	5.0	0.4	54	20.8	3.0	2.9	19.9	130	-18.2	-68	45.5	116 (N/A)	3.0	8.90
Spruce	1.3	0.3	1.2	0.2	9	5.0	0.7	0.7	4.9	32	-4.4	-16	9.9	24 (N/A)	2.8	2.02
White ash	0.9	0.1	0.6	0.0	5	10.1	1.5	1.4	10.1	64	0.0	0	24.8	69 (N/A)	2.1	7.72
Northern red oak	1.6	0.3	0.8	0.1	9	5.8	0.8	0.8	5.6	36	-2.2	-8	13.5	37 (N/A)	1.9	4.57
Cherry plum	0.2	0.0	0.1	0.0	1	1.0	0.1	0.1	0.9	6	0.0	0	2.6	7 (N/A)	1.9	0.91
Blue spruce	0.5	0.1	0.5	0.1	3	2.1	0.3	0.3	2.0	13	-1.6	-6	4.2	11 (N/A)	1.6	1.51
Swamp white oak	0.5	0.1	0.3	0.0	3	3.7	0.5	0.5	3.4	23	-0.2	-1	9.0	25 (N/A)	1.4	4.21
Norway maple	0.7	0.1	0.4	0.0	4	4.0	0.6	0.6	3.9	25	-0.2	-1	10.2	29 (N/A)	1.4	4.76
Eastern cottonwood	2.8	0.4	1.3	0.1	15	8.4	1.2	1.2	8.0	52	0.0	0	23.4	67 (N/A)	1.4	11.15
Callery pear	0.2	0.0	0.2	0.0	1	2.1	0.3	0.3	1.9	13	-0.1	0	5.0	14 (N/A)	1.2	2.80
Siberian elm	1.6	0.3	0.8	0.1	9	6.7	1.0	0.9	6.3	42	0.0	0	17.8	51 (N/A)	1.2	10.12
Black cherry	1.1	0.2	0.5	0.1	6	4.0	0.6	0.5	3.7	25	0.0	0	10.7	31 (N/A)	1.2	6.11
Ginkgo	0.1	0.0	0.1	0.0	1	1.0	0.1	0.1	0.9	6	0.0	0	2.3	7 (N/A)	1.2	1.30
Northern hackberry	3.5	0.6	1.7	0.2	19	9.2	1.3	1.3	8.7	57	0.0	0	26.4	76 (N/A)	1.2	15.16
Elm	4.7	0.8	2.1	0.2	25	8.4	1.2	1.2	8.1	53	0.0	0	26.6	77 (N/A)	1.2	15.44
Maple	0.3	0.0	0.2	0.0	1	2.0	0.3	0.3	1.8	12	-0.1	0	4.7	13 (N/A)	1.2	2.63
Bur oak	1.8	0.3	0.8	0.1	9	5.2	0.8	0.7	5.0	32	0.0	0	14.6	42 (N/A)	0.9	10.48
Black maple	0.8	0.1	0.4	0.0	4	3.4	0.5	0.5	3.3	22	-0.3	-1	8.8	25 (N/A)	0.9	6.20
American elm	1.7	0.3	0.8	0.1	9	4.7	0.7	0.7	4.6	30	0.0	0	13.6	39 (N/A)	0.7	12.95
Mulberry	0.7	0.1	0.3	0.0	4	2.2	0.3	0.3	2.1	14	0.0	0	6.1	17 (N/A)	0.7	5.82
Eastern red cedar	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	-0.2	-1	0.2	0 (N/A)	0.7	0.16
Norway spruce	1.5	0.3	1.2	0.2	10	2.4	0.4	0.3	2.3	15	-7.1	-27	1.5	-2 (N/A)	0.7	-0.57
Austrian pine	0.6	0.1	0.5	0.1	4	1.8	0.3	0.2	1.7	11	-1.7	-6	3.6	9 (N/A)	0.7	2.89
Broadleaf Deciduous Medium	0.9	0.2	0.5	0.0	5	2.3	0.3	0.3	2.1	14	-0.2	-1	6.4	18 (N/A)	0.7	6.09
Conifer Evergreen Large	0.9	0.2	0.7	0.1	6	2.1	0.3	0.3	2.0	13	-4.0	-15	2.6	4 (N/A)	0.7	1.35
River birch	2.6	0.4	1.2	0.1	14	4.7	0.7	0.6	4.4	29	-0.6	-2	14.2	41 (N/A)	0.7	13.58
Black walnut	0.6	0.1	0.3	0.0	3	2.7	0.4	0.4	2.6	17	0.0	0	7.0	20 (N/A)	0.5	9.95
White oak	0.8	0.1	0.4	0.0	4	2.0	0.3	0.3	1.9	12	0.0	0	5.8	17 (N/A)	0.5	8.29
American sycamore	1.6	0.3	0.7	0.1	8	3.7	0.5	0.5	3.5	23	0.0	0	10.9	31 (N/A)	0.5	15.71
Oak	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.4	4 (N/A)	0.5	1.93
Eastern hemlock	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	1 (N/A)	0.2	1.48
Littleleaf linden	0.4	0.1	0.2	0.0	2	1.1	0.2	0.2	1.0	7	-0.2	-1	2.9	8 (N/A)	0.2	8.23
Ash	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1 (N/A)	0.2	1.21
Boxelder	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3 (N/A)	0.2	3.26
Scotch pine	0.2	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.5	-2	1.2	3 (N/A)	0.2	2.82
Birch	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.2	0.14
Paper birch	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3 (N/A)	0.2	2.99
Broadleaf Evergreen Small	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.2	0.27
Conifer Evergreen Medium	0.2	0.0	0.2	0.0	1	0.6	0.1	0.1	0.6	4	-0.6	-2	1.2	3 (N/A)	0.2	2.89
Amur maple	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8 (N/A)	0.2	8.35
Plum	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1 (N/A)	0.2	0.71
Red maple	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.2	0.13
Citywide total	97.5	16.4	50.4	4.9	534	314.1	45.8	43.7	298.9	1,959	-59.8	-224	811.9	2,268 (N/A)	100.0	5.26

Table 4: Annual Carbon Stored

Windsor Heights

Stored CO2 Benefits of Public Trees

3/31/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Broadleaf Deciduous	19,718	148	(N/A)	10.2	0.8	3.36
Green ash	359,651	2,697	(N/A)	9.0	15.1	69.16
Pear	29,510	221	(N/A)	7.4	1.2	6.92
Cottonwood	411,640	3,087	(N/A)	6.0	17.2	118.74
Apple	44,493	334	(N/A)	5.8	1.9	13.35
Honeylocust	61,763	463	(N/A)	5.1	2.6	21.06
Lilac	9,005	68	(N/A)	3.9	0.4	3.97
Sugar maple	30,447	228	(N/A)	3.9	1.3	13.43
Eastern white pine	11,160	84	(N/A)	3.9	0.5	4.92
Silver maple	344,577	2,584	(N/A)	3.7	14.4	161.52
Eastern redbud	9,176	69	(N/A)	3.2	0.4	4.92
Pin oak	265,281	1,990	(N/A)	3.0	11.1	153.05
Spruce	8,967	67	(N/A)	2.8	0.4	5.60
White ash	30,409	228	(N/A)	2.1	1.3	25.34
Northern red oak	30,123	226	(N/A)	1.9	1.3	28.24
Cherry plum	3,134	24	(N/A)	1.9	0.1	2.94
Blue spruce	2,341	18	(N/A)	1.6	0.1	2.51
Swamp white oak	9,128	68	(N/A)	1.4	0.4	11.41
Norway maple	12,208	92	(N/A)	1.4	0.5	15.26
Eastern cottonwood	90,994	682	(N/A)	1.4	3.8	113.74
Callery pear	4,420	33	(N/A)	1.2	0.2	6.63
Siberian elm	39,216	294	(N/A)	1.2	1.6	58.82
Black cherry	16,762	126	(N/A)	1.2	0.7	25.14
Ginkgo	1,432	11	(N/A)	1.2	0.1	2.15
Northern hackberry	54,753	411	(N/A)	1.2	2.3	82.13
Elm	160,628	1,205	(N/A)	1.2	6.7	240.94
Maple	3,739	28	(N/A)	1.2	0.2	5.61
Bur oak	59,738	448	(N/A)	0.9	2.5	112.01
Black maple	9,450	71	(N/A)	0.9	0.4	17.72
American elm	35,427	266	(N/A)	0.7	1.5	88.57
Mulberry	10,688	80	(N/A)	0.7	0.4	26.72
Eastern red cedar	89	1	(N/A)	0.7	0.0	0.22
Norway spruce	18,323	137	(N/A)	0.7	0.8	45.81
Austrian pine	3,355	25	(N/A)	0.7	0.1	8.39
Broadleaf Deciduous	15,599	117	(N/A)	0.7	0.7	39.00
Conifer Evergreen La	9,831	74	(N/A)	0.7	0.4	24.58
River birch	42,840	321	(N/A)	0.7	1.8	107.10
Black walnut	19,445	146	(N/A)	0.5	0.8	72.92
White oak	26,129	196	(N/A)	0.5	1.1	97.98
American sycamore	51,886	389	(N/A)	0.5	2.2	194.57
Oak	1,220	9	(N/A)	0.5	0.1	4.57
Eastern hemlock	257	2	(N/A)	0.2	0.0	1.93
Littleleaf linden	8,218	62	(N/A)	0.2	0.3	61.63
Ash	218	2	(N/A)	0.2	0.0	1.64
Boxelder	1,101	8	(N/A)	0.2	0.0	8.26
Scotch pine	1,170	9	(N/A)	0.2	0.0	8.78
Birch	17	0	(N/A)	0.2	0.0	0.13
Paper birch	1,035	8	(N/A)	0.2	0.0	7.76
Broadleaf Evergreen S	14	0	(N/A)	0.2	0.0	0.10
Conifer Evergreen Me	1,118	8	(N/A)	0.2	0.0	8.39
Amur maple	6,743	51	(N/A)	0.2	0.3	50.57
Plum	178	1	(N/A)	0.2	0.0	1.33
Red maple	17	0	(N/A)	0.2	0.0	0.13
Citywide total	2,388,777	17,916	(N/A)	100.0	100.0	41.57

Table 5: Annual Carbon Sequestered

Windsor Heights

Annual CO Benefits of Public Trees

3/31/2020

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
Broadleaf Deciduous Smal	2,292	17	-96	-25	-1	2,198	16	4,370	33 (N/A)	10.2	1.8	0.74
Green ash	21,941	165	-1,726	-99	-14	16,439	123	36,555	274 (N/A)	9.0	15.3	7.03
Pear	3,427	26	-142	-34	-1	3,759	28	7,011	53 (N/A)	7.4	2.9	1.64
Cottonwood	12,817	96	-1,976	-76	-15	12,679	95	23,444	176 (N/A)	6.0	9.8	6.76
Apple	3,181	24	-214	-27	-2	3,272	25	6,212	47 (N/A)	5.8	2.6	1.86
Honeylocust	6,325	47	-297	-34	-2	7,335	55	13,329	100 (N/A)	5.1	5.6	4.54
Lilac	927	7	-44	-10	0	764	6	1,638	12 (N/A)	3.9	0.7	0.72
Sugar maple	3,296	25	-147	-23	-1	3,888	29	7,013	53 (N/A)	3.9	2.9	3.09
Eastern white pine	1,029	8	-54	-21	-1	1,708	13	2,662	20 (N/A)	3.9	1.1	1.17
Silver maple	24,060	180	-1,655	-62	-13	9,009	68	31,353	235 (N/A)	3.7	13.1	14.70
Eastern redbud	1,055	8	-44	-11	0	1,142	9	2,142	16 (N/A)	3.2	0.9	1.15
Pin oak	20,188	151	-1,273	-48	-10	7,362	55	26,228	197 (N/A)	3.0	11.0	15.13
Spruce	974	7	-43	-18	0	1,811	14	2,724	20 (N/A)	2.8	1.1	1.70
White ash	4,131	31	-146	-17	-1	3,746	28	7,714	58 (N/A)	2.1	3.2	6.43
Northern red oak	1,433	11	-145	-14	-1	2,057	15	3,331	25 (N/A)	1.9	1.4	3.12
Cherry plum	328	2	-15	-3	0	348	3	658	5 (N/A)	1.9	0.3	0.62
Blue spruce	269	2	-11	-8	0	734	6	985	7 (N/A)	1.6	0.4	1.05
Swamp white oak	1,506	11	-44	-8	0	1,274	10	2,728	20 (N/A)	1.4	1.1	3.41
Norway maple	1,483	11	-59	-8	-1	1,433	11	2,848	21 (N/A)	1.4	1.2	3.56
Eastern cottonwood	4,193	31	-437	-19	-3	2,943	22	6,680	50 (N/A)	1.4	2.8	8.35
Callery pear	901	7	-21	-5	0	711	5	1,586	12 (N/A)	1.2	0.7	2.38
Siberian elm	2,579	19	-188	-14	-2	2,351	18	4,727	35 (N/A)	1.2	2.0	7.09
Black cherry	917	7	-80	-11	-1	1,384	10	2,210	17 (N/A)	1.2	0.9	3.32
Ginkgo	177	1	-7	-4	0	341	3	508	4 (N/A)	1.2	0.2	0.76
Northern hackberry	2,442	18	-263	-18	-2	3,209	24	5,370	40 (N/A)	1.2	2.3	8.06
Elm	3,337	25	-771	-21	-6	2,980	22	5,525	41 (N/A)	1.2	2.3	8.29
Maple	573	4	-18	-5	0	677	5	1,228	9 (N/A)	1.2	0.5	1.84
Bur oak	2,423	18	-287	-12	-2	1,838	14	3,963	30 (N/A)	0.9	1.7	7.43
Black maple	1,297	10	-45	-6	0	1,233	9	2,478	19 (N/A)	0.9	1.0	4.65
American elm	1,098	8	-170	-9	-1	1,719	13	2,638	20 (N/A)	0.7	1.1	6.59
Mulberry	860	6	-51	-6	0	767	6	1,570	12 (N/A)	0.7	0.7	3.93
Eastern red cedar	27	0	0	-1	0	59	0	84	1 (N/A)	0.7	0.0	0.21
Norway spruce	699	5	-88	-10	-1	868	7	1,470	11 (N/A)	0.7	0.6	3.68
Austrian pine	272	2	-16	-6	0	639	5	889	7 (N/A)	0.7	0.4	2.22
Broadleaf Deciduous Medi	690	5	-76	-5	-1	779	6	1,388	10 (N/A)	0.7	0.6	3.47
Conifer Evergreen Large	487	4	-47	-7	0	744	6	1,176	9 (N/A)	0.7	0.5	2.94
River birch	370	3	-206	-12	-2	1,616	12	1,768	13 (N/A)	0.7	0.7	4.42
Black walnut	1,302	10	-93	-5	-1	945	7	2,149	16 (N/A)	0.5	0.9	8.06
White oak	1,034	8	-125	-5	-1	699	5	1,602	12 (N/A)	0.5	0.7	6.01
American sycamore	1,919	14	-249	-9	-2	1,300	10	2,962	22 (N/A)	0.5	1.2	11.11
Oak	283	2	-6	-2	0	207	2	483	4 (N/A)	0.5	0.2	1.81
Eastern hemlock	53	0	-1	-1	0	94	1	145	1 (N/A)	0.2	0.1	1.08
Littleleaf linden	789	6	-39	-3	0	380	3	1,127	8 (N/A)	0.2	0.5	8.45
Ash	96	1	-2	-1	0	65	0	158	1 (N/A)	0.2	0.1	1.18
Boxelder	181	1	-5	-1	0	173	1	347	3 (N/A)	0.2	0.1	2.60
Scotch pine	116	1	-6	-2	0	216	2	324	2 (N/A)	0.2	0.1	2.43
Birch	5	0	0	0	0	7	0	12	0 (N/A)	0.2	0.0	0.09
Paper birch	209	2	-5	-1	0	159	1	361	3 (N/A)	0.2	0.2	2.71
Broadleaf Evergreen Small	4	0	0	0	0	14	0	18	0 (N/A)	0.2	0.0	0.13
Conifer Evergreen Medium	91	1	-5	-2	0	213	2	296	2 (N/A)	0.2	0.1	2.22
Amur maple	0	0	-32	-4	0	335	3	299	2 (N/A)	0.2	0.1	2.24
Plum	38	0	-1	-1	0	37	0	74	1 (N/A)	0.2	0.0	0.55
Red maple	3	0	0	0	0	7	0	9	0 (N/A)	0.2	0.0	0.07
Citywide total	140,126	1,051	-11,473	-751	-92	110,668	830	238,570	1,789 (N/A)	100.0	100.0	4.15

Table 6: Annual Social and Aesthetic Benefits

Windsor Heights

Annual Aesthetic/Other Benefits of Public Trees

3/31/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Broadleaf Deciduous Small	119	(N/A)	10.2	0.9	2.71
Green ash	1,958	(N/A)	9.0	14.6	50.21
Pear	192	(N/A)	7.4	1.4	5.99
Cottonwood	1,144	(N/A)	6.0	8.6	44.02
Apple	181	(N/A)	5.8	1.4	7.25
Honeylocust	1,236	(N/A)	5.1	9.2	56.20
Lilac	50	(N/A)	3.9	0.4	2.93
Sugar maple	439	(N/A)	3.9	3.3	25.85
Eastern white pine	256	(N/A)	3.9	1.9	15.05
Silver maple	1,820	(N/A)	3.7	13.6	113.75
Eastern redbud	58	(N/A)	3.2	0.4	4.16
Pin oak	1,522	(N/A)	3.0	11.4	117.09
Spruce	284	(N/A)	2.8	2.1	23.67
White ash	543	(N/A)	2.1	4.1	60.37
Northern red oak	137	(N/A)	1.9	1.0	17.15
Cherry plum	16	(N/A)	1.9	0.1	1.96
Blue spruce	134	(N/A)	1.6	1.0	19.17
Swamp white oak	170	(N/A)	1.4	1.3	28.38
Norway maple	159	(N/A)	1.4	1.2	26.55
Eastern cottonwood	332	(N/A)	1.4	2.5	55.32
Callery pear	108	(N/A)	1.2	0.8	21.52
Siberian elm	206	(N/A)	1.2	1.5	41.16
Black cherry	53	(N/A)	1.2	0.4	10.57
Ginkgo	21	(N/A)	1.2	0.2	4.21
Northern hackberry	312	(N/A)	1.2	2.3	62.30
Elm	227	(N/A)	1.2	1.7	45.32
Maple	104	(N/A)	1.2	0.8	20.82
Bur oak	198	(N/A)	0.9	1.5	49.59
Black maple	191	(N/A)	0.9	1.4	47.86
American elm	156	(N/A)	0.7	1.2	51.97
Mulberry	51	(N/A)	0.7	0.4	16.89
Eastern red cedar	31	(N/A)	0.7	0.2	10.34
Norway spruce	100	(N/A)	0.7	0.7	33.20
Austrian pine	76	(N/A)	0.7	0.6	25.23
Broadleaf Deciduous Medium	71	(N/A)	0.7	0.5	23.52
Conifer Evergreen Large	91	(N/A)	0.7	0.7	30.30
River birch	31	(N/A)	0.7	0.2	10.49
Black walnut	111	(N/A)	0.5	0.8	55.72
White oak	81	(N/A)	0.5	0.6	40.67
American sycamore	133	(N/A)	0.5	1.0	66.60
Oak	43	(N/A)	0.5	0.3	21.64
Eastern hemlock	15	(N/A)	0.2	0.1	15.42
Littleleaf linden	81	(N/A)	0.2	0.6	81.48
Ash	13	(N/A)	0.2	0.1	12.89
Boxelder	27	(N/A)	0.2	0.2	27.10
Scotch pine	32	(N/A)	0.2	0.2	32.32
Birch	3	(N/A)	0.2	0.0	2.74
Paper birch	29	(N/A)	0.2	0.2	28.56

Broadleaf Evergreen Small	0 (N/A)	0.2	0.0	0.50
Conifer Evergreen Medium	25 (N/A)	0.2	0.2	25.23
Amur maple	0 (N/A)	0.2	0.0	0.00
Plum	2 (N/A)	0.2	0.0	2.06
Red maple	0 (N/A)	0.2	0.0	0.04
Citywide total	13,375 (N/A)	100.0	100.0	31.03

Table 7: Summary of Benefits in Dollars

Windsor Heights

Total Annual Benefits of Public Trees by Species ($)

3/31/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Broadleaf Deciduous Sn	313	33	46	134	119	645	(N/A)	1.3
Green ash	2,029	274	349	2,564	1,958	7,175	(N/A)	14.9
Pear	530	53	78	217	192	1,068	(N/A)	2.2
Cottonwood	1,498	176	285	2,076	1,144	5,179	(N/A)	10.7
Apple	433	47	74	238	181	973	(N/A)	2.0
Honeylocust	902	100	143	803	1,236	3,185	(N/A)	6.6
Lilac	109	12	17	54	50	242	(N/A)	0.5
Sugar maple	472	53	71	352	439	1,387	(N/A)	2.9
Eastern white pine	239	20	20	362	256	898	(N/A)	1.9
Silver maple	1,100	235	212	2,303	1,820	5,670	(N/A)	11.7
Eastern redbud	153	16	23	64	58	315	(N/A)	0.7
Pin oak	911	197	116	1,447	1,522	4,193	(N/A)	8.7
Spruce	212	20	24	343	284	883	(N/A)	1.8
White ash	405	58	69	377	543	1,453	(N/A)	3.0
Northern red oak	253	25	37	236	137	688	(N/A)	1.4
Cherry plum	44	5	7	19	16	92	(N/A)	0.2
Blue spruce	98	7	11	138	134	387	(N/A)	0.8
Swamp white oak	169	20	25	118	170	503	(N/A)	1.0
Norway maple	175	21	29	135	159	519	(N/A)	1.1
Eastern cottonwood	368	50	67	573	332	1,390	(N/A)	2.9
Callery pear	99	12	14	64	108	296	(N/A)	0.6
Siberian elm	301	35	51	339	206	932	(N/A)	1.9
Black cherry	179	17	31	93	53	372	(N/A)	0.8
Ginkgo	45	4	7	25	21	102	(N/A)	0.2
Northern hackberry	405	40	76	509	312	1,341	(N/A)	2.8
Elm	369	41	77	742	227	1,456	(N/A)	3.0
Maple	89	9	13	58	104	274	(N/A)	0.6
Bur oak	227	30	42	359	198	856	(N/A)	1.8
Black maple	147	19	25	121	191	503	(N/A)	1.0
American elm	197	20	39	199	156	611	(N/A)	1.3
Mulberry	102	12	17	57	51	239	(N/A)	0.5
Eastern red cedar	8	1	0	11	31	51	(N/A)	0.1
Norway spruce	107	11	-2	330	100	546	(N/A)	1.1
Austrian pine	74	7	9	126	76	290	(N/A)	0.6
Broadleaf Deciduous M	104	10	18	122	71	326	(N/A)	0.7
Conifer Evergreen Large	86	9	4	208	91	398	(N/A)	0.8
River birch	213	13	41	306	31	604	(N/A)	1.3
Black walnut	115	16	20	147	111	409	(N/A)	0.8
White oak	88	12	17	153	81	351	(N/A)	0.7
American sycamore	164	22	31	298	133	648	(N/A)	1.3
Oak	26	4	4	21	43	98	(N/A)	0.2
Eastern hemlock	14	1	1	16	15	48	(N/A)	0.1
Littleleaf linden	50	8	8	64	81	213	(N/A)	0.4
Ash	9	1	1	4	13	29	(N/A)	0.1
Boxelder	22	3	3	20	27	75	(N/A)	0.2
Scotch pine	24	2	3	42	32	103	(N/A)	0.2
Birch	1	0	0	0	3	4	(N/A)	0.0
Paper birch	21	3	3	16	29	71	(N/A)	0.1

Broadleaf Evergreen Sm	2	0	0	1	0	4 (N/A)	0.0
Conifer Evergreen Medi	25	2	3	42	25	97 (N/A)	0.2
Amur maple	46	2	8	32	0	89 (N/A)	0.2
Plum	5	1	1	2	2	11 (N/A)	0.0
Red maple	1	0	0	0	0	2 (N/A)	0.0
Citywide Total	13,779	1,789	2,268	17,080	13,375	48,292 (N/A)	100.0

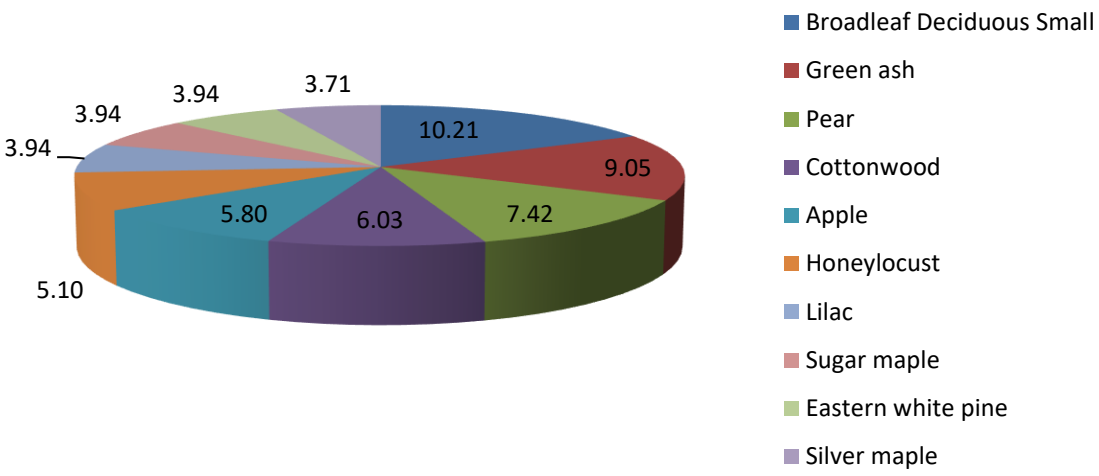

Figure 1: Species Distribution

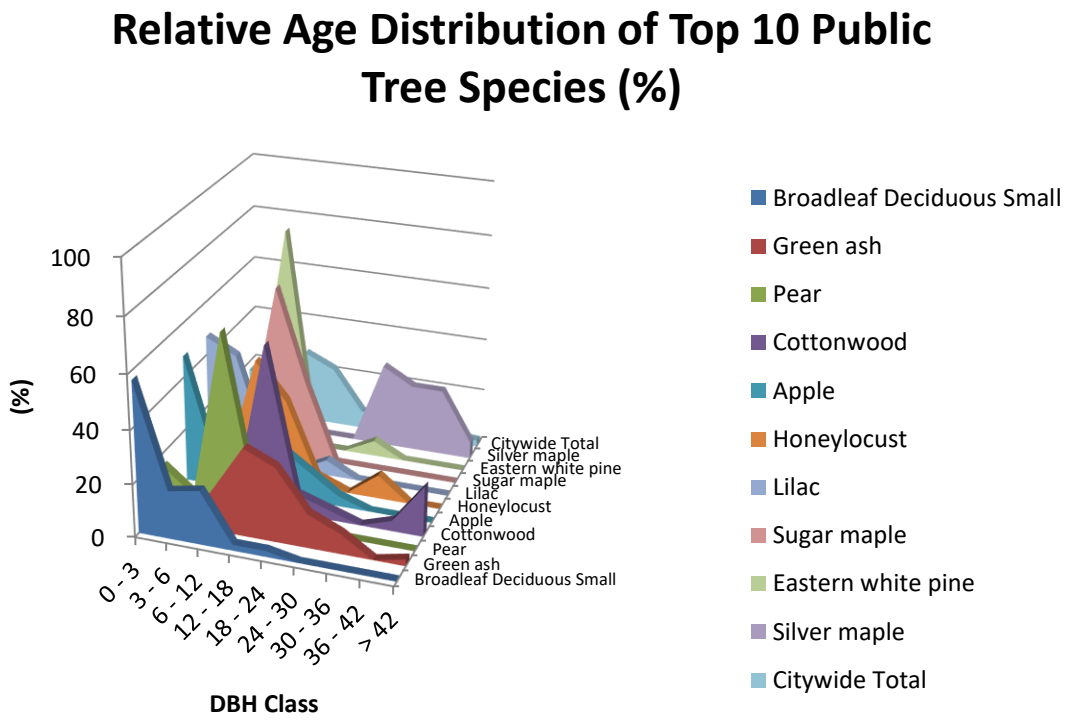

Figure 2: Relative Age Class

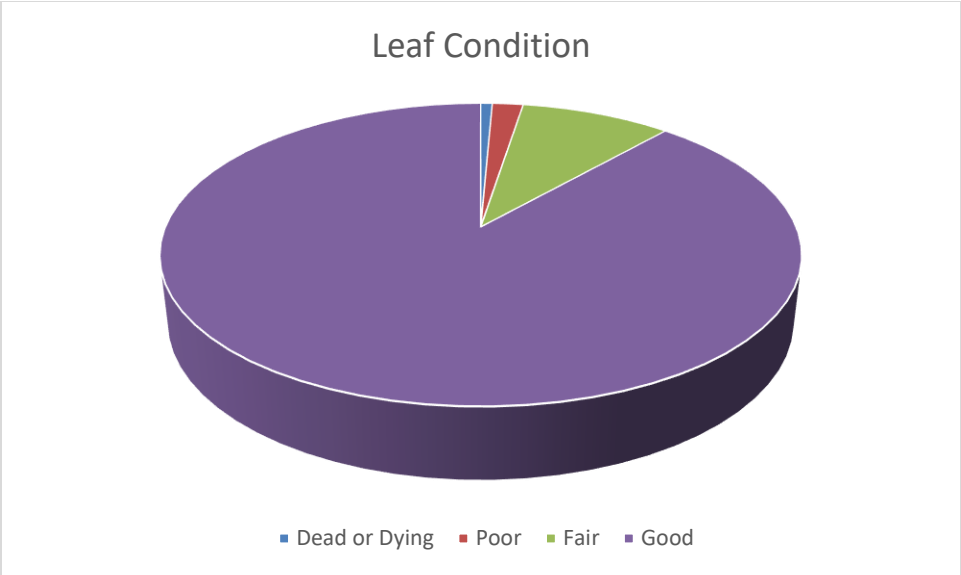

Figure 3: Foliage Condition

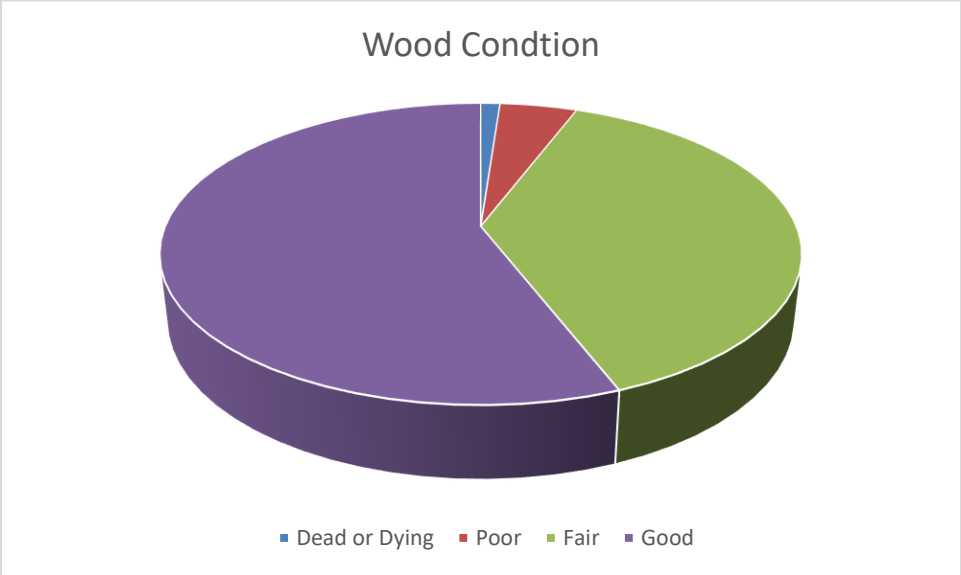

Figure 4: Wood Condition

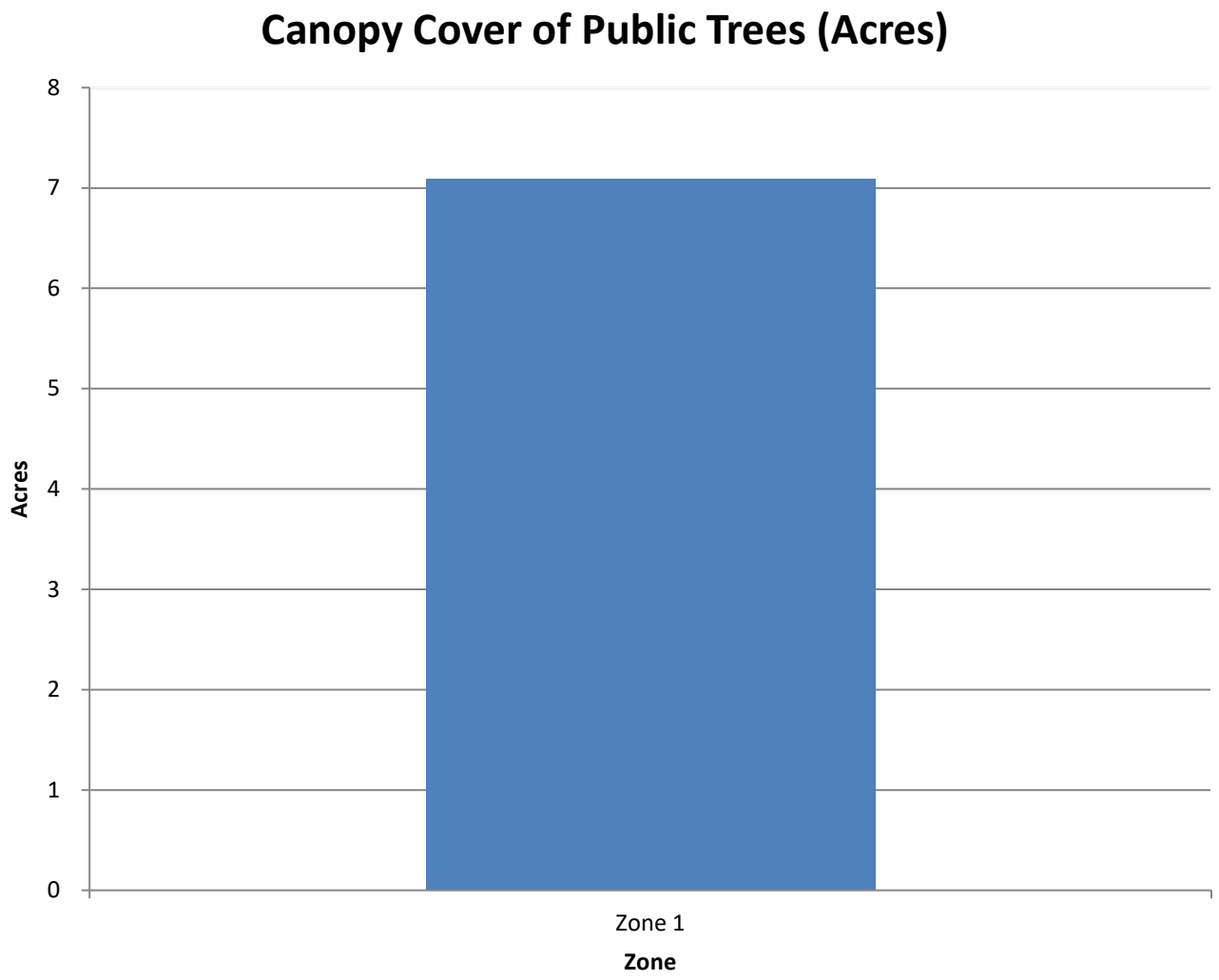

Figure 5: Canopy Cover in Acres

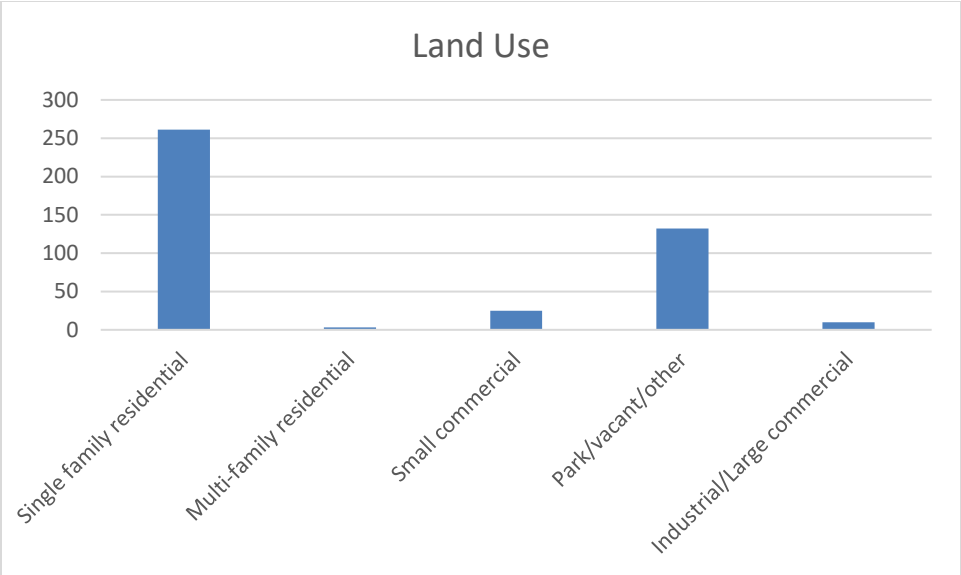

Figure 6: Land Use of city/park trees

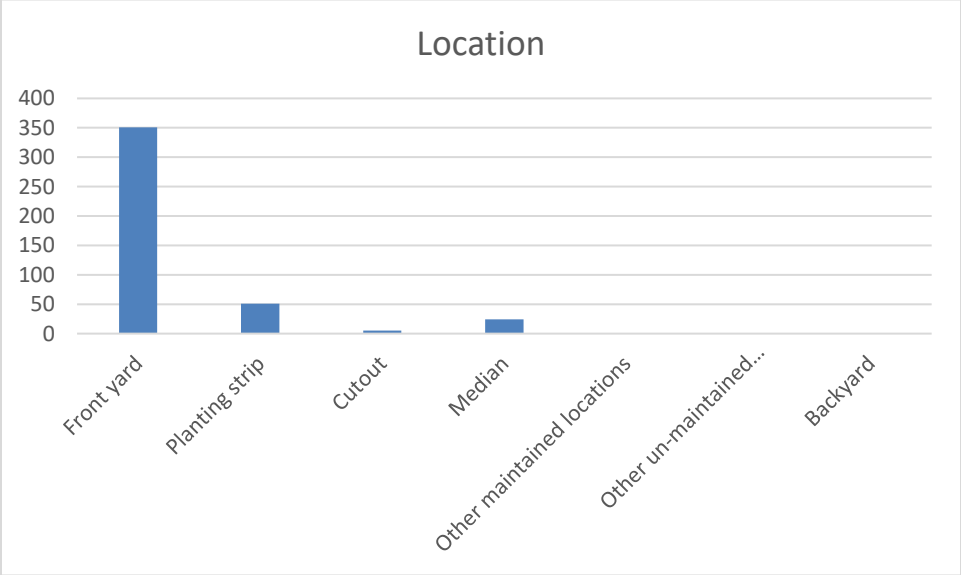

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

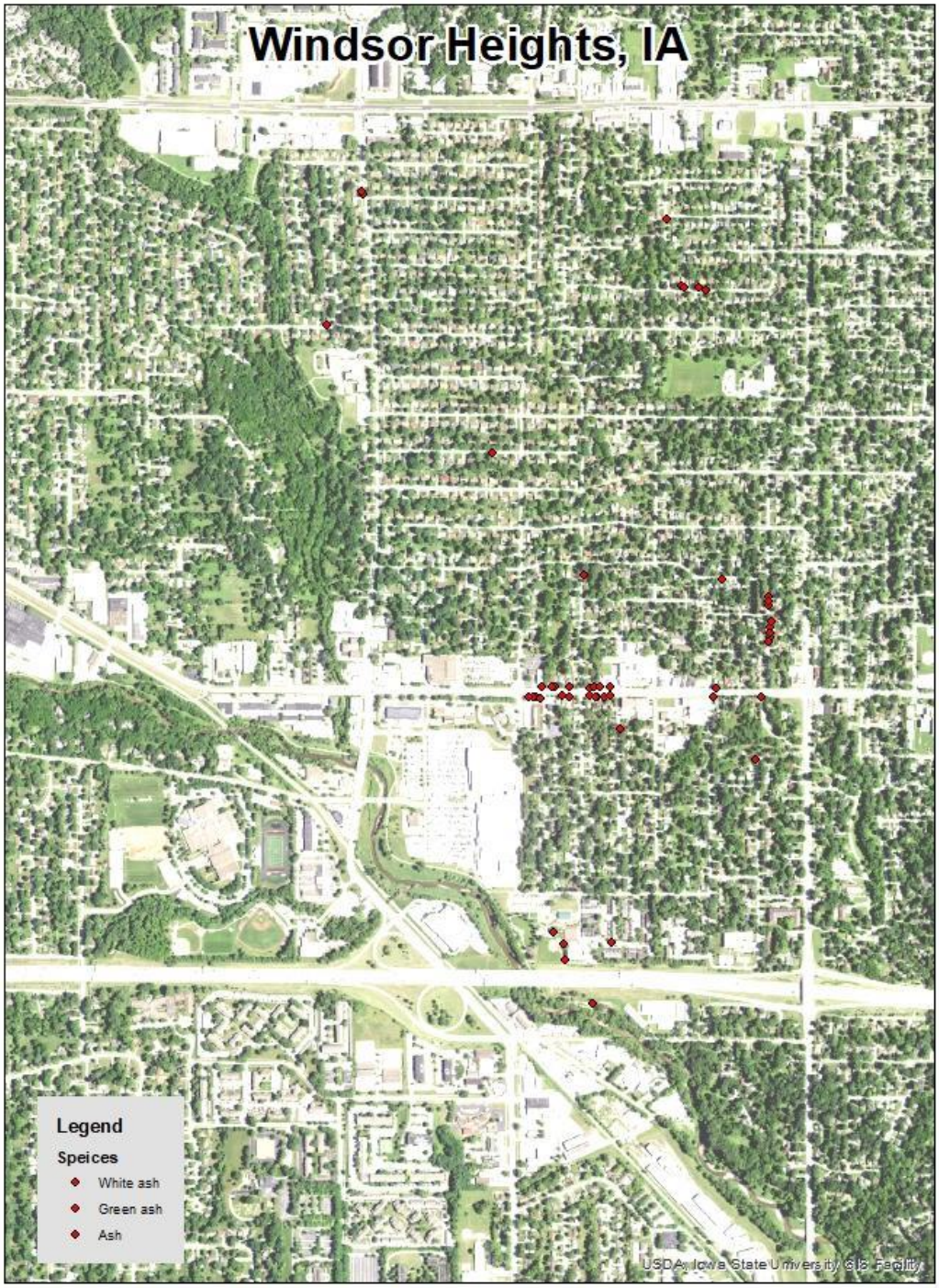

Figure 1: Location of Ash Trees

Figure 2: Location of EAB symptoms

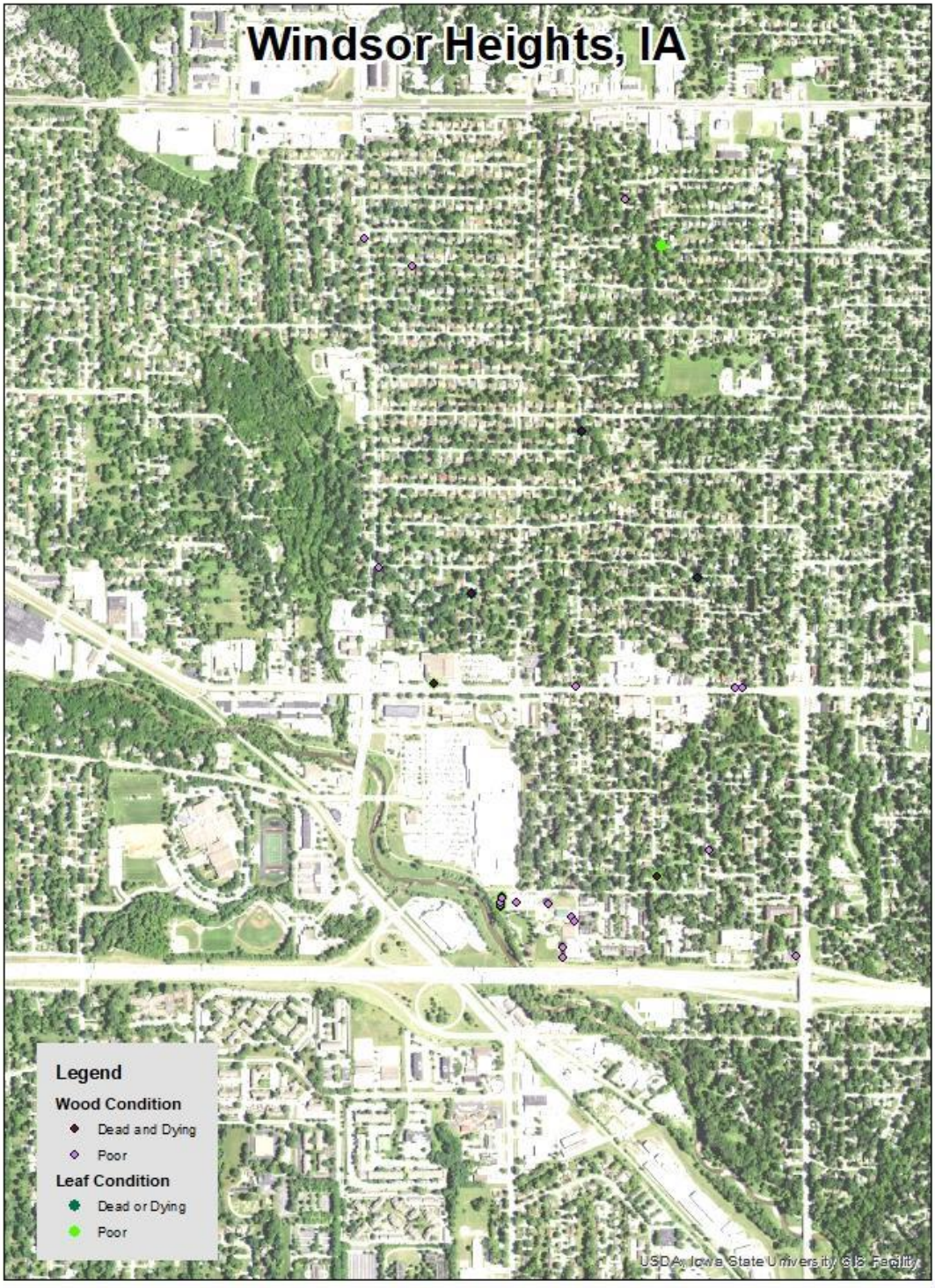

Figure 3: Location of Poor Condition Trees

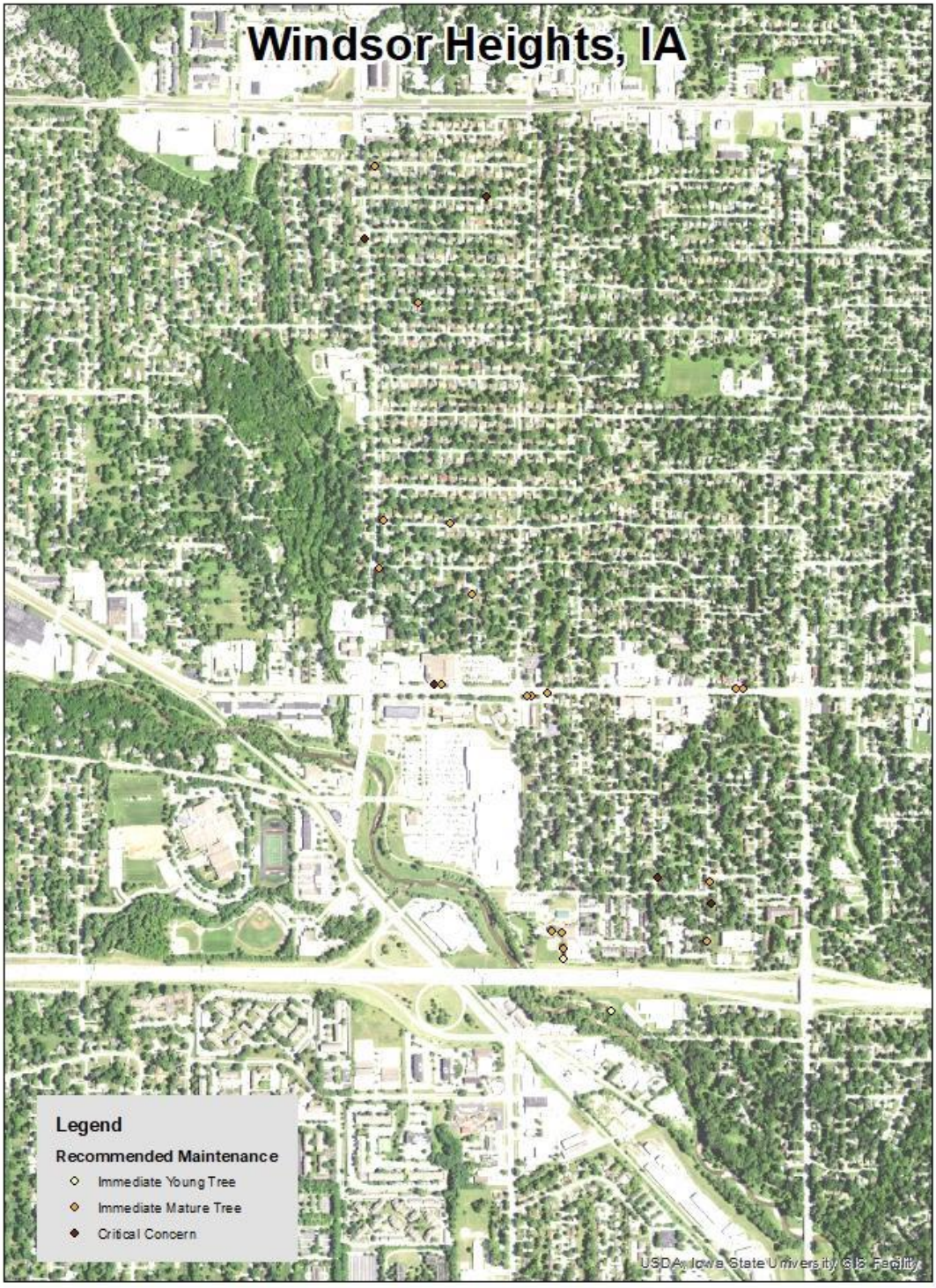

Figure 4: Location of Trees with Recommended Maintenance

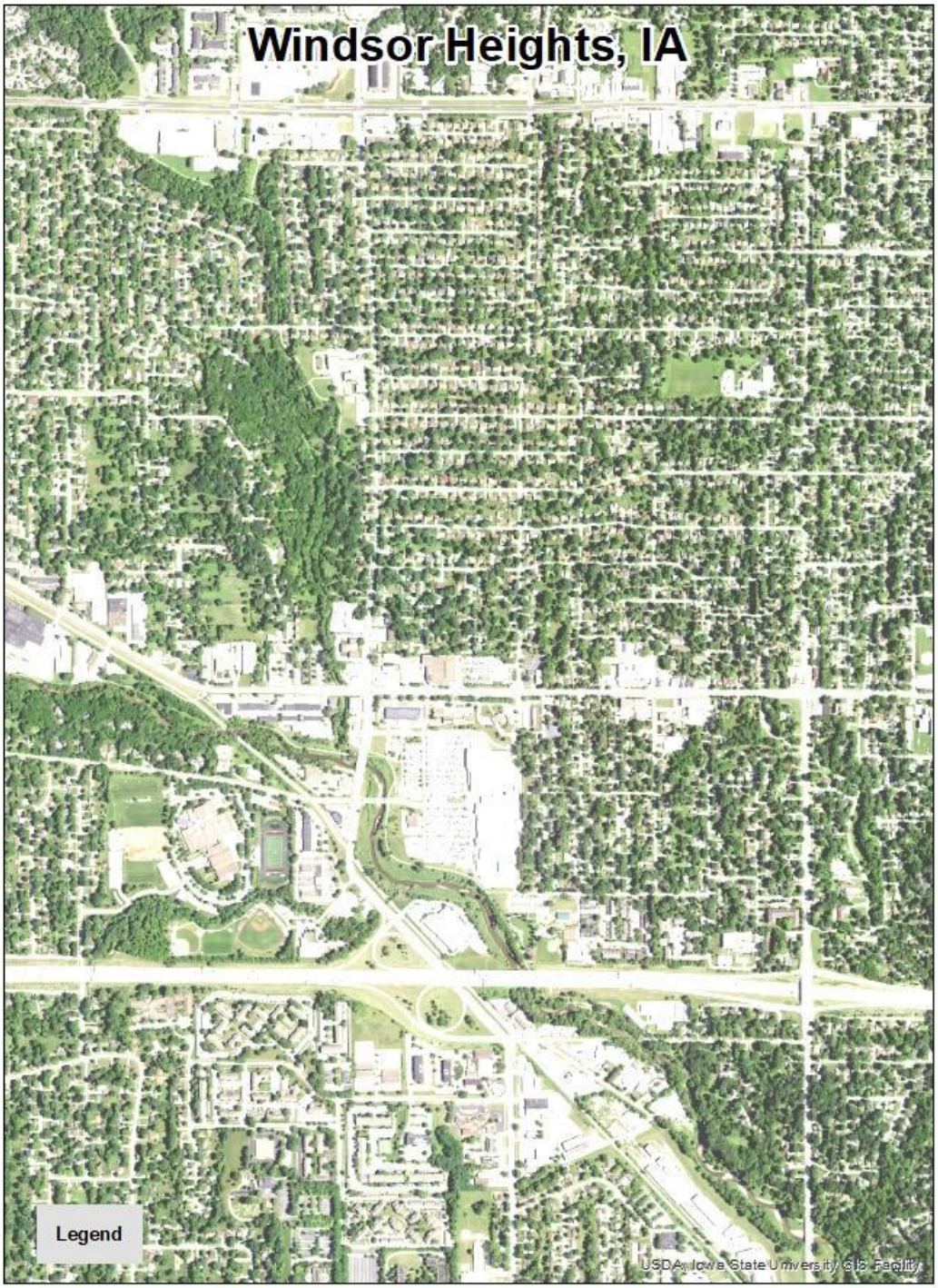

Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal*****

Appendix C: Windsor Heights Tree Ordinances

CHAPTER 151
TREES AND VEGETATION

151.01 Definitions 151.12 Obstruction of Enforcement 151.02 Planting Restrictions 151.13 Permit to Plant in Streets 151.03 Vision Clearance at Street Intersections 151.14 Trees

Assessment for Planting or Care of

151.04 Assessment 151.15 Planting New Trees; Assessment 151.05 Shrubs Unauthorized Interference with Trees or

151.16 Schedule of Assessments

151.06 Hitching or Anchoring Articles to Trees 151.17 Filing Assessment Schedule for Public

Inspection 151.07 Permission for Permanent Anchorage 151.18 Objections to Assessment Schedule 151.08 Guying Poles to Trees in Case of Emergency 151.19 Adoption of Assessment Schedule 151.09 Permit to Remove Trees for Construction Purposes

151.20 Certifying Assessment Schedule for Collection 151.10 Protection During Excavation or Construction 151.21 Dead and Diseased Trees 151.11 Tree Trim Specifications

151.01 DEFINITIONS.

For use in this chapter, the following terms are defined:

1. “Parking” means that part of the street, avenue, or highway in the City not covered by sidewalk and lying between the lot line and the curb line or, on unpaved streets, that part of the street, avenue, or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.
2. “Superintendent” means the Public Works Director or such other person as may be designated by the Council.
3. “Tree” means any woody perennial plant having a single, elongate main stem with few or no branches on its lower part and shrubs of arborescent form but does not include any shrub that is less than fifteen (15) feet in height.

151.02 PLANTING RESTRICTIONS.

No tree shall be planted in any street or parking unless a permit is issued pursuant to Section 151.13 of this chapter.

151.03 VISION CLEARANCE AT STREET INTERSECTIONS.

On a corner lot where setback or side yard exists, no fence, wall, shrubbery, ground, sign, billboard, marquee, or other obstruction to vision between a height of 2 feet and 10 feet above the centerline grade of intersecting streets shall be erected, placed, planted, allowed to grow, or maintained within the triangular yard space formed by the intersecting street

lines and a line joining points on such street lines 25 feet from the point of intersection of the streets. Public utility poles and existing trees trimmed from the ground level to a height of 10 feet shall not be considered obstructions to vision.

151.04 ASSESSMENT.

If the abutting property owner fails to trim the trees as required in this chapter, the City may serve notice on such property owner requiring said property owner to do so within five (5) days. If said

owner fails to trim the trees within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

(Code of Iowa, Sec. 364.12[2d & e])

151.05 UNAUTHORIZED INTERFERENCE WITH TREES OR SHRUBS.

No person shall remove, prune, cut, molest, break, deface, destroy, spray, repair, or do surgery work upon any tree or part thereof, or in any manner interfere with, disturb, or injure any tree, shrub, or plant, upon parking or the public property of the City. No person shall permit any chemical, either solids or fluids, to seep, drain, or be emptied on or about any tree, shrub, or plant that is now or may hereafter be growing upon any public property of the City, without first obtaining a permit from the City Administrator.

151.06 HITCHING OR ANCHORING ARTICLES TO TREES.

No person shall hitch or fasten any animal to any tree or shrub, or fasten to the same, for the purpose of anchorage, any wire, rope, chain or cable, nor shall any person nail, tie, or in any manner fasten any card, sign, poster, board, or any other article to any tree, shrub or plant that is now or may hereafter be growing upon any parking or public property of the City.

151.07 PERMISSION FOR PERMANENT ANCHORAGE.

Permission may be granted by the City Administrator for permanent anchorage to trees if good practice in line construction indicates the desirability and the elimination of stubs or poles will result by so doing.

151.08 GUYING POLES TO TREES IN CASE OF EMERGENCY.

In the event of storms or other emergencies, poles may be guyed temporarily to trees.

151.09 PERMIT TO REMOVE TREES FOR CONSTRUCTION PURPOSES.

Any person desiring to remove a live tree standing on a street or parking thereof for construction of walks, drives, buildings, or any other structures for his or her own gain or purposes shall first obtain a permit from the City Administrator. If a permit is issued, the permittee must pay the cost of removal of such trees and shrubs, or the permittee may remove the same at permittee's own expense.

151.10 PROTECTION DURING EXCAVATION OR CONSTRUCTION.

All trees, shrubs, or plants within the limits of any street, parking, or other property of the City near any excavation or construction of any building or structure shall be guarded with a good substantial frame or box not less than four feet square and six feet high. All building material or other debris shall be kept at least three feet from any tree, shrub, or plant.

151.11 TREE TRIM SPECIFICATIONS.

1. Any person trimming trees or causing trees, bushes, and other plants to be trimmed under the authority of this section or sections of this Code pertaining to utility franchises, if the entity wishing to trim is not itself the owner, shall:

A. Cause written notice to be given to the owner, occupant, or person in control of the property at least 15 days prior to any trimming; provided, however, notice shall not be required if trimming is necessary to restore electrical service or relieve a public emergency resulting from storm, accident, similar casualty, or other cause which immediately threatens electrical service or public safety. The notice shall state the nature of the trimming to be performed, the person's right to trim the tree, shrubbery, bush, or other plants, the date when such trimming must be completed if the owner desires to do the trimming, and whether an assessment or charge will be imposed by such person for trimming the tree, bush, or other plant.

B. Trim trees, bushes, and plants to the extent necessary to remove obstruction to protect lives and property.

C. Employ persons skilled in tree trimming so that the life and general aesthetic qualities of the tree are preserved.

2. The owner of any tree, shrub, or plant protruding into or overhanging a street or sidewalk shall trim the branches thereof to remove any obstruction of the view of any street lamp, street sign, traffic control device, or street intersection. A clear space of ten feet above the surface of a street or sidewalk must be maintained. All trimming shall conform to the specifications in subsection 1 of this section and to those required pursuant to the City's Traffic Code.

3. The City Administrator may order the removal of any tree, shrub, or plant or any part thereof which does not conform to the specification of subsection 2 of this section. Notice shall be given to the owner of the property as set forth in subsection 1 of this section. If the owner, occupant, or person in control fails to comply with the notice, the City Administrator shall cause the obstructing branches or foliage to be removed and shall submit the costs incident to the service of notice and removal to the City Council, which shall certify the same to the county auditor for collection with and in the same manner as general property taxes. Provided, however, in the event the City Administrator determines that a hazardous condition exists which constitutes an immediate danger to public safety because of the extensive nature or location of an obstruction caused by any tree, shrub, plant, or any part thereof, the City Administrator may cause the removal thereof forthwith without notice; and in such event, costs may be assessed in the same manner as provided above, after notice to the property owner and opportunity for hearing before the City Council is given.

4. Except as provided by subsection 3 of this section, no tree, bush, or shrub shall be removed without the written consent of the owner of the property upon which the tree, bush, or shrub is located.

5. Nothing in this section shall be construed to affect the rights of a landowner as against a neighboring landowner.

151.12 OBSTRUCTION OF ENFORCEMENT.

No person shall hinder, obstruct, or otherwise interfere with the Superintendent or his/her representatives while engaged in carrying out the provisions of this chapter.

151.13 PERMIT TO PLANT IN STREETS.

1. No person shall plant or set out any tree, shrub, or plant in or on any parking, public highway, or street or other City property without first obtaining a permit from the City Administrator, which permit shall designate where such plantings may be done.

2. The permit shall be denied if such planting is likely to create a public danger or nuisance and shall not provide the permittee with any guarantee or assurance that the tree, shrub, or plant will be protected from subsequent trimming or destruction if such is required for health, welfare, or safety of the City's residents.

151.14ASSESSMENT FOR PLANTING OR CARE OF TREES.

The cost of planting, pruning, caring for, removing, or maintaining trees and shrubs, in whole or in part, upon the parking or public streets of the City may be assessed against the lots and parcels of land in front of which such trees or shrubs are planted and maintained.

151.15PLANTING NEW TREES; ASSESSMENT.

No plantings of new trees or shrubs shall be made and assessed against the abutting property owners except by action of the City Council. Notice of a proposal to plant new trees or shrubs must be made by publication in two newspapers of general circulation in the City 15 days prior to final action thereon.

151.16SCHEDULE OF ASSESSMENTS.

The cost of planting new trees and shrubs and the maintenance thereof, including removals and partial removal of trees and shrubs, shall be certified to the City Council by the Superintendent in a scheduled form setting forth the nature of the work done, the amount of the special assessment, the lots of specific portions thereof against which assessed, and the names of the owners thereof as far as practicable.

151.17 FILING ASSESSMENT SCHEDULE FOR PUBLIC INSPECTION.

A schedule of assessments for planting of new trees and shrubs and maintenance, including removals and partial removal of trees and shrubs, shall be filed with the Clerk for public inspection.

151.18 OBJECTIONS TO ASSESSMENT SCHEDULE.

Before final adoption of the schedule of assessments provided for in this chapter, the City Council shall give notice by two publications in each of two newspapers published in the City, stating that the schedule is on file in the office of the City Clerk and that within 20 days after the first publication all objections thereto or to the prior proceedings, on account of errors, irregularities or inequalities, must be made in writing and filed with the Clerk.

151.19 ADOPTION OF ASSESSMENT SCHEDULE.

After the expiration of the 20-day period mentioned in Section 151.18 of this chapter, the City Council shall consider objections to the schedule of assessments, make the necessary corrections, and make, approve, and adopt the special assessments as shown in the schedule.

151.20 CERTIFYING ASSESSMENT SCHEDULE FOR COLLECTION.

Upon final adoption of special assessments as shown in the schedule of assessments, the City Council shall cause the same to be certified to the County Treasurer with directions that the cost of the improvements or services as scheduled shall be assessed against the parcels of property designated therein, in the amounts set forth thereby, and that such amounts shall be collected as other special assessments.

151.21 DEAD AND DISEASED TREES.

1. Right to Enter, Test, and Inspect. The Public Works Director shall enforce the provisions of this section. To secure enforcement hereof, the Superintendent shall have the right and is hereby empowered to enter upon the property of any person within the City for the purpose of testing, inspecting, and obtaining samples of any trees, brush, wood, or debris thereon.

2. Permitting Dead or Diseased Trees or Plants to Stand.

A. No property owner shall maintain or permit to stand upon his or her property any tree, shrub, plant or part thereof which is dead, diseased, or so damaged as to be a menace to public safety.

B. When the Superintendent determines that any tree, shrub, plant or part thereof is dead, diseased, or so damaged as to be a menace to public safety, the Superintendent may request the City Council to direct the property owner to remove the same within thirty (30) days, or to appear before the City Council for hearing on the matter during said period to show cause why the tree, shrub, plant or the appropriate part thereof should not be removed by the City with the cost of removal assessed against the property owner. Such notice to show cause and notice of the proposed City Council action shall be by certified mail to the property owner of record.

C. If, after hearing, the City Council approves removal, the Clerk shall send a copy of the resolution by certified mail to the property owner directing such removal within 30 days or the City shall remove and assess the cost of removal against the property owner.

3. Removal of Trees, Shrubs, and Plants. The Superintendent may remove or cause to be removed all trees, shrubs, plants or parts thereof upon the public streets or highways or other City property within the City when removal shall be beneficial to the public peace, health, and safety, or for public improvements or if such trees, shrubs, or plants constitute a public nuisance or are dead or diseased, or detrimental to the growth of adjacent trees, plants, or shrubs growing in the public streets or other City property.

4. Removal of Trees Infected with Dutch Elm Disease or Oak Wilt.

A. In accordance with Section 364.12 of the *Code of Iowa*, any owner, occupant, or person in control of any property shall remove from such property, at his or her own expense, any tree, brush, wood, or debris infected with Dutch elm disease or oak wilt or any dead oak or elm which retains bark,

when so notified by the Superintendent. The Superintendent shall cause to be mailed to such owner, occupant, or person in control written notice that said person may appear before the City Council at an appointed time not less than fourteen (14) days from the date of mailing to show cause why the infected tree, brush, wood, or debris should not be declared a public nuisance. At that meeting the City Council may resolve and declare the same to be a public nuisance and may order its removal by the owner, occupant, or person in control within thirty (30) days from the date of service of a copy of the resolution and order on the owner, occupant, or person in control; provided however, upon timely receipt of a request in writing from the property owner showing inability to perform, hardship, or other good cause, the City Administrator may grant an extension of time to a maximum of an additional thirty (30) days for said removal by the owner, occupant or other person. No extension of time exceeding sixty (60) days may be granted without prior approval by the City Council.

B. If the owner, occupant, or person in control fails to comply with the resolution and order of the City Council to so remove previously specified public nuisance, the Superintendent shall cause that public nuisance to be removed and shall submit the costs incident to the service and removal to the City Council, which shall certify the same to the County Treasurer for collection with and in the same manner as general property taxes.

5. Diseased Tree Inspection Fees.

A. Fees for the City inspection of a tree or trees shall be paid to the City Treasurer in an amount set by resolution of the City Council, provided fees for inspections not requested by the owner or the owner’s representative shall be assessed only against those trees showing evidence of disease which requires removal of the tree.

B. For the purpose of this section, “private property” is defined as property not owned by the City.

The State of Iowa is an Equal Opportunity Employer and provider of ADA services.

Federal law prohibits employment discrimination on the basis of race, color, age, religion, national origin, sex or disability. State law prohibits employment discrimination on the basis of race, color, creed, age, sex, sexual orientation, gender identity, national origin, religion, pregnancy, or disability. State law also prohibits public accommodation (such as access to services or physical facilities) discrimination on the basis of race, color, creed, religion, sex, sexual orientation, gender identity, religion, national origin, or disability. If you believe you have been discriminated against in any program, activity or facility as described above, or if you desire further information, please contact the Iowa Civil Rights Commission, 1-800-457-4416, or write to the Iowa Department of Natural Resources, Wallace State Office Bldg., 502 E 9th St, Des Moines IA 50319.

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