Harcourt, IA

Urban Forestry Management Plan

SUMMER 2022

JEO CONSULTING GROUP

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Executive Summary

EXECUTIVE SUMMARY

Overview

This plan was developed to assist the City of Harcourt in managing its urban forest, including budgeting and future planning. Trees bring numerous benefits to a community, and sound management helps leaders take advantage of these benefits. Management is especially important now considering the serious threats posed by forest pests like the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees except mountain ash. There is a strong possibility that 27% of Harcourt's city-owned trees will die once EAB becomes established in the community, unless local leaders begin preventative treatment. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2022, JEO conducted a tree inventory using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 210 trees inventoried.

- Harcourt trees provide $44,084 of benefits annually, an average of $210 per tree
- There are over 35 species of trees
- The top three genera are: Maple 33%, Ash 27%, and Walnut 11%
- 45% of trees need some type of management
- 50 trees should be removed

Recommendations

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

- Out of the 50 trees needing removal, 27 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*
- 37 of the 57 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation.
- All trees should be pruned on a routine schedule: one third of the city every other year.
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.
- Check ash trees yearly with a visual survey.
- With the current budget it could take 8 years to remove ash. We suggest that city officials request a budget increase to $10,000 annually and apply for grants to plant replacement trees.

Introduction

INTRODUCTION

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

Trees are an important part of Harcourt's infrastructure and one of the city's greatest assets. The benefits of trees are immense. Trees improve air quality, intercept stormwater runoff, conserve energy, lower traffic speeds, increase property values, reduce crime, improve mental health, and create a desirable place to live, to name just a few. Good urban forestry management will maintain these important benefits for the people of Harcourt and future generations.

Urban forestry management sets goals and develops management strategies to achieve them. To develop management strategies, a comprehensive public tree inventory must be conducted. The inventory informs maintenance, removal schedules, tree planting, and budgeting. Aligning management actions with the tree inventory results will help meet Harcourt's urban forestry goals.

Assist Harcourt with Managing its Urban Forest

Inform on the Benefits of a Healthy Urban Forest

Establish Preventative Treatment for Emerald Ash Borer

Develop Efficient City Tree Management Techniques

Mitigate Public Safety Issues

Findings

INVENTORY

In 2022, JEO conducted a tree inventory that included 100% of the city-owned trees on both streets and parks. The team collected tree data using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

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

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

INVENTORY RESULTS

JEO entered the data collected for the 210 city trees into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. Following are results from the i-Tree STREETS analysis.

ANNUAL BENEFITS

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Harcourt's trees reduce energy-related costs by approximately $11,134 annually (Appendix A, Table 1). These savings are both in electricity (52.6 MWh) and in natural gas (7,285.7 Therms).

Annual Stormwater Benefits

Harcourt's trees intercept about 631,363 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $17,110 in benefit to the city.

Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and lessens emissions of volatile organic matter (ozone). In Harcourt, it is estimated that trees remove 700.3 lbs of air pollution (ozone (O3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO2), and sulfur dioxide (SO2)) per year with a net value of $1,984 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Harcourt, trees sequester about 145,062 lbs of carbon per year with an associated value of $1,650 (Appendix A, Table 5). In addition, the trees store 2,642,762 lbs of carbon, with a yearly benefit of $19,821 (Appendix A, Table 4).

Annual Aesthetics Benefits

The social benefits of trees are hard to capture. The i-Tree analysis does have a calculation for this area that includes aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Harcourt receives $12,206 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, Harcourt's trees provide $44,084 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 210 trees in Harcourt provide approximately $210 annually (Appendix A, Table 7).

ENERGY	STORMWATER	AIR QUALITY	CARBON	AESTHETICS	SUMMARY
• Reduce energy cost by **$11,134**	• Intercept 631,363 **gallons** • Provides **$17,110** benefit	• Remove 700 **lbs** of pollution • Net value of **$1,984**	• Sequester **145,062 lbs** • Value of **$1,650** • Store **2,642,762 lbs** • Value of **$19,821**	• **$12,206** in social benefits	• **$44,084** annual benefits • Each tree provides **$210** annually

FOREST STRUCTURE

Species Distribution

Harcourt has over 35 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Maple	70	33%
Ash	57	27%
Walnut	24	11%
Oak	14	7%
Basswood/Linden	9	4%
Hackberry	6	3%
Locust	6	3%
Pine	6	3%
Spruce	6	3%
Sycamore	3	1%
Mulberry	2	1%
Apple	1	<1%
Plum	1	<1%
Poplar	1	<1%
Tulip	1	<1%

Age Class

Most of Harcourt's trees (30%) are between 24 and 30 inches in diameter at 4.5 ft (Appendix A, Figure 2).

To prepare for natural mortality and to maintain canopy cover, most trees should be in the smallest size category (a downward slope), indicating youth. Harcourt's size curve is on the larger side, indicating an older than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the urban forest's overall health. The foliage condition results for Harcourt indicate that 70% of the trees are in good health, with only 20% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 70% of Harcourt's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Twenty two percent of the tree population's wood condition is in poor health, dead, or dying. This 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).

Action	Number of Trees	Percentage
Tree Removal	50	24%
Crown Cleaning	35	17%
Crown Raising	8	4%
Tree Staking	1	<1%
Crown Reduction	0	0%

Canopy Cover

The total canopy with both private and public trees is 37 acres or 6% cover. The canopy cover included in the Harcourt inventory includes approximately 6 acres (Appendix A, Figure 4). The city's canopy goal is to increase canopy by 10% in 30 years. To achieve this goal it is estimated that 12 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Harcourt'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	Percentage
Single Family Residential	51%
Park/Vacant/Other	46%
Industrial/Large Commercial	3%
Small Commercial	0%
Multifamily Residential	0%

Recommendations

RECOMMENDATIONS

Risk Management

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

HAZARDOUS TREES

Harcourt has 4 critical concern trees that need immediate removal. These trees can be seen on the Location of Trees with Recommended Maintenance Map (Appendix B, Figure 4). We recommend starting 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 maintenance. There are a total of 47 trees with maintenance needs.

POOR TREE SPECIES

After removing the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 50 removals, 47 are ash trees. There are a total of 57 ash trees, and 38 of those have signs and symptoms that have been associated with EAB. In addition, there are 30 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising removes lower branches that are two inches in diameter or larger to provide clearance for pedestrians or vehicles. Crown reduction removes individual limbs from structures or utility wires. We recommend that all trees be pruned on a routine schedule every five to seven years. Please refer to the Six Year Maintenance Plan for further information.

Planting

Most of the planting over the next five years will replace the trees that are removed. We recommend planting 1.2 trees for every tree removed, since survival rates will not be 100%. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Harcourt.

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 (33%) (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: crabapple, Japanese Lilac, serviceberry, oak (red, white), hackberry, linden, elm (disease resistant), cork, London plane, ironwood hornbeam as outlined in (Appendix C). All trees planted must meet the restrictions in city ordinance (Appendix C).

Continual Monitoring

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

EMERALD ASH BORER PLAN

Ash Tree Removal

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

Treatment of Ash Trees

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

EAB Quarantines

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

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

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

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

Wood Disposal

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

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance (Appendix C). The new plantings will be a diverse mix and will not include crabapple, Japanese Lilac, serviceberry, oak (red, white), hackberry, linden, elm (disease resistant), cork, London plane, ironwood hornbeam.

Postponed Work

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

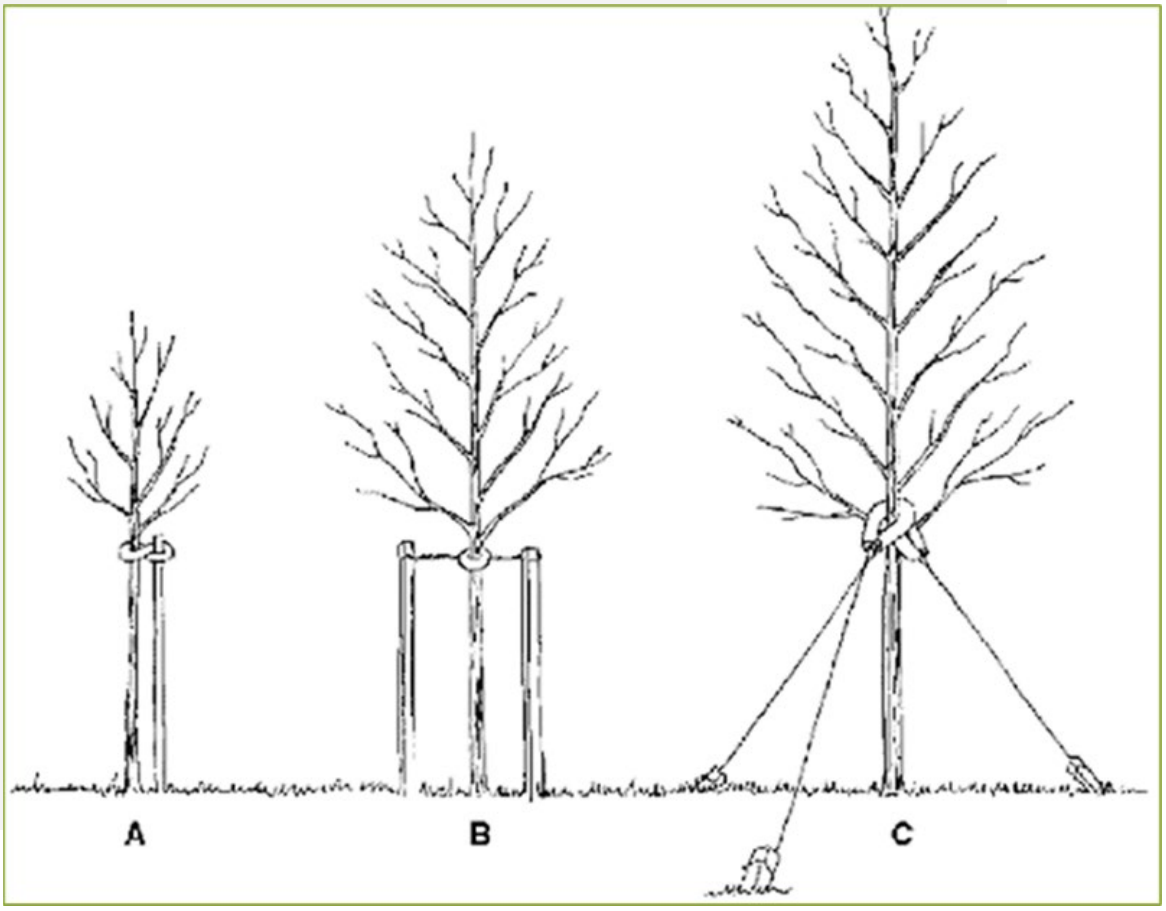
Monitoring

It is recommended that ash trees be checked with a visual survey every year for tree death and for EAB signs and symptoms including canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used. City Code (Appendix C) states “A property owner may remove a tree that is on personal property as long as the property owner does the actual work. Otherwise, the property owner must hire a licensed tree surgeon to remove the tree.”

Schedule & Budget



PROPOSED WORK SCHEDULE & BUDGET

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

YEAR 1	Est. Cost
Remove 2 trees recommended for immediate removal	$1,400
Remove 4 ash trees in poor condition	$2,800
Plant 5 trees in open locations	$750
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$4,950**

YEAR 2	Est. Cost
Remove 4 trees recommended for immediate removal	$2,800
Plant 7 trees in open locations	$1,050
Prune 1/3 of city owned trees	$1,050
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$4,900**

YEAR 3	Est. Cost
Remove 1 tree recommended for immediate removal	$700
Remove 5 ash trees in poor condition	$3,500
Plant 5 trees in open locations	$750
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$4,950**

YEAR 4	Est. Cost
Remove 4 ash trees	$2,800
Plant 7 trees in open locations	$1,050
Prune 1/3 of city owned trees	$1,050
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$4,900**

YEAR 5	Est. Cost
Remove 6 ash trees	$4,200
Plant 5 trees in open locations	$750
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$4,950**

YEAR 6	Est. Cost
Remove 3 ash trees	$2,100
Plant 12 trees in open locations	$1,800
Prune 1/3 of city owned trees	$1,050
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$4,950**

Estimated costs based on average costs of $700/tree for removal, $150/tree for planting and maintenance, and $15/tree for pruning.

***To remove all ash trees within 6 years alone, the budget would need to be $6,650 a year. If the budget were increased to $10,000 a year all ash could be removed in 4 years.*

PROPOSED WORK SCHEDULE WITH INCREASED BUDGET

Budget Allowance of $5,000/Year for removals paired with grant funds up to $5,000 for tree planting/management – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	Est. Cost
Remove 5 trees recommended for immediate removal	$3,500
Remove 7 ash trees in poor condition	$4,900
Plant 10 trees in open locations	$1,500
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$9,900**

YEAR 2	Est. Cost
Remove 10 ash trees in poor condition	$7,000
Plant 13 trees in open locations	$1,950
Prune 1/3 of city owned trees	$1,050
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,000**

YEAR 3	Est. Cost
Remove 12 ash trees	$8,400
Plant 10 trees in open locations	$1,500
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$9,900**

YEAR 4	Est. Cost
Remove 10 ash trees	$7,000
Plant 13 trees in open locations	$1,950
Prune 1/3 of city owned trees	$1,050
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$10,000**

YEAR 5	Est. Cost
Remove 9 ash trees	$6,300
Plant 24 trees in open locations	$3,600
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$9,900**

YEAR 6	Est. Cost
Remove 10 ash trees	$7,000
Plant 13 trees in open locations	$1,950
Prune 1/3 of city owned trees	$1,050
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$9,810**

Purposed Budget Increase

EAB could potentially kill all ash trees in Harcourt within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to $6,650 a year. If the budget were increased to $10,000 per year all ash could be removed within 4 years.

Additionally, we recommend that Harcourt apply for grants to fund replacement trees. Utility Company grants are usually between $500 and $10,000 for community-based, tree-planting projects that include parks, gateways, cemeteries, nature trails, libraries, nursing homes, and schools.

Another option considered by many communities is treating selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removal all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For instance, in this treatment scenario, the average ash diameter is 20 inches and at $15 per inch, about 4 trees could be treated per year (every other year treatment). Eight trees would be selected for treatment, and Harcourt would still need to find $34,300 for removal. Alternatively, if there are 12 treatable trees, it would cost approximately $1,800 a year for treatment and leave $3,200 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 Harcourt. We suggest considering an increased budget to plan for this.

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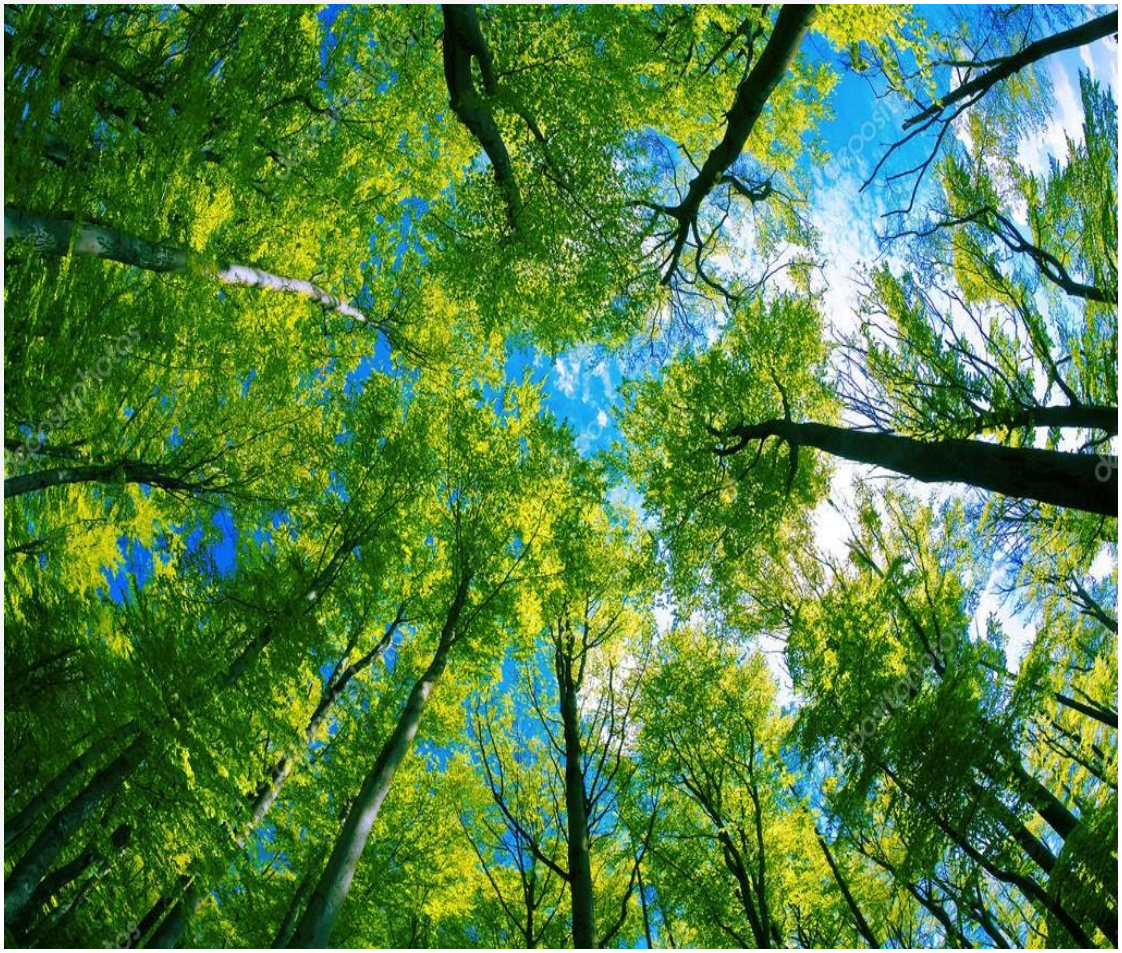
Appendices



APPENDIX A: i-TREE DATA

Table 1: Annual Energy Benefits

Harcourt

Annual Energy Benefits of Public Trees

2/7/2023

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	16.4	1,243	2,296.6	2,251	3,493	(N/A)	24.8	31.4	67.18
Silver maple	11.8	894	1,575.7	1,544	2,438	(N/A)	15.2	21.9	76.20
Black walnut	6.7	511	926.7	908	1,419	(N/A)	11.4	12.7	59.14
Norway maple	5.9	446	856.2	839	1,286	(N/A)	11.0	11.5	55.89
Amur maple	0.0	3	6.2	6	9	(N/A)	4.8	0.1	0.87
Northern hackberry	2.4	182	322.2	316	498	(N/A)	4.3	4.5	55.32
Northern red oak	0.5	37	65.7	64	101	(N/A)	3.3	0.9	14.47
Honeylocust	1.0	76	135.7	133	209	(N/A)	2.9	1.9	34.81
Blue spruce	0.4	30	49.2	48	78	(N/A)	2.9	0.7	13.08
Eastern white pine	0.5	37	66.0	65	102	(N/A)	2.9	0.9	16.98
Bur oak	0.4	28	53.2	52	80	(N/A)	2.4	0.7	15.98
Littleleaf linden	0.0	1	1.6	2	2	(N/A)	1.9	0.0	0.57
Mountain ash	0.5	36	76.1	75	110	(N/A)	1.4	1.0	36.82
American sycamore	1.4	103	181.1	177	281	(N/A)	1.4	2.5	93.56
American basswood	0.8	62	115.5	113	175	(N/A)	1.4	1.6	58.43
Black maple	0.8	63	109.9	108	170	(N/A)	1.4	1.5	56.77
Basswood	0.7	50	93.7	92	142	(N/A)	1.0	1.3	70.91
White ash	0.7	55	97.5	96	151	(N/A)	1.0	1.4	75.44
Pin oak	0.6	46	84.4	83	129	(N/A)	1.0	1.2	64.44
Maple	0.6	43	79.8	78	121	(N/A)	1.0	1.1	60.68
Tulip tree	0.0	0	0.5	0	1	(N/A)	0.5	0.0	0.66
Black poplar	0.3	20	38.1	37	57	(N/A)	0.5	0.5	57.32
Plum	0.1	6	12.8	13	18	(N/A)	0.5	0.2	18.19
Apple	0.1	6	12.8	13	18	(N/A)	0.5	0.2	18.19
White mulberry	0.2	14	24.7	24	38	(N/A)	0.5	0.3	38.13
Mulberry	0.0	2	3.8	4	5	(N/A)	0.5	0.0	5.40
Total	52.6	3,994	7,285.7	7,140	11,134	(N/A)	100.0	100.0	53.02

Table 2: Annual Stormwater Benefits

Harcourt

Annual Stormwater Benefits of Public Trees

2/7/2023

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	199,021	5,393	(N/A)	24.8	31.5	103.72
Silver maple	182,714	4,952	(N/A)	15.2	28.9	154.74
Black walnut	67,596	1,832	(N/A)	11.4	10.7	76.33
Norway maple	58,055	1,573	(N/A)	11.0	9.2	68.40
Amur maple	74	2	(N/A)	4.8	0.0	0.20
Northern hackberry	18,885	512	(N/A)	4.3	3.0	56.87
Northern red oak	4,319	117	(N/A)	3.3	0.7	16.72
Honeylocust	10,554	286	(N/A)	2.9	1.7	47.67
Blue spruce	4,747	129	(N/A)	2.9	0.8	21.44
Eastern white pine	10,689	290	(N/A)	2.9	1.7	48.28
Bur oak	3,252	88	(N/A)	2.4	0.5	17.63
Littleleaf linden	27	1	(N/A)	1.9	0.0	0.19
Mountain ash	2,613	71	(N/A)	1.4	0.4	23.60
American sycamore	21,717	589	(N/A)	1.4	3.4	196.17
American basswood	7,758	210	(N/A)	1.4	1.2	70.08
Black maple	7,338	199	(N/A)	1.4	1.2	66.29
Basswood	7,886	214	(N/A)	1.0	1.2	106.85
White ash	8,525	231	(N/A)	1.0	1.4	115.51
Pin oak	5,987	162	(N/A)	1.0	0.9	81.13
Maple	5,734	155	(N/A)	1.0	0.9	77.70
Tulip tree	18	0	(N/A)	0.5	0.0	0.48
Black poplar	2,591	70	(N/A)	0.5	0.4	70.21
Plum	264	7	(N/A)	0.5	0.0	7.17
Apple	264	7	(N/A)	0.5	0.0	7.17
White mulberry	667	18	(N/A)	0.5	0.1	18.06
Mulberry	69	2	(N/A)	0.5	0.0	1.86
Citywide total	631,363	17,110	(N/A)	100.0	100.0	81.48

Table 3: Annual Air Quality Benefits

Harcourt

Annual Air Quality Benefits of Public Trees

2/7/2023

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2								
Green ash	26.7	4.3	12.4	1.2	141	78.7	11.4	10.9	74.2	489	0.0	0	219.7	630	(N/A)	24.8	12.11
Silver maple	35.3	6.0	17.0	1.6	190	55.8	8.1	7.8	53.3	348	-19.1	-72	165.8	466	(N/A)	15.2	14.58
Black walnut	7.5	1.2	3.7	0.3	40	32.2	4.7	4.5	30.5	201	0.0	0	84.7	241	(N/A)	11.4	10.04
Norway maple	12.2	2.1	5.9	0.5	66	28.6	4.1	3.9	26.7	177	-2.8	-11	81.3	232	(N/A)	11.0	10.09
Amur maple	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)	4.8	0.11
Northern hackberry	3.1	0.5	1.6	0.1	17	11.4	1.7	1.6	10.9	71	0.0	0	30.9	88	(N/A)	4.3	9.80
Northern red oak	0.9	0.2	0.4	0.0	5	2.3	0.3	0.3	2.2	14	-1.3	-5	5.4	14	(N/A)	3.3	2.07
Honeylocust	2.0	0.3	0.9	0.1	11	4.8	0.7	0.7	4.5	30	-1.5	-6	12.5	35	(N/A)	2.9	5.79
Blue spruce	0.6	0.1	0.5	0.1	4	1.9	0.3	0.3	1.8	12	-1.7	-6	3.8	9	(N/A)	2.9	1.53
Eastern white pine	1.3	0.2	1.0	0.2	8	2.3	0.3	0.3	2.2	15	-5.7	-21	2.2	1	(N/A)	2.9	0.24
Bur oak	0.3	0.0	0.2	0.0	2	1.8	0.3	0.2	1.7	11	0.0	0	4.4	13	(N/A)	2.4	2.52
Littleleaf linden	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)	1.9	0.07
Mountain ash	0.9	0.2	0.4	0.0	5	2.4	0.3	0.3	2.1	14	0.0	0	6.7	19	(N/A)	1.4	6.41
American sycamore	3.9	0.6	1.7	0.2	20	6.5	0.9	0.9	6.2	40	0.0	0	20.9	61	(N/A)	1.4	20.21
American basswood	1.0	0.2	0.5	0.0	5	3.9	0.6	0.5	3.7	24	-0.8	-3	9.6	26	(N/A)	1.4	8.83
Black maple	1.8	0.3	0.8	0.1	10	3.9	0.6	0.5	3.7	24	-0.6	-2	11.2	32	(N/A)	1.4	10.61
Basswood	1.0	0.2	0.5	0.0	5	3.2	0.5	0.4	3.0	20	0.0	0	8.7	25	(N/A)	1.0	12.48
White ash	1.3	0.2	0.6	0.1	7	3.5	0.5	0.5	3.3	22	0.0	0	9.9	28	(N/A)	1.0	14.19
Pin oak	0.9	0.2	0.5	0.0	5	2.9	0.4	0.4	2.8	18	-1.8	-7	6.3	17	(N/A)	1.0	8.29
Maple	1.5	0.3	0.7	0.1	8	2.7	0.4	0.4	2.6	17	-0.5	-2	8.1	23	(N/A)	1.0	11.54
Tulip tree	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)	0.5	0.08
Black poplar	0.3	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	0.0	0	3.3	9	(N/A)	0.5	9.34
Plum	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	0.5	2.55
Apple	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	0.5	2.55
White mulberry	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7	(N/A)	0.5	6.56
Mulberry	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)	0.5	0.71
Citywide total	102.7	17.1	49.8	4.7	551	251.9	36.6	34.9	238.4	1,567	-35.8	-134	700.3	1,984	(N/A)	100.0	9.45

Table 4: Annual Carbon Stored

Harcourt

Stored CO2 Benefits of Public Trees

2/7/2023

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	871,266	6,534	(N/A)	24.8	33.0	125.66
Silver maple	899,235	6,744	(N/A)	15.2	34.0	210.76
Black walnut	240,105	1,801	(N/A)	11.4	9.1	75.03
Norway maple	200,853	1,506	(N/A)	11.0	7.6	65.50
Amur maple	138	1	(N/A)	4.8	0.0	0.10
Northern hackberry	48,270	362	(N/A)	4.3	1.8	40.22
Northern red oak	18,897	142	(N/A)	3.3	0.7	20.25
Honeylocust	25,772	193	(N/A)	2.9	1.0	32.21
Blue spruce	3,361	25	(N/A)	2.9	0.1	4.20
Eastern white pine	14,183	106	(N/A)	2.9	0.5	17.73
Bur oak	9,529	71	(N/A)	2.4	0.4	14.29
Littleleaf linden	50	0	(N/A)	1.9	0.0	0.09
Mountain ash	14,393	108	(N/A)	1.4	0.5	35.98
American sycamore	134,499	1,009	(N/A)	1.4	5.1	336.25
American basswood	34,073	256	(N/A)	1.4	1.3	85.18
Black maple	19,515	146	(N/A)	1.4	0.7	48.79
Basswood	31,546	237	(N/A)	1.0	1.2	118.30
White ash	24,230	182	(N/A)	1.0	0.9	90.86
Pin oak	23,457	176	(N/A)	1.0	0.9	87.96
Maple	15,891	119	(N/A)	1.0	0.6	59.59
Tulip tree	12	0	(N/A)	0.5	0.0	0.09
Black poplar	8,458	63	(N/A)	0.5	0.3	63.43
Plum	908	7	(N/A)	0.5	0.0	6.81
Apple	908	7	(N/A)	0.5	0.0	6.81
White mulberry	3,037	23	(N/A)	0.5	0.1	22.78
Mulberry	178	1	(N/A)	0.5	0.0	1.33
Citywide total	2,642,762	19,821	(N/A)	100.0	100.0	94.38

The value of stored carbon dioxide is calculated as the total amount of carbon dioxide sequestered annually over the life of each tree, summed for the population. This value should not be added to the Replacement Value or double-counting of the carbon dioxide storage benefit will occur.

Table 5: Annual Carbon Sequestered

Harcourt

Annual CO Benefits of Public Trees

2/7/2023

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
Green ash	39,457	296	-4,182	-176	-33	27,462	206	62,561	469 (N/A)	24.8	28.4	9.02
Silver maple	58,184	436	-4,317	-141	-33	19,762	148	73,488	551 (N/A)	15.2	33.4	17.22
Black walnut	16,321	122	-1,153	-68	-9	11,300	85	26,401	198 (N/A)	11.4	12.0	8.25
Norway maple	8,617	65	-964	-61	-8	9,866	74	17,458	131 (N/A)	11.0	7.9	5.69
Amur maple	87	1	-1	-2	0	56	0	140	1 (N/A)	4.8	0.1	0.10
Northern hackberry	2,479	19	-232	-21	-2	4,025	30	6,250	47 (N/A)	4.3	2.8	5.21
Northern red oak	306	2	-91	-6	-1	815	6	1,023	8 (N/A)	3.3	0.5	1.10
Honeylocust	3,391	25	-124	-9	-1	1,678	13	4,936	37 (N/A)	2.9	2.2	6.17
Blue spruce	277	2	-16	-6	0	670	5	924	7 (N/A)	2.9	0.4	1.16
Eastern white pine	641	5	-68	-10	-1	822	6	1,386	10 (N/A)	2.9	0.6	1.73
Bur oak	876	7	-46	-4	0	613	5	1,439	11 (N/A)	2.4	0.7	2.16
Littleleaf linden	73	1	0	-1	0	15	0	86	1 (N/A)	1.9	0.0	0.16
Mountain ash	114	1	-69	-8	-1	794	6	830	6 (N/A)	1.4	0.4	2.08
American sycamore	2,303	17	-646	-16	-5	2,282	17	3,923	29 (N/A)	1.4	1.8	9.81
American basswood	2,165	16	-164	-9	-1	1,371	10	3,364	25 (N/A)	1.4	1.5	8.41
Black maple	1,407	11	-94	-7	-1	1,385	10	2,690	20 (N/A)	1.4	1.2	6.73
Basswood	1,714	13	-151	-7	-1	1,105	8	2,660	20 (N/A)	1.0	1.2	9.97
White ash	2,160	16	-116	-6	-1	1,223	9	3,260	24 (N/A)	1.0	1.5	12.23
Pin oak	2,371	18	-113	-6	-1	1,020	8	3,272	25 (N/A)	1.0	1.5	12.27
Maple	923	7	-76	-5	-1	954	7	1,796	13 (N/A)	1.0	0.8	6.73
Tulip tree	3	0	0	0	0	4	0	7	0 (N/A)	0.5	0.0	0.05
Black poplar	660	5	-41	-3	0	441	3	1,058	8 (N/A)	0.5	0.5	7.93
Plum	114	1	-4	-1	0	124	1	232	2 (N/A)	0.5	0.1	1.74
Apple	114	1	-4	-1	0	124	1	232	2 (N/A)	0.5	0.1	1.74
White mulberry	268	2	-15	-2	0	308	2	560	4 (N/A)	0.5	0.3	4.20
Mulberry	38	0	-1	-1	0	37	0	74	1 (N/A)	0.5	0.0	0.55
Citywide total	145,062	1,088	-12,687	-579	-99	88,255	662	220,051	1,650 (N/A)	100.0	100.0	7.86

Table 6: Annual Social and Aesthetic Benefits

Harcourt

Annual Aesthetic/Other Benefits of Public Trees

2/7/2023

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	3,067	(N/A)	24.8	25.1	58.97
Silver maple	4,166	(N/A)	15.2	34.1	130.20
Black walnut	1,385	(N/A)	11.4	11.3	57.69
Norway maple	796	(N/A)	11.0	6.5	34.62
Amur maple	0	(N/A)	4.8	0.0	0.03
Northern hackberry	383	(N/A)	4.3	3.1	42.59
Northern red oak	32	(N/A)	3.3	0.3	4.54
Honeylocust	779	(N/A)	2.9	6.4	129.88
Blue spruce	91	(N/A)	2.9	0.7	15.13
Eastern white pine	138	(N/A)	2.9	1.1	22.95
Bur oak	102	(N/A)	2.4	0.8	20.41
Littleleaf linden	11	(N/A)	1.9	0.1	2.74
Mountain ash	6	(N/A)	1.4	0.1	2.14
American sycamore	145	(N/A)	1.4	1.2	48.42
American basswood	168	(N/A)	1.4	1.4	56.05
Black maple	175	(N/A)	1.4	1.4	58.32
Basswood	131	(N/A)	1.0	1.1	65.59
White ash	228	(N/A)	1.0	1.9	113.86
Pin oak	199	(N/A)	1.0	1.6	99.74
Maple	109	(N/A)	1.0	0.9	54.54
Tulip tree	5	(N/A)	0.5	0.0	5.26
Black poplar	58	(N/A)	0.5	0.5	57.69
Plum	6	(N/A)	0.5	0.1	6.40
Apple	6	(N/A)	0.5	0.1	6.40
White mulberry	15	(N/A)	0.5	0.1	15.48
Mulberry	2	(N/A)	0.5	0.0	2.06
Citywide total	12,206	(N/A)	100.0	100.0	58.12

Table 7: Summary of Benefits in Dollars

Harcourt

Total Annual Benefits, Net Benefits, and Costs for Public Trees

2/7/2023

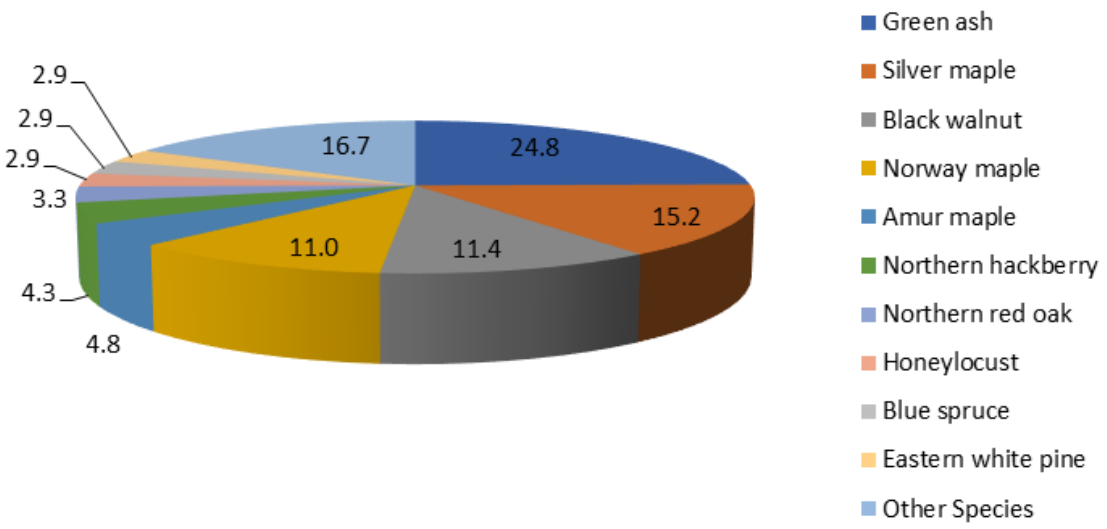
Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	11,134	(N/A)	53.02	(N/A)	42.17	(N/A)
CO2	1,650	(N/A)	7.86	(N/A)	6.25	(N/A)
Air Quality	1,984	(N/A)	9.45	(N/A)	7.52	(N/A)
Stormwater	17,110	(N/A)	81.48	(N/A)	64.81	(N/A)
Aesthetic/Other	12,206	(N/A)	58.12	(N/A)	46.23	(N/A)
Total Benefits	44,084	(N/A)	209.92	(N/A)	166.98	(N/A)
Costs						
Planting	0		0.00		0.00	
Contract Pruning	0		0.00		0.00	
Pest Management	0		0.00		0.00	
Irrigation	0		0.00		0.00	
Removal	0		0.00		0.00	
Administration	0		0.00		0.00	
Inspection/Service	0		0.00		0.00	
Infrastructure Repairs	0		0.00		0.00	
Litter Clean-up	0		0.00		0.00	
Liability/Claims	0		0.00		0.00	
Other Costs	0		0.00		0.00	
Total Costs	0		0.00		0.00	
Net Benefits	44,084	(N/A)	209.92	(N/A)	166.98	(N/A)
Benefit-cost ratio	0.00	(N/A)				

Figure 1: Species Distribution

Harcourt

Species Distribution of Public Trees

2/7/2023



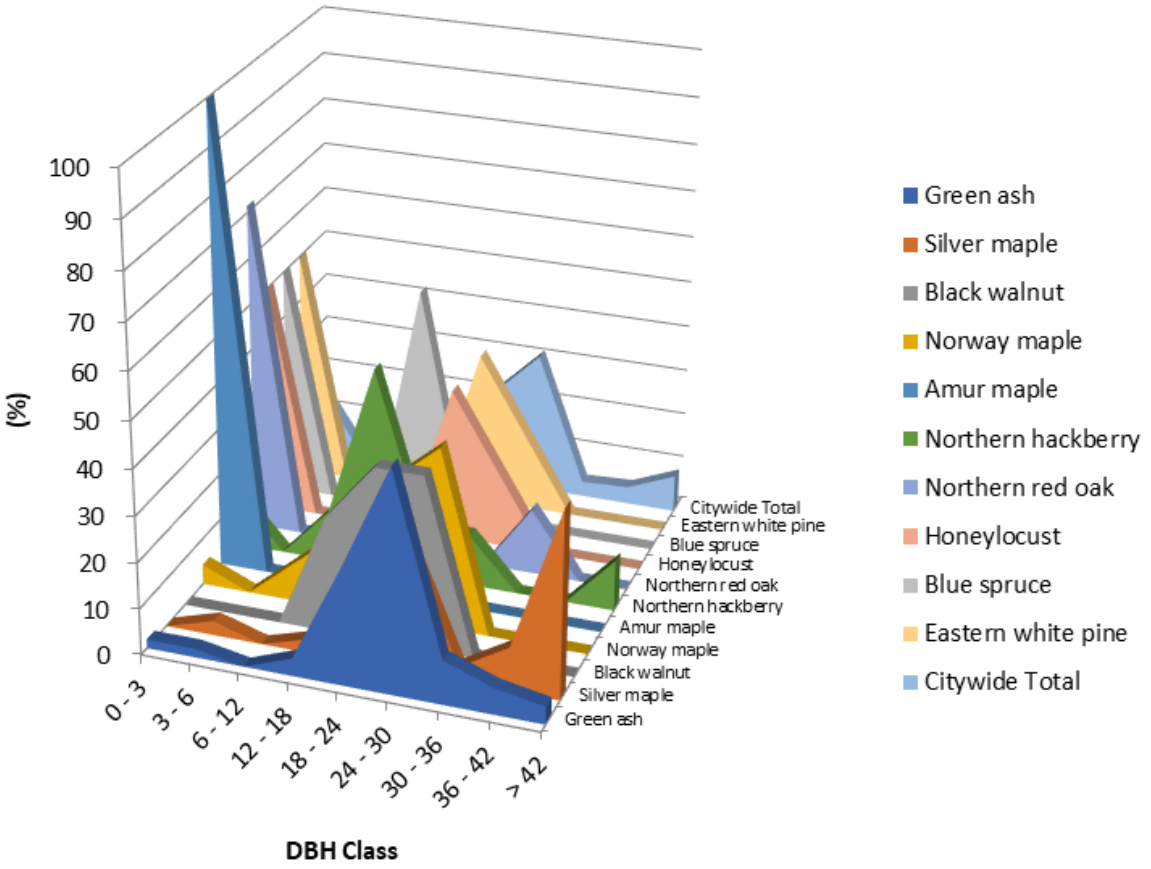
Species	Percent
Green ash	24.8
Silver maple	15.2
Black walnut	11.4
Norway maple	11.0
Amur maple	4.8
Northern hackberry	4.3
Northern red oak	3.3
Honeylocust	2.9
Blue spruce	2.9
Eastern white pine	2.9
Other Species	16.7
Total	100.0

Figure 2: Relative Age Class

Harcourt

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

2/7/2023



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Green ash	1.92	1.92	0.00	3.85	25.00	48.08	9.62	5.77	3.85
Silver maple	0.00	3.13	0.00	3.13	12.50	28.13	3.13	9.38	40.63
Black walnut	0.00	0.00	0.00	25.00	37.50	37.50	0.00	0.00	0.00
Norway maple	4.35	0.00	8.70	17.39	30.43	39.13	0.00	0.00	0.00
Amur maple	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Northern hackberry	11.11	0.00	11.11	44.44	11.11	11.11	0.00	0.00	11.11
Northern red oak	71.43	0.00	0.00	14.29	0.00	0.00	14.29	0.00	0.00
Honeylocust	50.00	0.00	0.00	0.00	33.33	16.67	0.00	0.00	0.00
Blue spruce	50.00	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00
Eastern white pine	50.00	0.00	0.00	0.00	33.33	16.67	0.00	0.00	0.00
Citywide Total	16.67	1.43	3.33	11.43	20.95	30.95	3.33	3.81	8.10

Figure 3: Foliage Condition

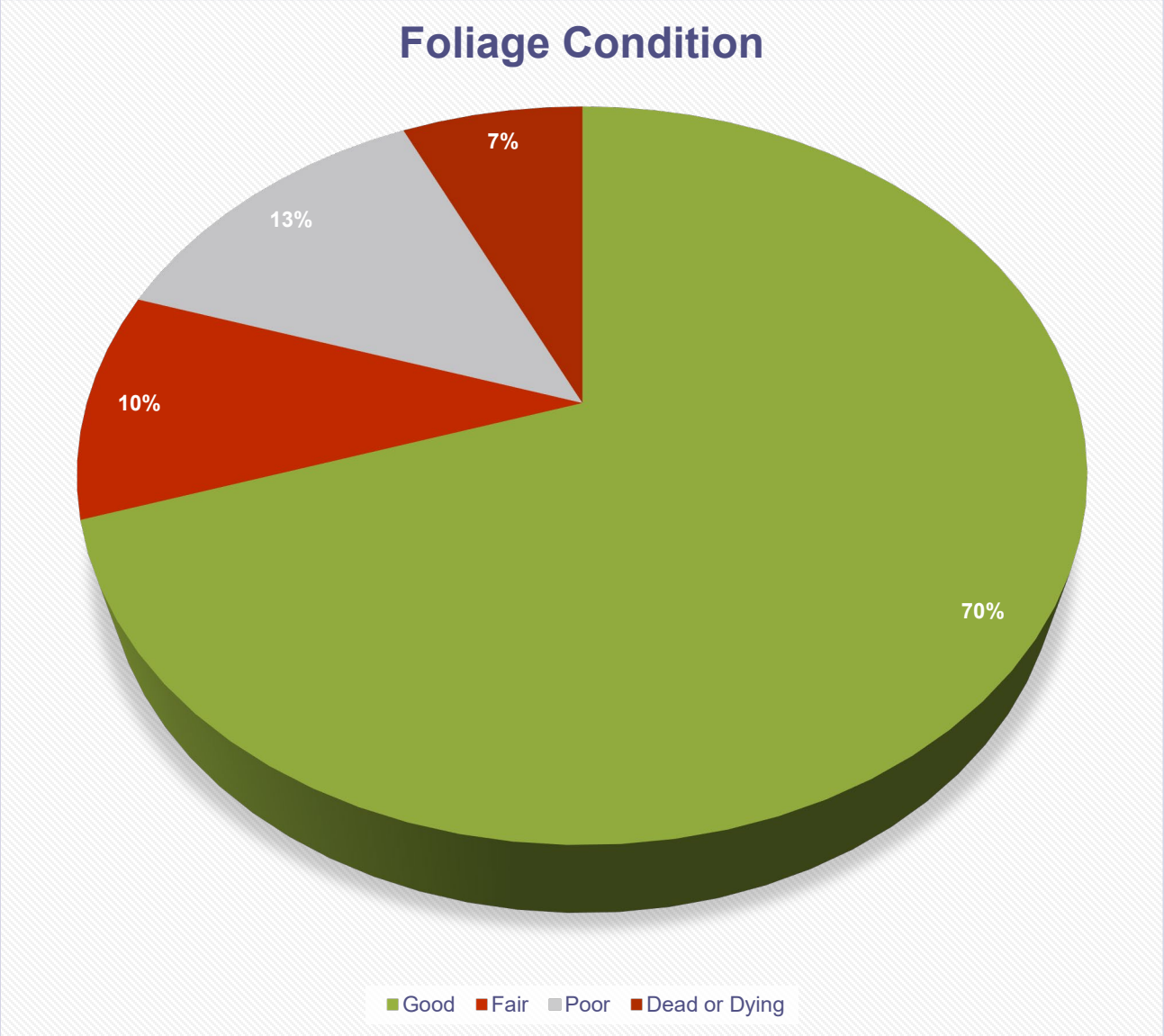


Figure 4: Wood Condition

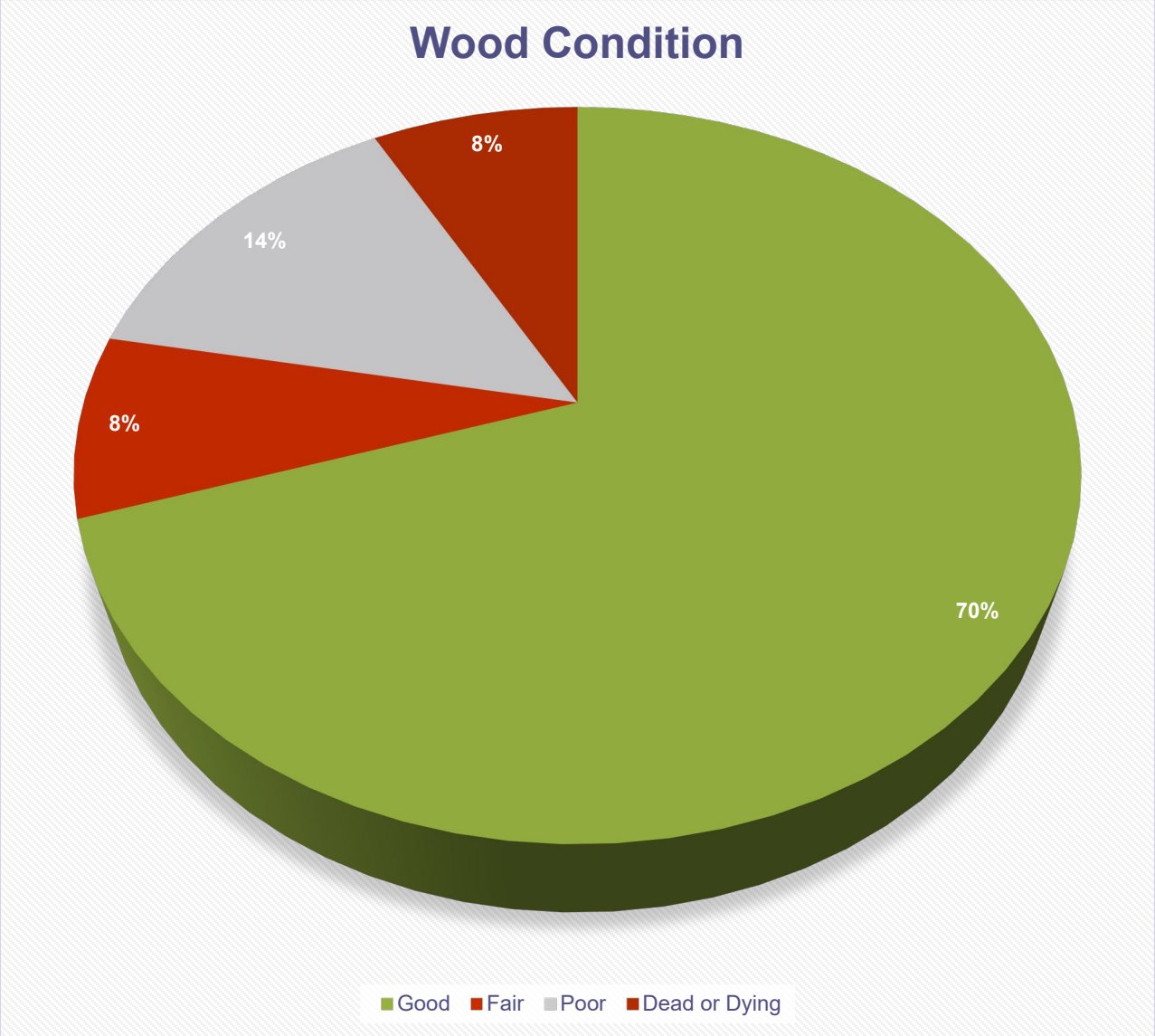
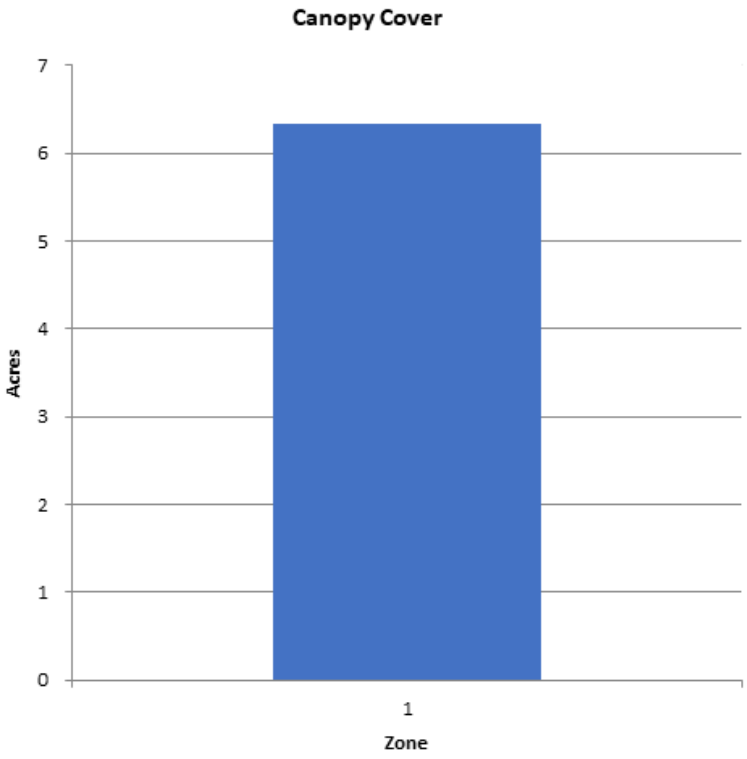


Figure 5: Canopy Cover in Acres

Harcourt

Canopy Cover of Public Trees (Acres)

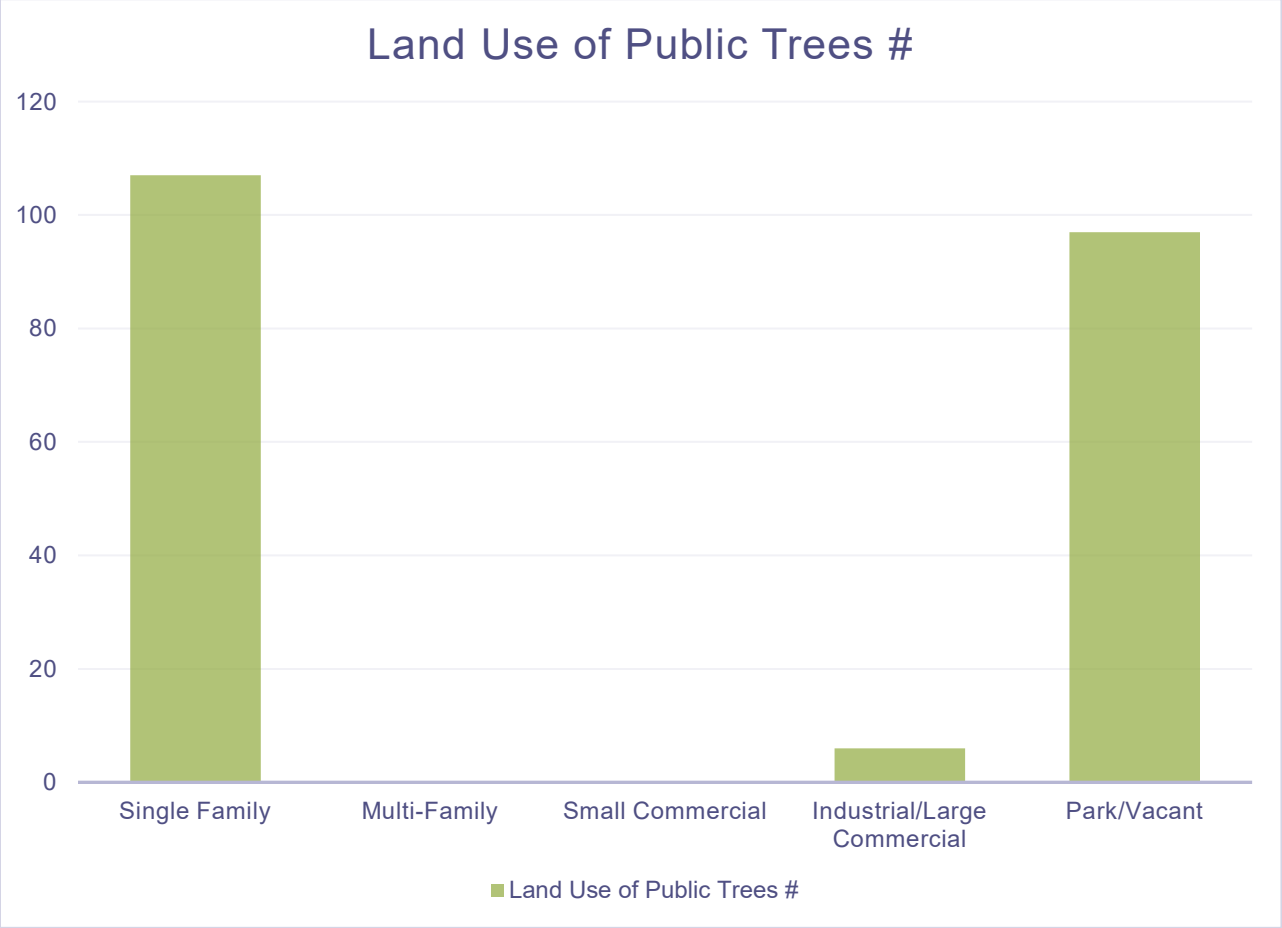
2/7/2023



Zone	Acres	% of Total Canopy Cover
1	6	100.0
Citywide total	6	100.0

	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide Total	0	0	6	0.00	0.00

Figure 6: Land Use of City/Park Trees



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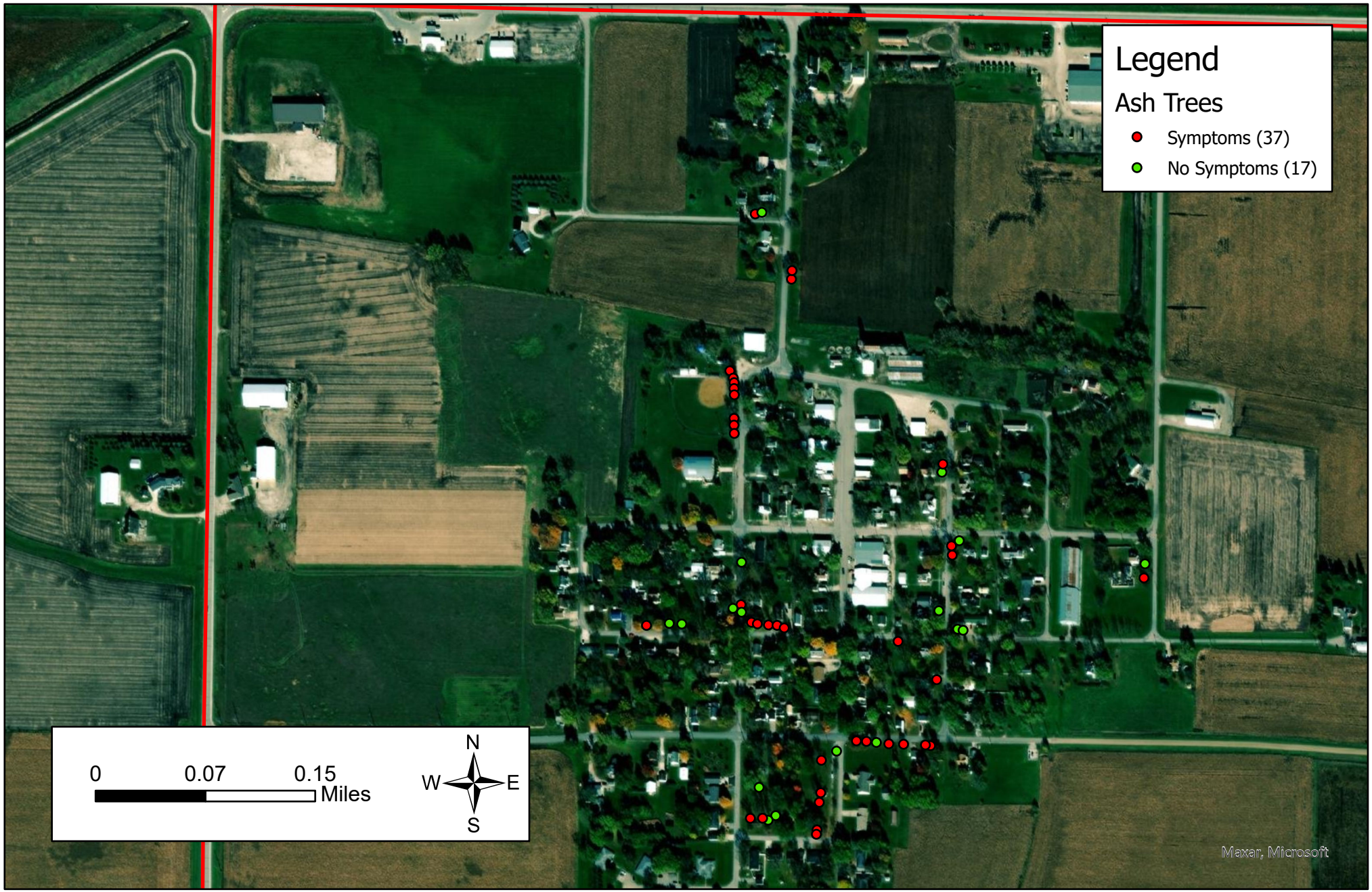
File: 2022 IDNR Tree Inventory.aprx

2022 IDNR Tree Inventory

Figure 1 - Ash Tree Location
Harcourt, Iowa

JEO CONSULTING GROUP INC



Created By: D. Genereux
Date: 1/26/2023
Software: ArcGIS Pro 3.0.3
File: 2022 IDNR Tree Inventory.aprx

2022 IDNR Tree Inventory

Figure 2 - EAB Symptoms
Harcourt, Iowa

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Date: 1/26/2023
Software: ArcGIS Pro 3.0.3
File: 2022 IDNR Tree Inventory.aprx

2022 IDNR Tree Inventory

Figure 3 - Poor Condition Trees
Harcourt, Iowa

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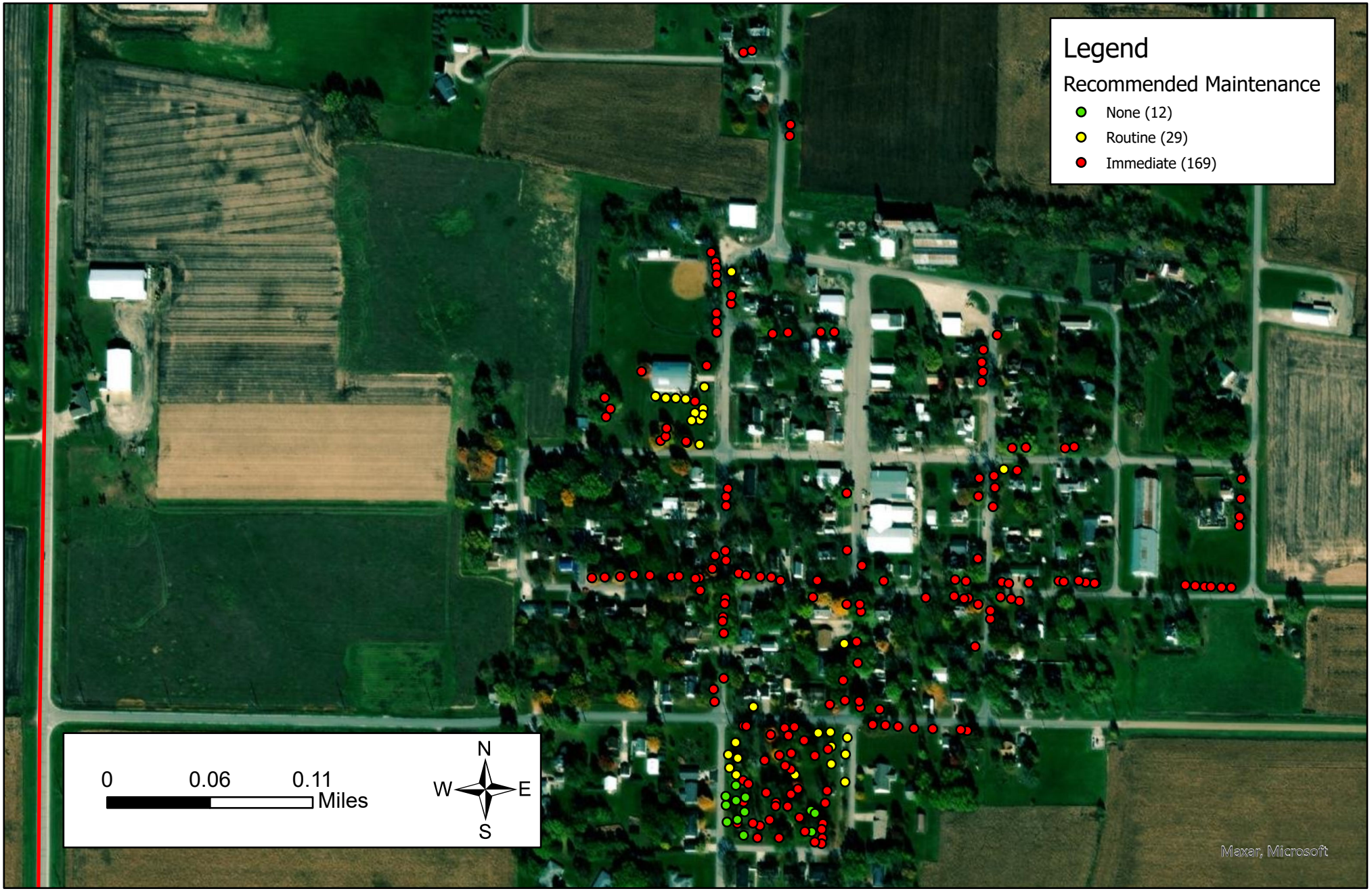

Created By: D. Genereux
Date: 1/26/2023
Software: ArcGIS Pro 3.0.3
File: 2022 IDNR Tree Inventory.aprx

2022 IDNR Tree Inventory

Figure 4 - Recommended Maintenance
Harcourt, Iowa

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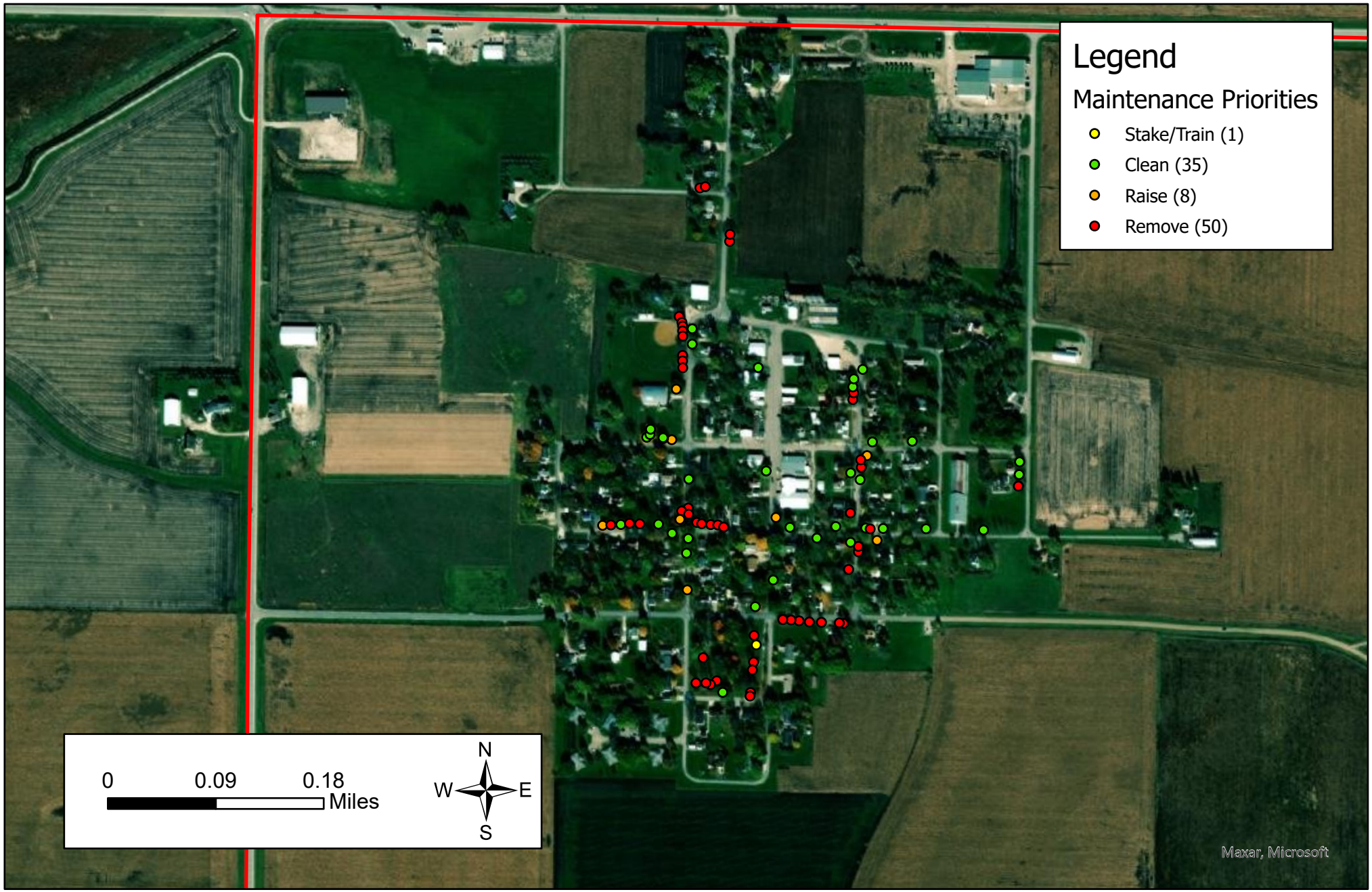

Created By: D. Genereux
Date: 1/26/2023
Software: ArcGIS Pro 3.0.3
File: 2022 IDNR Tree Inventory.aprx

2022 IDNR Tree Inventory

Figure 5 - Maintenance Priorities
Harcourt, Iowa

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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: HARCOURT TREE ORDINANCES

Harcourt ordinance pertaining to trees is brief, and because my printer does not scan doc to e-mail, I will type them out here.

Under Chapter 2 Nuisances: 3-2-1 Definitions "The following are declared to be nuisances."

1-H "Cotton-bearing cottonwood trees and all other cotton-bearing poplar trees in the City."

1-L "Trees infected with Dutch elm disease. (Code of Iowa, Sec.657.2(12)"

3-2-3 "The following actions are required-----"

1. "The removal of diseased trees or dead wood, but not diseased trees and dead wood outside the lot and property between sidewalk and street edge."

7. "The maintenance, by the property owner, of all property outside the lot and property lines and inside the curb lines upon the public streets, including maintaining a fifteen (15) foot clearance above the street from trees extending over the streets."