Spillville, 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 Spillville 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 20% of Spillville'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 176 trees inventoried.

- Spillville trees provide $23,587 of benefits annually, an average of $135 per tree
- There are over 26 species of trees
- The top three genera are: Maple 37%, Ash 20%, and Apple 15%
- 41% of trees need some type of management
- 1 tree should be removed

Recommendations

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

- Out of the 1 tree needing removal, it is 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*
- 7 of the 35 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 30 years to remove ash. We suggest that city officials request a budget increase to $2,000 annually and apply for grants to plant replacement trees.

Introduction

INTRODUCTION

This plan was developed to assist Spillville 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 Spillville, 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 Spillville'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 Spillville 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 Spillville's urban forestry goals.

Assist Spillville 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 175 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. Spillville's trees reduce energy-related costs by approximately $6,498 annually (Appendix A, Table 1). These savings are both in electricity (30.9 MWh) and in natural gas (4,236.2 Therms).

Annual Stormwater Benefits

Spillville's trees intercept about 310,169 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $8,406 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 Spillville, it is estimated that trees remove 387 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 $1,087 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Spillville, trees sequester about 76,961 lbs of carbon per year with an associated value of $922 (Appendix A, Table 5). In addition, the trees store 1,158,498 lbs of carbon, with a yearly benefit of $8,689 (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. Spillville receives $6,676 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, Spillville's trees provide $23,587 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 139 trees in Spillville provide approximately $135 annually (Appendix A, Table 7).

ENERGY	STORMWATER	AIR QUALITY	CARBON	AESTHETICS	SUMMARY
• Reduce energy cost by **$6,498**	• Intercept 310,169 **gallons** • Provides **$8,406** benefit	• Remove 387 **lbs** of pollution • Net value of **$1,087**	• Sequester 76,961 **lbs** • Value of **$922** • Store 1,158,498 **lbs** • Value of **$8,689**	• **$6,676** in social benefits	• **$23,587** annual benefits • Each tree provides **$135** annually

FOREST STRUCTURE

Species Distribution

Spillville has over 26 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Maple	64	37%	Spruce	4	2%
Ash	35	20%	Birch	3	2%
Apple	27	15%	Cedar	2	1%
Basswood/Linden	10	6%	Cherry	1	1%
Elm	8	5%	Cottonwood	1	1%
Oak	8	5%	Hackberry	1	1%
Pine	5	3%	Lilac	1	1%
Walnut	5	3%			

Age Class

Most of Spillville's trees (22%) are between 12 and 18 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. Spillville'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 urban forest's overall health. The foliage condition results for Spillville indicate that 98% of the trees are in good health, with only 1% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 80% of Spillville's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Three percent of the tree population's wood condition is in poor health, dead, or dying. This 3% 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
Crown Cleaning	32	18%
Crown Reduction	20	11%
Crown Raising	18	10%
Tree Staking	2	1%
Tree Removal	1	1%

Canopy Cover

The total canopy with both private and public trees is 103 acres or 37% cover. The canopy cover included in the Spillville inventory includes approximately 3 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 2 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Spillville'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	86%
Park/Vacant/Other	7%
Industrial/Large Commercial	4%
Multifamily Residential	2%
Small Commercial	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

Spillville has 1 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 2 trees over 24 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 73 trees with maintenance needs.

POOR TREE SPECIES

After removing the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 1 removal, 0 are ash trees. There are a total of 35 ash trees, and 7 of those have signs and symptoms that have been associated with EAB. In addition, there are 3 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising 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 Spillville.

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 (37%) (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 section 6.11.3 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 6.11.3 (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 6.11.3 (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.

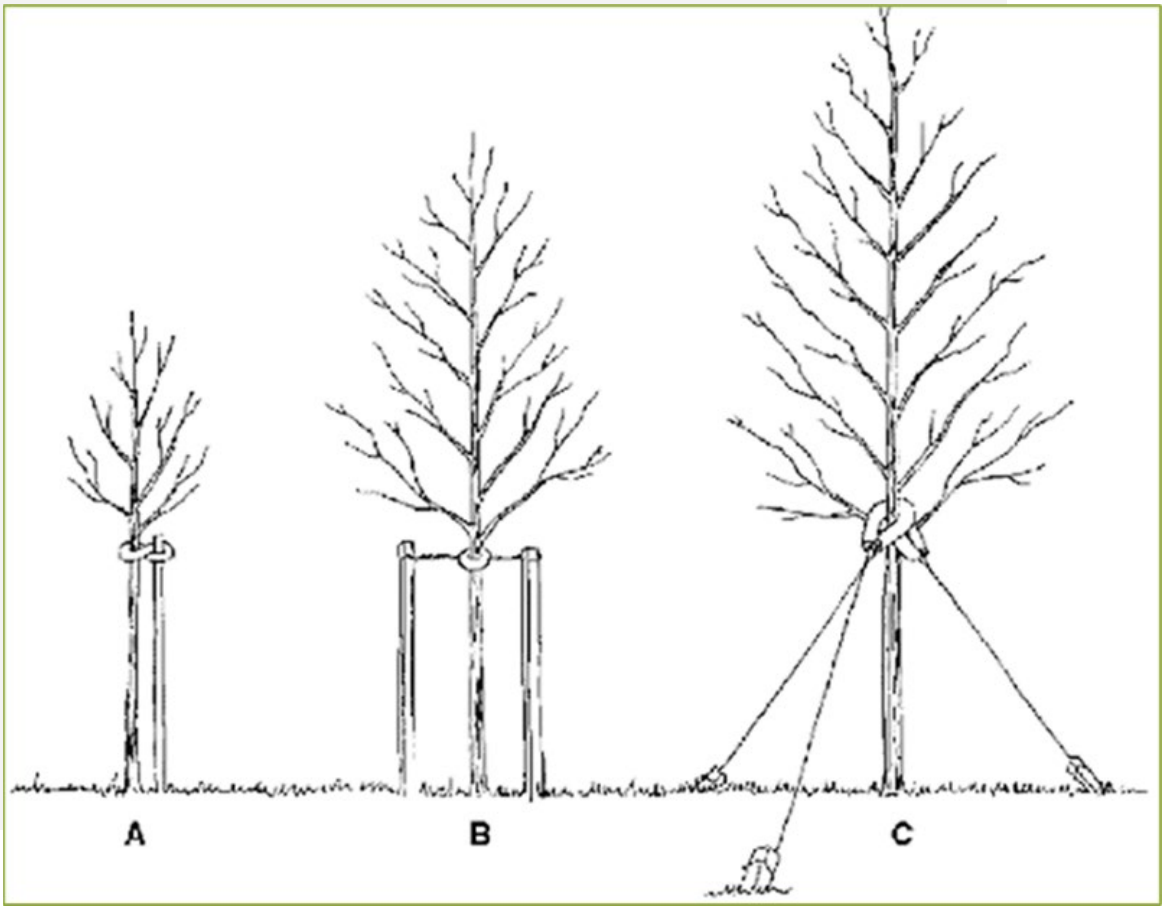
Monitoring

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 6.11.3 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 $800/Year – (Based off $2/Capita Tree Budget)

YEAR 1	Est. Cost
	$
Remove 1 ash tree in poor condition	$700
	$
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$700**

YEAR 2	Est. Cost
	$
Plant 1 trees in open locations	$150
Prune 1/4 of city owned trees	$650
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$800**

YEAR 3	Est. Cost
	$
	$
Plant 5 trees in open locations	$750
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$750**

YEAR 4	Est. Cost
	$
Plant 1 tree in open locations	$150
Prune 1/4 of city owned trees	$650
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$800**

YEAR 5	Est. Cost
Prune 1/4 of city owned trees	$650
Plant 1 tree in open locations	$150
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$800**

YEAR 6	Est. Cost
	$
Plant 1 tree in open locations	$150
Prune 1/4 of city owned trees	$650
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$800**

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 $4,000 a year. If the budget were increased to $2,000 a year all ash could be removed in 12 years.*

PROPOSED WORK SCHEDULE WITH INCREASED BUDGET

Budget Allowance of $2,000/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	Est. Cost
	$
Remove 2 ash trees in poor condition	$1,400
Plant 4 trees in open locations	$600
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,000**

YEAR 2	Est. Cost
Remove 1 ash tree in poor condition	$700
Plant 4 trees in open locations	$600
Prune 1/4 of city owned trees	$650
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$1,950**

YEAR 3	Est. Cost
Remove 2 ash trees	$1,400
Plant 4 trees in open locations	$600
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,000**

YEAR 4	Est. Cost
Remove 1 ash tree	$700
Plant 4 trees in open locations	$600
Prune 1/4 of city owned trees	$650
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$1,950**

YEAR 5	Est. Cost
Remove 2 ash trees	$1,400
Plant 4 trees in open locations	$600
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,000**

YEAR 6	Est. Cost
Remove 1 ash tree	$700
Plant 4 trees in open locations	$600
Prune 1/4 of city owned trees	$650
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$1,950**

Purposed Budget Increase

EAB could potentially kill all ash trees in Spillville within four years of its arrival. To remove all ash trees within six years, the budget would need to be increased to $4,000 a year. If the budget were increased to $2,000 per year all ash could be removed within 13 years. Additionally, we recommend that Spillville 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 2 trees could be treated per year (every other year treatment). Four trees would be selected for treatment, and Spillville would still need to find $21,000 for removal. Alternatively, if there are 2 treatable trees, it would cost approximately $300 a year for treatment and leave $500 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 Spillville. We suggest considering an increased budget to plan for this.

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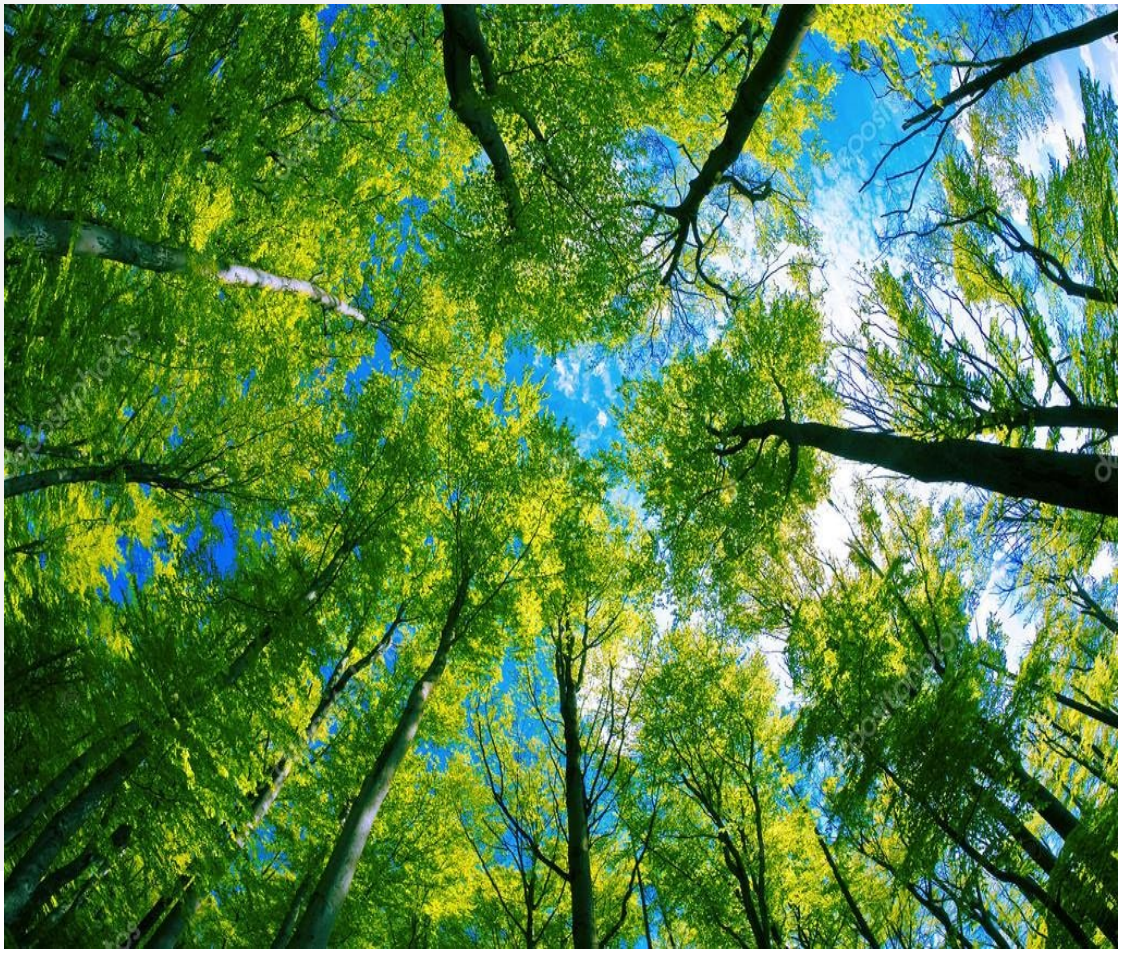
Appendices



APPENDIX A: i-TREE DATA

Table 1: Annual Energy Benefits

Spillville

Annual Energy Benefits of Public Trees

2/8/2023

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	7.4	564	981.8	962	1,526	(N/A)	16.6	23.5	52.62
Apple	2.1	156	305.5	299	455	(N/A)	15.4	7.0	16.87
Norway maple	4.6	347	662.9	650	996	(N/A)	15.4	15.3	36.91
Silver maple	5.2	394	672.4	659	1,053	(N/A)	9.1	16.2	65.78
American basswood	2.8	213	404.4	396	609	(N/A)	4.6	9.4	76.15
Elm	1.1	84	155.0	152	236	(N/A)	4.6	3.6	29.52
Sugar maple	0.8	61	101.9	100	161	(N/A)	4.6	2.5	20.15
Red maple	0.9	67	114.9	113	179	(N/A)	3.4	2.8	29.91
Amur maple	0.3	22	49.9	49	71	(N/A)	3.4	1.1	11.80
White ash	1.4	105	177.3	174	279	(N/A)	3.4	4.3	46.49
Eastern white pine	0.5	38	72.2	71	109	(N/A)	2.9	1.7	21.82
Black walnut	1.5	114	214.9	211	325	(N/A)	2.9	5.0	64.98
Blue spruce	0.2	13	22.4	22	35	(N/A)	2.3	0.5	8.69
Northern red oak	0.1	8	16.6	16	24	(N/A)	1.7	0.4	8.15
Bur oak	0.0	3	4.6	5	7	(N/A)	1.7	0.1	2.38
Birch	0.0	3	7.0	7	10	(N/A)	1.1	0.2	5.04
Eastern red cedar	0.2	17	32.9	32	49	(N/A)	1.1	0.8	24.57
Littleleaf linden	0.1	8	16.4	16	24	(N/A)	1.1	0.4	12.03
Paper birch	0.2	18	27.0	26	44	(N/A)	0.6	0.7	44.23
Maple	0.0	0	0.7	1	1	(N/A)	0.6	0.0	1.03
Swamp white oak	0.2	18	29.5	29	47	(N/A)	0.6	0.7	46.78
Black cherry	0.2	14	24.7	24	38	(N/A)	0.6	0.6	38.13
Northern hackberry	0.3	23	45.0	44	67	(N/A)	0.6	1.0	67.04
Northern pin oak	0.2	18	29.5	29	47	(N/A)	0.6	0.7	46.78
Eastern cottonwood	0.5	37	63.1	62	99	(N/A)	0.6	1.5	98.63
Japanese tree lilac	0.0	2	3.8	4	5	(N/A)	0.6	0.1	5.40
Total	30.9	2,346	4,236.2	4,152	6,498	(N/A)	100.0	100.0	37.13

Table 2: Annual Stormwater Benefits

Spillville

Annual Stormwater Benefits of Public Trees

2/8/2023

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	70,750	1,917	(N/A)	16.6	22.8	66.12
Apple	7,287	197	(N/A)	15.4	2.3	7.31
Norway maple	34,890	946	(N/A)	15.4	11.2	35.02
Silver maple	70,450	1,909	(N/A)	9.1	22.7	119.32
American basswood	37,697	1,022	(N/A)	4.6	12.2	127.70
Elm	15,214	412	(N/A)	4.6	4.9	51.54
Sugar maple	4,388	119	(N/A)	4.6	1.4	14.87
Red maple	5,221	141	(N/A)	3.4	1.7	23.58
Amur maple	999	27	(N/A)	3.4	0.3	4.51
White ash	14,102	382	(N/A)	3.4	4.5	63.70
Eastern white pine	10,613	288	(N/A)	2.9	3.4	57.52
Black walnut	17,206	466	(N/A)	2.9	5.5	93.25
Blue spruce	1,877	51	(N/A)	2.3	0.6	12.72
Northern red oak	567	15	(N/A)	1.7	0.2	5.12
Bur oak	207	6	(N/A)	1.7	0.1	1.87
Birch	175	5	(N/A)	1.1	0.1	2.37
Eastern red cedar	3,269	89	(N/A)	1.1	1.1	44.30
Littleleaf linden	554	15	(N/A)	1.1	0.2	7.51
Paper birch	1,466	40	(N/A)	0.6	0.5	39.72
Maple	12	0	(N/A)	0.6	0.0	0.32
Swamp white oak	1,409	38	(N/A)	0.6	0.5	38.19
Black cherry	667	18	(N/A)	0.6	0.2	18.06
Northern hackberry	2,432	66	(N/A)	0.6	0.8	65.89
Northern pin oak	1,409	38	(N/A)	0.6	0.5	38.19
Eastern cottonwood	7,239	196	(N/A)	0.6	2.3	196.17
Japanese tree lilac	69	2	(N/A)	0.6	0.0	1.86
Citywide total	310,169	8,406	(N/A)	100.0	100.0	48.03

Table 3: Annual Air Quality Benefits

Spillville

Annual Air Quality Benefits of Public Trees

2/8/2023

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	7.8	1.2	3.9	0.3	42	35.2	5.1	4.9	33.7	220	0.0	0	92.2	262	(N/A)	16.6	9.03
Apple	1.8	0.3	0.9	0.1	10	10.0	1.4	1.4	9.3	62	0.0	0	25.3	72	(N/A)	15.4	2.66
Norway maple	6.1	1.0	3.1	0.3	33	22.2	3.2	3.1	20.7	137	-1.5	-6	58.2	165	(N/A)	15.4	6.11
Silver maple	11.8	2.0	5.9	0.5	64	24.4	3.6	3.4	23.5	153	-6.2	-23	68.8	193	(N/A)	9.1	12.09
American basswood	5.7	1.0	2.7	0.3	30	13.6	2.0	1.9	12.7	84	-4.7	-18	35.1	97	(N/A)	4.6	12.14
Elm	2.1	0.3	1.0	0.1	11	5.3	0.8	0.7	5.0	33	0.0	0	15.4	44	(N/A)	4.6	5.55
Sugar maple	0.3	0.1	0.2	0.0	2	3.8	0.6	0.5	3.7	24	-0.3	-1	8.8	24	(N/A)	4.6	3.06
Red maple	0.9	0.2	0.5	0.0	5	4.2	0.6	0.6	4.0	26	-0.3	-1	10.5	30	(N/A)	3.4	4.92
Amur maple	0.1	0.0	0.1	0.0	1	1.5	0.2	0.2	1.3	9	0.0	0	3.4	10	(N/A)	3.4	1.63
White ash	2.0	0.3	1.0	0.1	11	6.5	1.0	0.9	6.3	41	0.0	0	18.0	51	(N/A)	3.4	8.57
Eastern white pine	1.2	0.2	1.0	0.2	8	2.4	0.4	0.3	2.3	15	-6.1	-23	2.0	0	(N/A)	2.9	0.07
Black walnut	2.1	0.3	1.0	0.1	11	7.3	1.1	1.0	6.8	45	0.0	0	19.7	56	(N/A)	2.9	11.24
Blue spruce	0.2	0.0	0.2	0.0	1	0.8	0.1	0.1	0.8	5	-0.6	-2	1.6	4	(N/A)	2.3	1.00
Northern red oak	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	-0.1	0	1.2	3	(N/A)	1.7	1.10
Bur oak	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)	1.7	0.35
Birch	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1	(N/A)	1.1	0.67
Eastern red cedar	0.7	0.1	0.5	0.1	4	1.1	0.2	0.1	1.0	7	-1.8	-7	2.0	4	(N/A)	1.1	2.19
Littleleaf linden	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3	(N/A)	1.1	1.67
Paper birch	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7	(N/A)	0.6	7.42
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)	0.6	0.13
Swamp white oak	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8	(N/A)	0.6	7.92
Black cherry	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)	0.6	6.56
Northern hackberry	0.3	0.1	0.2	0.0	2	1.5	0.2	0.2	1.4	9	0.0	0	3.8	11	(N/A)	0.6	10.85
Northern pin oak	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8	(N/A)	0.6	7.92
Eastern cottonwood	1.6	0.3	0.7	0.1	8	2.3	0.3	0.3	2.2	14	0.0	0	7.7	23	(N/A)	0.6	22.55
Japanese tree lilac	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)	0.6	0.71
Citywide total	45.7	7.7	23.3	2.2	249	147.6	21.5	20.5	140.1	919	-21.9	-82	386.7	1,087	(N/A)	100.0	6.21

Table 4: Annual Carbon Stored

Spillville

Stored CO2 Benefits of Public Trees

2/8/2023

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	253,131	1,898	(N/A)	16.6	21.8	65.46
Apple	29,599	222	(N/A)	15.4	2.6	8.22
Norway maple	101,912	764	(N/A)	15.4	8.8	28.31
Silver maple	263,237	1,974	(N/A)	9.1	22.7	123.39
American basswood	214,111	1,606	(N/A)	4.6	18.5	200.73
Elm	70,865	531	(N/A)	4.6	6.1	66.44
Sugar maple	10,324	77	(N/A)	4.6	0.9	9.68
Red maple	10,769	81	(N/A)	3.4	0.9	13.46
Amur maple	3,257	24	(N/A)	3.4	0.3	4.07
White ash	38,321	287	(N/A)	3.4	3.3	47.90
Eastern white pine	15,532	116	(N/A)	2.9	1.3	23.30
Black walnut	67,089	503	(N/A)	2.9	5.8	100.63
Blue spruce	1,166	9	(N/A)	2.3	0.1	2.19
Northern red oak	1,050	8	(N/A)	1.7	0.1	2.62
Bur oak	210	2	(N/A)	1.7	0.0	0.52
Birch	235	2	(N/A)	1.1	0.0	0.88
Eastern red cedar	2,204	17	(N/A)	1.1	0.2	8.27
Littleleaf linden	1,211	9	(N/A)	1.1	0.1	4.54
Paper birch	3,672	28	(N/A)	0.6	0.3	27.54
Maple	17	0	(N/A)	0.6	0.0	0.13
Swamp white oak	3,624	27	(N/A)	0.6	0.3	27.18
Black cherry	3,037	23	(N/A)	0.6	0.3	22.78
Northern hackberry	4,142	31	(N/A)	0.6	0.4	31.07
Northern pin oak	3,624	27	(N/A)	0.6	0.3	27.18
Eastern cottonwood	55,982	420	(N/A)	0.6	4.8	419.86
Japanese tree lilac	178	1	(N/A)	0.6	0.0	1.33
Citywide total	1,158,498	8,689	(N/A)	100.0	100.0	49.65

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

Spillville

Annual CO Benefits of Public Trees

2/8/2023

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	16,949	127	-1,215	-73	-10	12,457	93	28,118	211 (N/A)	16.6	22.9	7.27
Apple	3,105	23	-142	-29	-1	3,449	26	6,383	48 (N/A)	15.4	5.2	1.77
Norway maple	8,027	60	-492	-46	-4	7,664	57	15,153	114 (N/A)	15.4	12.3	4.21
Silver maple	20,363	153	-1,264	-55	-10	8,699	65	27,742	208 (N/A)	9.1	22.6	13.00
American basswood	11,572	87	-1,028	-34	-8	4,704	35	15,214	114 (N/A)	4.6	12.4	14.26
Elm	2,639	20	-340	-13	-3	1,861	14	4,146	31 (N/A)	4.6	3.4	3.89
Sugar maple	1,163	9	-52	-9	0	1,354	10	2,456	18 (N/A)	4.6	2.0	2.30
Red maple	1,501	11	-52	-8	0	1,479	11	2,920	22 (N/A)	3.4	2.4	3.65
Amur maple	455	3	-16	-5	0	484	4	919	7 (N/A)	3.4	0.7	1.15
White ash	3,670	28	-184	-12	-1	2,324	17	5,798	43 (N/A)	3.4	4.7	7.25
Eastern white pine	635	5	-75	-10	-1	849	6	1,399	10 (N/A)	2.9	1.1	2.10
Black walnut	3,796	28	-322	-16	-3	2,526	19	5,984	45 (N/A)	2.9	4.9	8.98
Blue spruce	106	1	-6	-3	0	282	2	380	3 (N/A)	2.3	0.3	0.71
Northern red oak	157	1	-5	-2	0	182	1	332	2 (N/A)	1.7	0.3	0.83
Bur oak	79	1	-1	-1	0	57	0	135	1 (N/A)	1.7	0.1	0.34
Birch	101	1	-2	-1	0	72	1	170	1 (N/A)	1.1	0.1	0.64
Eastern red cedar	0	0	-11	-4	0	374	3	359	3 (N/A)	1.1	0.3	1.35
Littleleaf linden	283	2	-6	-2	0	177	1	452	3 (N/A)	1.1	0.4	1.69
Paper birch	445	3	-18	-2	0	393	3	819	6 (N/A)	0.6	0.7	6.14
Maple	3	0	0	0	0	7	0	9	0 (N/A)	0.6	0.0	0.07
Swamp white oak	386	3	-17	-2	0	395	3	762	6 (N/A)	0.6	0.6	5.71
Black cherry	268	2	-15	-2	0	308	2	560	4 (N/A)	0.6	0.5	4.20
Northern hackberry	354	3	-20	-3	0	507	4	838	6 (N/A)	0.6	0.7	6.29
Northern pin oak	386	3	-17	-2	0	395	3	762	6 (N/A)	0.6	0.6	5.71
Eastern cottonwood	479	4	-269	-6	-2	813	6	1,017	8 (N/A)	0.6	0.8	7.63
Japanese tree lilac	38	0	-1	-1	0	37	0	74	1 (N/A)	0.6	0.1	0.55
Citywide total	76,961	577	-5,568	-340	-44	51,848	389	122,900	922 (N/A)	100.0	100.0	5.27

Table 6: Annual Social and Aesthetic Benefits

Spillville

Annual Aesthetic/Other Benefits of Public Trees

2/8/2023

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	1,492	(N/A)	16.6	22.3	51.43
Apple	176	(N/A)	15.4	2.6	6.51
Norway maple	827	(N/A)	15.4	12.4	30.63
Silver maple	1,618	(N/A)	9.1	24.2	101.10
American basswood	759	(N/A)	4.6	11.4	94.85
Elm	216	(N/A)	4.6	3.2	26.98
Sugar maple	151	(N/A)	4.6	2.3	18.86
Red maple	229	(N/A)	3.4	3.4	38.10
Amur maple	25	(N/A)	3.4	0.4	4.23
White ash	417	(N/A)	3.4	6.2	69.45
Eastern white pine	90	(N/A)	2.9	1.4	18.04
Black walnut	305	(N/A)	2.9	4.6	61.05
Blue spruce	48	(N/A)	2.3	0.7	11.90
Northern red oak	19	(N/A)	1.7	0.3	6.44
Bur oak	25	(N/A)	1.7	0.4	8.42
Birch	16	(N/A)	1.1	0.2	7.81
Eastern red cedar	0	(N/A)	1.1	0.0	0.00
Littleleaf linden	42	(N/A)	1.1	0.6	20.86
Paper birch	46	(N/A)	0.6	0.7	45.86
Maple	0	(N/A)	0.6	0.0	0.04
Swamp white oak	39	(N/A)	0.6	0.6	39.16
Black cherry	15	(N/A)	0.6	0.2	15.48
Northern hackberry	52	(N/A)	0.6	0.8	52.26
Northern pin oak	39	(N/A)	0.6	0.6	39.16
Eastern cottonwood	29	(N/A)	0.6	0.4	28.57
Japanese tree lilac	2	(N/A)	0.6	0.0	2.06
Citywide total	6,676	(N/A)	100.0	100.0	38.15

Table 7: Summary of Benefits in Dollars

Spillville

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

2/8/2023

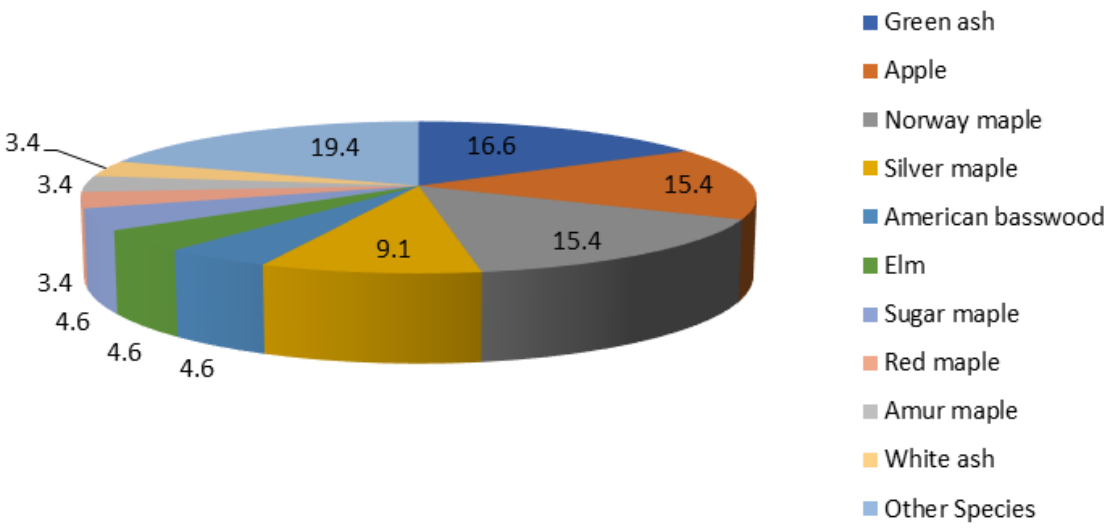
Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	6,498	(N/A)	37.13	(N/A)	16.88	(N/A)
CO2	922	(N/A)	5.27	(N/A)	2.39	(N/A)
Air Quality	1,087	(N/A)	6.21	(N/A)	2.82	(N/A)
Stormwater	8,406	(N/A)	48.03	(N/A)	21.83	(N/A)
Aesthetic/Other	6,676	(N/A)	38.15	(N/A)	17.34	(N/A)
Total Benefits	23,587	(N/A)	134.78	(N/A)	61.27	(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	23,587	(N/A)	134.78	(N/A)	61.27	(N/A)
Benefit-cost ratio	0.00	(N/A)				

Figure 1: Species Distribution

Spillville

Species Distribution of Public Trees

2/8/2023



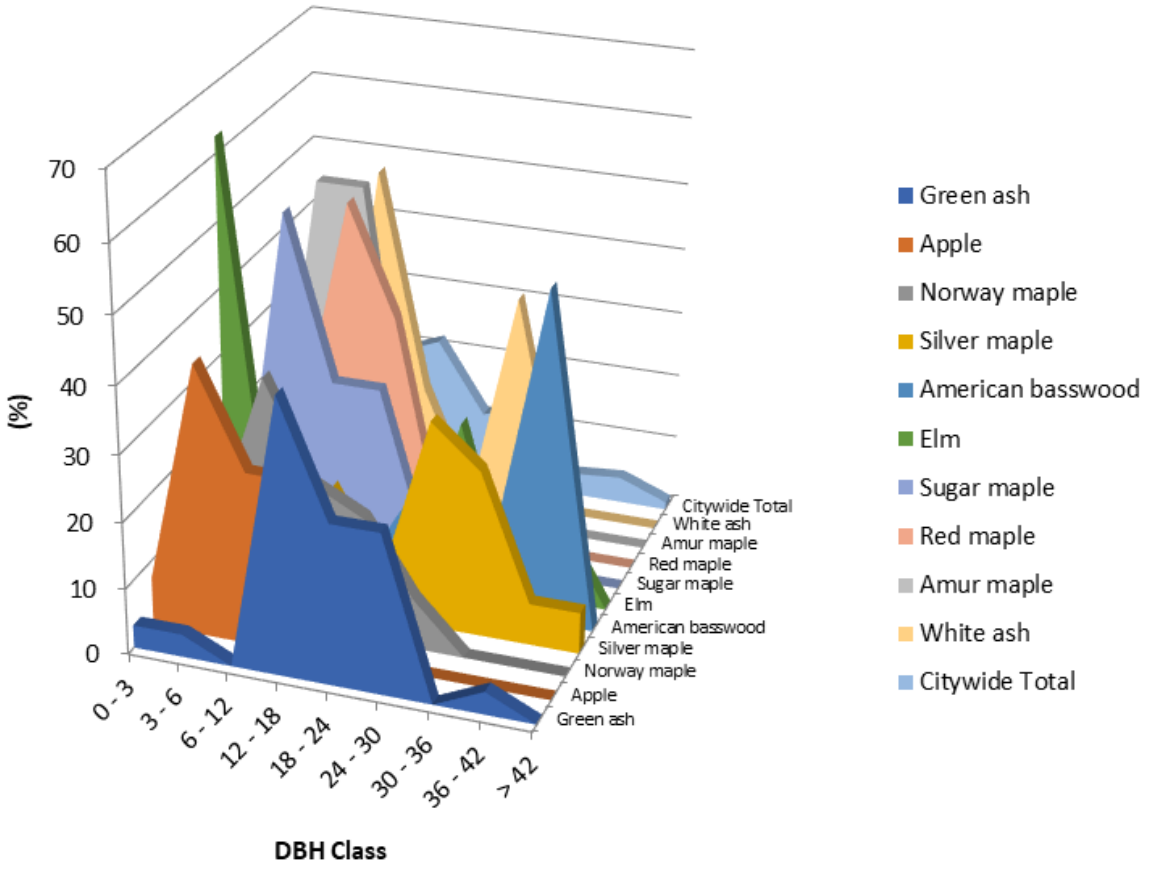
Species	Percent
Green ash	16.6
Apple	15.4
Norway maple	15.4
Silver maple	9.1
American basswood	4.6
Elm	4.6
Sugar maple	4.6
Red maple	3.4
Amur maple	3.4
White ash	3.4
Other Species	19.4
Total	100.0

Figure 2: Relative Age Class

Spillville

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

2/8/2023



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Green ash	3.45	3.45	0.00	41.38	24.14	24.14	0.00	3.45	0.00
Apple	7.41	40.74	25.93	25.93	0.00	0.00	0.00	0.00	0.00
Norway maple	0.00	14.81	37.04	22.22	18.52	7.41	0.00	0.00	0.00
Silver maple	0.00	0.00	6.25	18.75	6.25	31.25	25.00	6.25	6.25
American basswood	0.00	0.00	0.00	0.00	12.50	25.00	12.50	50.00	0.00
Elm	62.50	0.00	0.00	0.00	0.00	25.00	0.00	12.50	0.00
Sugar maple	0.00	50.00	25.00	25.00	0.00	0.00	0.00	0.00	0.00
Red maple	0.00	16.67	50.00	33.33	0.00	0.00	0.00	0.00	0.00
Amur maple	0.00	50.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00
White ash	0.00	0.00	50.00	16.67	0.00	33.33	0.00	0.00	0.00
Citywide Total	9.14	17.14	18.86	21.71	10.86	13.71	3.43	4.00	1.14

Figure 3: Foliage Condition

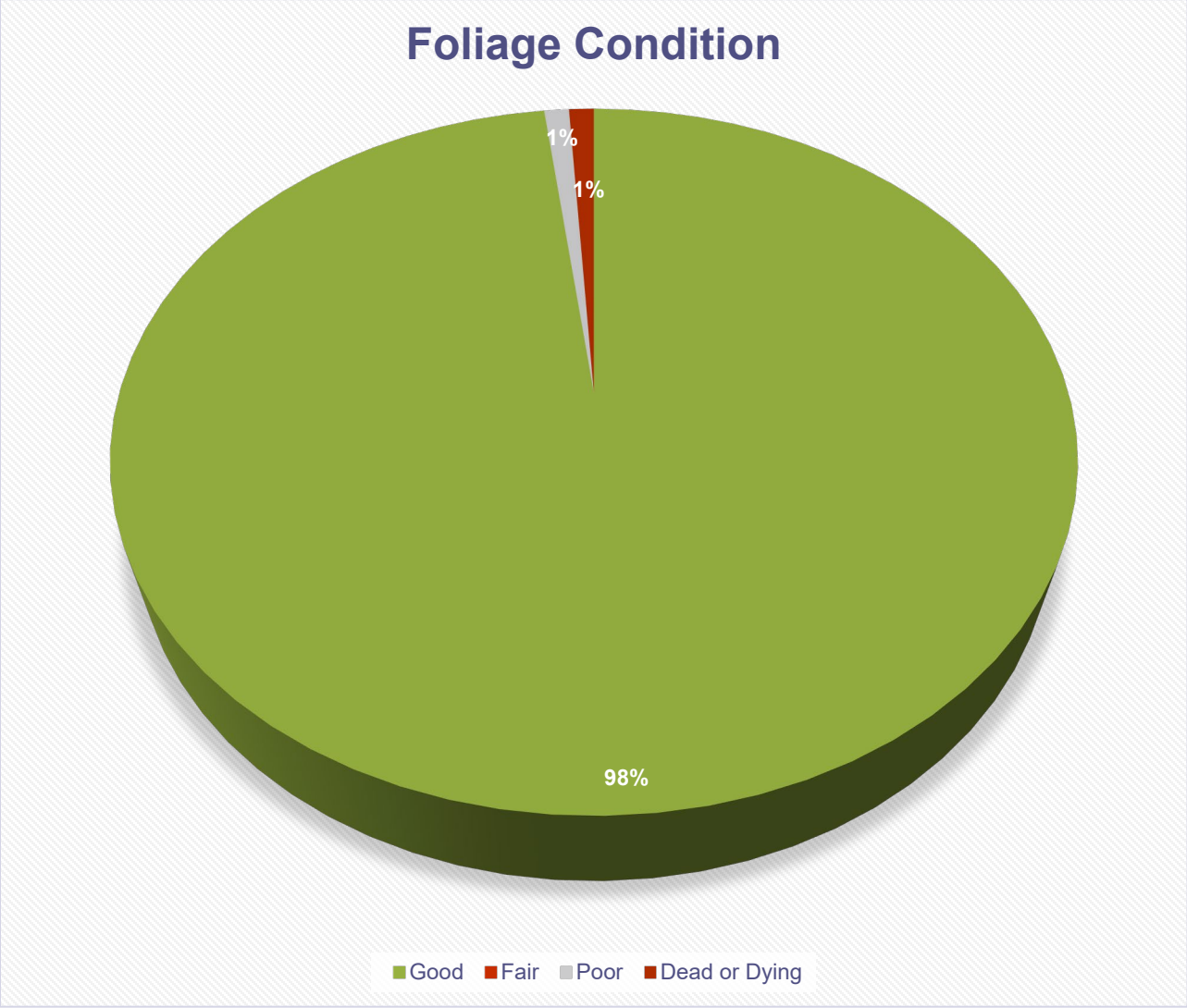


Figure 4: Wood Condition

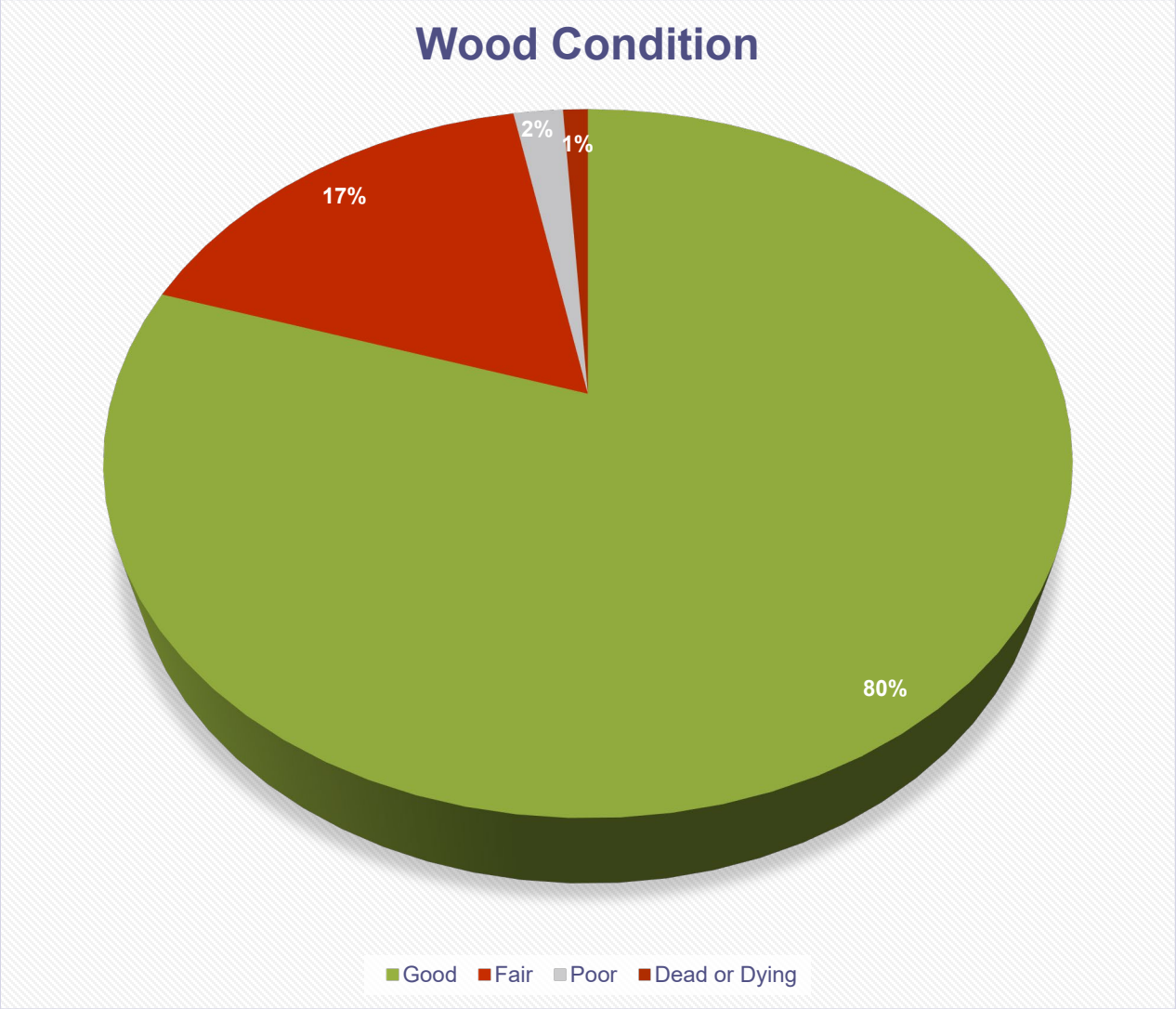
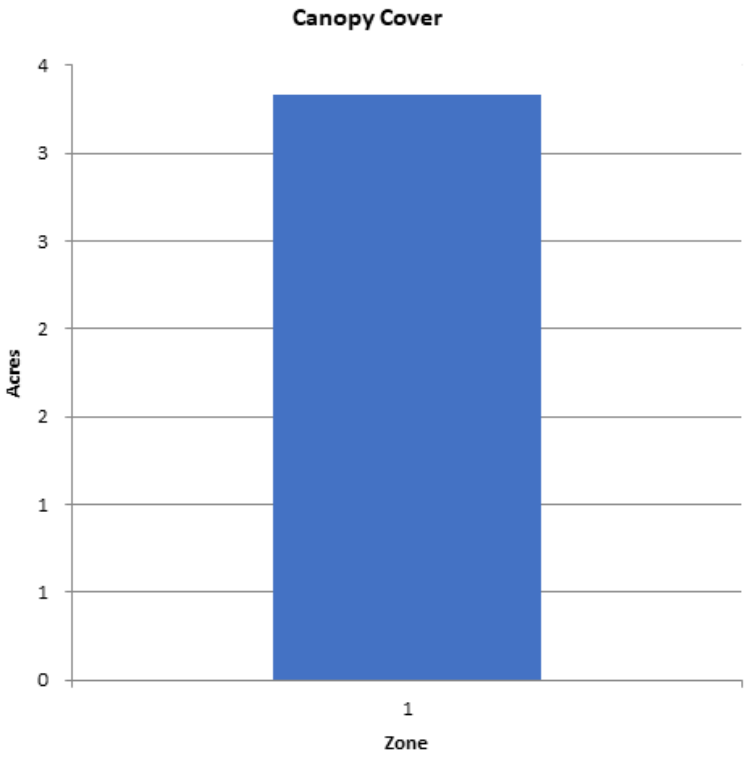


Figure 5: Canopy Cover in Acres

Spillville

Canopy Cover of Public Trees (Acres)

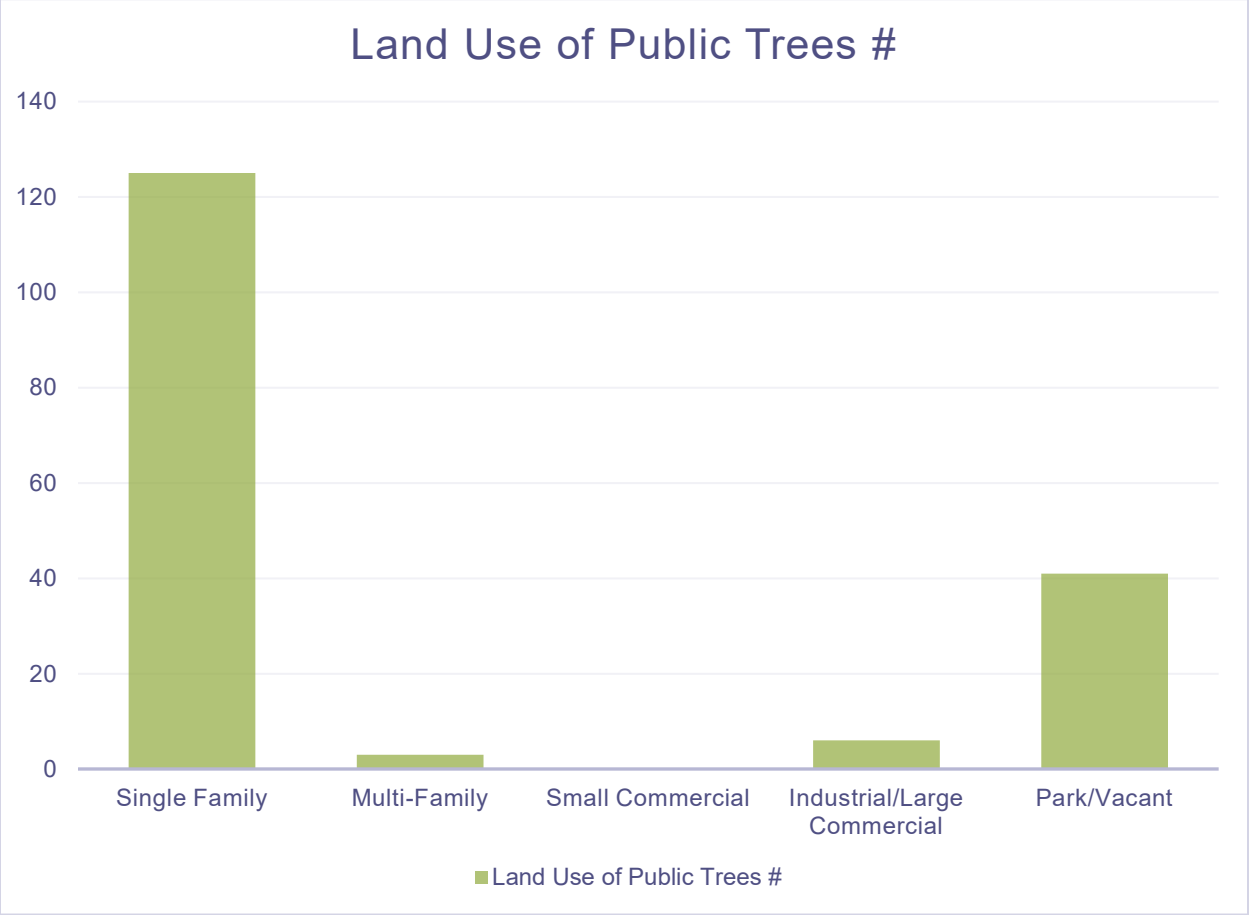
2/8/2023



Zone	Acres	% of Total Canopy Cover
1	3	100.0
Citywide total	3	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	3	0.00	0.00

Figure 6: Land Use of City/Park Trees



APPENDIX B: ArcGIS MAPPING

Figure 1: Location of Ash Trees

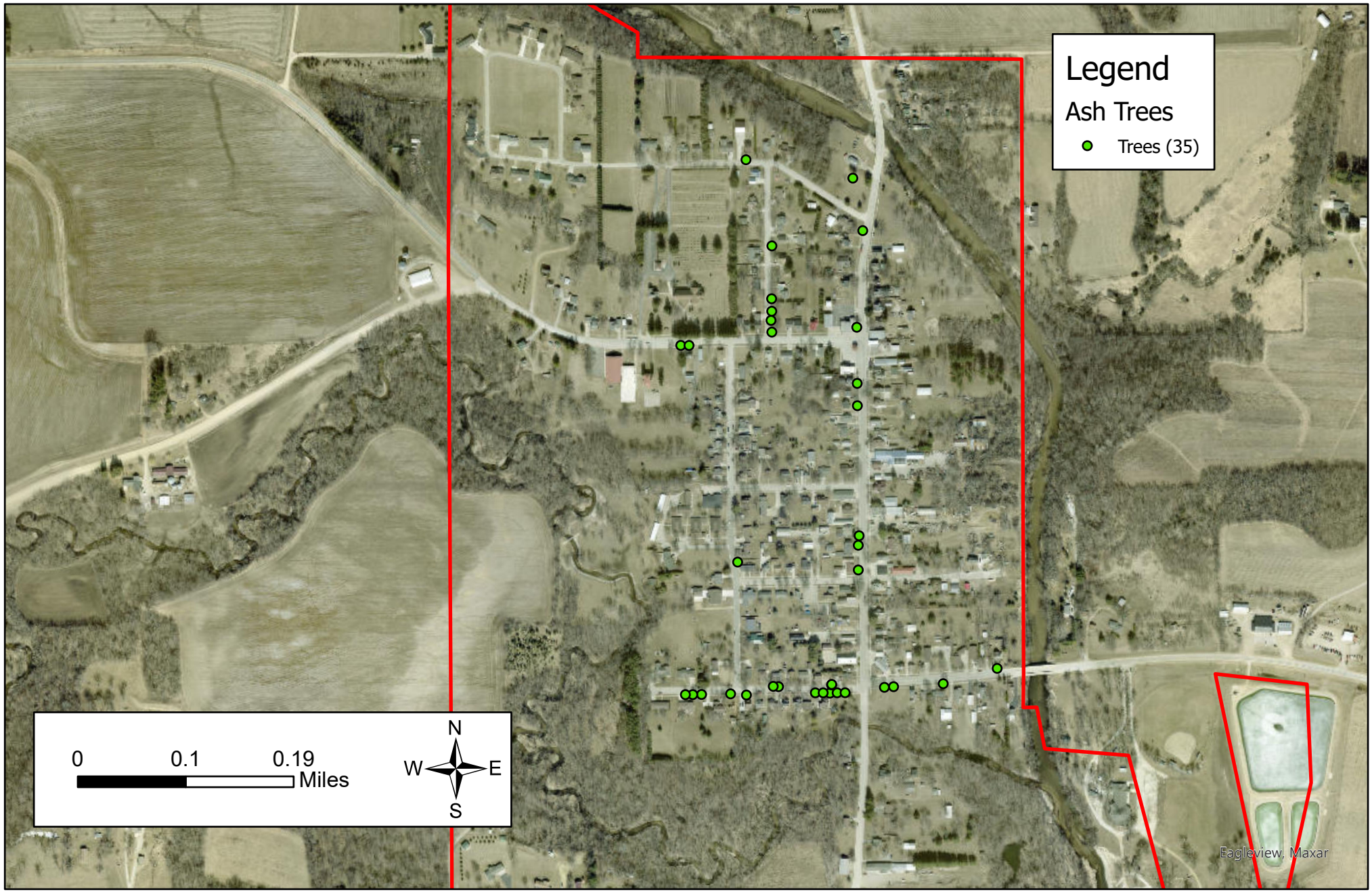
Figure 2: Location of EAB Symptoms

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

Figure 5: Maintenance Tasks

City ownership of the trees recommended for removal should be verified prior to any removal



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 1 - Ash Tree Location
Spillville, Iowa

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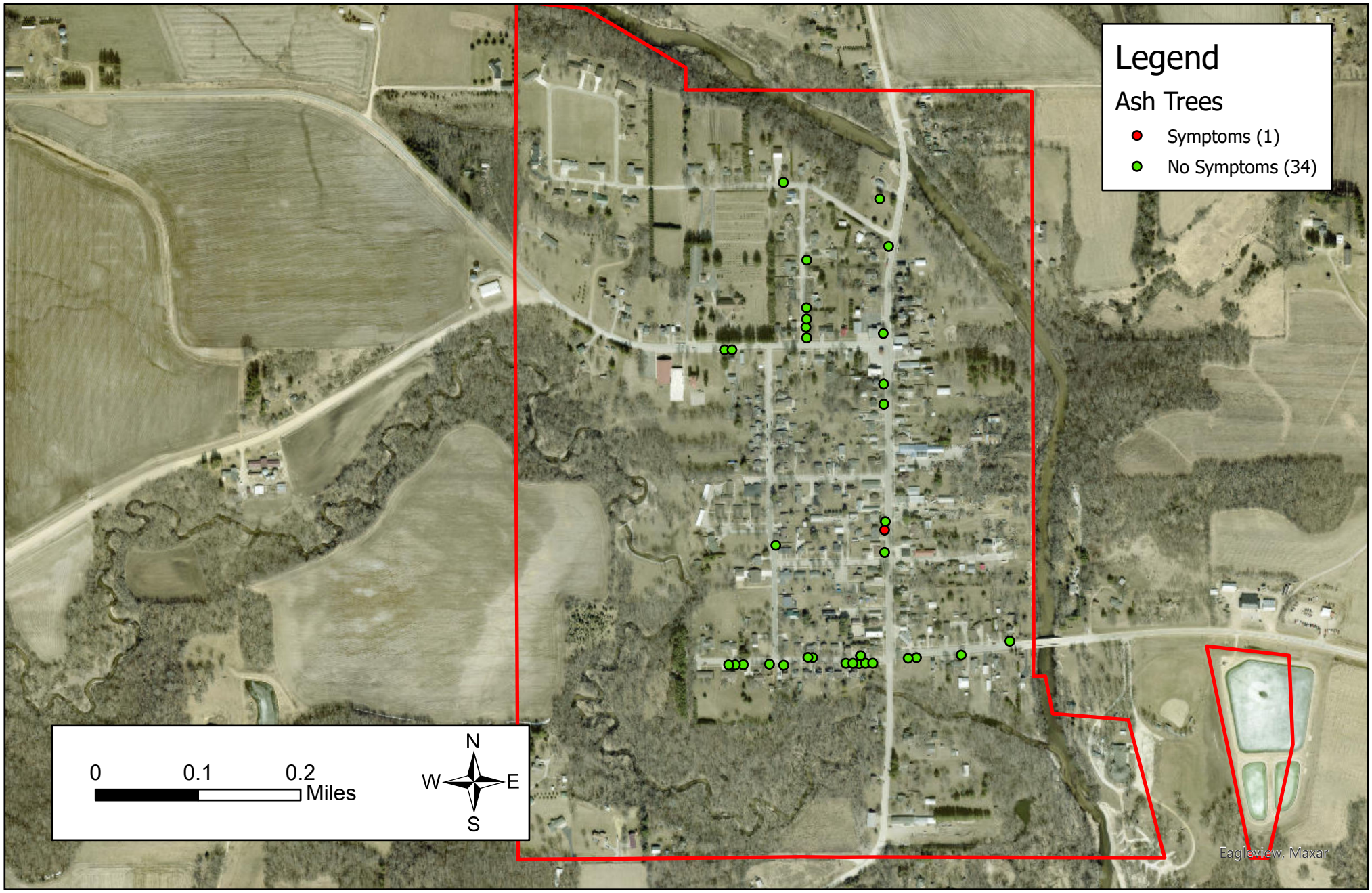

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File: 2022 IDNR Tree Inventory.aprx

2022 IDNR Tree Inventory

Figure 2 - EAB Symptoms
Spillville, Iowa

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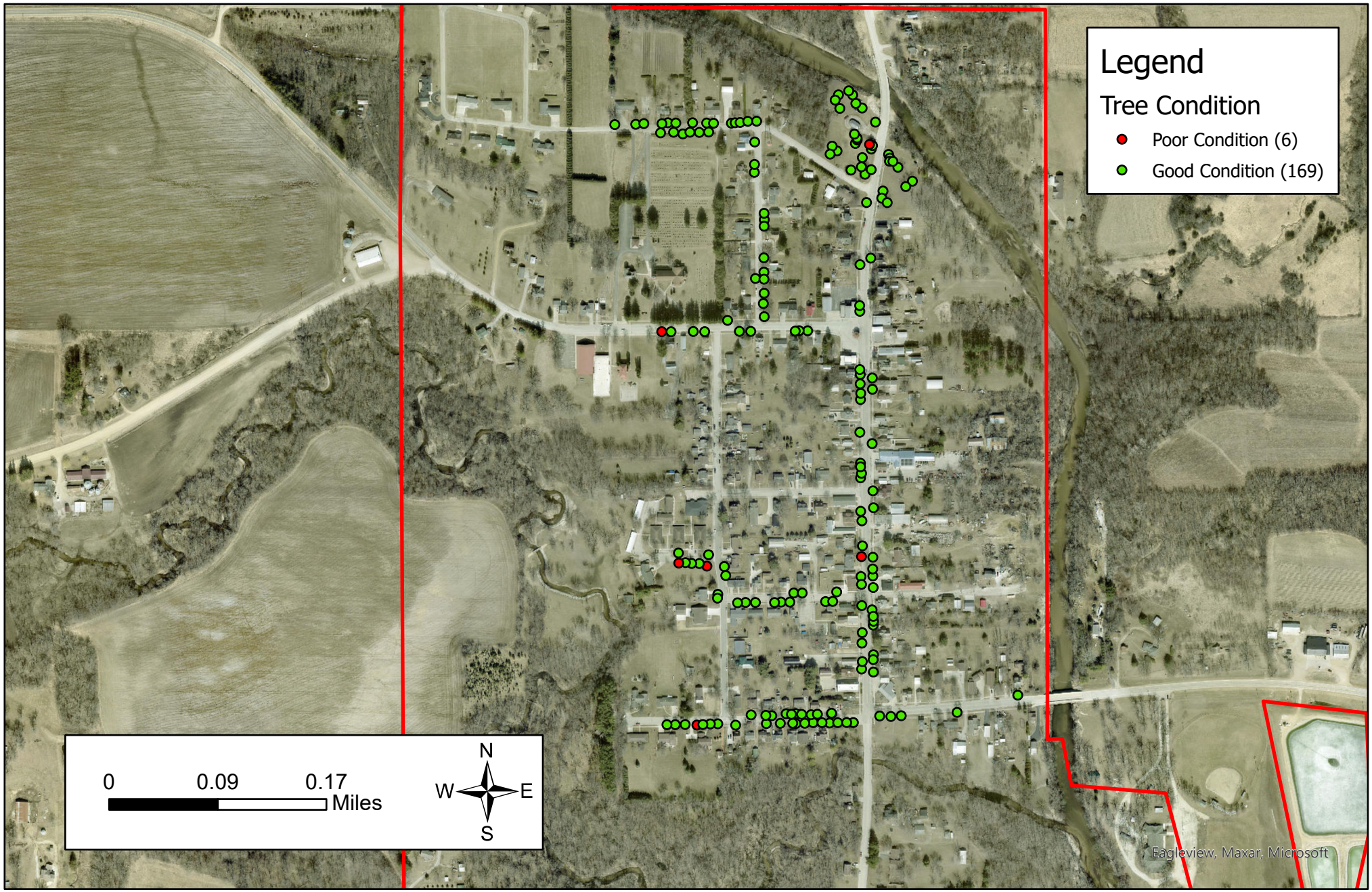

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Date: 1/26/2023
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2022 IDNR Tree Inventory

Figure 3 - Poor Condition Trees
Spillville, Iowa

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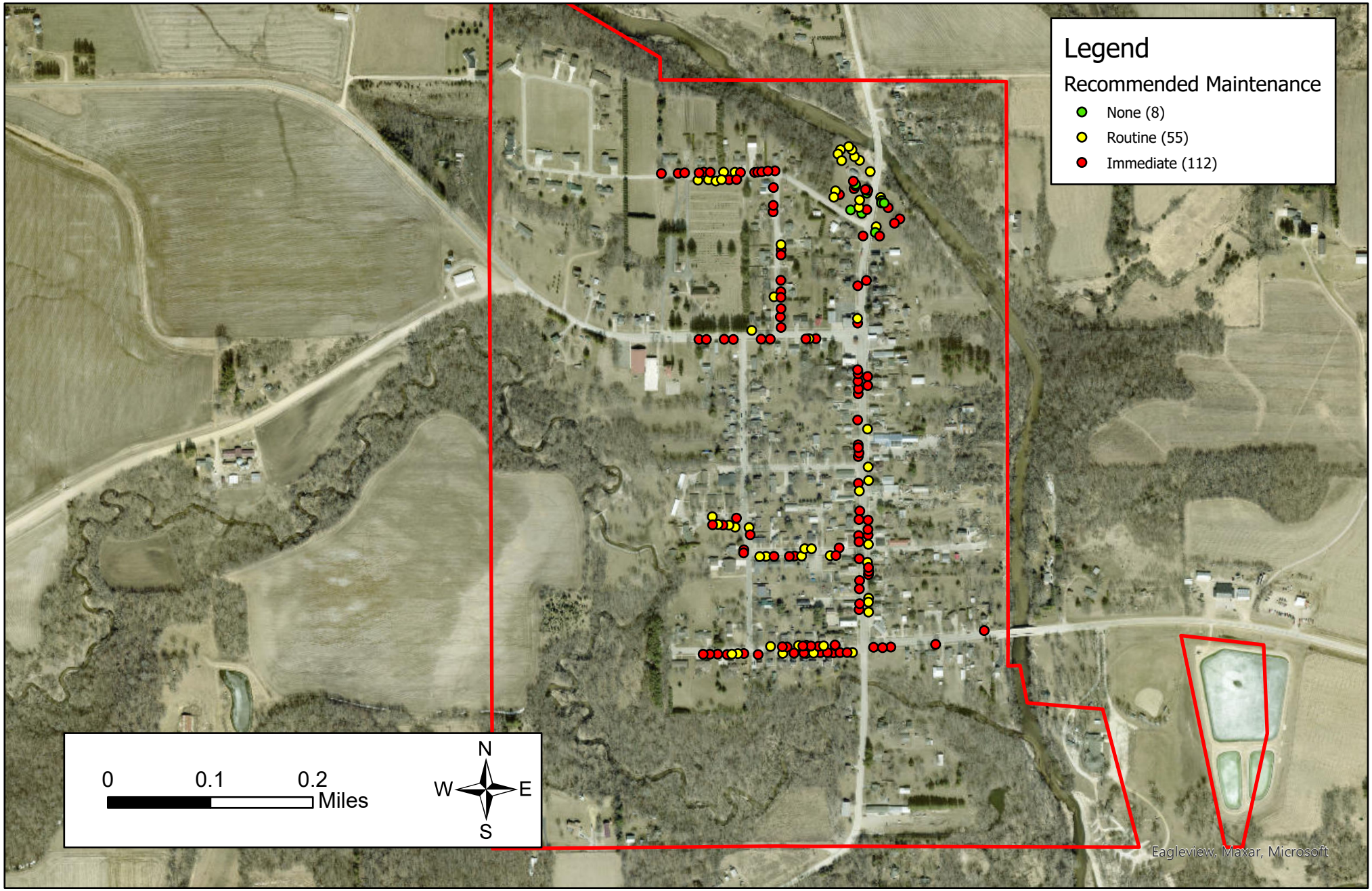

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2022 IDNR Tree Inventory

Figure 4 - Recommended Maintenance
Spillville, Iowa

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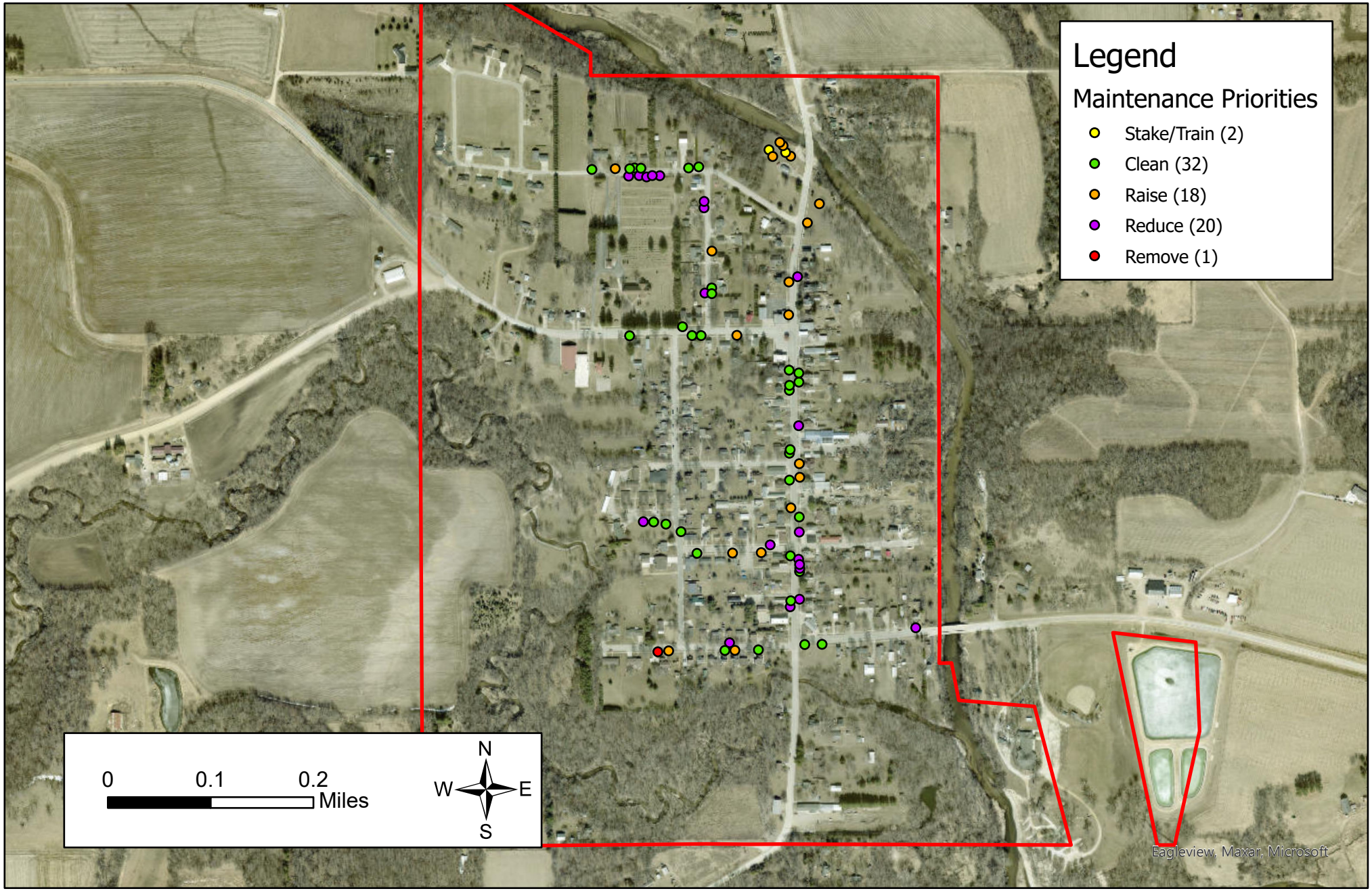

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Date: 1/26/2023
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2022 IDNR Tree Inventory

Figure 5 - Maintenance Priorities
Spillville, Iowa

JEO CONSULTING GROUP INC

APPENDIX C: SPILLVILLE TREE ORDINANCES

6-11-1 CREATION AND ESTABLISHMENT. There is hereby created and established a city tree board for the city of Spillville, Iowa, which shall consist of five or more members and one city council representative appointed by the mayor and confirmed by the city council.

6-11-2 COMPENSATION. Members of the board shall serve without compensation.

6-11-3 DUTIES AND RESPONSIBILITIES. It shall be the responsibility of the board to study, investigate, council and develop a written plan for the care, preservation, trimming, planting, replanting, removal, or disposition of trees and shrubs in public areas. Such a plan will be presented to the city council and upon its approval shall constitute the official comprehensive treeplan for the city of Spillville, Iowa. The board shall review annually and update if needed the comprehensive city tree plan. The board, when requested by the city council, shall consider, investigate, make findings, report, and recommend upon any special matter of question within thescope of its work.

6-11-4 OPERATION. The board shall choose its own officers, make its own rules and regulations, and keep a journal of its proceedings. A majority of the members shall be quorum forthe transaction of business.

(Ordinance July 6, 1993)