

2016 COMMUNITY TREE MANAGEMENT PLAN

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Executive Summary

Overview

This plan was developed to assist the City of Underwood with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows communities to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a possibility that 16% of your municipally managed trees will die once EAB becomes established in the community. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2016, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street right of way and park trees. Below are some key findings of the 68 trees inventoried.

- Each of Underwood's municipal trees provides an average of \$103 worth of benefits to the community each year
- There are over 18 species of trees
- The top three genres are: Spruce – 38.2%, Ash – 16.3%, and Other Hardwoods – 10.3%.
- 10% of trees are in need of some type of management
- 3 trees are recommended for removal

Recommendations

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

- The 3 trees recommended for removal should be addressed within the next 3 years.
City ownership of the trees recommended for removal should be verified prior to any removal
- 5 of the 11 ash trees are in need of follow up because they are displaying signs and symptoms associated with EAB.
- The costs of removing and replacing all 10 (11 total ash trees, 1 is recommended for removal) city managed street and park ash trees is estimated to be \$6,800 using contracted labor. Community tree grants can help offset the estimated \$2,400 in replacement tree costs (hazard tree replacement and ash replacement combined). Budgeting approximately \$900 per year for contracted work or in-kind municipal time for the next 10 years should allow you to adequately prepare your community's budget for the repercussions of a potential EAB outbreak (for city maintained trees only). This suggested yearly budget also includes the removal and replacement of the 3 trees recommended for removal.
- All trees should be pruned on a routine schedule- one third of the city every two years.

Introduction

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

Trees are an important component of Underwood's infrastructure and one of the greatest assets to the community. The benefits of trees are immense. Trees provide the community with improved air quality, stormwater runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and create a desirable place to live, to name just a few benefits. It is essential that these benefits be maintained for the people of Underwood and future generations through good urban forestry management.

Good urban tree management involves setting goals and developing management strategies to achieve these goals. An essential part of developing management strategies is a comprehensive public tree inventory. The inventory supplies information that will be used for maintenance, removal schedules, tree planting and budgeting. Basing actions on this information will help meet Underwood's urban forestry goals.

Inventory

In 2016, a tree inventory was conducted that included 100% of the city owned street right of way and park trees. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document. Your community tree information is available for your use on a web-based GIS program. This GIS website, in addition to the fact sheet on how to operate the website, can be found at: <http://www.iowadnr.gov/Conservation/Forestry/Urban-Forestry/Community-Tree-Inventories>.

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

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance,

priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms of EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

The data collected for the 68 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STREETs), part of the i-Tree suite. The following are results from the i-Tree STREETs analysis. Findings

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Underwood's trees reduce energy related costs by approximately \$1,758 annually (Appendix A, Table 1). These savings are both in Electricity (8.3 MWh) and in Natural Gas (1,148.7 Therms).

Annual Stormwater Benefits

Underwood's trees intercept about 92,499 gallons of rainfall or snow melt each year (Appendix A, Table 2). This interception provides \$2,505 of benefits to the city.

Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and emitting volatile organic matter (ozone). In Underwood, it is estimated that trees remove 106.3 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 \$299 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere. In Underwood, trees sequester about 32,752 lbs of carbon a year with an associated value of \$246 (Appendix A, Table 5). In addition, the trees store 341,527 lbs of carbon, with a yearly benefit of \$2,561 (Appendix A, Table 4).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Underwood receives \$2,113 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, Underwood's trees provide \$6,992 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 68 trees in Underwood provide approximately \$102.82 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Underwood has over 18 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genus is as follows:

Underwood Species List by Genus		
<i>Genus</i>	<i>Total Trees</i>	<i>Percent of Total</i>
Spruce	26	38.2%
Ash	11	16.2%
Hardwood	7	10.3%
Oak	6	8.8%
Maple	3	4.4%
Buckeye	3	4.4%
Redbud	2	2.9%
Honey Locust	2	2.9%
Juniper	2	2.9%
Pear	2	2.9%
Hackberry	1	1.5%
Other Conifer	1	1.5%
Apple	1	1.5%
Linden	1	1.5%
TOTALS	68	100.0%

Age Class

48.5% of Underwood's trees fall between 0 and 3 inches in diameter. For age, a Bell Curve is preferred and should show the highest amount of trees around 18 inches in diameter at 4.5 ft. Almost half of Underwood's municipally managed trees are seedling and sapling sized, indicating a younger than average population of trees. Continue to plant trees, as feasible, to increase your canopy cover goals for the community.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Underwood indicate that 94% of the trees were in good or fair health in 2016, with only 6% of the sampled trees in poor or dead/dying foliar health (Appendix A, Figure 3). Similarly, 90% of Underwood's trees are in good or fair health for wood

condition (appendix A, Figure 4). Wood condition that is in poor health or is considered dead or dying is about 10% of the population. This 10% 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 A, Figures 8 & 9).

TASK	Number of Trees	% of Total trees
Stake/Train	13	19%
Clean	4	6%
Remove	3	4%

Canopy Cover

The estimated canopy cover for the entire town of Underwood is approximately 48.83 acres (as calculated by the Iowa DNR). The canopy cover estimated by i-tree for the inventoried right of way and park trees is 0.95 acres (Appendix A, Figure 5). According to the 2010 census, Underwood occupies 295.20 acres. Thus the canopy cover on city parks and right of way areas is about 0.3%, and over the entire community is 17%.

Land Use and Location

The majority of Underwood's trees are found in parks and other vacant lots (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use

Park/Vacant/Other	82.4%
Single Family Residential	17.7%

Location

Front yard	89.7%
Planting Strip	8.8%
Cut-out	1.5%

Recommendations

Risk Management

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

Hazardous trees

Underwood has 1 critical concern tree that is in need of crown cleaning (trimming) as soon as possible. This tree can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figures 4 and 5). In addition, there are 3 trees identified as needing removal in the next 1-3 years. There is one tree recommended for crown cleaning in the next 3 years, and 2 trees recommended for cleaning in the next 5 years. Finally, there are 13 young trees that are recommended for staking/training/corrective pruning within the next 5 years. Addressing these issues now will allow these trees to continue their healthy development into Underwood's community tree canopy. These recommendations are summarized on the following table.

PRIORITY TASK	CRITICAL CONCERN	MATURE TREE IMMEDIATE	MATURE TREE ROUTINE	YOUNG TREE IMMEDIATE	YOUNG TREE ROUTINE	TOTAL
NONE:			25		23	48
STAKE/TRAIN					13	
CLEAN	1	1	2			4
RAISE						
REDUCE						
REMOVE		3				3
TREAT PEST/DISEASE						
TOTAL	1	4	27		36	68

Poor tree species

After the removal of the critical concern and immediate concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 1 & Appendix B, Figure 3). Of the 3 trees recommended for removal, 1 is an ash trees. There are a total of 11 ash trees, and 5 trees have signs and symptoms that have been associated with EAB. Two of the ash trees are considered to be in poor health or dead/dying. EAB symptomatic trees should be examined as soon as possible. [*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 five main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, crown reduction, and treat pest/disease. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. Treat pest/disease trees showed indications of foliar or structural

decline due to insect, disease, or rot. These trees should be investigated further by a certified arborist who can look into the integrity of the tree. It is recommended that all trees be pruned on a routine schedule every five to seven years.

Planting

It is suggested that for every tree removed, a replanting rate of 1.2 should be used, 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 canopy cover in Underwood.

It is important to plant a diverse mix of species in Underwood 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, Underwood is heavily planted with Spruce (38.2%) and Ash species (16.2%) (Appendix A, Figure 1). *Spruce should not be planted until this percentage can be lowered.* Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, Chinese and Siberian elms, willow, and black walnut. All trees planted must meet the restrictions in city ordinance (Appendix C).

Bur oak, chinkapin oak, white oak, red oak, black oak, Kentucky coffee tree, American linden (basswood), thornless honey locust, black cherry, sycamore, and hackberry are all suited to Underwood's upland soils – and are presently underutilized. In addition, ironwood (*Ostrya virginiana*), eastern redbud (*Cercis canadensis*), and serviceberry (*Amelanchier arborea*) would make great alternatives to low growing trees for right of ways.

Recommended Species to plant in Western Iowa:

COMMON NAME	SCIENTIFIC NAME	CULTIVARS / SELECTIONS
LARGE SHADE TREES – Plant 35 feet apart and away from overhead power lines.		
White Oak	<i>Quercus alba</i>	
Bur Oak	<i>Quercus macrocarpa</i>	
Red Oak	<i>Quercus rubra</i>	
Black Oak	<i>Quercus velutina</i>	
Chinkapin Oak	<i>Quercus muehlenbergii</i>	
American Basswood (Linden)	<i>Tilia Americana</i>	Boulevard, Front Yard, Legend, Redmond
Thornless Honey locust	<i>Gleditsia triacanthos var. inermis</i>	Shademaster, Skyline
American elm	<i>Ulmus Americana</i>	Princeton, Valley Forge
Kentucky coffee tree	<i>Gymnocladus dioicus</i>	Expresso
Black Cherry	<i>Prunus serotina</i>	
Hackberry	<i>Celtis occidentalis</i>	Chicagoland, Prairie Pride, Windy City
LOW GROWING TREES (less than 30 feet tall) planted as close as 12 feet.		
Eastern redbud	<i>Cercis canadensis</i>	
Downy Hawthorn	<i>Crataegus mollis</i>	

Ironwood (hop hornbeam)	<i>Ostrya virginiana</i>	
American hornbeam	<i>Carpinus caroliniana</i>	
Serviceberry	<i>Amelanchier arborea</i>	Autumn brilliance, Cumulus, Princess Diana
Flowering crabapple	<i>Malus</i>	Prairiefire, Adams, Sentinel, Snowdrift
Red mulberry	<i>Morus rubra</i>	
American (wild) plum	<i>Prunus americana</i>	

EVERGREEN TREES – planted 25 feet apart and away from overhead power lines.

Eastern White Pine	<i>Pinus strobes</i>
Jack pine	<i>Pinus banksiana</i>
Juniper (Eastern red cedar)	<i>Juniperus virginiana</i>
Norway spruce	<i>Picea abies</i>
Concolor fir	<i>Abies concolor</i>

Continual Monitoring

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended that ash trees be checked with a visual survey every year for tree death 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 should be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 3). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 1 & Appendix B, Figure 2). [*City ownership of the tree recommended for removal should be verified prior to any removal*](#)

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of over 25 million 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. The entire state of Iowa is under USDA quarantine for EAB.

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.

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? 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.

Canopy Replacement

As budget permits, all removed ash trees should be replaced. All trees should meet the restrictions in city ordinance 151.02 (Appendix C). The new plantings should be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese/Siberian elm, willow or black walnut.

Postponed Work

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

Monitoring

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

Private Ash Trees

It is strongly suggested that private property owners monitor the condition of their privately managed trees. There are numerous options available to them, including: removal and replanting, treating with insecticides, and monitoring until an issue arises. These options are spelled out in: <https://store.extension.iastate.edu/Product/Emerald-Ash-Borer-Management-Options>. Check your city tree ordinance to be sure additional actions are not required for these private trees.

Treating for EAB

Many landowners will want to treat their ash trees with insecticides to prolong the life of their ash trees. This is only recommended by Iowa State University Extension when EAB has been found within 15 miles of the tree in question. The closest known populations of EAB to Underwood are Missouri Valley, IA (23 miles) and Omaha, Nebraska (26 miles).

Insecticidal applications can have serious environmental side effects when improperly applied. “Do it yourself” insecticides (drenches, granulars) have application limits – such as only a certain number of diameter inches may be treated per acre. Encourage your residents to report ash treatments with the city or their neighbors – in order to prevent over-application of these insecticides. Please contact me if you have any questions.

Your community should put heavy thought and consideration into your emerald ash borer plan. For instance, it may be more economical to budget for ash removals as they come, than it would be to treat each city-managed ash tree for the next 5 to 10 years.

Maintenance Plan and Budget

The following tasks are placed in order of yearly priority. These tasks should be fulfilled as your budget or personnel time allows. Critical concern trees should be treated immediately, and immediate mature tree tasks should be completed within 2-3 years (which is their expected lifetime before they become critical concern trees). Mature tree routine trees should be followed up on within 5 years. If you are interested in creating a scheduled maintenance and replanting plan, based on a set budget, please contact me. For now, a priority list looks like this:

2017: Clean the 1 tree identified for critical concern cleaning and also clean the 1 tree identified for mature tree immediate cleaning. If there is time, consider removing the 2 trees indicated for mature tree routine removal (which would be ahead of schedule). There are 3 trees identified for mature tree immediate removal. If these 3 trees have not been removed already, they should be removed as soon as possible in 2017.

Discuss increasing tree removal and replacement financial budgets and/or increasing staff time dedicated to community tree work with city staff.

Look into tree planting grants for community entities (Trees for Kids, Trees Forever grants).

Perform yearly ash survey of 11 city managed ash trees.

2017-2019: Complete the staking/training/corrective pruning follow-up work on the 13 young trees identified as needing assistance.

Determine how much money can be budgeted over the next 10 years for potential forest health issues.

Start replanting trees that you have removed, as time and finances permit. Four trees should be replanted to replace the 3 hazard trees removed. 12 additional trees will be needed to replace all 10 remaining ash if an EAB infestation occurs. Plan on budgeting or requesting \$150/tree for replanting and young tree maintenance costs (if you do not have a grant to cover the replanting costs).

Monitor for suspicious ash trees.

2019-2021:

Consider implementing a routine trimming (cleaning) regimen for the remaining city trees. Ideally, routine trimming should be done to 1/3 of the city's trees every 2 years. In other words, all public and right of way trees should be trimmed once every 6 years.

Also – consider evaluating Underwood's street trees again for hazards by 2021 (if not before).

Monitor for tree health issues – all species.

Proposed Budget Increase

Emerald Ash Borer could potentially kill all ash trees in Underwood within 4 years of its arrival. To remove and replace all 10 (11 total ash trees, 1 is recommended for removal) inventoried ash trees, you would need to budget an estimated \$6,800 (calculated using \$500/tree removal price and \$150/tree replacement price). Your 3 trees recommended for removal (and replacement) would cost an additional \$2,100 for a total estimated 10 year tree budget of \$8,900 (which does not include the recommended trimming/cleaning costs). If municipal crews usually take down right of way and park trees, the removal costs will undoubtedly be much less than this figure. However, if you rely on contractors to remove and replant your city trees – you will want to be budgeting for at least \$900 to \$1,500 per year for the next 10 years.

It is recommended that Underwood 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. The Trees for Kids Grant will be a great option for your community to use for tree planting projects on public lands. Trees Forever may also have community improvement grants that can assist with replanting expenses.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Underwood

Annual Energy Benefits of Public Trees

1/11/2017

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Blue spruce	0.5	34	73.7	72	107	(N/A)	36.8	6.1	4.26
Green ash	3.2	244	423.2	415	658	(N/A)	16.2	37.4	59.84
Broadleaf Deciduous Small	0.0	2	4.4	4	6	(N/A)	10.3	0.3	0.87
Silver maple	1.0	78	137.6	135	213	(N/A)	4.4	12.1	70.94
Ohio buckeye	0.7	56	98.6	97	152	(N/A)	4.4	8.7	50.75
Northern red oak	0.1	8	15.4	15	23	(N/A)	2.9	1.3	11.39
Black walnut	0.7	54	100.5	99	153	(N/A)	2.9	8.7	76.46
Oak	0.0	0	0.9	1	1	(N/A)	2.9	0.1	0.66
Eastern redbud	0.0	1	1.2	1	2	(N/A)	2.9	0.1	0.87
Callery pear	0.2	16	33.7	33	49	(N/A)	2.9	2.8	24.47
Honeylocust	0.6	47	84.6	83	130	(N/A)	2.9	7.4	64.79
Littleleaf linden	0.1	6	12.5	12	18	(N/A)	1.5	1.0	18.25
Swamp white oak	0.0	3	6.2	6	9	(N/A)	1.5	0.5	8.99
Northern hackberry	0.4	33	60.8	60	92	(N/A)	1.5	5.2	92.23
Pin oak	0.4	29	51.8	51	80	(N/A)	1.5	4.6	80.25
Apple	0.2	14	24.7	24	38	(N/A)	1.5	2.2	38.13
Spruce	0.1	4	9.5	9	14	(N/A)	1.5	0.8	13.58
Conifer Evergreen Large	0.1	4	9.5	9	14	(N/A)	1.5	0.8	13.58
Total	8.3	632	1,148.7	1,126	1,758	(N/A)	100.0	100.0	25.86

Table 2: Annual Stormwater Benefits

Underwood

Annual Stormwater Benefits of Public Trees

1/11/2017

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Blue spruce	5,492	149	(N/A)	36.8	5.9	5.95
Green ash	37,110	1,006	(N/A)	16.2	40.1	91.43
Broadleaf Deciduous Small	52	1	(N/A)	10.3	0.1	0.20
Silver maple	15,075	409	(N/A)	4.4	16.3	136.17
Ohio buckeye	5,297	144	(N/A)	4.4	5.7	47.85
Northern red oak	548	15	(N/A)	2.9	0.6	7.42
Black walnut	9,433	256	(N/A)	2.9	10.2	127.82
Oak	36	1	(N/A)	2.9	0.0	0.48
Eastern redbud	15	0	(N/A)	2.9	0.0	0.20
Callery pear	1,172	32	(N/A)	2.9	1.3	15.88
Honeylocust	5,810	157	(N/A)	2.9	6.3	78.73
Littleleaf linden	461	12	(N/A)	1.5	0.5	12.48
Swamp white oak	163	4	(N/A)	1.5	0.2	4.41
Northern hackberry	4,984	135	(N/A)	1.5	5.4	135.08
Pin oak	4,943	134	(N/A)	1.5	5.3	133.95
Apple	667	18	(N/A)	1.5	0.7	18.06
Spruce	596	16	(N/A)	1.5	0.6	16.14
Conifer Evergreen Large	596	16	(N/A)	1.5	0.6	16.14
Citywide total	92,449	2,505	(N/A)	100.0	100.0	36.84

Table 3: Annual Air Quality Benefits

Underwood

Annual Air Quality Benefits of Public Trees

1/11/2017

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								
Blue spruce	0.7	0.1	0.6	0.1	5	2.3	0.3	0.3	2.1	14	-1.8	-7	4.7	12 (N/A)		36.8	0.47
Green ash	4.9	0.8	2.3	0.2	26	15.2	2.2	2.1	14.5	95	0.0	0	42.3	121 (N/A)		16.2	10.99
Broadleaf Deciduous Small	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)		10.3	0.11
Silver maple	2.5	0.4	1.2	0.1	14	4.9	0.7	0.7	4.6	30	-1.3	-5	13.9	39 (N/A)		4.4	13.03
Ohio buckeye	0.9	0.2	0.5	0.0	5	3.5	0.5	0.5	3.3	22	-0.2	-1	9.2	26 (N/A)		4.4	8.66
Northern red oak	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	-0.1	0	1.1	3 (N/A)		2.9	1.55
Black walnut	1.3	0.2	0.6	0.1	7	3.4	0.5	0.5	3.2	21	0.0	0	9.8	28 (N/A)		2.9	14.09
Oak	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)		2.9	0.08
Eastern redbud	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)		2.9	0.11
Callery pear	0.1	0.0	0.1	0.0	1	1.0	0.1	0.1	1.0	6	0.0	0	2.5	7 (N/A)		2.9	3.47
Honeylocust	1.1	0.2	0.5	0.0	6	2.9	0.4	0.4	2.8	18	-0.8	-3	7.6	21 (N/A)		2.9	10.61
Littleleaf linden	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	2	0.0	0	0.9	3 (N/A)		1.5	2.55
Swamp white 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)		1.5	1.21
Northern hackberry	0.9	0.1	0.4	0.0	5	2.1	0.3	0.3	2.0	13	0.0	0	6.1	18 (N/A)		1.5	17.54
Pin oak	0.9	0.2	0.5	0.0	5	1.8	0.3	0.3	1.8	12	-1.7	-6	4.0	10 (N/A)		1.5	10.20
Apple	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)		1.5	6.56
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)		1.5	1.48
Conifer Evergreen Large	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)		1.5	1.48
Citywide total	13.8	2.3	7.0	0.7	75	39.9	5.8	5.5	37.8	248	-6.3	-24	106.3	299 (N/A)		100.0	4.40

Table 4: Annual Carbon Stored

Underwood

Stored CO2 Benefits of Public Trees

1/11/2017

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Blue spruce	5,552	42	(N/A)	36.8	1.6	1.67
Green ash	163,041	1,223	(N/A)	16.2	47.7	111.16
Broadleaf Deciduous	96	1	(N/A)	10.3	0.0	0.10
Silver maple	55,900	419	(N/A)	4.4	16.4	139.75
Ohio buckeye	15,194	114	(N/A)	4.4	4.4	37.98
Northern red oak	1,037	8	(N/A)	2.9	0.3	3.89
Black walnut	41,716	313	(N/A)	2.9	12.2	156.43
Oak	24	0	(N/A)	2.9	0.0	0.09
Eastern redbud	28	0	(N/A)	2.9	0.0	0.10
Callery pear	2,201	17	(N/A)	2.9	0.6	8.26
Honeylocust	13,485	101	(N/A)	2.9	3.9	50.57
Littleleaf linden	1,025	8	(N/A)	1.5	0.3	7.68
Swamp white oak	218	2	(N/A)	1.5	0.1	1.64
Northern hackberry	13,507	101	(N/A)	1.5	4.0	101.30
Pin oak	24,952	187	(N/A)	1.5	7.3	187.14
Apple	3,037	23	(N/A)	1.5	0.9	22.78
Spruce	257	2	(N/A)	1.5	0.1	1.93
Conifer Evergreen La	257	2	(N/A)	1.5	0.1	1.93
Citywide total	341,527	2,561	(N/A)	100.0	100.0	37.67

Table 5: Annual Carbon Sequestered

Underwood

Annual CO Benefits of Public Trees

1/11/2017

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
Blue spruce	125	1	-27	-11	0	759	6	847	6 (N/A)	36.8	2.6	0.25
Green ash	7,053	53	-783	-33	-6	5,382	40	11,619	87 (N/A)	16.2	35.5	7.92
Broadleaf Deciduous Smal	61	0	-1	-1	0	39	0	98	1 (N/A)	10.3	0.3	0.10
Silver maple	4,214	32	-268	-11	-2	1,724	13	5,658	42 (N/A)	4.4	17.3	14.15
Ohio buckeye	1,242	9	-73	-7	-1	1,230	9	2,392	18 (N/A)	4.4	7.3	5.98
Northern red oak	152	1	-5	-1	0	171	1	317	2 (N/A)	2.9	1.0	1.19
Black walnut	1,816	14	-200	-8	-2	1,202	9	2,811	21 (N/A)	2.9	8.6	10.54
Oak	5	0	0	0	0	9	0	13	0 (N/A)	2.9	0.0	0.05
Eastern redbud	17	0	0	0	0	11	0	28	0 (N/A)	2.9	0.1	0.10
Callery pear	448	3	-11	-2	0	352	3	787	6 (N/A)	2.9	2.4	2.95
Honeylocust	1,873	14	-65	-5	-1	1,030	8	2,833	21 (N/A)	2.9	8.7	10.62
Littleleaf linden	223	2	-5	-1	0	134	1	351	3 (N/A)	1.5	1.1	2.63
Swamp white oak	96	1	-2	-1	0	65	0	158	1 (N/A)	1.5	0.5	1.18
Northern hackberry	616	5	-65	-4	-1	721	5	1,269	10 (N/A)	1.5	3.9	9.51
Pin oak	2,196	16	-120	-4	-1	652	5	2,723	20 (N/A)	1.5	8.3	20.43
Apple	268	2	-15	-2	0	308	2	560	4 (N/A)	1.5	1.7	4.20
Spruce	53	0	-1	-1	0	94	1	145	1 (N/A)	1.5	0.4	1.08
Conifer Evergreen Large	53	0	-1	-1	0	94	1	145	1 (N/A)	1.5	0.4	1.08
Citywide total	20,511	154	-1,641	-95	-13	13,978	105	32,752	246 (N/A)	100.0	100.0	3.61

Table 6: Annual Social and Aesthetic Benefits

Underwood

Annual Aesthetic/Other Benefits of Public Trees

1/11/2017

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Blue spruce	160	(N/A)	36.8	7.6	6.40
Green ash	577	(N/A)	16.2	27.3	52.48
Broadleaf Deciduous Small	0	(N/A)	10.3	0.0	0.03
Silver maple	332	(N/A)	4.4	15.7	110.74
Ohio buckeye	121	(N/A)	4.4	5.7	40.46
Northern red oak	18	(N/A)	2.9	0.8	8.89
Black walnut	132	(N/A)	2.9	6.3	66.10
Oak	11	(N/A)	2.9	0.5	5.26
Eastern redbud	0	(N/A)	2.9	0.0	0.03
Callery pear	52	(N/A)	2.9	2.5	26.22
Honeylocust	389	(N/A)	2.9	18.4	194.60
Littleleaf linden	31	(N/A)	1.5	1.5	31.20
Swamp white oak	13	(N/A)	1.5	0.6	12.89
Northern hackberry	73	(N/A)	1.5	3.4	72.66
Pin oak	157	(N/A)	1.5	7.4	157.02
Apple	15	(N/A)	1.5	0.7	15.48
Spruce	15	(N/A)	1.5	0.7	15.42
Conifer Evergreen Large	15	(N/A)	1.5	0.7	15.42
Citywide total	2,113	(N/A)	100.0	100.0	31.08

Table 7: Summary of Benefits in Dollars

Underwood

Total Annual Benefits of Public Trees by Species (\$)

1/11/2017

Species	Energy	CO ₂	Air Quality	Stormwater	Aesthetic/Other	Total (\$)	Standard Error	% of Total \$
Blue spruce	107	6	12	149	160	434	(N/A)	6.3
Green ash	658	87	121	1,006	577	2,449	(N/A)	35.4
Broadleaf Deciduous Sn	6	1	1	1	0	9	(N/A)	0.1
Silver maple	213	42	39	409	332	1,035	(N/A)	15.0
Ohio buckeye	152	18	26	144	121	461	(N/A)	6.7
Northern red oak	23	2	3	15	18	61	(N/A)	0.9
Black walnut	153	21	28	256	132	590	(N/A)	8.5
Oak	1	0	0	1	11	13	(N/A)	0.2
Eastern redbud	2	0	0	0	0	3	(N/A)	0.0
Callery pear	49	6	7	32	52	146	(N/A)	2.1
Honeylocust	130	21	21	157	389	719	(N/A)	10.4
Littleleaf linden	18	3	3	12	31	67	(N/A)	1.0
Swamp white oak	9	1	1	4	13	29	(N/A)	0.4
Northern hackberry	92	10	18	135	73	327	(N/A)	4.7
Pin oak	80	20	10	134	157	402	(N/A)	5.8
Apple	38	4	7	18	15	82	(N/A)	1.2
Spruce	14	1	1	16	15	48	(N/A)	0.7
Conifer Evergreen Large	14	1	1	16	15	48	(N/A)	0.7
Citywide Total	1,758	246	299	2,505	2,113	6,922	(N/A)	100.0

Table 8: Underwood's community trees by diameter class and maintenance priority.

Underwood

Recommended Maintenance for Public Trees (None)

1/11/2017

DBH Class (in)										
Zone	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total
	0	0	0	0	0	0	0	0	0	0
Citywide total	0	0	0	0	0	0	0	0	0	0

DBH Class (in)											
Maintenance Type	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total	% of Total Population
None	0	0	0	0	0	0	0	0	0	0	0.00
Young tree (routine)	33	2	1	0	0	0	0	0	0	36	52.94
Young tree (immediate)	0	0	0	0	0	0	0	0	0	0	0.00
Mature tree (routine)	0	0	6	7	6	2	4	2	0	27	39.71
Mature tree (immediate)	0	0	2	0	0	0	2	0	0	4	5.88
Critical concern (public safety)	0	0	0	0	0	0	0	1	0	1	1.47
Citywide total	33	2	9	7	6	2	6	3	0	68	100.00

Table 9: Underwood's community trees by diameter class and prioritized maintenance tasks.

Underwood										
Priority Task Summary for Public Trees (None)										
1/11/2017										
DBH Class (in)										
Zone	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total
I	21	1	7	6	5	2	4	2	0	48
Citywide total	21	1	7	6	5	2	4	2	0	48
DBH Class (in)										
Maintenance Type	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total % of Total Population
None	21	1	7	6	5	2	4	2	0	48 70.59
Stake/Train	12	1	0	0	0	0	0	0	0	13 19.12
Clean	0	0	0	1	1	0	1	1	0	4 5.88
Raise	0	0	0	0	0	0	0	0	0	0 0.00
Reduce	0	0	0	0	0	0	0	0	0	0 0.00
Remove	0	0	2	0	0	0	1	0	0	3 4.41
Treat pest/disease	0	0	0	0	0	0	0	0	0	0 0.00
Citywide total	33	2	9	7	6	2	6	3	0	68 100.00

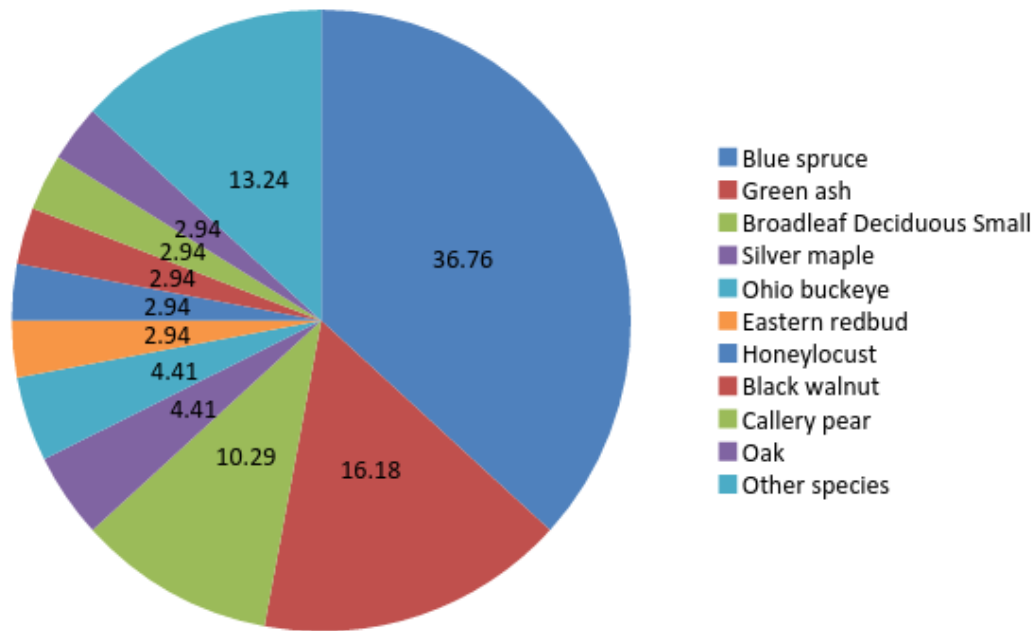


Figure 1: Species Distribution

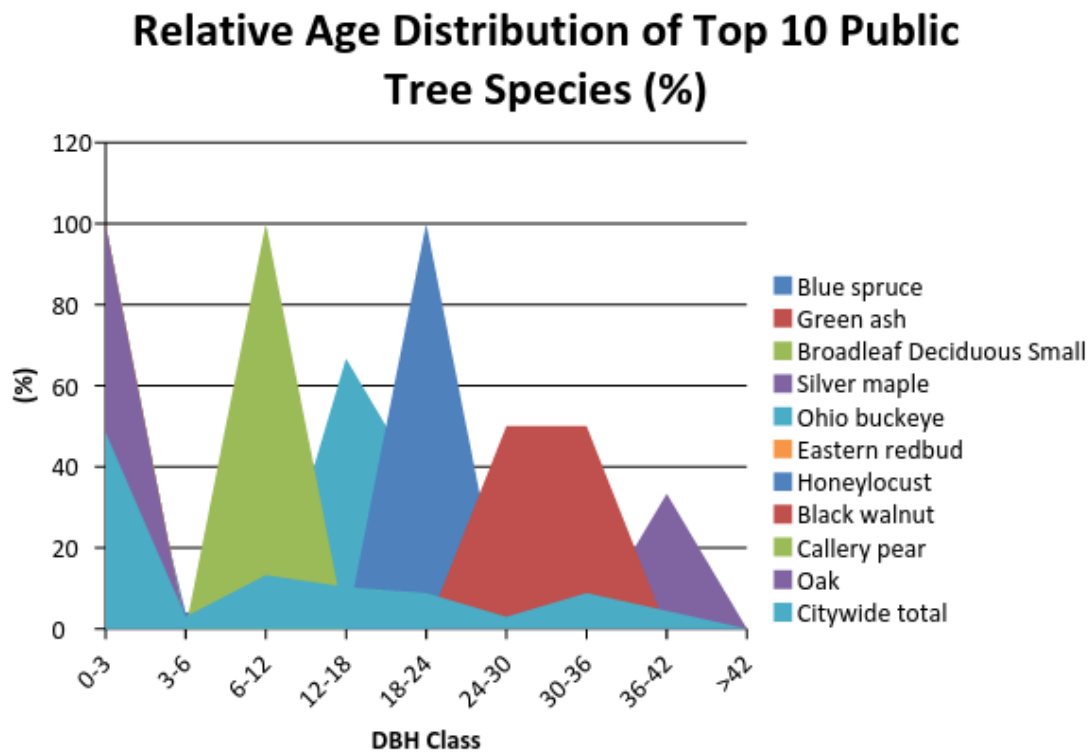


Figure 2: Relative Age Class

Leaf Condition

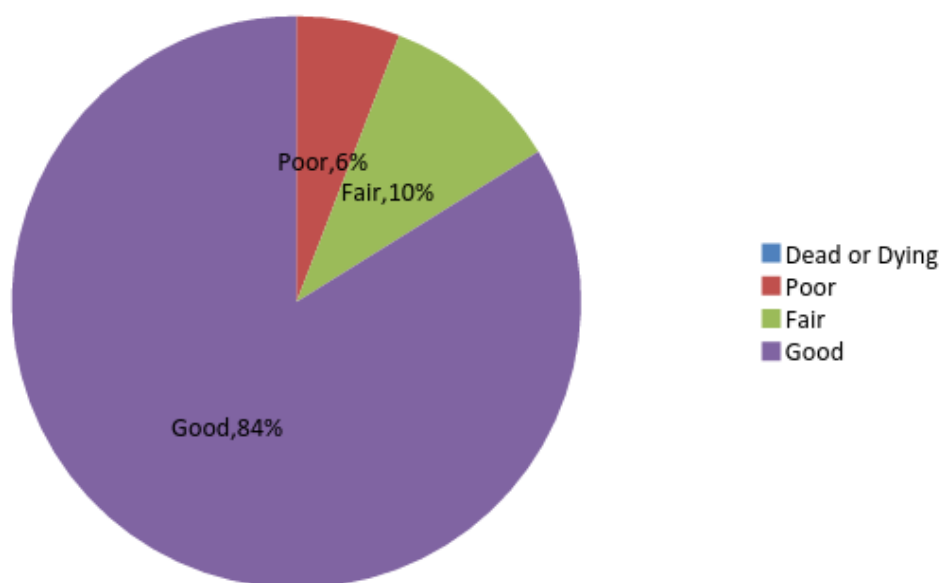


Figure 3: Foliage Condition

Wood Condition

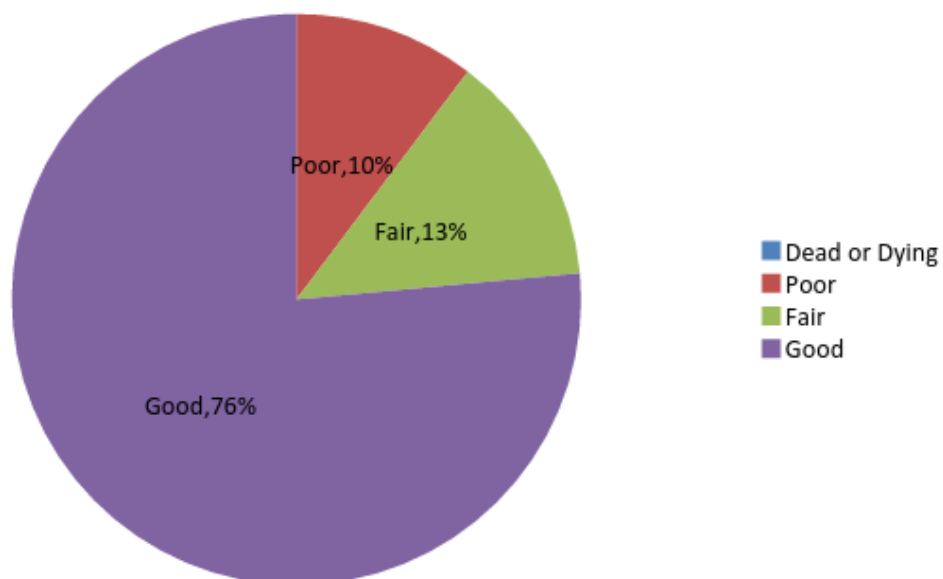


Figure 4: Wood Condition

Canopy Cover

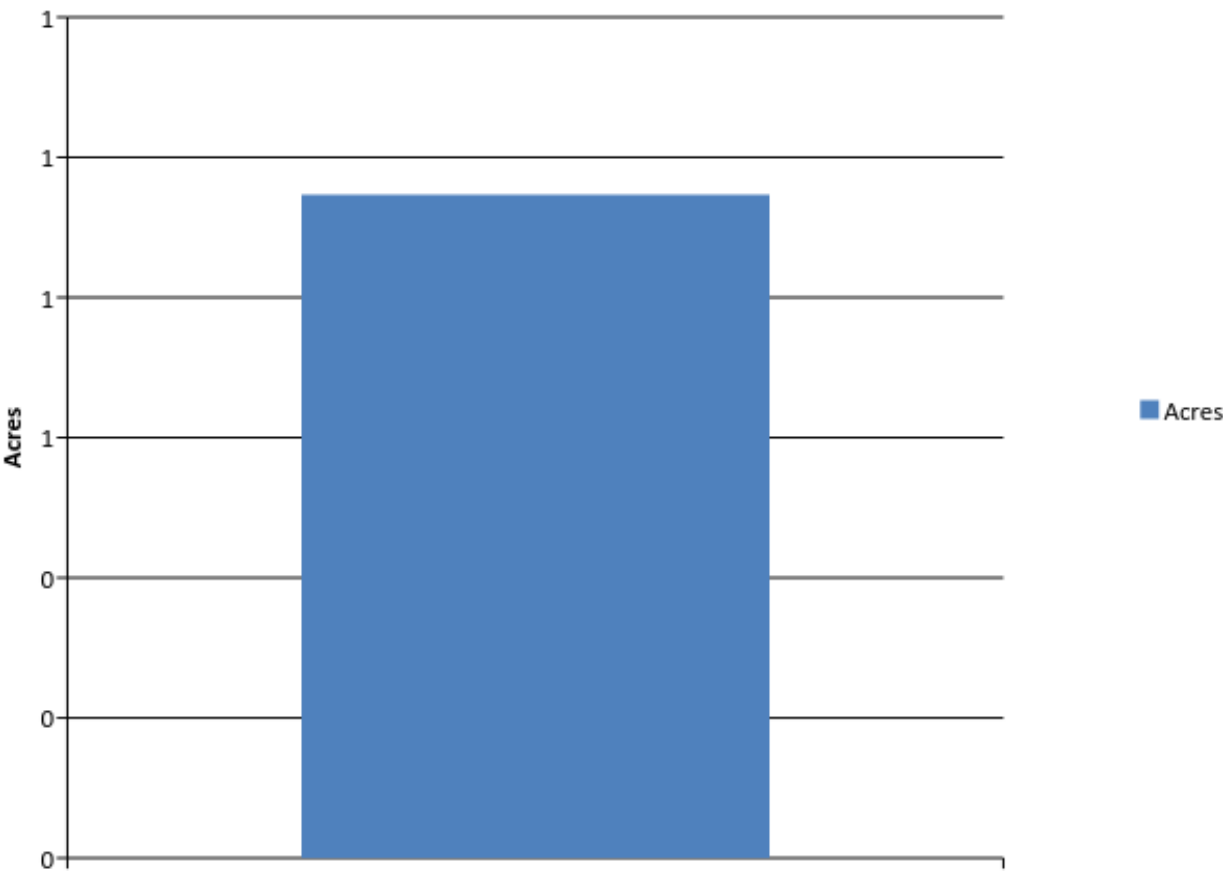


Figure 5: Canopy Cover in Acres

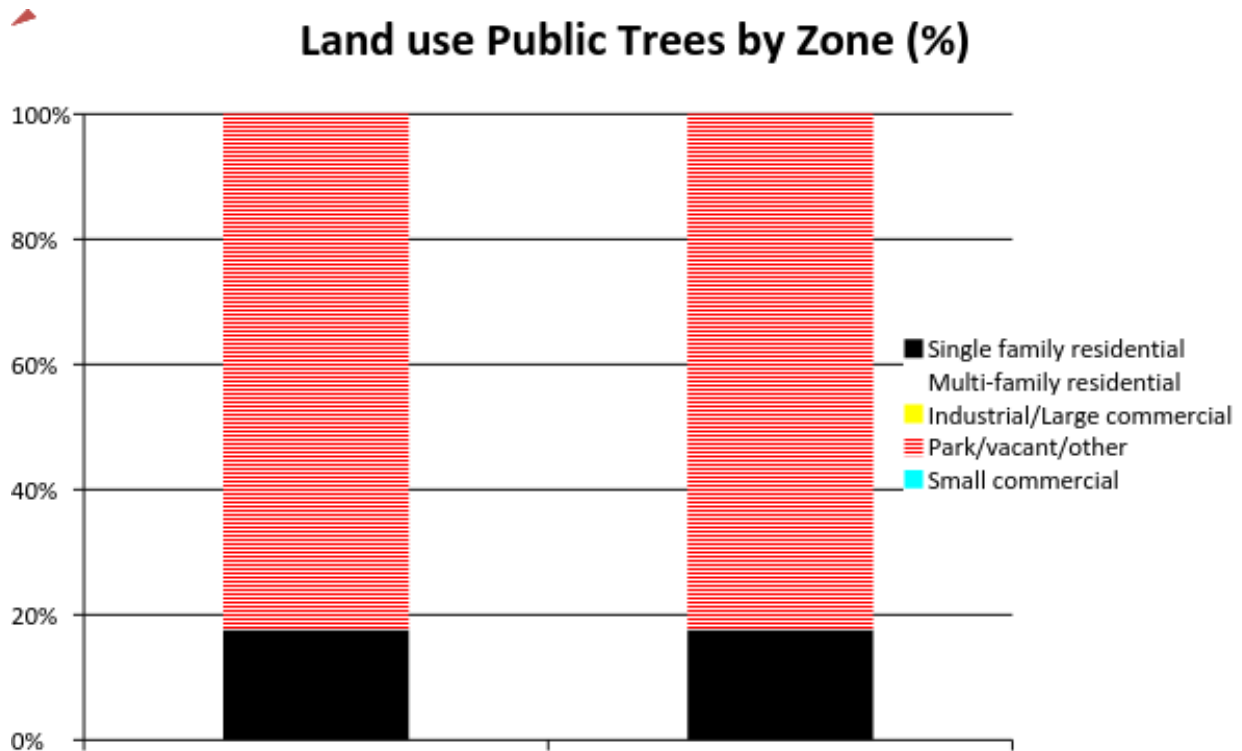


Figure 6: Land Use of city/park trees

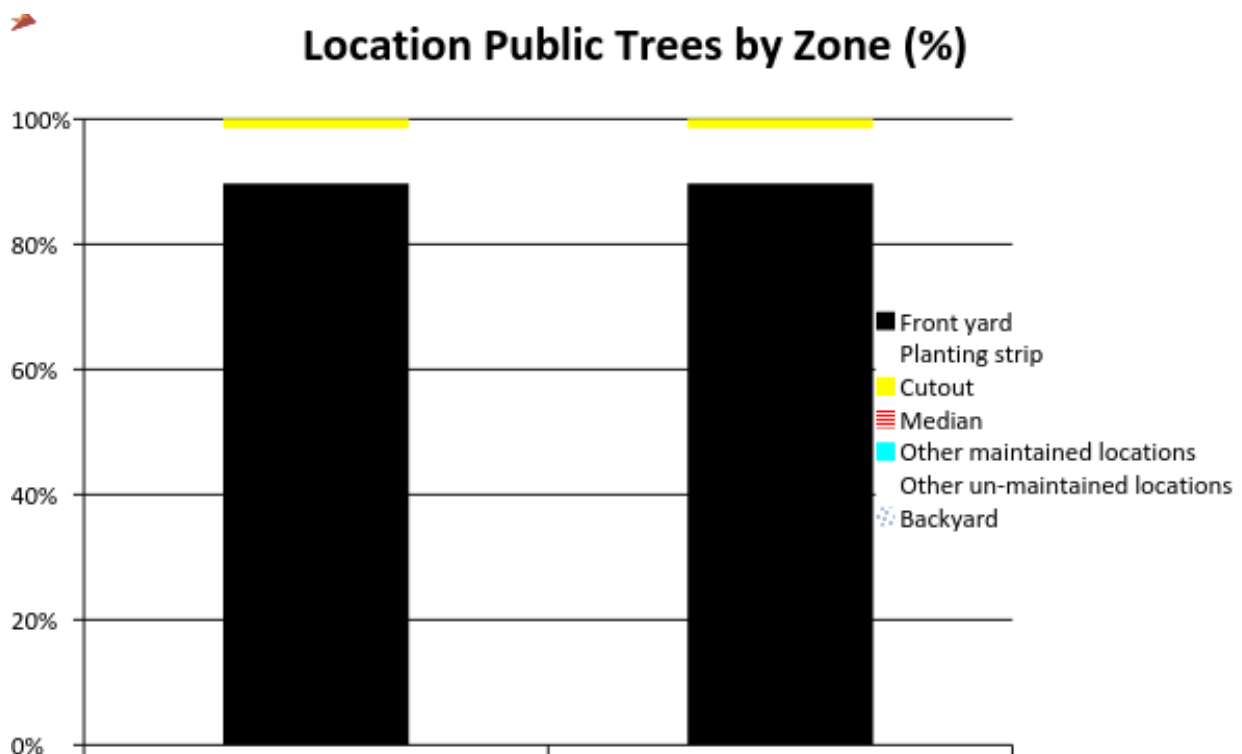


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

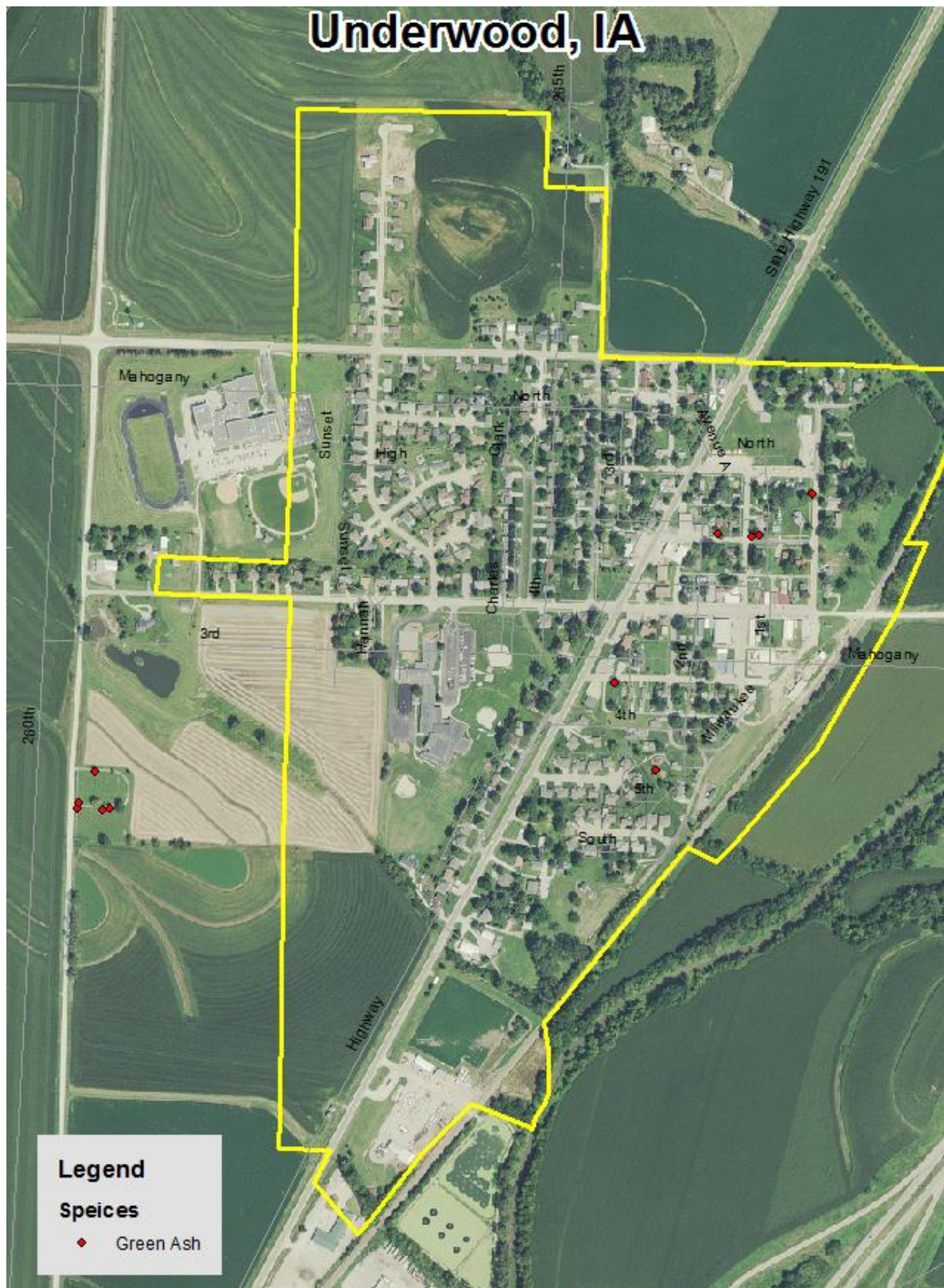


Figure 1: Location of Ash Trees

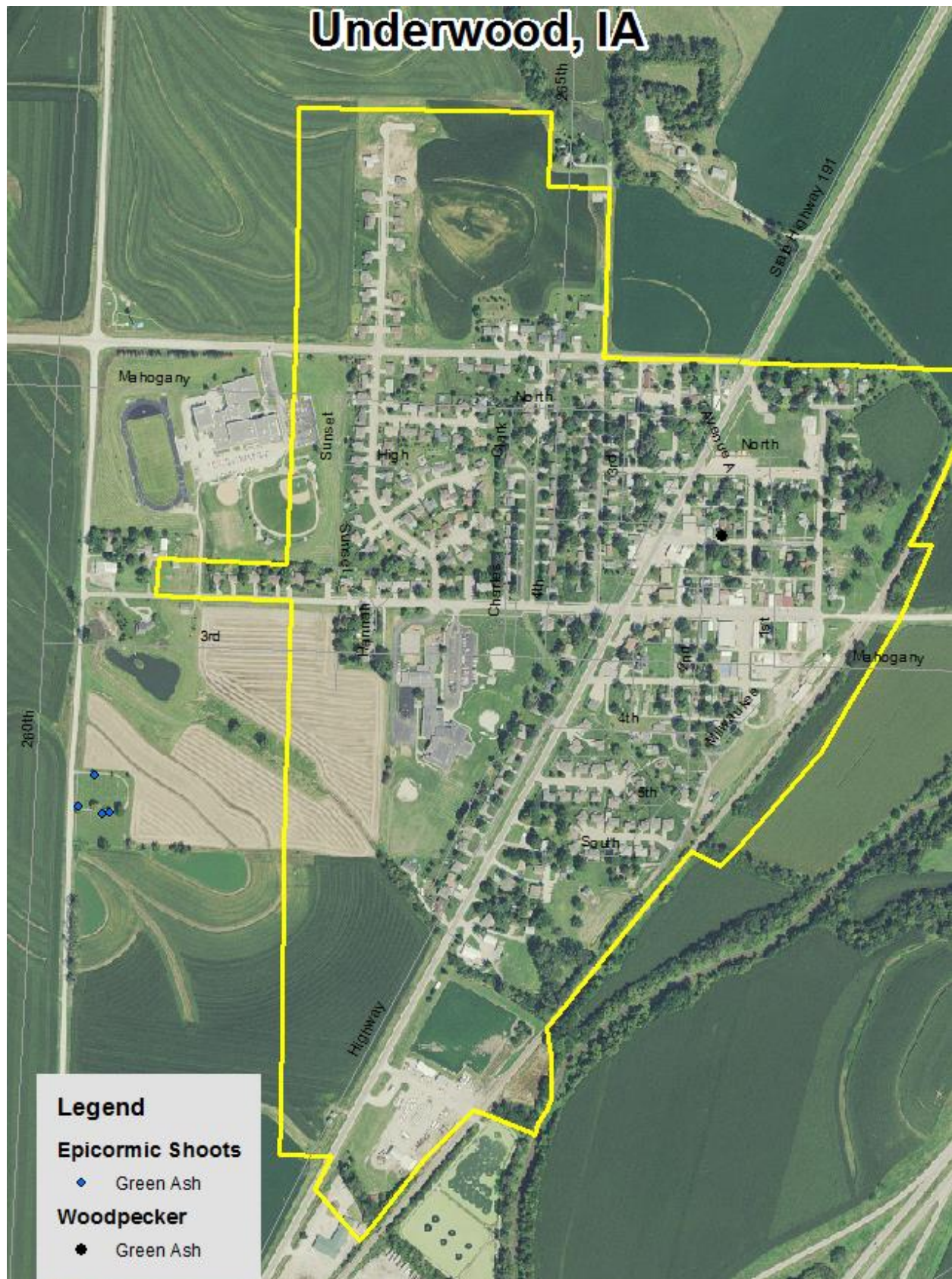


Figure 2: Location of EAB symptoms



Figure 3: Location of Poor Condition Trees

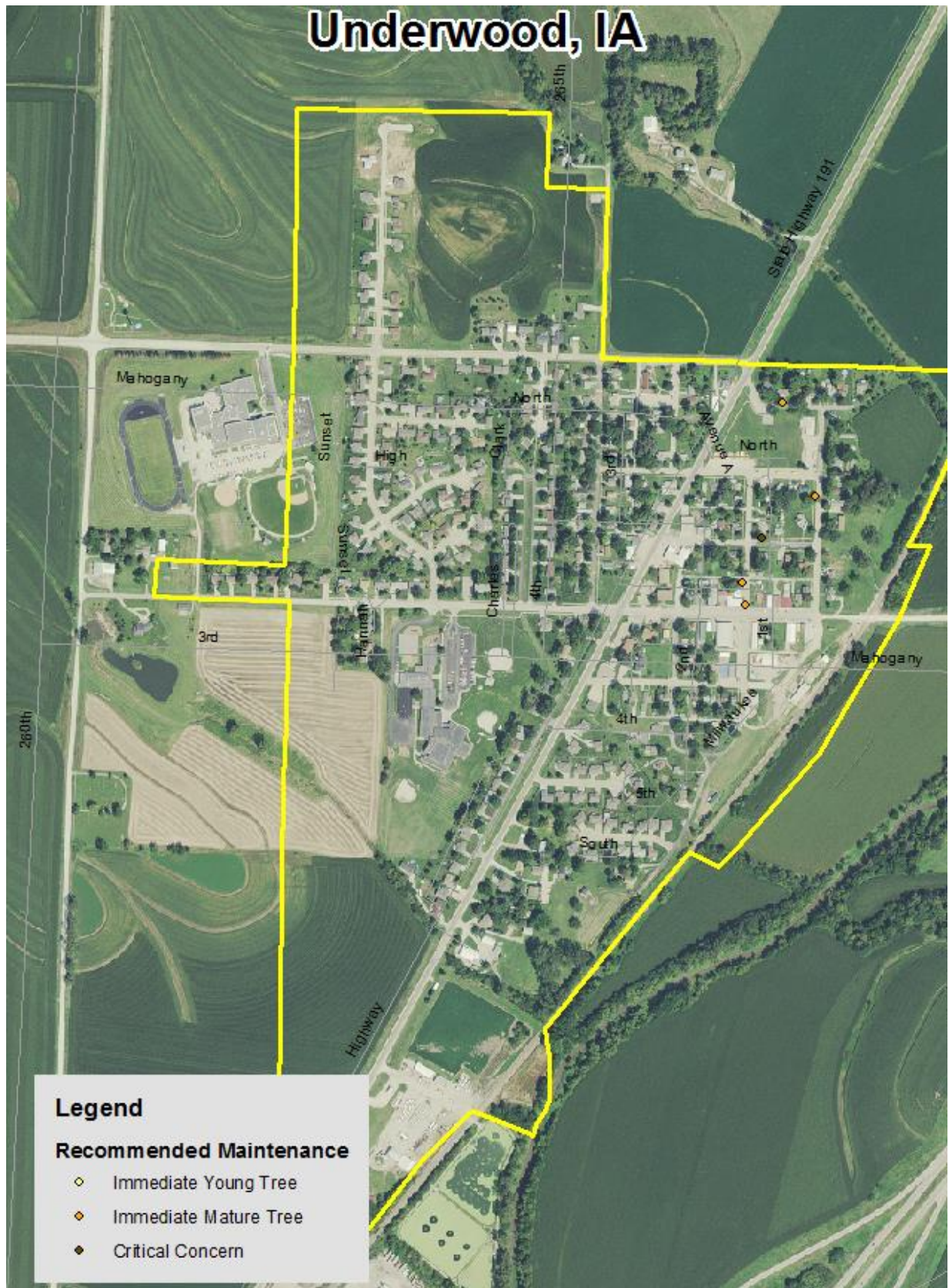


Figure 4: Location of Trees with Recommended Maintenance

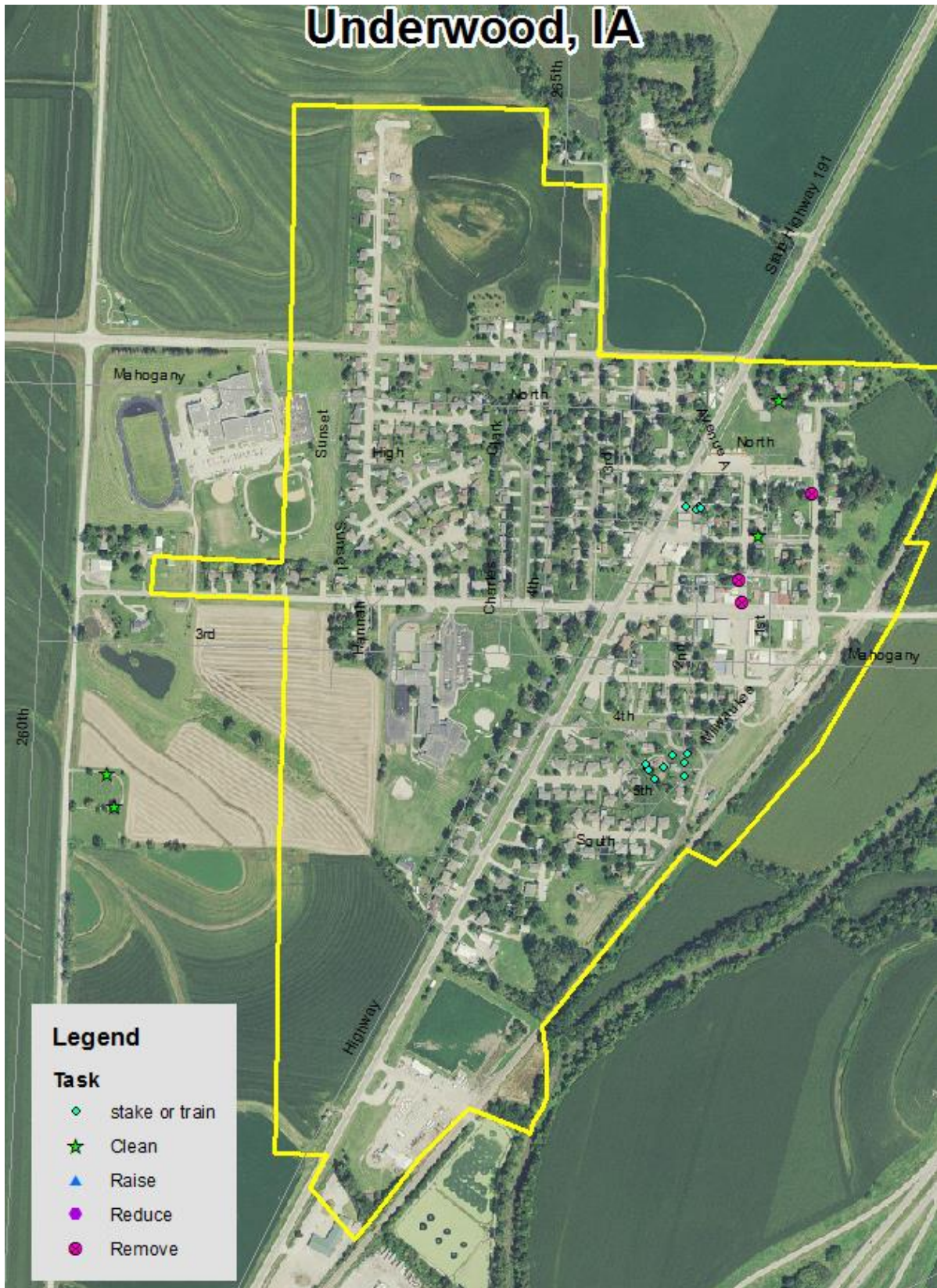


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Underwood Tree Ordinances

CHAPTER 151

TREES

151.01 Definition
151.02 Planting Restrictions
151.03 Duty to Trim Trees

151.04 Trimming Trees to be Supervised
151.05 Disease Control
151.06 Inspection and Removal

151.01 DEFINITION. For use in this chapter, “parking” means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

151.02 PLANTING RESTRICTIONS. No tree shall be planted in any parking or street except in accordance with the following:

1. **Alignment.** All trees planted in any street shall be planted in the parking midway between the outer line of the sidewalk and the curb.
2. **Spacing.** Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways.
3. **Prohibited Trees.** No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm or evergreen.

151.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

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

151.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 151.03, 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.

151.05 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.

151.06 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

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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 within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.

(Code of Iowa, Sec. 364.12[3b & h])

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

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

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