Luxemburg IA

Urban Forestry Management Plan

SUMMER 2021

JEO CONSULTING GROUP

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Executive Summary

EXECUTIVE SUMMARY

Overview

This plan was developed to assist the City of Luxemburg 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 4.5% of Luxemburg'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 2021, 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 111 trees inventoried.

- Luxemburg's trees provide $9,896 of benefits annually, an average of $89.16 per tree
- There are over 25 species of trees
- The top three genera are: Maple 30%, Spruce 20%, and Oak 19%
- 35% of trees need some type of management
- No trees should be removed at this time

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.

- Although no trees are recommended for removal, if the city has multiple trees needing removal, anything 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*
- All 4 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 2-3 years to remove ash. We suggest that city officials request a budget increase to $2,500 annually and apply for grants to plant replacement trees

Introduction

INTRODUCTION

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

Assist Luxemburg with Managing its Urban Forest

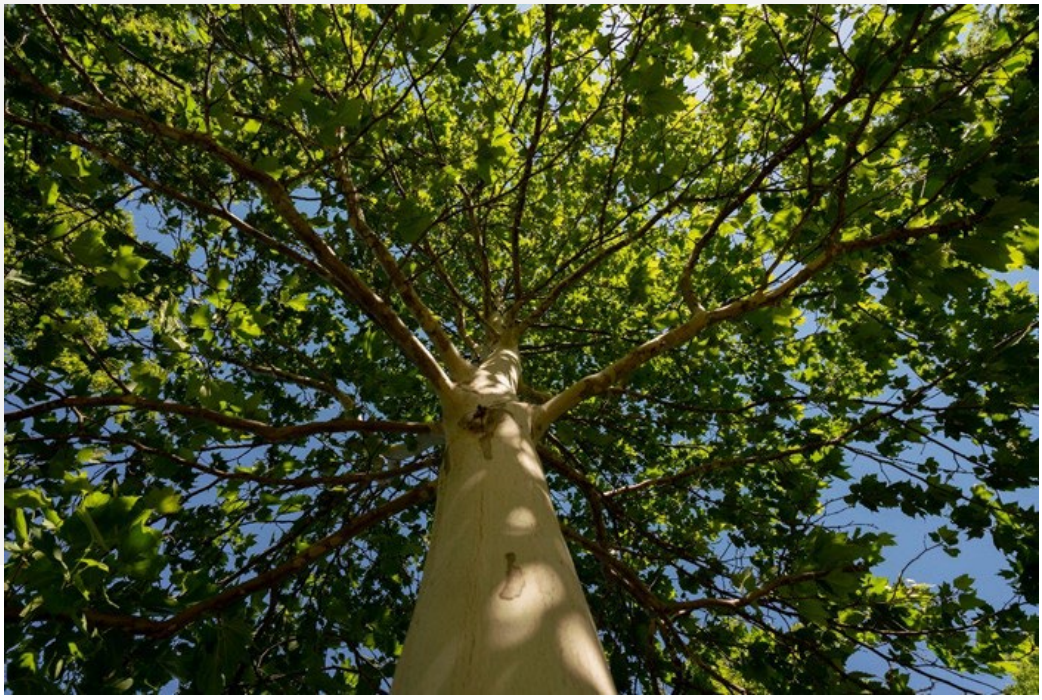
Inform on the Benefits of a Healthy Urban Forest

Establish Preventative Treatment for Emerald Ash Borer

Develop Efficient City Tree Management Techniques

Mitigate Public Safety Issues

Findings



INVENTORY

In 2021, 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 111 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. Luxemburg's trees reduce energy-related costs by approximately $2,828 annually (Appendix A, Table 1). These savings are both in electricity (13.3 MWh) and in natural gas (1,852.7 Therms).

Annual Stormwater Benefits

Luxemburg's trees intercept about 114,418 gallons of rainfall or snow melt per year (Appendix A, Table 2). This interception provides $3,101 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 Luxemburg, it is estimated that trees remove 154 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 $425 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Luxemburg, trees sequester about 26,847 lbs of carbon per year with an associated value of $358 (Appendix A, Table 5). In addition, the trees store 280,218 lbs of carbon, with a yearly benefit of $2,102 (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. Luxemburg receives $3,185 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, Luxemburg's trees provide $9,896 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 111 trees in Luxemburg provide approximately $89.16 annually (Appendix A, Table 7).

ENERGY	STORMWATER	AIR QUALITY	CARBON	AESTHETICS	SUMMARY
• Reduce energy cost by **$2,828**	• Intercept **114,418 gallons** • Provides **$3,101** benefit	• Remove **154 lbs** of pollution • Net value of **$425**	• Sequester **26,847 lbs** • Value of **$358** • Store **280,218 lbs** • Value of **$2,102**	• **$3,185** in social benefits	• **$9,896** annual benefits • Each tree provides **$89.16** annually

FOREST STRUCTURE

Species Distribution

Luxemburg has over 25 different tree species along city streets and parks (Appendix A, Figure 1).

The distribution of trees by genera is as follows:

Maple	39	30%
Spruce	22	20%
Oak	21	19%
Ash	5	4.5%
Apple (Crab)	5	4.5%
Japanese tree lilac	3	3%
Birch	3	3%

Hackberry	3	3%
Elm	2	2%
Basswood/Linden	2	2%
Pear	2	2%
Eastern redbud	2	2%
Willow	1	1%
Ginkgo	1	1%

Age Class

Most of Luxemburg's trees (64%) are between 3 and 12 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. Luxemburg's size curve indicates 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 Luxemburg indicate that 73% of the trees are in good health, with only 2% of the foliage in poor health, dead, or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 83% of Luxemburg's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). Two percent of the tree population's wood condition is in poor health, dead, or dying. This 2% 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	7	6%
Crown Reduction	0	0%
Tree Removal	0	0%
Crown Raising	29	26%
Tree Staking	3	3%

Canopy Cover

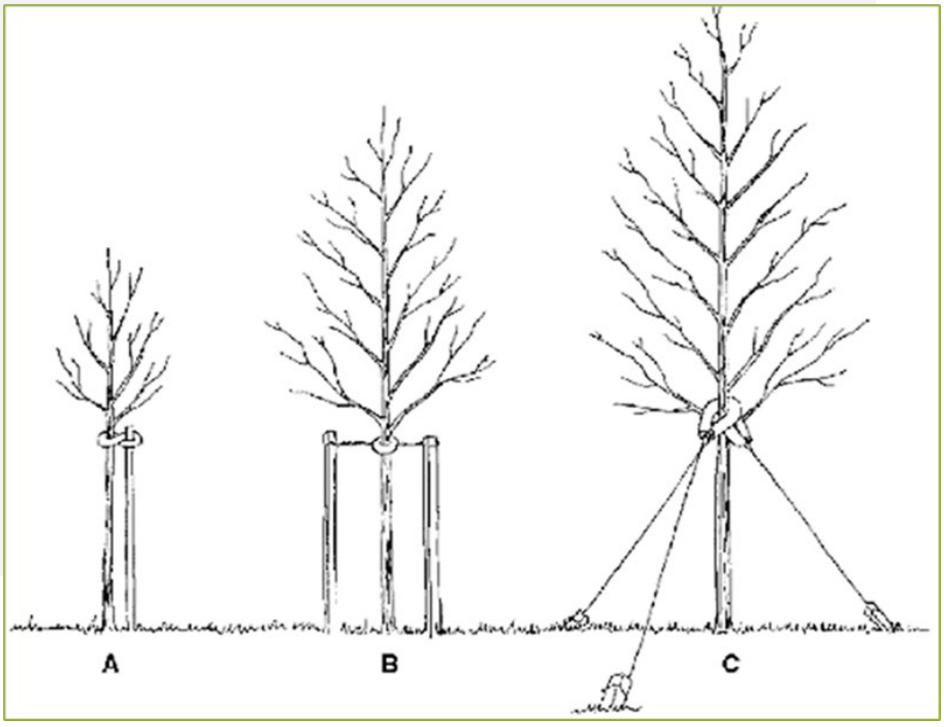
The total canopy with both private and public trees is 11.46 acres or 4% of total cover. The city's canopy goal is to increase canopy by 20% in 30 years. To achieve this goal it is estimated that 10 trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Luxemburg'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	22.5%
Industrial/Large Commercial	0%
Park/Vacant/Other	76.5%
Small Commercial	1%
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

Luxemburg has no trees that need immediate removal. These trees would normally 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. Trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the Proposed Schedule and Budget 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 39 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). There are a total of 4 ash trees, and all of those have signs and symptoms that have been associated with EAB and 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 Proposed Budget and Schedule 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 Luxemburg.

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 (30%) (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: walnut, elm, cottonwood, poplar, box elder, Chinese elm, evergreen or willow. Although city ordinances do not include a formal list of species to avoid planting, we strongly recommend a list be created to provide guidance on what residents should and should not plant. All trees planted and cared for must meet the restrictions in the city ordinances (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 should not include walnut, elm, cottonwood, poplar, box elder, Chinese elm, evergreen, willow, ash, or maple. Excellent alternatives include honeylocust, swamp white oak, Kentucky coffeetree, and ginkgo.

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.

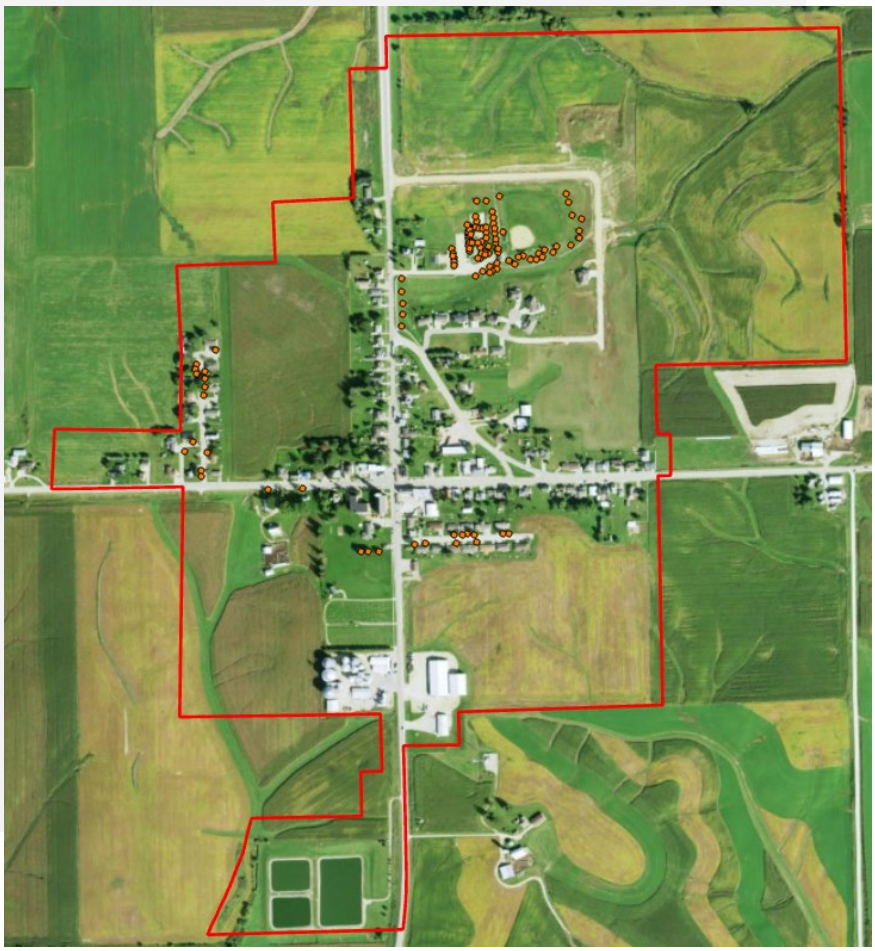
Monitoring

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 6-14-7 states “The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased or damaged, and such trees and shrubs shall be subject to the following: If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.”

Schedule & Budget



PROPOSED WORK SCHEDULE & BUDGET

Budget Allowance of $1,000/Year – (Based off Reported Yearly Tree Budget)

YEAR 1	Est. Cost
Remove 1 ash tree	$700
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$1,000**

YEAR 2	Est. Cost
Remove 1 ash tree	$700
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$1,000**

YEAR 3	Est. Cost
Remove 1 ash tree	$700
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$1,000**

YEAR 4	Est. Cost
Remove 1 ash tree	$700
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$1,000**

YEAR 5	Est. Cost
Reserved removal cost	$700
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$1,000**

YEAR 6	Est. Cost
Reserved removal cost	$700
Plant 2 trees in open locations	$300
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$1,000**

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

PROPOSED WORK SCHEDULE WITH INCREASED BUDGET

Budget Allowance of $2,500/Year – (Budget Increase Suggested to Best Manage City Trees)

YEAR 1	Est. Cost
Remove 3 ash trees	$2,100
Plant 3 trees in open locations	$450
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,550**

YEAR 2	Est. Cost
Remove 1 ash tree	$700
Prune 1/3 of city owned trees	$555
Plant 8 trees in open locations	$1,200
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,455**

YEAR 3	Est. Cost
Prune 1/3 of city owned trees	$555
Plant 12 trees in open locations	$1,800
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,355**

YEAR 4	Est. Cost
Prune 1/3 of city owned trees	$555
Plant 12 trees in open locations	$1,800
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,355**

YEAR 5	Est. Cost
Prune 1/3 of city owned trees	$555
Plant 12 trees in open locations	$1,800
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,355**

YEAR 6	Est. Cost
Prune 1/3 of city owned trees	$555
Plant 12 trees in open locations	$1,800
Visual Survey of EAB Signs/Symptoms	n/a
TOTAL	**$2,355**

Proposed Budget Increase

EAB could potentially kill all ash trees in Luxemburg within four years of its arrival. To remove all ash trees within one year, the budget would need to be increased to $2,800 a year. If the budget were increased to $2,500 per year all ash could be removed within 2 years. Additionally, we recommend that Luxemburg 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 3 trees could be treated per year (every other year treatment). Three trees would be selected for treatment, and Luxemburg would still need to find $18,200 for removal. Alternatively, if there are 6 treatable trees, it would cost approximately $1,800 a year for treatment and would leave no money 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 Luxemburg. 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

Luxemburg

Annual Energy Benefits of Public Trees

2/3/2022

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	3.6	274	438.8	430	704	(N/A)	18.0	24.9	35.18
Blue spruce	1.0	77	163.4	160	237	(N/A)	17.1	8.4	12.45
Northern red oak	0.6	48	86.6	85	133	(N/A)	9.9	4.7	12.07
Norway maple	1.7	127	245.1	240	368	(N/A)	8.1	13.0	40.83
Red maple	0.7	56	101.3	99	155	(N/A)	5.4	5.5	25.85
Green ash	1.4	110	208.1	204	314	(N/A)	4.5	11.1	62.76
Apple	0.4	28	64.2	63	91	(N/A)	4.5	3.2	18.19
White oak	0.2	14	24.8	24	38	(N/A)	3.6	1.3	9.52
Sugar maple	0.5	38	70.9	70	107	(N/A)	3.6	3.8	26.80
Northern hackberry	0.3	21	45.0	44	65	(N/A)	2.7	2.3	21.76
Swamp white oak	0.2	19	39.9	39	58	(N/A)	2.7	2.0	19.31
Japanese tree lilac	0.0	4	8.2	8	12	(N/A)	2.7	0.4	3.89
Callery pear	0.1	6	12.4	12	18	(N/A)	1.8	0.6	8.99
Eastern redbud	0.0	3	7.6	7	11	(N/A)	1.8	0.4	5.40
Paper birch	0.3	22	41.8	41	63	(N/A)	1.8	2.2	31.57
Norway spruce	0.3	25	44.3	43	69	(N/A)	1.8	2.4	34.32
American elm	0.5	38	55.0	54	92	(N/A)	1.8	3.2	45.87
Pin oak	0.4	29	54.2	53	82	(N/A)	1.8	2.9	41.01
Willow	0.3	24	47.4	46	71	(N/A)	0.9	2.5	70.84
River birch	0.0	3	6.2	6	9	(N/A)	0.9	0.3	8.99
Ginkgo	0.0	0	0.4	0	1	(N/A)	0.9	0.0	0.57
Northern pin oak	0.1	8	16.9	17	24	(N/A)	0.9	0.9	24.47
Spruce	0.1	4	9.5	9	14	(N/A)	0.9	0.5	13.58
Basswood	0.2	18	27.0	26	44	(N/A)	0.9	1.6	44.23
Littleleaf linden	0.2	17	33.8	33	50	(N/A)	0.9	1.8	50.34
Total	13.3	1,012	1,852.7	1,816	2,828	(N/A)	100.0	100.0	25.48

Table 2: Annual Stormwater Benefits

Luxemburg

Annual Stormwater Benefits of Public Trees

2/3/2022

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	32,440	879	(N/A)	18.0	28.4	43.96
Blue spruce	11,640	315	(N/A)	17.1	10.2	16.60
Northern red oak	3,294	89	(N/A)	9.9	2.9	8.11
Norway maple	12,600	341	(N/A)	8.1	11.0	37.94
Red maple	4,242	115	(N/A)	5.4	3.7	19.16
Green ash	15,658	424	(N/A)	4.5	13.7	84.87
Apple	1,322	36	(N/A)	4.5	1.2	7.17
White oak	1,123	30	(N/A)	3.6	1.0	7.61
Sugar maple	3,699	100	(N/A)	3.6	3.2	25.06
Northern hackberry	1,416	38	(N/A)	2.7	1.2	12.79
Swamp white oak	1,335	36	(N/A)	2.7	1.2	12.06
Japanese tree lilac	145	4	(N/A)	2.7	0.1	1.31
Callery pear	325	9	(N/A)	1.8	0.3	4.41
Eastern redbud	137	4	(N/A)	1.8	0.1	1.86
Paper birch	2,762	75	(N/A)	1.8	2.4	37.43
Norway spruce	7,574	205	(N/A)	1.8	6.6	102.63
American elm	2,782	75	(N/A)	1.8	2.4	37.69
Pin oak	2,976	81	(N/A)	1.8	2.6	40.32
Willow	3,764	102	(N/A)	0.9	3.3	102.01
River birch	163	4	(N/A)	0.9	0.1	4.41
Ginkgo	7	0	(N/A)	0.9	0.0	0.19
Northern pin oak	586	16	(N/A)	0.9	0.5	15.88
Spruce	596	16	(N/A)	0.9	0.5	16.14
Basswood	1,466	40	(N/A)	0.9	1.3	39.72
Littleleaf linden	2,366	64	(N/A)	0.9	2.1	64.13
Citywide total	114,418	3,101	(N/A)	100.0	100.0	27.93

Table 3: Annual Air Quality Benefits

Luxemburg

Annual Air Quality Benefits of Public Trees

2/3/2022

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								
Silver maple	3.7	0.6	2.1	0.2	20	16.7	2.5	2.4	16.3	105	-2.5	-9	41.8	116	(N/A)	18.0	5.81
Blue spruce	1.0	0.2	1.0	0.1	7	5.0	0.7	0.7	4.6	31	-3.6	-13	9.8	25	(N/A)	17.1	1.30
Northern red oak	0.4	0.1	0.3	0.0	2	3.0	0.4	0.4	2.9	19	-0.6	-2	6.9	19	(N/A)	9.9	1.72
Norway maple	2.1	0.4	1.1	0.1	12	8.2	1.2	1.1	7.6	50	-0.5	-2	21.2	60	(N/A)	8.1	6.69
Red maple	0.6	0.1	0.3	0.0	4	3.5	0.5	0.5	3.3	22	-0.3	-1	8.7	24	(N/A)	5.4	4.07
Green ash	1.8	0.3	0.9	0.1	10	7.0	1.0	1.0	6.6	43	0.0	0	18.6	53	(N/A)	4.5	10.59
Apple	0.2	0.0	0.1	0.0	1	1.9	0.3	0.3	1.7	11	0.0	0	4.5	13	(N/A)	4.5	2.55
White oak	0.0	0.0	0.0	0.0	0	0.9	0.1	0.1	0.8	5	0.0	0	2.0	6	(N/A)	3.6	1.40
Sugar maple	0.4	0.1	0.2	0.0	2	2.4	0.3	0.3	2.3	15	-0.3	-1	5.7	16	(N/A)	3.6	3.93
Northern hackberry	0.1	0.0	0.1	0.0	0	1.4	0.2	0.2	1.3	9	0.0	0	3.2	9	(N/A)	2.7	3.00
Swamp white oak	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.1	8	0.0	0	2.9	8	(N/A)	2.7	2.72
Japanese tree lilac	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	2	(N/A)	2.7	0.51
Callery pear	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	2	(N/A)	1.8	1.21
Eastern redbud	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1	(N/A)	1.8	0.71
Paper birch	0.3	0.0	0.1	0.0	1	1.4	0.2	0.2	1.3	9	0.0	0	3.6	10	(N/A)	1.8	5.11
Norway spruce	0.9	0.2	0.7	0.1	6	1.6	0.2	0.2	1.5	10	-4.2	-16	1.2	0	(N/A)	1.8	-0.06
American elm	0.2	0.0	0.1	0.0	1	2.3	0.3	0.3	2.3	14	0.0	0	5.5	15	(N/A)	1.8	7.68
Pin oak	0.4	0.1	0.2	0.0	2	1.8	0.3	0.3	1.7	11	-0.8	-3	4.0	11	(N/A)	1.8	5.29
Willow	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14	(N/A)	0.9	13.58
River birch	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)	0.9	1.21
Ginkgo	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)	0.9	0.07
Northern pin oak	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)	0.9	3.47
Spruce	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)	0.9	1.48
Basswood	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)	0.9	7.42
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)	0.9	8.23
Citywide total	13.7	2.4	8.2	0.8	79	63.9	9.3	8.8	60.4	397	-13.4	-50	154.0	425	(N/A)	100.0	3.83

Table 4: Annual Carbon Stored

Luxemburg

Stored CO2 Benefits of Public Trees

2/3/2022

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	85,085	638	(N/A)	18.0	30.4	31.91
Blue spruce	4,152	31	(N/A)	17.1	1.5	1.64
Northern red oak	6,789	51	(N/A)	9.9	2.4	4.63
Norway maple	35,487	266	(N/A)	8.1	12.7	29.57
Red maple	8,245	62	(N/A)	5.4	2.9	10.31
Green ash	56,919	427	(N/A)	4.5	20.3	85.38
Apple	4,540	34	(N/A)	4.5	1.6	6.81
White oak	1,591	12	(N/A)	3.6	0.6	2.98
Sugar maple	10,365	78	(N/A)	3.6	3.7	19.43
Northern hackberry	920	7	(N/A)	2.7	0.3	2.30
Swamp white oak	2,420	18	(N/A)	2.7	0.9	6.05
Japanese tree lilac	369	3	(N/A)	2.7	0.1	0.92
Callery pear	437	3	(N/A)	1.8	0.2	1.64
Eastern redbud	356	3	(N/A)	1.8	0.1	1.33
Paper birch	8,643	65	(N/A)	1.8	3.1	32.41
Norway spruce	10,833	81	(N/A)	1.8	3.9	40.62
American elm	6,074	46	(N/A)	1.8	2.2	22.78
Pin oak	9,243	69	(N/A)	1.8	3.3	34.66
Willow	14,280	107	(N/A)	0.9	5.1	107.10
River birch	218	2	(N/A)	0.9	0.1	1.64
Ginkgo	5	0	(N/A)	0.9	0.0	0.03
Northern pin oak	1,101	8	(N/A)	0.9	0.4	8.26
Spruce	257	2	(N/A)	0.9	0.1	1.93
Basswood	3,672	28	(N/A)	0.9	1.3	27.54
Littleleaf linden	8,218	62	(N/A)	0.9	2.9	61.63
Citywide total	280,218	2,102	(N/A)	100.0	100.0	18.93

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

Luxemburg

Annual CO $_2$ Benefits of Public Trees

2/3/2022

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
Silver maple	9,787	73	-409	-34	-3	6,045	45	15,389	115 (N/A)	18.0	32.3	5.77
Blue spruce	591	4	-20	-19	0	1,691	13	2,242	17 (N/A)	17.1	4.7	0.89
Northern red oak	917	7	-33	-8	0	1,059	8	1,935	15 (N/A)	9.9	4.1	1.32
Norway maple	3,077	23	-170	-17	-1	2,814	21	5,704	43 (N/A)	8.1	12.0	4.75
Red maple	1,183	9	-40	-7	0	1,233	9	2,370	18 (N/A)	5.4	5.0	2.96
Green ash	3,693	28	-273	-15	-2	2,429	18	5,833	44 (N/A)	4.5	12.2	8.75
Apple	569	4	-22	-6	0	621	5	1,162	9 (N/A)	4.5	2.4	1.74
White oak	431	3	-8	-3	0	305	2	725	5 (N/A)	3.6	1.5	1.36
Sugar maple	878	7	-50	-6	0	833	6	1,656	12 (N/A)	3.6	3.5	3.10
Northern hackberry	182	1	-5	-3	0	468	4	642	5 (N/A)	2.7	1.3	1.61
Swamp white oak	544	4	-12	-3	0	416	3	945	7 (N/A)	2.7	2.0	2.36
Japanese tree lilac	85	1	-2	-1	0	80	1	161	1 (N/A)	2.7	0.3	0.40
Callery pear	191	1	-3	-1	0	129	1	316	2 (N/A)	1.8	0.7	1.18
Eastern redbud	76	1	-2	-1	0	74	1	147	1 (N/A)	1.8	0.3	0.55
Paper birch	734	6	-41	-3	0	490	4	1,179	9 (N/A)	1.8	2.5	4.42
Norway spruce	443	3	-52	-6	0	557	4	943	7 (N/A)	1.8	2.0	3.53
American elm	443	3	-29	-4	0	836	6	1,246	9 (N/A)	1.8	2.6	4.67
Pin oak	1,044	8	-44	-4	0	638	5	1,633	12 (N/A)	1.8	3.4	6.13
Willow	370	3	-69	-4	-1	539	4	837	6 (N/A)	0.9	1.8	6.27
River birch	96	1	-2	-1	0	65	0	158	1 (N/A)	0.9	0.3	1.18
Ginkgo	2	0	0	0	0	4	0	6	0 (N/A)	0.9	0.0	0.04
Northern pin oak	224	2	-5	-1	0	176	1	393	3 (N/A)	0.9	0.8	2.95
Spruce	53	0	-1	-1	0	94	1	145	1 (N/A)	0.9	0.3	1.08
Basswood	445	3	-18	-2	0	393	3	819	6 (N/A)	0.9	1.7	6.14
Littleleaf linden	789	6	-39	-3	0	380	3	1,127	8 (N/A)	0.9	2.4	8.45
Citywide total	26,847	201	-1,350	-153	-11	22,368	168	47,712	358 (N/A)	100.0	100.0	3.22

Table 6: Annual Social and Aesthetic Benefits

Luxemburg

Annual Aesthetic/Other Benefits of Public Trees

2/3/2022

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	1,012	(N/A)	18.0	31.8	50.58
Blue spruce	349	(N/A)	17.1	11.0	18.39
Northern red oak	103	(N/A)	9.9	3.2	9.35
Norway maple	312	(N/A)	8.1	9.8	34.71
Red maple	193	(N/A)	5.4	6.0	32.09
Green ash	304	(N/A)	4.5	9.6	60.85
Apple	32	(N/A)	4.5	1.0	6.40
White oak	73	(N/A)	3.6	2.3	18.19
Sugar maple	109	(N/A)	3.6	3.4	27.13
Northern hackberry	59	(N/A)	2.7	1.9	19.82
Swamp white oak	65	(N/A)	2.7	2.1	21.78
Japanese tree lilac	4	(N/A)	2.7	0.1	1.38
Callery pear	26	(N/A)	1.8	0.8	12.89
Eastern redbud	4	(N/A)	1.8	0.1	2.06
Paper birch	72	(N/A)	1.8	2.3	36.21
Norway spruce	73	(N/A)	1.8	2.3	36.67
American elm	74	(N/A)	1.8	2.3	36.79
Pin oak	106	(N/A)	1.8	3.3	53.12
Willow	31	(N/A)	0.9	1.0	31.46
River birch	13	(N/A)	0.9	0.4	12.89
Ginkgo	0	(N/A)	0.9	0.0	0.37
Northern pin oak	26	(N/A)	0.9	0.8	26.22
Spruce	15	(N/A)	0.9	0.5	15.42
Basswood	46	(N/A)	0.9	1.4	45.86
Littleleaf linden	81	(N/A)	0.9	2.6	81.48
Citywide total	3,185	(N/A)	100.0	100.0	28.69

Table 7: Summary of Benefits in Dollars

Luxemburg

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

2/3/2022

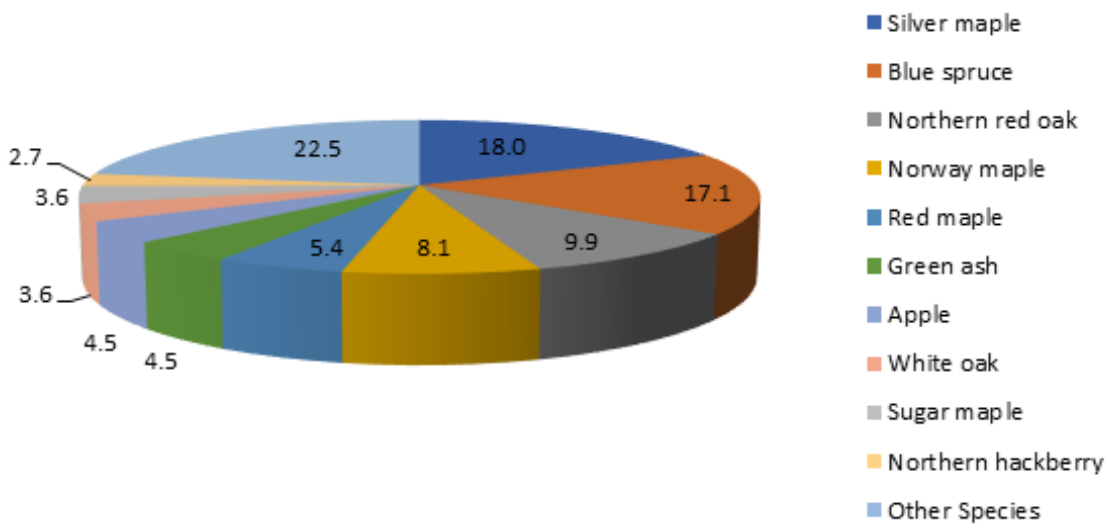
Benefits	Total ($)	Standard Error	$/tree	Standard Error	$/capita	Standard Error
Energy	2,828	(N/A)	25.48	(N/A)	0.00	(N/A)
CO2	358	(N/A)	3.22	(N/A)	0.00	(N/A)
Air Quality	425	(N/A)	3.83	(N/A)	0.00	(N/A)
Stormwater	3,101	(N/A)	27.93	(N/A)	0.00	(N/A)
Aesthetic/Other	3,185	(N/A)	28.69	(N/A)	0.00	(N/A)
Total Benefits	9,896	(N/A)	89.16	(N/A)	0.00	(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	9,896	(N/A)	89.16	(N/A)	0.00	(N/A)
Benefit-cost ratio	0.00	(N/A)				

Figure 1: Species Distribution

Luxemburg

Species Distribution of Public Trees

2/3/2022



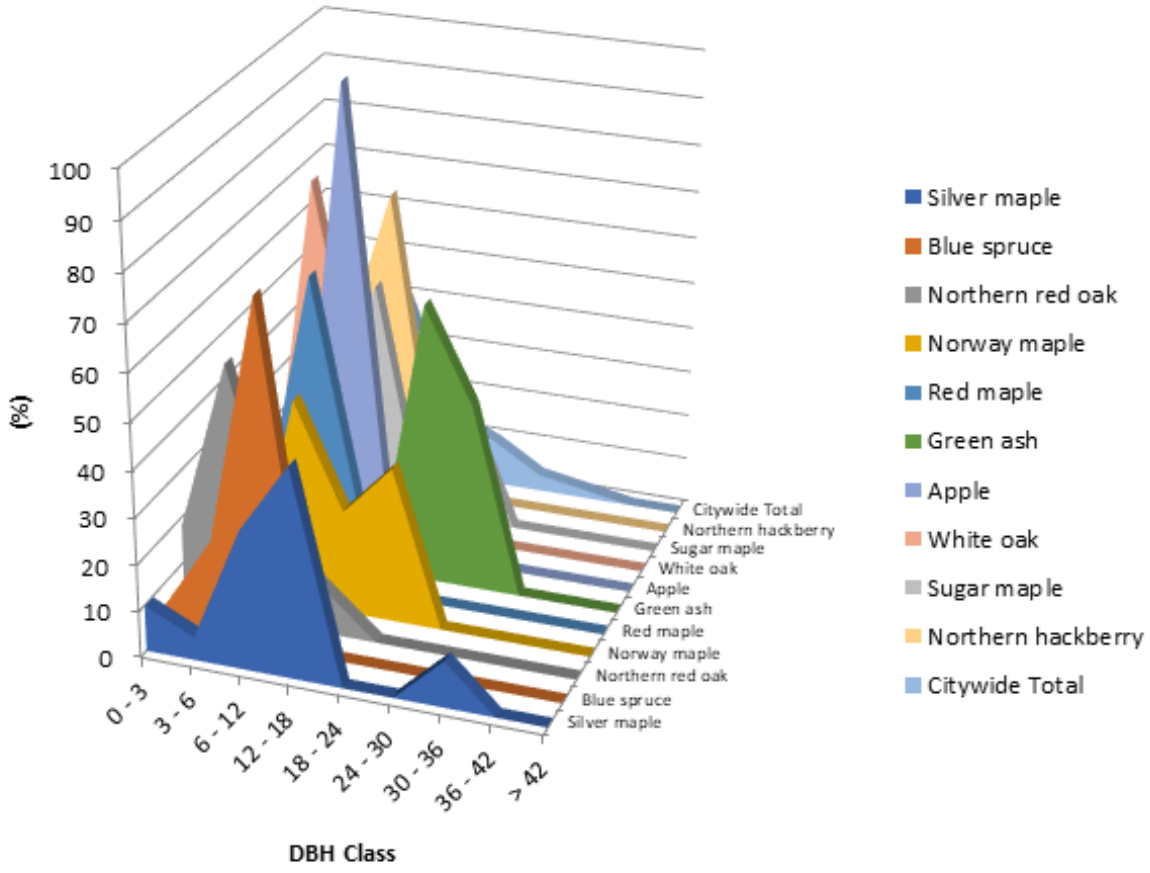
Species	Percent
Silver maple	18.0
Blue spruce	17.1
Northern red oak	9.9
Norway maple	8.1
Red maple	5.4
Green ash	4.5
Apple	4.5
White oak	3.6
Sugar maple	3.6
Northern hackberry	2.7
Other Species	22.5
Total	100.0

Figure 2: Relative Age Class

Luxemburg

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

2/3/2022



	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Silver maple	10.00	5.00	30.00	45.00	0.00	0.00	10.00	0.00	0.00
Blue spruce	5.26	21.05	73.68	0.00	0.00	0.00	0.00	0.00	0.00
Northern red oak	18.18	54.55	18.18	9.09	0.00	0.00	0.00	0.00	0.00
Norway maple	0.00	0.00	44.44	22.22	33.33	0.00	0.00	0.00	0.00
Red maple	0.00	16.67	66.67	16.67	0.00	0.00	0.00	0.00	0.00
Green ash	0.00	0.00	0.00	0.00	60.00	40.00	0.00	0.00	0.00
Apple	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
White oak	0.00	75.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00
Sugar maple	0.00	25.00	50.00	0.00	25.00	0.00	0.00	0.00	0.00
Northern hackberry	0.00	33.33	66.67	0.00	0.00	0.00	0.00	0.00	0.00
Citywide Total	6.31	23.42	40.54	14.41	9.91	3.60	1.80	0.00	0.00

Figure 3: Foliage Condition

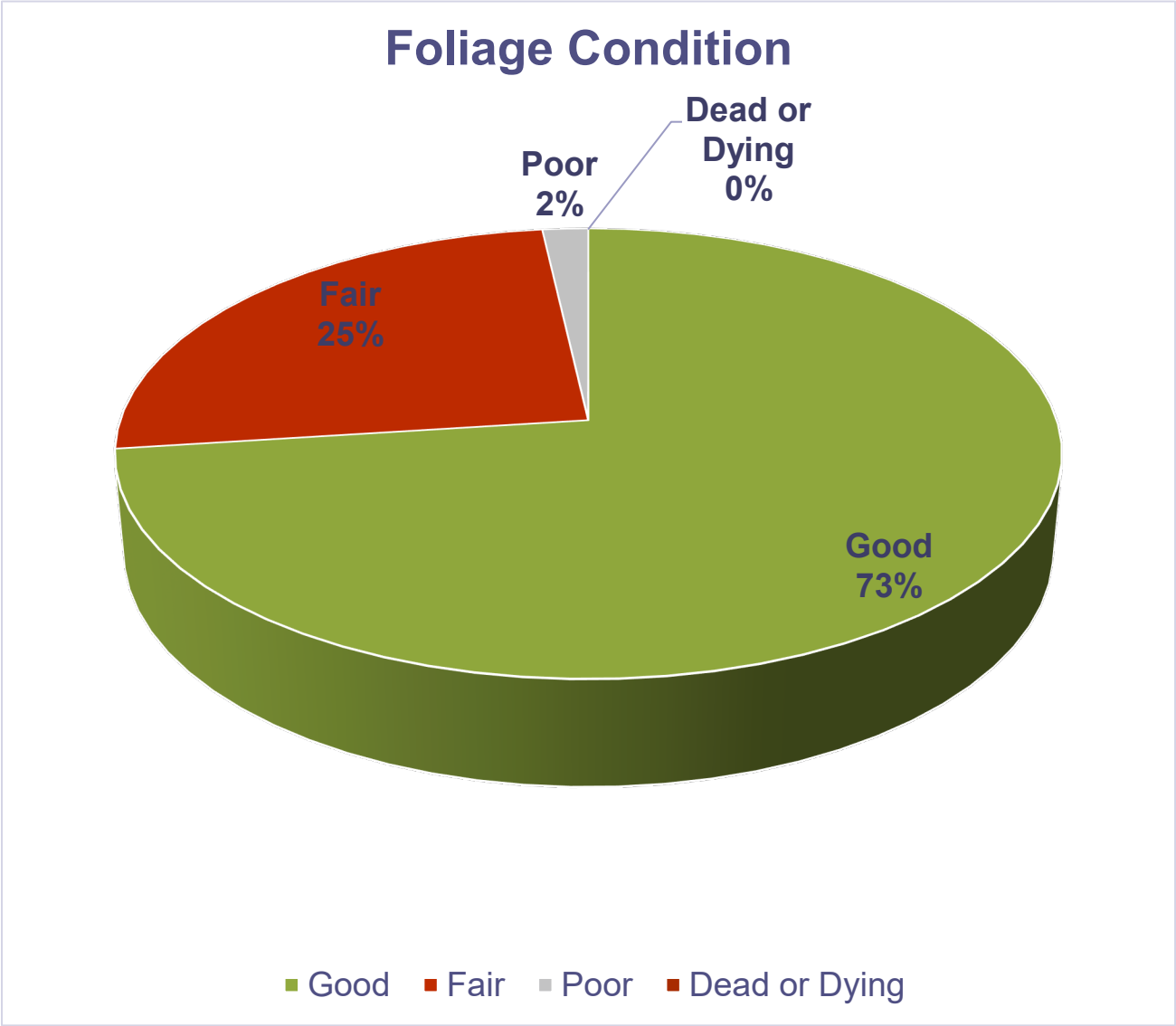


Figure 4: Wood Condition

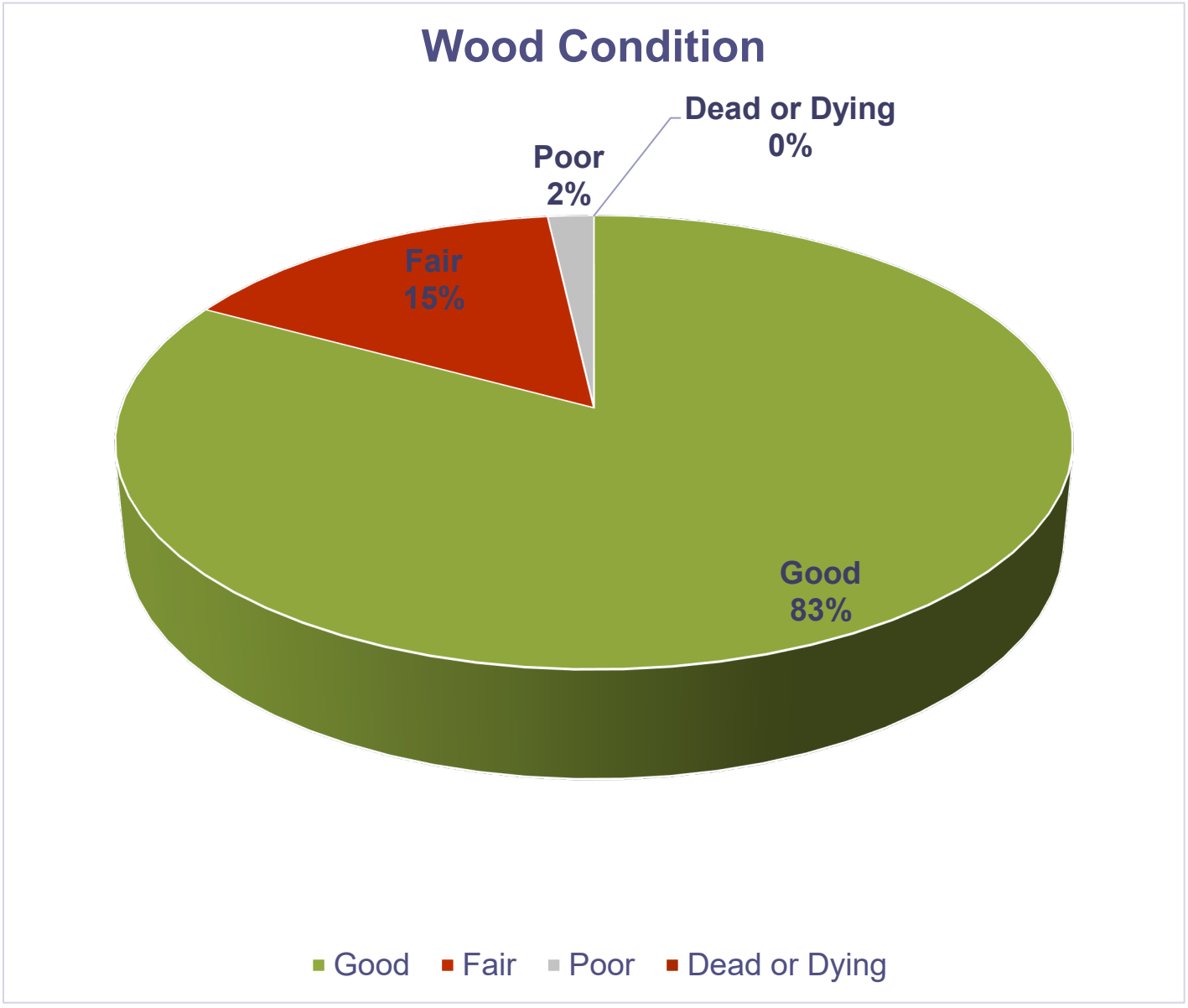
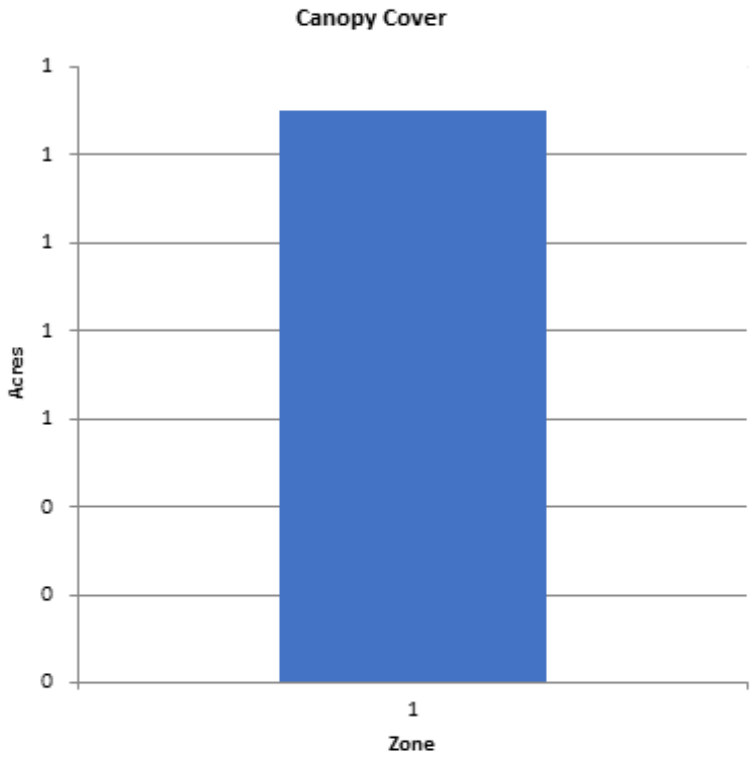


Figure 5: Canopy Cover in Acres

Luxemburg

Canopy Cover of Public Trees (Acres)

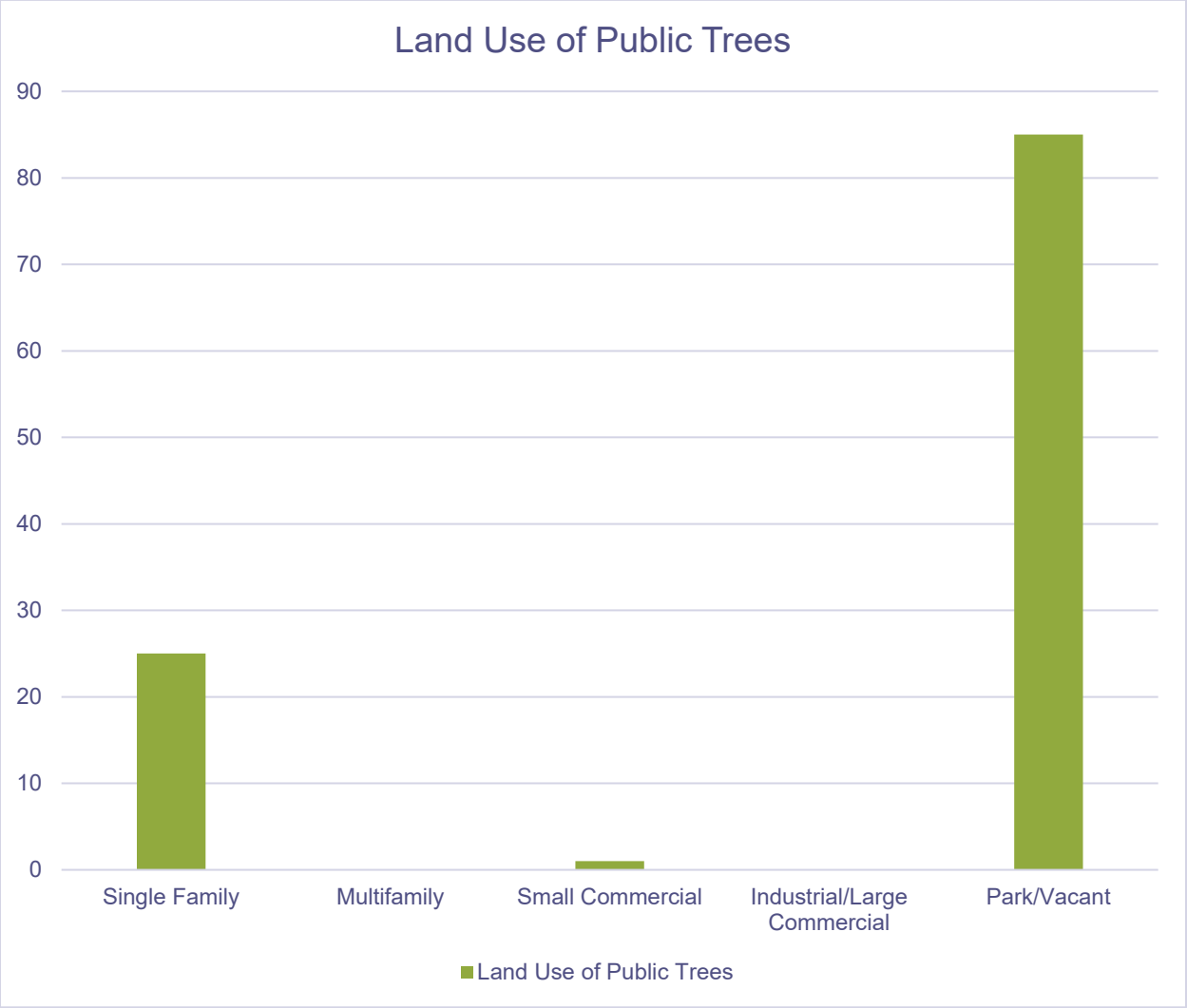
2/3/2022



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

Figure 6: Land Use of City/Park Trees



APPENDIX B: ArcGIS MAPPING

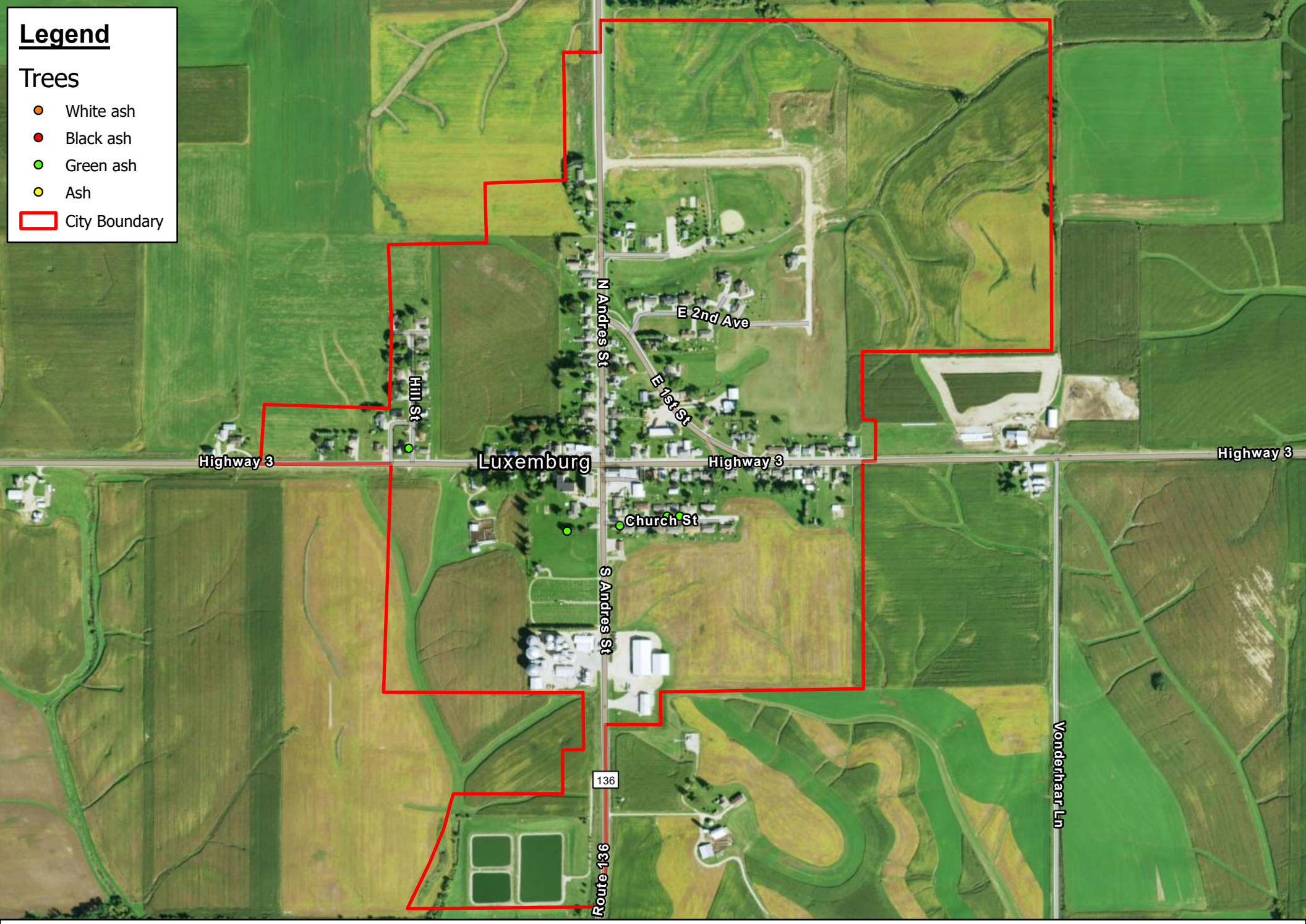
Figure 1: Location of Ash Trees

Figure 2: Location of EAB Symptoms

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

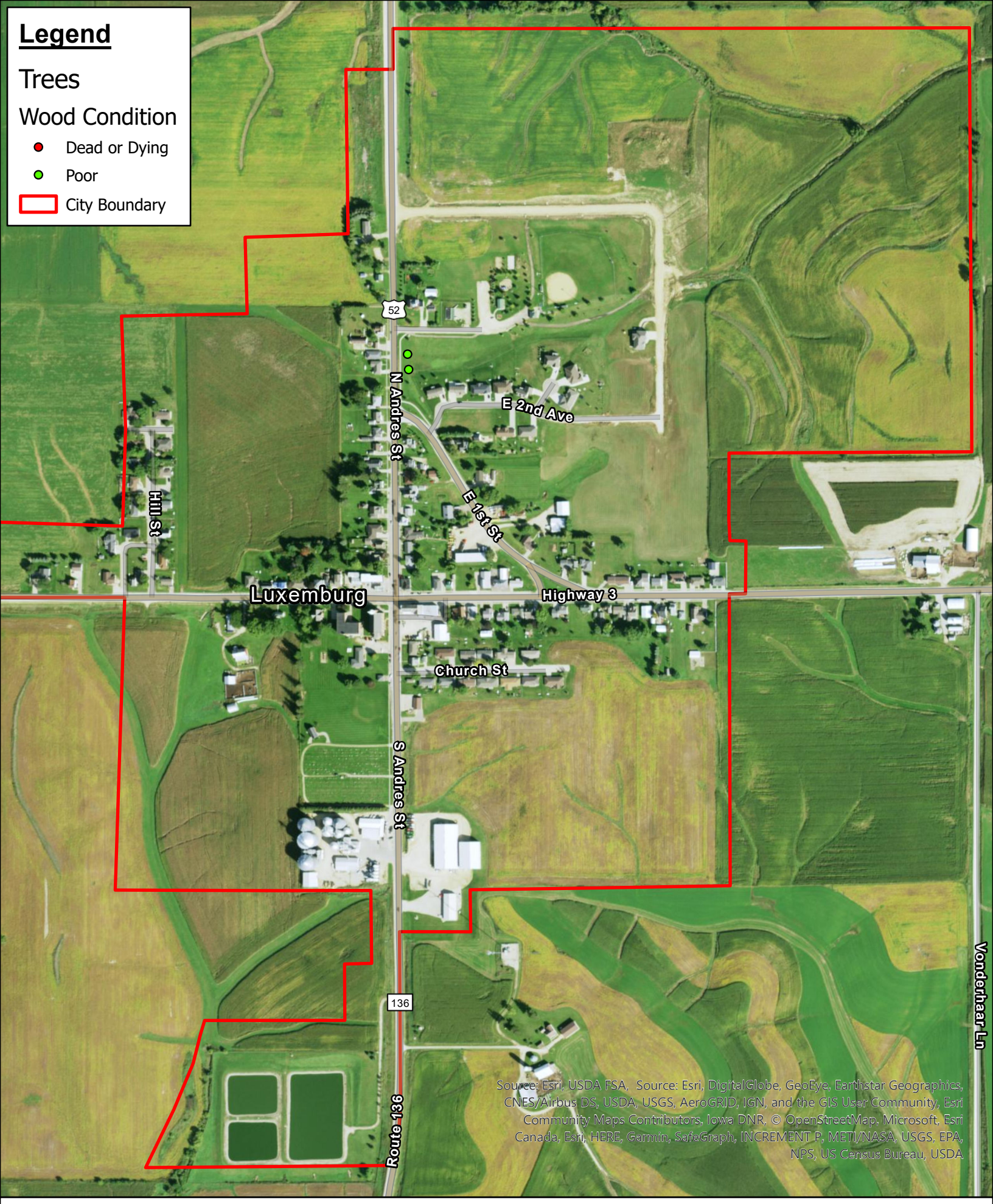
City ownership of the trees recommended for removal should be verified prior to any removal



Ash Tree Location

0 345 690 1,380 Feet

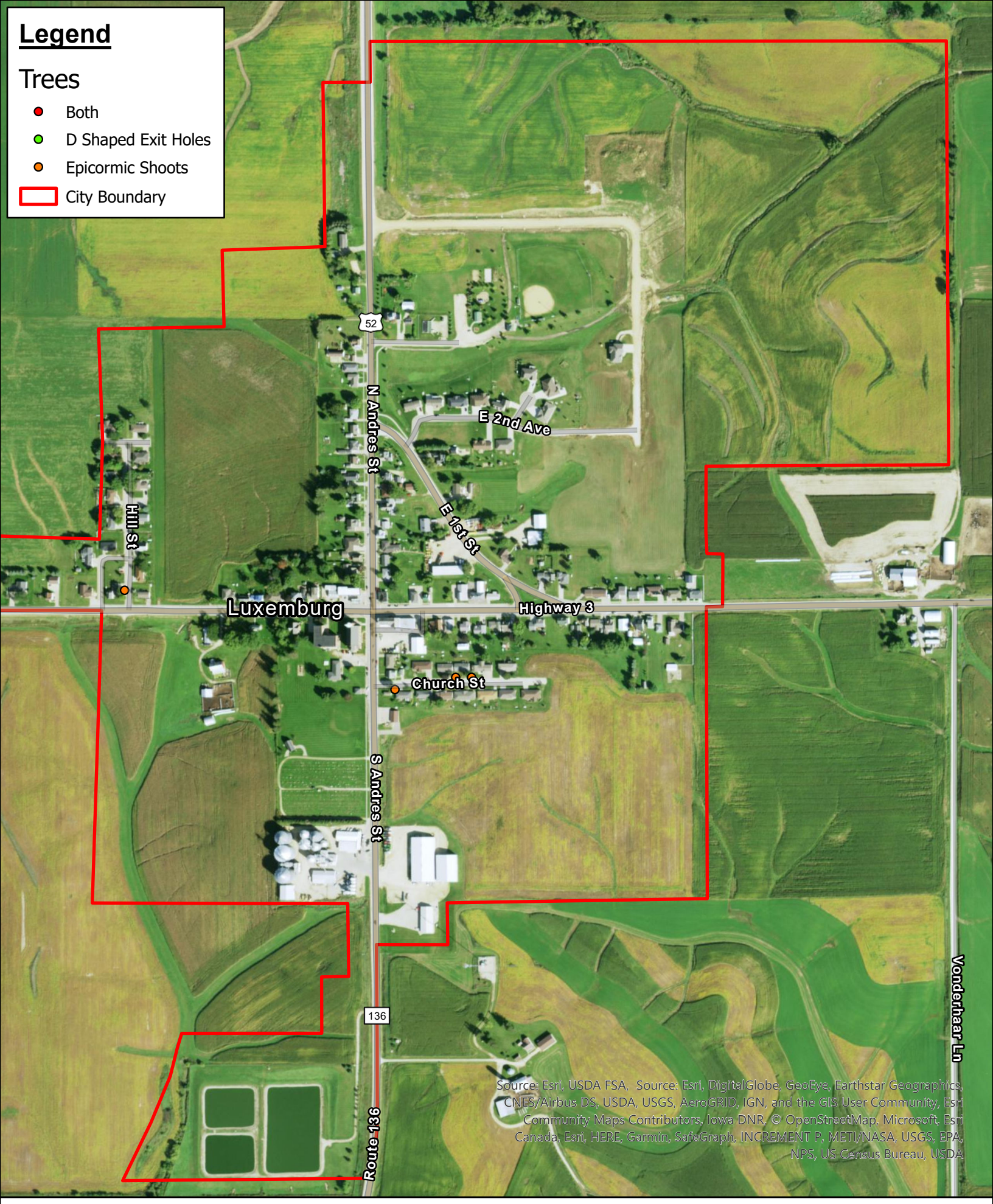
N



Poor Condition Trees

0 265 530 1,060 Feet

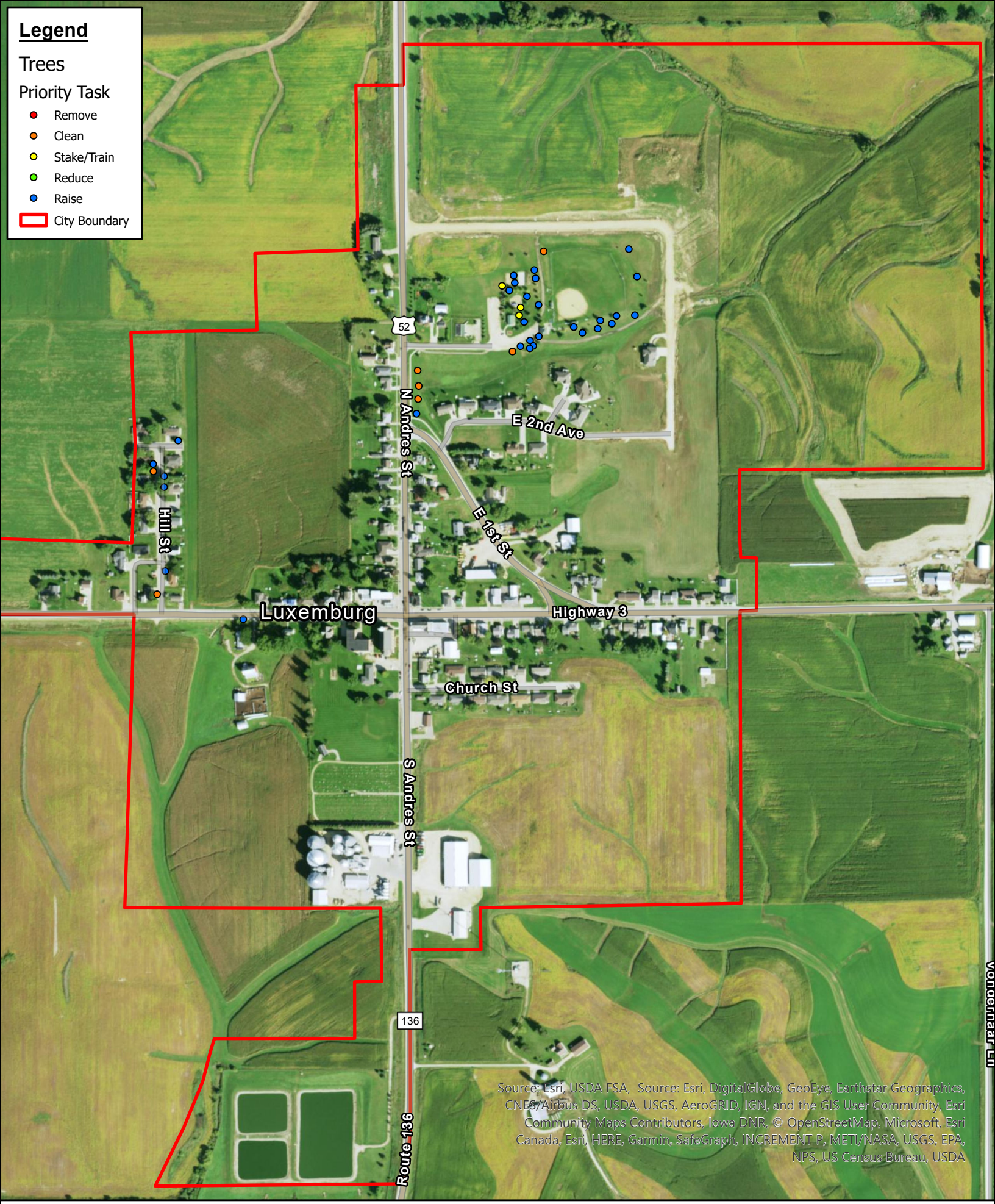
N



EAB Signs/Symptoms

0 265 530 1,060 Feet

N



Priority Task

0 265 530 1,060 Feet

N

APPENDIX C: LUXEMBURG TREE ORDINANCES

6-14-1 TITLE.

This Ordinance shall be known as the Municipal Tree Ordinance for the city of Luxemburg, in Dubuque County, State of Iowa.

6-14-2 PURPOSE.

It is the purpose of this Ordinance to promote and protect the public health, safety, and general welfare by providing for the regulation of the planting, maintenance, and removal of trees, shrubs, and other plants within the city of Luxemburg.

6-14-3 DEFINITIONS.

1. Large Trees. Those trees attaining a height of 45 feet (45') or more.

2. Park. All public parks having individual names.

3. Tree Lawn. That part of a street or highway, not covered by sidewalk or other paving, lying between the property line and that portion of the street or highway usually used for vehicular traffic.

6-14-4 TREE COMMITTEE.

There is hereby created and established a city tree committee under the City's Park Board. This committee shall report at least annually to the City Council. They will assist the City Council with planting, and maintenance programs for all public trees. They will promote the goals of the tree program and have the following responsibilities:

1. Study, investigate, counsel, and develop a written plan for the care, preservation, trimming, planting, replanting, removal or disposition of trees in City public areas.

2. Promote and educate the citizens of the City on the values and care of public trees within the City.

3. Pursue grant opportunities and other sources of funding to enhance tree planting and maintenance within the City.

4. When requested by the Park Board, consider, investigate, make findings, report and recommend upon any special matter or question within the scope of its work.

6-14-5 TRIMMING TREES TO BE SUPERVISED.

It is unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

6-14-6 DISEASE CONTROL.

Any dead, diseased or damaged tree or shrub which may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance.

6-14-7 INSPECTION AND REMOVAL.

The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be dead, diseased or damaged, and such trees and shrubs shall be subject to the following:

1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.

2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal with fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (14) days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property. (Ord. 4-07, Passed May 7, 2007)