Oxford, IA

2015 Urban Forest Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Oxford with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 13% (19) of Oxford's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2014, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 146 trees inventoried.

- Oxford's trees provide $13,653 of benefits annually, an average of $93 a tree
- There are 19 public living ash trees currently present
- There are over 28 species of trees
- The top four genera are: Maple 36%, Arborvitae 16%, Ash 13%, and Oak 12%
- 8% of trees are in need of some type of management
- 5 trees are recommended for removal and one tree at this point is an ash

Recommendations

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

- Of the 5 trees needing removal, only 1 tree (silver maple) is between 18 and 24 inches in diameter at 4.5 ft. *City ownership of the trees recommended for removal should be verified prior to any removal* The 4 remaining trees recommended for removal are 12 inches and less in diameter
- 1 of the 20 public ash trees is dead (no symptoms related to EAB though), and none of the 19 remaining live trees were showing any symptoms that could be related to an EAB infestation at the time of the survey in 2014
- All public 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, boxelder, Siberian elm, evergreen (street trees), willow (street trees), arborvitae (currently more than 10%), or black walnut
- Check ash trees with a visual survey yearly

Introduction

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

Trees are an important component of Oxford'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 Oxford and future generations through good urban forestry management.

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

Inventory

In 2014, a tree inventory was conducted that included 100% of the city owned trees on the streets and in the parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

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

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

Inventory_Results

The data collected for the 146 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Oxford's trees reduce energy related costs by approximately $3,894 annually (Appendix A, Table 1). These savings are both in Electricity (18.8 MWh) and in Natural Gas (2,514.5 Therms).

Annual Stormwater Benefits

Oxford's trees intercept about 165,650 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $4,489 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 Oxford, it is estimated that trees remove 222 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $617 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Oxford, trees sequester about 39,161 lbs of carbon a year with an associated value of $274 (Appendix A, Table 5). In addition, the trees store 507,061 lbs of carbon, with a yearly benefit of $3,803 (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. Oxford receives $4,378 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STRATUM analysis, Oxford's trees provide $13,653 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 146 trees in Oxford provide approximately $93 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Oxford has 28 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by species is as follows:

Northern white Cedar (Arborvitae)	23	16%
Silver Maple	15	10%
Green Ash	15	10%
Red Maple	14	10%
Sugar Maple	10	7%
Red Oak	8	6%
Norway Maple	7	5%
Maple	6	4%
Apple (Crab)	6	4%
White Ash	5	3%
Other	37	25%

Age Class

Most of Oxford's trees (79%) are between 1 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2), and 60% of the trees are 12 inches in diameter or less. This means in general that the public tree canopy in Oxford is generally young.

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 Oxford indicate that 89% of the trees are in good health, with only 4% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, only 61% of Oxford's trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 8% of the population. This 8% 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 5).

Crown Raising	5	3%
Tree Removal	5	3%
Crown Cleaning	2	1%

Canopy Cover

The total canopy with both private and public trees is estimated at ~15% in Oxford. The canopy cover included in the Oxford inventory includes approximately 2 acres (Appendix A, Figure 5).

Land Use and Location

The majority of Oxford's city and park trees are in planting strips in either single family residential neighborhoods or parks (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street and park trees.

Land Use	
Single family residential	50%
Park/vacant/other	45%
Small commercial	5%

Location	
Planting strip	85%
Front yard	13%
Median	1%
Cutout (surrounded by pavement)	1%

Recommendations

Risk Management

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

Hazardous trees

Oxford has 5 trees that need to be considered for removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 5). Only one of these trees is between 18 to 24 inches in diameter at 4.5 ft., and the remaining 4 trees are 12 inches and less in diameter. On 9/4/2014 I sent a letter to Public Works indicating 12 different tree situations that needed to be evaluated to determine if removal was needed or just pruning to eliminate the potential hazard.

Poor tree species

After the removal of trees of concern, trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all public trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed and potentially fill-in some open spaces. It is recommended to plant 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 Oxford.

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 (36%) (Appendix A, Figure 1). Maples should not be planted until this percentage drops below 20%. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Since northern white cedar (arborvitae) is currently at 16% additional plants of this species should be limited on public ground. Other species to avoid because they are public nuisances include: cottonwood, poplar, boxelder, Siberian elm, evergreen (street trees only), willow (street trees only) or black walnut. All trees planted on public property must be approved by the Town Council according to Section 5 of the Tree Ordinance (Appendix C).

Continual Monitoring For EAB

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended that ash trees be checked with a visual survey every year for tree decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage. **Once EAB arrives in Oxford it could potentially kill all ash within 4 to 10 years of its arrival.**

EAB infested tree in Muscatine with top thinning and many new green epicormic sprouts

EAB infested tree in Muscatine with sprouting, wood pecker activity, and D-shaped exit holes

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

Year 1 – Year 6

According to information obtained from the community at this point there is no specific budget for forestry activities such as removal, tree planting, and pruning. Below are activities that the community should consider when developing annual budgets:

Removal: 5 trees have been identified to be evaluated for removal now, and 1 of these trees is a dead ash that needs to be removed. Cost of tree removal is between $600 to $1,000 per tree and for 5 trees that will be $3,000 to $5,000.

Planting and Replacement: Attempt to add new trees to public spaces such as parks and along streets where desirable when budget allows. The cost of new trees can be between $100 to $300 a tree.

Visual Survey for signs and symptoms of EAB on annual basis

Routine Pruning: Do routine pruning of park trees on 5 to 7 year rotation

***EAB could potentially kill all ash within 4 to 10 years of its arrival to Oxford. Once ash trees begin to actually die they can decline quickly which will require immediate removal. If all 19 remaining ash need to be removed at some point it will cost an estimated $600 to $1,000 per tree to remove them which is a total of $11,400 to $19,000.** *City ownership of any tree (s) recommended for removal should be verified prior to any removal*

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). At this point there is only one ash tree recommended for removal. *City ownership of the tree recommended for removal should be verified prior to any removal*

Treatment of Ash Trees

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

EAB Quarantines

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

A regulated article under the USDA's quarantine includes any of the following items:
- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

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

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website

http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees should be replaced. All new public trees must be approved by the Town Council according to Section 5 of the Tree Ordinance (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, boxelder, Siberian elm, evergreen (streets only), willow (streets only) or black walnut.

Postponed Work

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

Monitoring

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

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property when EAB starts killing trees. The current Oxford nuisance ordinance covers EAB and other pest concerns such as Dutch Elm Disease #10. Also, the current tree ordinance (Appendix C) does cover Dutch Elm Disease but not specifically EAB. You may want to consider a more general statement that will also cover future pest problems such as Asian Long Horned Beetle See example: If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the 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 thirty (30) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 30 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.

Budget

Current Budget

As already indicated there is no specific budget for forestry related activities. *EAB could potentially kill all ash within 4 to 10 years of its arrival. There are 19 living ash trees currently on public property, and if all 19 ash need to be removed at some point it will cost an estimated $600 to $1,000 per tree to remove them which is a total of $11,400 to $19,000. *City ownership of any tree (s) recommended for removal should be verified prior to any removal*

Purposed Budget Increase

EAB could potentially kill all ash trees in Oxford within 4 to 10 years of its arrival. In most cases once you begin to see tree death from EAB trees can die fairly quickly. Since there is currently no community budget for removing public trees, Oxford should consider future budgets that would include the removal of the existing 19 ash trees as they begin to die from EAB attack. Additionally, it is recommended that Oxford 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, and schools.

Works Cited

Census Bureau. 2010. http://censtats.census.gov/data/IA/1601964290.pdf (April, 2013)

USDA Forest Service, et al. 2006. i-Tree Software Suite v1.0 User's Manual. Pp. 27-40.

McPherson EG, Simpson JR, Peper PJ, Gardner SL, Vargas KE, Ho J, Maco S, Xiao Q. 2005b. City of Charleston, South Carolina, municipal forest resource analysis. Internal Tech Rep. Davis, CA: U.S. Department of Agriculture, Center for Urban Forest Research. p. 57

Nowak, D.J. and J.F. Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

Peper, Paula J.; McPherson, E. Gregory; Simpson, James R.; Vargas, Kelaine E.; Xiao, Qingfu 2009. Lower Midwest community tree guide: benefits, costs, and strategic planting. Gen. Tech. Rep. PSW-GTR-219. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. p.115

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Oxford

Annual Energy Benefits of Public Trees

11/14/2014

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern white cedar	0.2	12	28.5	28	40	(N/A)	15.8	1.0	1.74
Silver maple	3.7	281	462.5	453	734	(N/A)	10.3	18.8	48.93
Green ash	3.3	248	431.8	423	671	(N/A)	10.3	17.2	44.75
Red maple	2.3	176	287.6	282	458	(N/A)	9.6	11.8	32.69
Sugar maple	2.0	155	285.8	280	435	(N/A)	6.8	11.2	43.46
Northern red oak	0.3	20	39.4	39	59	(N/A)	5.5	1.5	7.39
Norway maple	1.2	87	166.0	163	250	(N/A)	4.8	6.4	35.73
Maple	0.4	28	47.2	46	75	(N/A)	4.1	1.9	12.43
Apple	0.2	18	40.8	40	58	(N/A)	4.1	1.5	9.67
White ash	0.3	26	48.5	47	74	(N/A)	3.4	1.9	14.72
Norway spruce	0.6	48	83.7	82	130	(N/A)	2.7	3.3	32.40
Bur oak	0.5	38	65.6	64	102	(N/A)	2.1	2.6	34.07
Black walnut	0.7	56	92.1	90	146	(N/A)	2.1	3.7	48.59
Broadleaf Deciduous Small	0.1	6	14.1	14	20	(N/A)	2.1	0.5	6.64
Pin oak	0.3	26	48.7	48	74	(N/A)	2.1	1.9	24.65
Conifer Evergreen Large	0.1	5	11.9	12	17	(N/A)	2.1	0.4	5.61
Elm	0.6	43	73.8	72	115	(N/A)	1.4	3.0	57.57
Sweetgum	0.1	4	7.4	7	12	(N/A)	1.4	0.3	5.82
Honeylocust	0.0	1	2.4	2	3	(N/A)	1.4	0.1	1.67
Japanese tree lilac	0.0	1	1.2	1	2	(N/A)	1.4	0.0	0.87
Eastern cottonwood	1.0	74	126.2	124	197	(N/A)	1.4	5.1	98.63
Oak	0.1	9	17.4	17	26	(N/A)	1.4	0.7	13.23
Tulip tree	0.0	2	3.7	4	6	(N/A)	0.7	0.1	5.82
Amur maple	0.0	2	3.8	4	5	(N/A)	0.7	0.1	5.40
Littleleaf linden	0.1	6	12.5	12	18	(N/A)	0.7	0.5	18.25
Northern hackberry	0.4	33	60.8	60	92	(N/A)	0.7	2.4	92.23
Swamp white oak	0.0	3	6.2	6	9	(N/A)	0.7	0.2	8.99
American basswood	0.3	23	44.7	44	67	(N/A)	0.7	1.7	66.72
Total	18.8	1,430	2,514.5	2,464	3,894	(N/A)	100.0	100.0	26.67

Table 2: Annual Stormwater Benefits

Oxford

Annual Stormwater Benefits of Public Trees

11/14/2014

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern white cedar	1,777	48	(N/A)	15.8	1.1	2.09
Silver maple	32,263	874	(N/A)	10.3	19.5	58.29
Green ash	26,161	709	(N/A)	10.3	15.8	47.26
Red maple	14,014	380	(N/A)	9.6	8.5	27.13
Sugar maple	20,586	558	(N/A)	6.8	12.4	55.79
Northern red oak	1,256	34	(N/A)	5.5	0.8	4.25
Norway maple	7,641	207	(N/A)	4.8	4.6	29.58
Maple	2,039	55	(N/A)	4.1	1.2	9.21
Apple	804	22	(N/A)	4.1	0.5	3.63
White ash	2,168	59	(N/A)	3.4	1.3	11.75
Norway spruce	13,512	366	(N/A)	2.7	8.2	91.55
Bur oak	4,074	110	(N/A)	2.1	2.5	36.80
Black walnut	5,522	150	(N/A)	2.1	3.3	49.88
Broadleaf Deciduous Small	279	8	(N/A)	2.1	0.2	2.52
Pin oak	2,720	74	(N/A)	2.1	1.6	24.57
Conifer Evergreen Large	638	17	(N/A)	2.1	0.4	5.77
Elm	5,409	147	(N/A)	1.4	3.3	73.29
Sweetgum	343	9	(N/A)	1.4	0.2	4.65
Honeylocust	39	1	(N/A)	1.4	0.0	0.53
Japanese tree lilac	15	0	(N/A)	1.4	0.0	0.20
Eastern cottonwood	14,478	392	(N/A)	1.4	8.7	196.17
Oak	779	21	(N/A)	1.4	0.5	10.56
Tulip tree	172	5	(N/A)	0.7	0.1	4.65
Amur maple	69	2	(N/A)	0.7	0.0	1.86
Littleleaf linden	461	12	(N/A)	0.7	0.3	12.48
Northern hackberry	4,984	135	(N/A)	0.7	3.0	135.08
Swamp white oak	163	4	(N/A)	0.7	0.1	4.41
American basswood	3,285	89	(N/A)	0.7	2.0	89.02
Citywide total	165,650	4,489	(N/A)	100.0	100.0	30.75

Table 3: Annual Air Quality Benefits

Oxford

Annual Air Quality Benefits of Public Trees

11/14/2014

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								
Northern white cedar	0.0	0.0	0.1	0.0	0	0.8	0.1	0.1	0.7	5	-0.6	-2	1.3	3	(N/A)	15.8	0.14
Silver maple	3.4	0.6	2.0	0.2	19	17.2	2.5	2.4	16.8	108	-2.4	-9	42.7	119	(N/A)	10.3	7.91
Green ash	2.3	0.4	1.3	0.1	13	15.5	2.3	2.2	14.8	97	0.0	0	38.8	110	(N/A)	10.3	7.30
Red maple	2.6	0.4	1.3	0.1	14	10.8	1.6	1.5	10.5	68	-1.0	-4	27.8	78	(N/A)	9.6	5.59
Sugar maple	2.5	0.4	1.3	0.1	14	9.8	1.4	1.4	9.2	61	-2.0	-8	24.1	67	(N/A)	6.8	6.70
Northern red oak	0.1	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	-0.2	-1	2.9	8	(N/A)	5.5	1.01
Norway maple	1.2	0.2	0.6	0.1	6	5.6	0.8	0.8	5.2	35	-0.3	-1	14.1	40	(N/A)	4.8	5.69
Maple	0.3	0.1	0.2	0.0	2	1.7	0.3	0.2	1.7	11	-0.1	0	4.4	12	(N/A)	4.1	2.06
Apple	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.1	7	0.0	0	2.8	8	(N/A)	4.1	1.32
White ash	0.1	0.0	0.1	0.0	0	1.6	0.2	0.2	1.6	10	0.0	0	3.8	11	(N/A)	3.4	2.14
Norway spruce	1.6	0.3	1.3	0.2	10	3.0	0.4	0.4	2.8	19	-7.0	-26	3.1	3	(N/A)	2.7	0.69
Bur oak	0.4	0.1	0.2	0.0	2	2.4	0.3	0.3	2.3	15	0.0	0	6.0	17	(N/A)	2.1	5.61
Black walnut	0.5	0.1	0.3	0.0	3	3.4	0.5	0.5	3.3	21	0.0	0	8.6	24	(N/A)	2.1	8.06
Broadleaf Deciduous Small	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	3	0.0	0	1.0	3	(N/A)	2.1	0.92
Pin oak	0.3	0.1	0.2	0.0	2	1.7	0.2	0.2	1.6	10	-0.7	-3	3.6	10	(N/A)	2.1	3.20
Conifer Evergreen Large	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2	(N/A)	2.1	0.56
Elm	0.6	0.1	0.3	0.0	3	2.7	0.4	0.4	2.6	17	0.0	0	7.0	20	(N/A)	1.4	9.95
Sweetgum	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	0.0	0	0.6	2	(N/A)	1.4	0.87
Honeylocust	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	0	0.0	0	0.1	0	(N/A)	1.4	0.21
Japanese tree lilac	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.1	0	(N/A)	1.4	0.11
Eastern cottonwood	3.2	0.5	1.4	0.1	16	4.6	0.7	0.6	4.4	29	0.0	0	15.5	45	(N/A)	1.4	22.55
Oak	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.4	4	(N/A)	1.4	1.93
Tulip tree	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)	0.7	0.87
Amur maple	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)	0.7	0.71
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)	0.7	2.55
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)	0.7	17.54
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)	0.7	1.21
American basswood	0.4	0.1	0.2	0.0	2	1.5	0.2	0.2	1.4	9	-0.4	-1	3.6	10	(N/A)	0.7	10.02
Citywide total	20.7	3.5	11.4	1.1	115	89.3	13.1	12.5	85.4	558	-14.9	-56	221.9	617	(N/A)	100.0	4.23

Table 4: Annual Carbon Stored

Oxford

Stored CO2 Benefits of Public Trees

11/14/2014

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern white cedar	200	1	(N/A)	15.8	0.0	0.07
Silver maple	77,766	583	(N/A)	10.3	15.3	38.88
Green ash	75,881	569	(N/A)	10.3	15.0	37.94
Red maple	30,226	227	(N/A)	9.6	6.0	16.19
Sugar maple	72,760	546	(N/A)	6.8	14.3	54.57
Northern red oak	1,809	14	(N/A)	5.5	0.4	1.70
Norway maple	19,596	147	(N/A)	4.8	3.9	21.00
Maple	4,313	32	(N/A)	4.1	0.9	5.39
Apple	2,527	19	(N/A)	4.1	0.5	3.16
White ash	3,475	26	(N/A)	3.4	0.7	5.21
Norway spruce	17,519	131	(N/A)	2.7	3.5	32.85
Bur oak	12,142	91	(N/A)	2.1	2.4	30.35
Black walnut	15,801	119	(N/A)	2.1	3.1	39.50
Broadleaf Deciduous	935	7	(N/A)	2.1	0.2	2.34
Pin oak	8,591	64	(N/A)	2.1	1.7	21.48
Conifer Evergreen La	115	1	(N/A)	2.1	0.0	0.29
Elm	19,445	146	(N/A)	1.4	3.8	72.92
Sweetgum	371	3	(N/A)	1.4	0.1	1.39
Honeylocust	28	0	(N/A)	1.4	0.0	0.10
Japanese tree lilac	28	0	(N/A)	1.4	0.0	0.10
Eastern cottonwood	111,964	840	(N/A)	1.4	22.1	419.86
Oak	1,220	9	(N/A)	1.4	0.2	4.57
Tulip tree	185	1	(N/A)	0.7	0.0	1.39
Amur maple	178	1	(N/A)	0.7	0.0	1.33
Littleleaf linden	1,025	8	(N/A)	0.7	0.2	7.68
Northern hackberry	13,507	101	(N/A)	0.7	2.7	101.30
Swamp white oak	218	2	(N/A)	0.7	0.0	1.64
American basswood	15,239	114	(N/A)	0.7	3.0	114.29
Citywide total	507,061	3,803	(N/A)	100.0	100.0	26.05

Table 5: Annual Carbon Sequestered

Oxford

Annual CO Benefits of Public Trees

11/14/2014

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
Northern white cedar	139	1	-1	-6	0	0	0	132	1 (N/A)	15.8	0.4	0.04
Silver maple	9,810	74	-373	-33	0	0	0	9,403	71 (N/A)	10.3	25.7	4.70
Green ash	7,257	54	-364	-32	0	0	0	6,861	51 (N/A)	10.3	18.8	3.43
Red maple	4,124	31	-145	-20	0	0	0	3,959	30 (N/A)	9.6	10.8	2.12
Sugar maple	4,302	32	-349	-23	0	0	0	3,930	29 (N/A)	6.8	10.8	2.95
Northern red oak	383	3	-9	-4	0	0	0	370	3 (N/A)	5.5	1.0	0.35
Norway maple	2,138	16	-94	-11	0	0	0	2,032	15 (N/A)	4.8	5.6	2.18
Maple	605	5	-21	-4	0	0	0	580	4 (N/A)	4.1	1.6	0.73
Apple	380	3	-12	-5	0	0	0	363	3 (N/A)	4.1	1.0	0.45
White ash	677	5	-18	-5	0	0	0	654	5 (N/A)	3.4	1.8	0.98
Norway spruce	818	6	-84	-12	0	0	0	722	5 (N/A)	2.7	2.0	1.35
Bur oak	1,108	8	-58	-5	0	0	0	1,044	8 (N/A)	2.1	2.9	2.61
Black walnut	1,550	12	-76	-7	0	0	0	1,468	11 (N/A)	2.1	4.0	3.67
Broadleaf Deciduous Smal	131	1	-5	-2	0	0	0	125	1 (N/A)	2.1	0.3	0.31
Pin oak	985	7	-41	-4	0	0	0	939	7 (N/A)	2.1	2.6	2.35
Conifer Evergreen Large	54	0	-1	-2	0	0	0	52	0 (N/A)	2.1	0.1	0.13
Elm	1,302	10	-93	-5	0	0	0	1,203	9 (N/A)	1.4	3.3	4.51
Sweetgum	148	1	-2	-1	0	0	0	145	1 (N/A)	1.4	0.4	0.55
Honeylocust	21	0	0	0	0	0	0	21	0 (N/A)	1.4	0.1	0.08
Japanese tree lilac	17	0	0	0	0	0	0	17	0 (N/A)	1.4	0.0	0.06
Eastern cottonwood	958	7	-537	-12	0	0	0	409	3 (N/A)	1.4	1.1	1.53
Oak	283	2	-6	-2	0	0	0	275	2 (N/A)	1.4	0.8	1.03
Tulip tree	74	1	-1	-1	0	0	0	73	1 (N/A)	0.7	0.2	0.55
Amur maple	38	0	-1	-1	0	0	0	37	0 (N/A)	0.7	0.1	0.27
Littleleaf linden	223	2	-5	-1	0	0	0	217	2 (N/A)	0.7	0.6	1.63
Northern hackberry	616	5	-65	-4	0	0	0	547	4 (N/A)	0.7	1.5	4.10
Swamp white oak	96	1	-2	-1	0	0	0	93	1 (N/A)	0.7	0.3	0.70
American basswood	925	7	-73	-4	0	0	0	848	6 (N/A)	0.7	2.3	6.36
Citywide total	39,161	294	-2,437	-204	-2	0	0	36,521	274 (N/A)	100.0	100.0	1.88

Table 6: Annual Social and Aesthetic Benefits

Oxford

Annual Aesthetic/Other Benefits of Public Trees

11/14/2014

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Northern white cedar	137	(N/A)	15.8	3.1	5.95
Silver maple	958	(N/A)	10.3	21.9	63.89
Green ash	707	(N/A)	10.3	16.1	47.13
Red maple	595	(N/A)	9.6	13.6	42.51
Sugar maple	474	(N/A)	6.8	10.8	47.36
Northern red oak	50	(N/A)	5.5	1.1	6.21
Norway maple	226	(N/A)	4.8	5.2	32.32
Maple	88	(N/A)	4.1	2.0	14.63
Apple	21	(N/A)	4.1	0.5	3.51
White ash	126	(N/A)	3.4	2.9	25.16
Norway spruce	167	(N/A)	2.7	3.8	41.87
Bur oak	109	(N/A)	2.1	2.5	36.27
Black walnut	149	(N/A)	2.1	3.4	49.80
Broadleaf Deciduous Small	6	(N/A)	2.1	0.1	2.16
Pin oak	99	(N/A)	2.1	2.3	32.99
Conifer Evergreen Large	21	(N/A)	2.1	0.5	6.83
Elm	111	(N/A)	1.4	2.5	55.72
Sweetgum	29	(N/A)	1.4	0.7	14.73
Honeylocust	1	(N/A)	1.4	0.0	0.38
Japanese tree lilac	0	(N/A)	1.4	0.0	0.03
Eastern cottonwood	57	(N/A)	1.4	1.3	28.57
Oak	43	(N/A)	1.4	1.0	21.64
Tulip tree	15	(N/A)	0.7	0.3	14.73
Amur maple	2	(N/A)	0.7	0.0	2.06
Littleleaf linden	31	(N/A)	0.7	0.7	31.20
Northern hackberry	73	(N/A)	0.7	1.7	72.66
Swamp white oak	13	(N/A)	0.7	0.3	12.89
American basswood	70	(N/A)	0.7	1.6	69.73
Citywide total	4,378	(N/A)	100.0	100.0	29.99

Table 7: Summary of Benefits in Dollars

Oxford

Total Annual Benefits of Public Trees by Species ($)

11/14/201

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Northern white cedar	40	1	3	48	137	229	(N/A)	1.7
Silver maple	734	71	119	874	958	2,756	(N/A)	20.2
Green ash	671	51	110	709	707	2,248	(N/A)	16.5
Red maple	458	30	78	380	595	1,541	(N/A)	11.3
Sugar maple	435	29	67	558	474	1,563	(N/A)	11.4
Northern red oak	59	3	8	34	50	154	(N/A)	1.1
Norway maple	250	15	40	207	226	739	(N/A)	5.4
Maple	75	4	12	55	88	234	(N/A)	1.7
Apple	58	3	8	22	21	111	(N/A)	0.8
White ash	74	5	11	59	126	274	(N/A)	2.0
Norway spruce	130	5	3	366	167	671	(N/A)	4.9
Bur oak	102	8	17	110	109	346	(N/A)	2.5
Black walnut	146	11	24	150	149	480	(N/A)	3.5
Broadleaf Deciduous Sn	20	1	3	8	6	38	(N/A)	0.3
Pin oak	74	7	10	74	99	263	(N/A)	1.9
Conifer Evergreen Larg	17	0	2	17	21	57	(N/A)	0.4
Elm	115	9	20	147	111	402	(N/A)	2.9
Sweetgum	12	1	2	9	29	53	(N/A)	0.4
Honeylocust	3	0	0	1	1	6	(N/A)	0.0
Japanese tree lilac	2	0	0	0	0	3	(N/A)	0.0
Eastern cottonwood	197	3	45	392	57	695	(N/A)	5.1
Oak	26	2	4	21	43	97	(N/A)	0.7
Tulip tree	6	1	1	5	15	27	(N/A)	0.2
Amur maple	5	0	1	2	2	10	(N/A)	0.1
Littleleaf linden	18	2	3	12	31	66	(N/A)	0.5
Northern hackberry	92	4	18	135	73	322	(N/A)	2.4
Swamp white oak	9	1	1	4	13	28	(N/A)	0.2
American basswood	67	6	10	89	70	242	(N/A)	1.8
Citywide Total	3,894	274	617	4,489	4,378	13,653	(N/A)	100.0

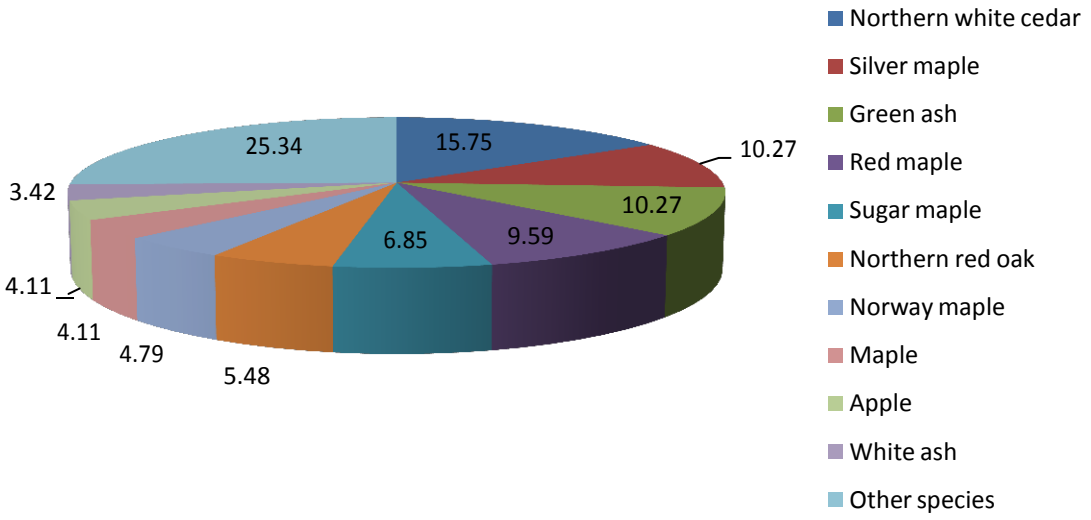


Figure 1: Species Distribution

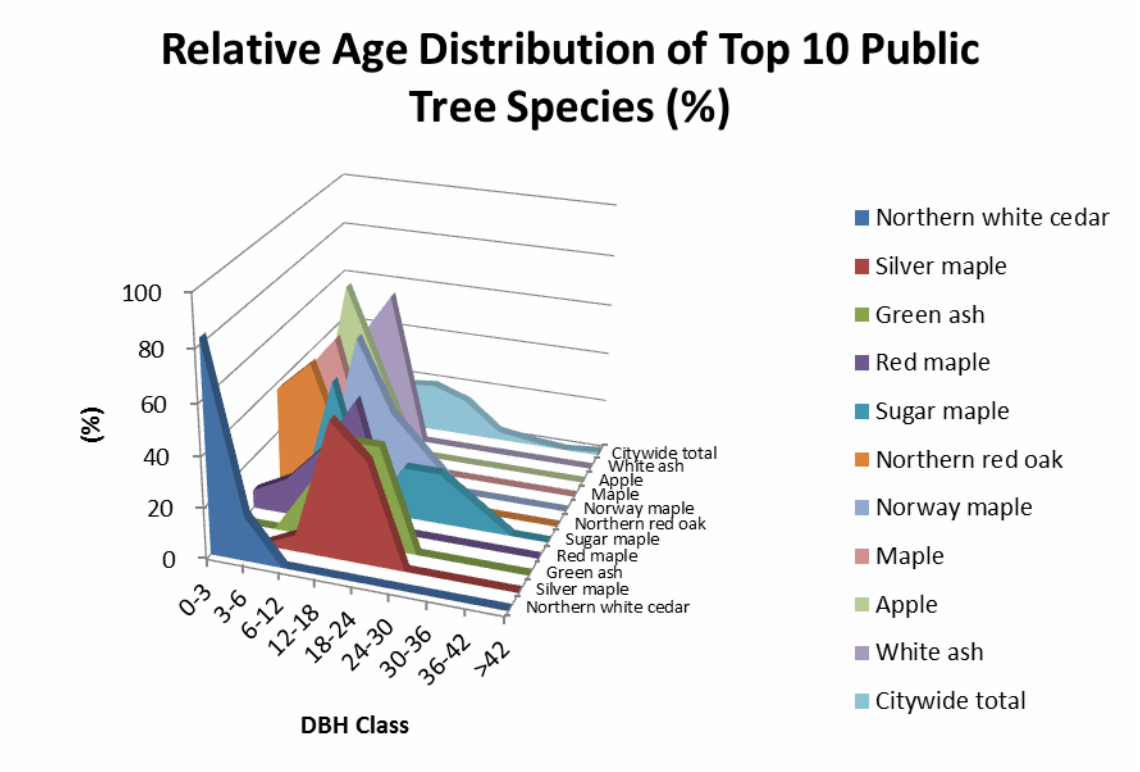


Figure 2: Relative Age Class

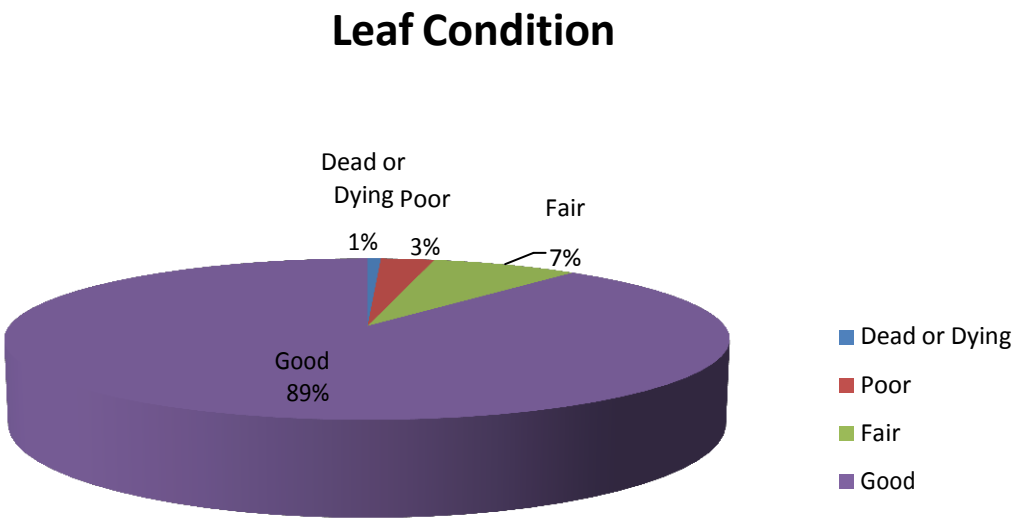


Figure 3: Foliage Condition

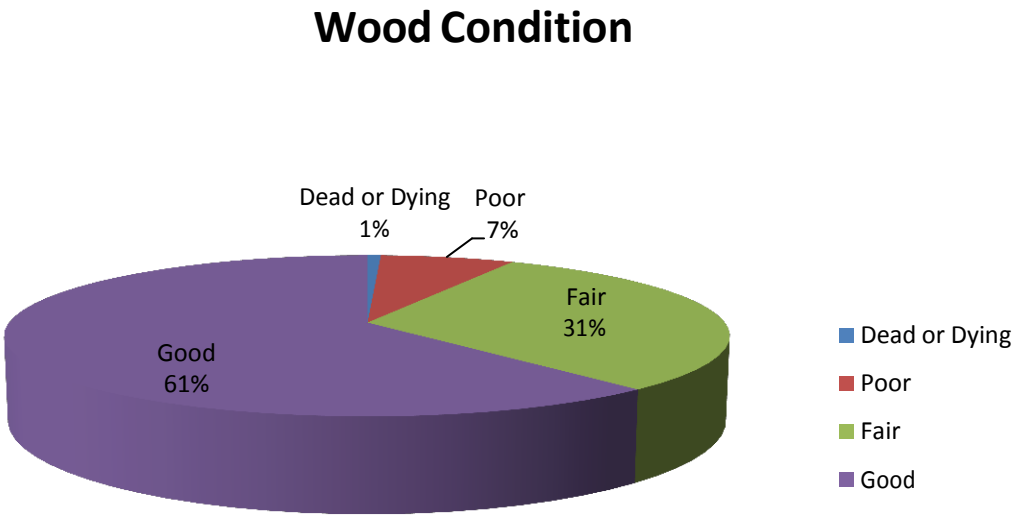


Figure 4: Wood Condition

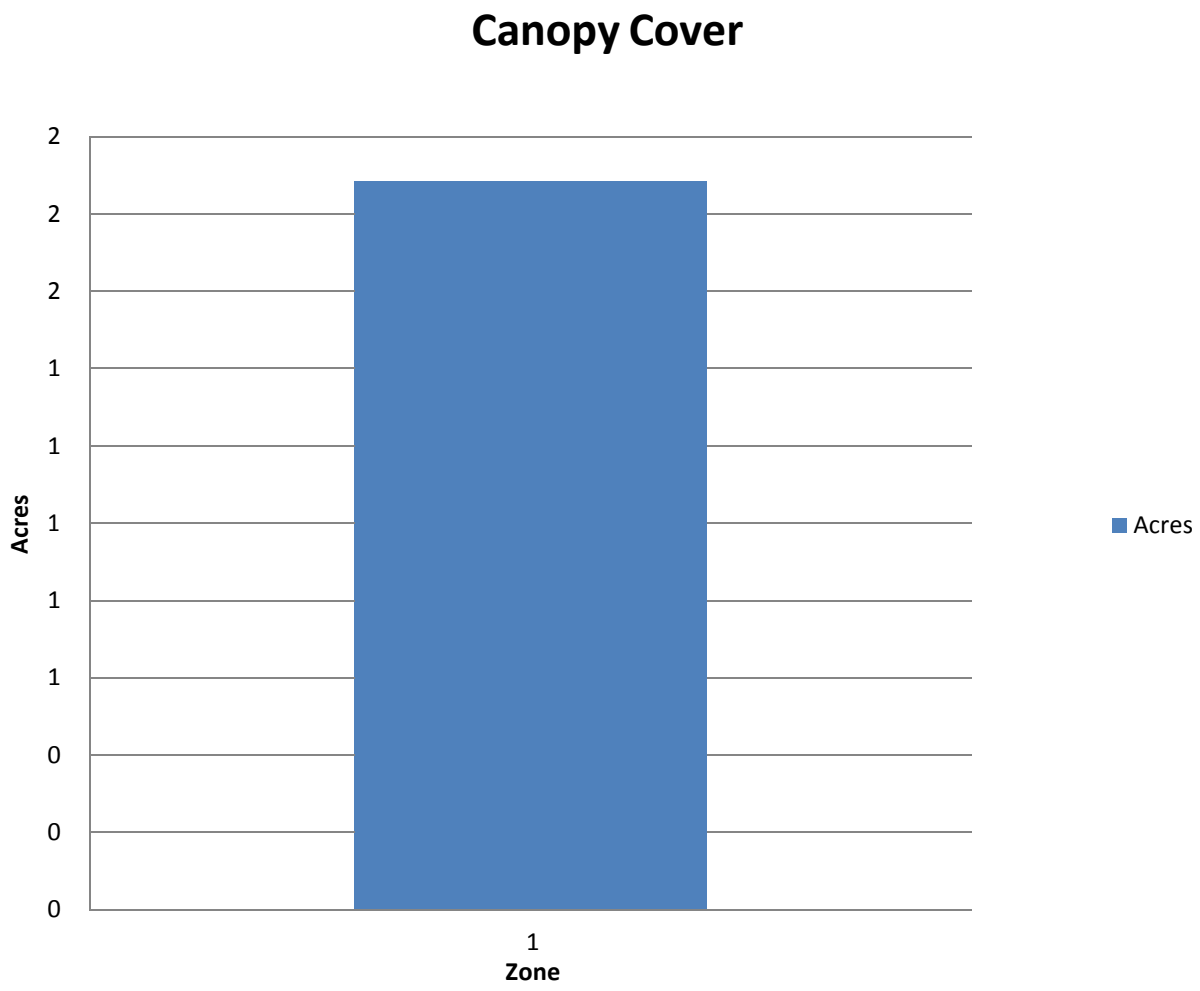


Figure 5: Canopy Cover in Acres

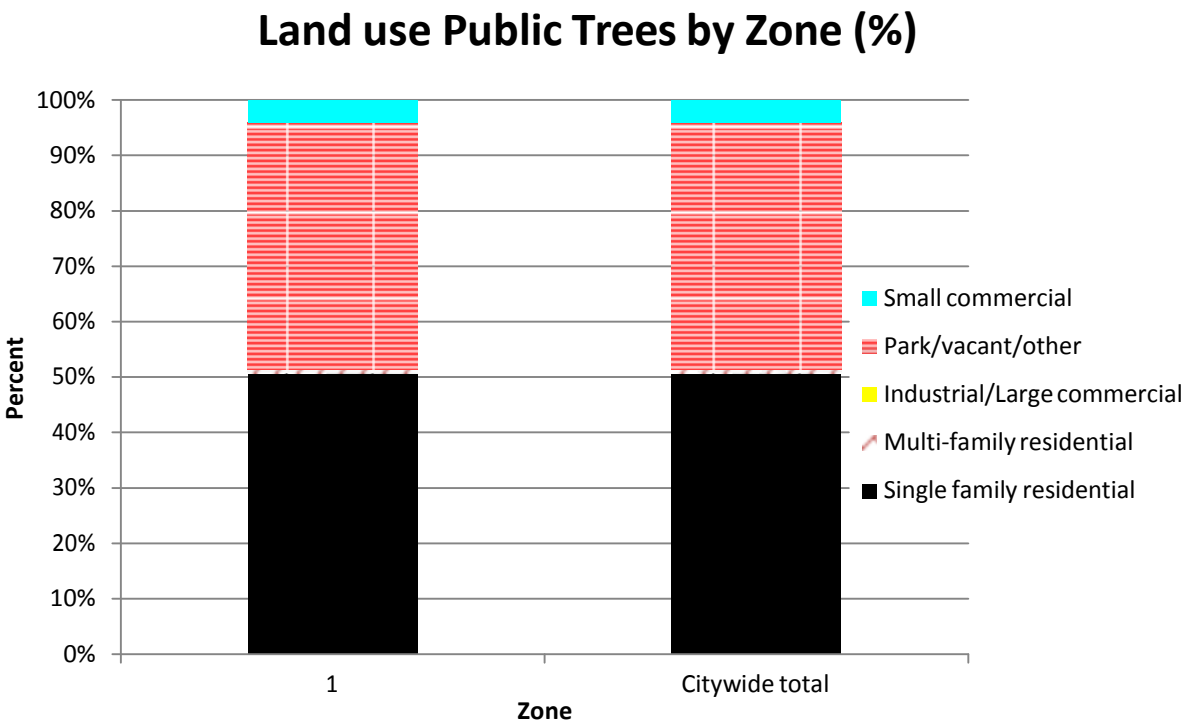


Figure 6: Land Use of city/park trees

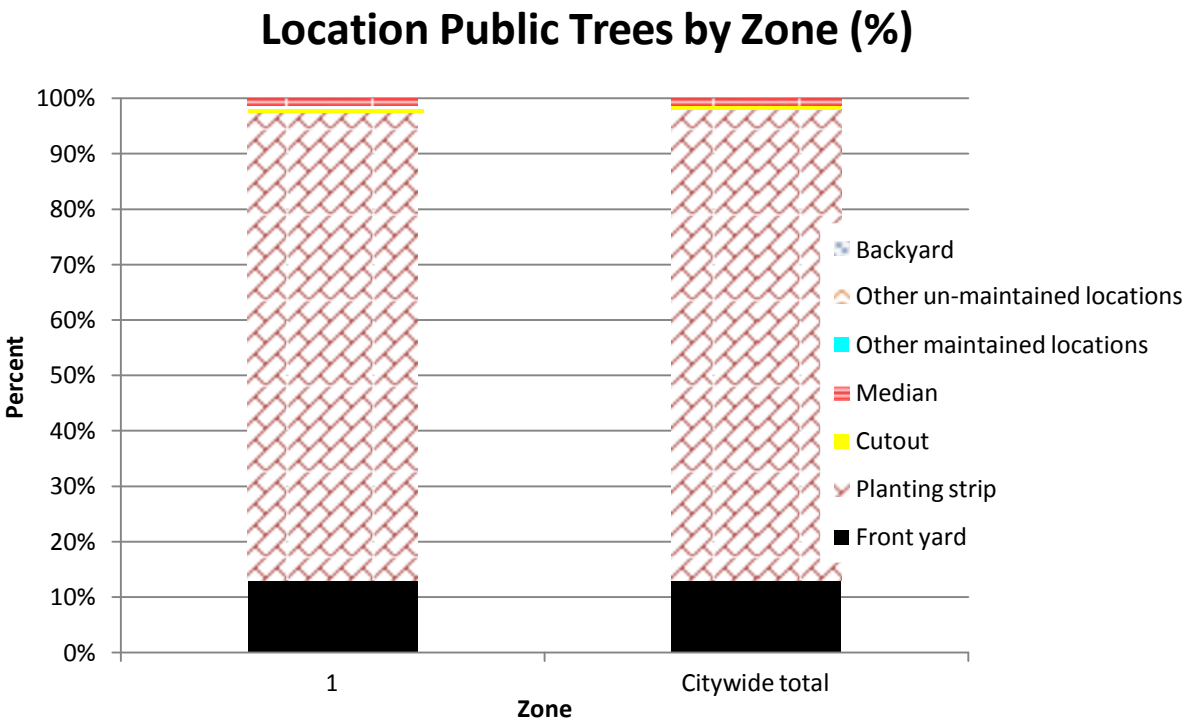
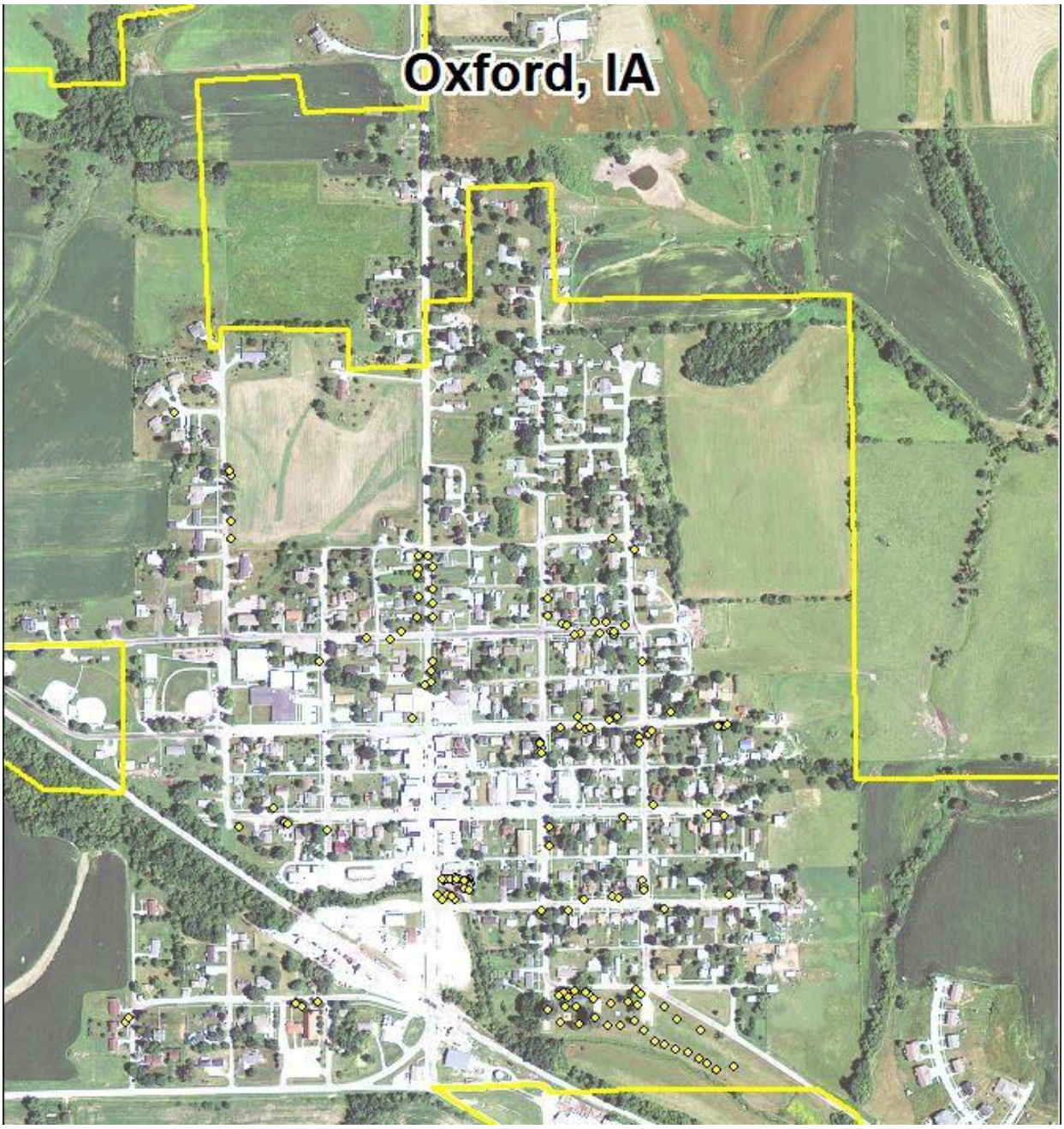


Figure 7: Location of city/park trees


Oxford, IA

Appendix B: ArcGIS Mapping

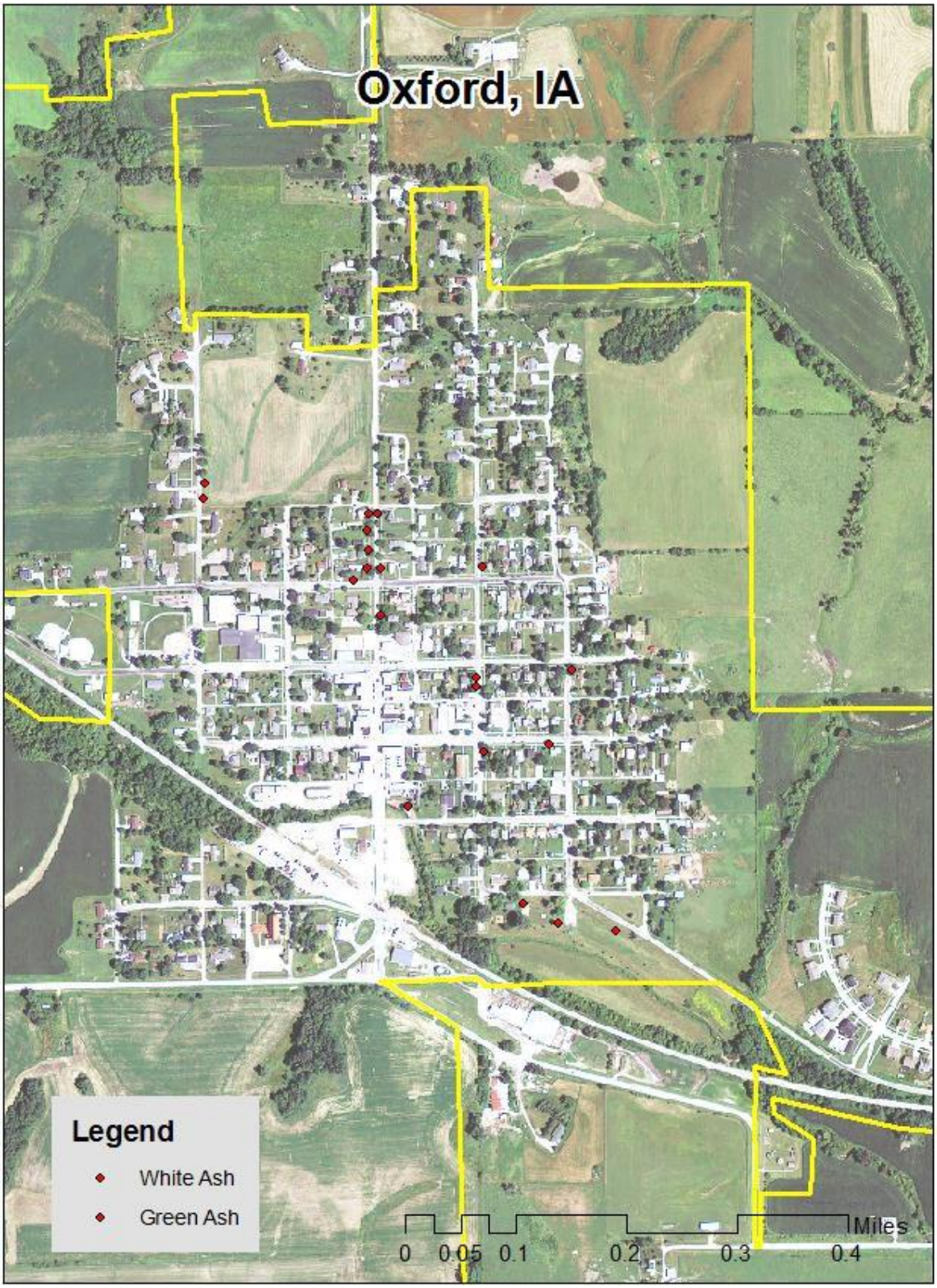


Figure 1: Location of Ash Trees

NO SIGNS OR SYMPTOMS

Figure 2: Location of EAB symptoms

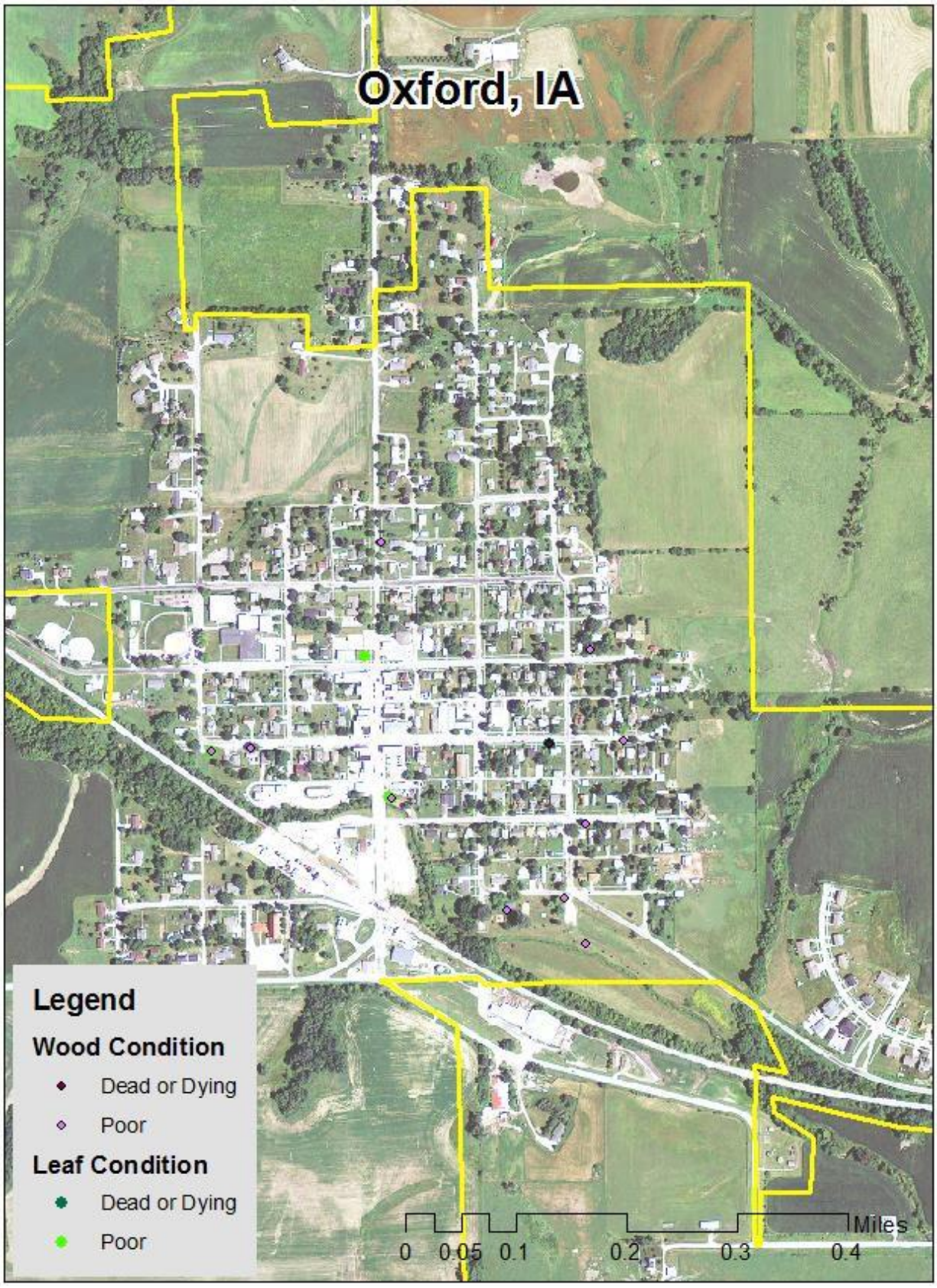


Figure 3: Location of Poor Condition Trees

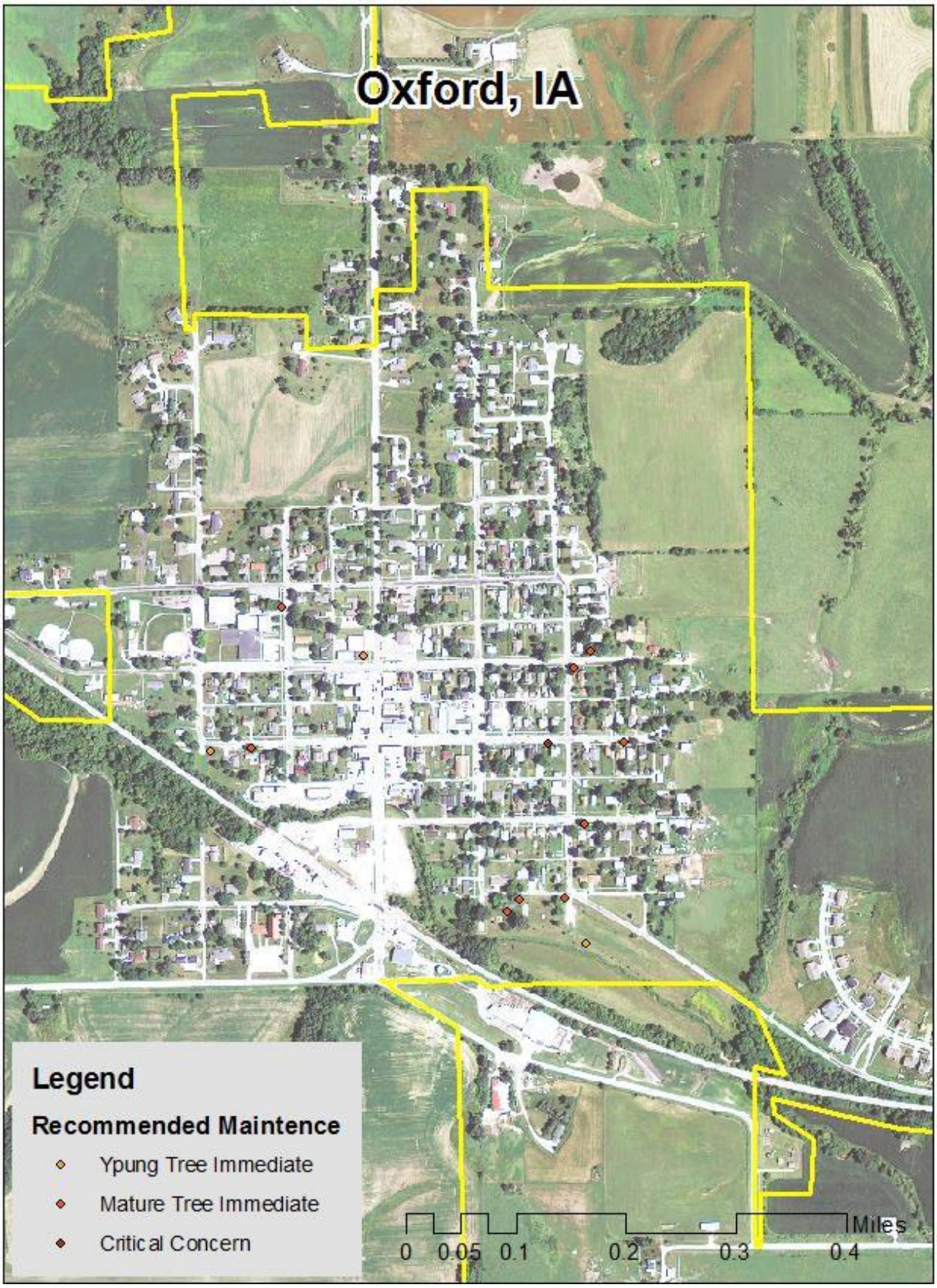


Figure 4: Location of Trees with Recommended Maintenance

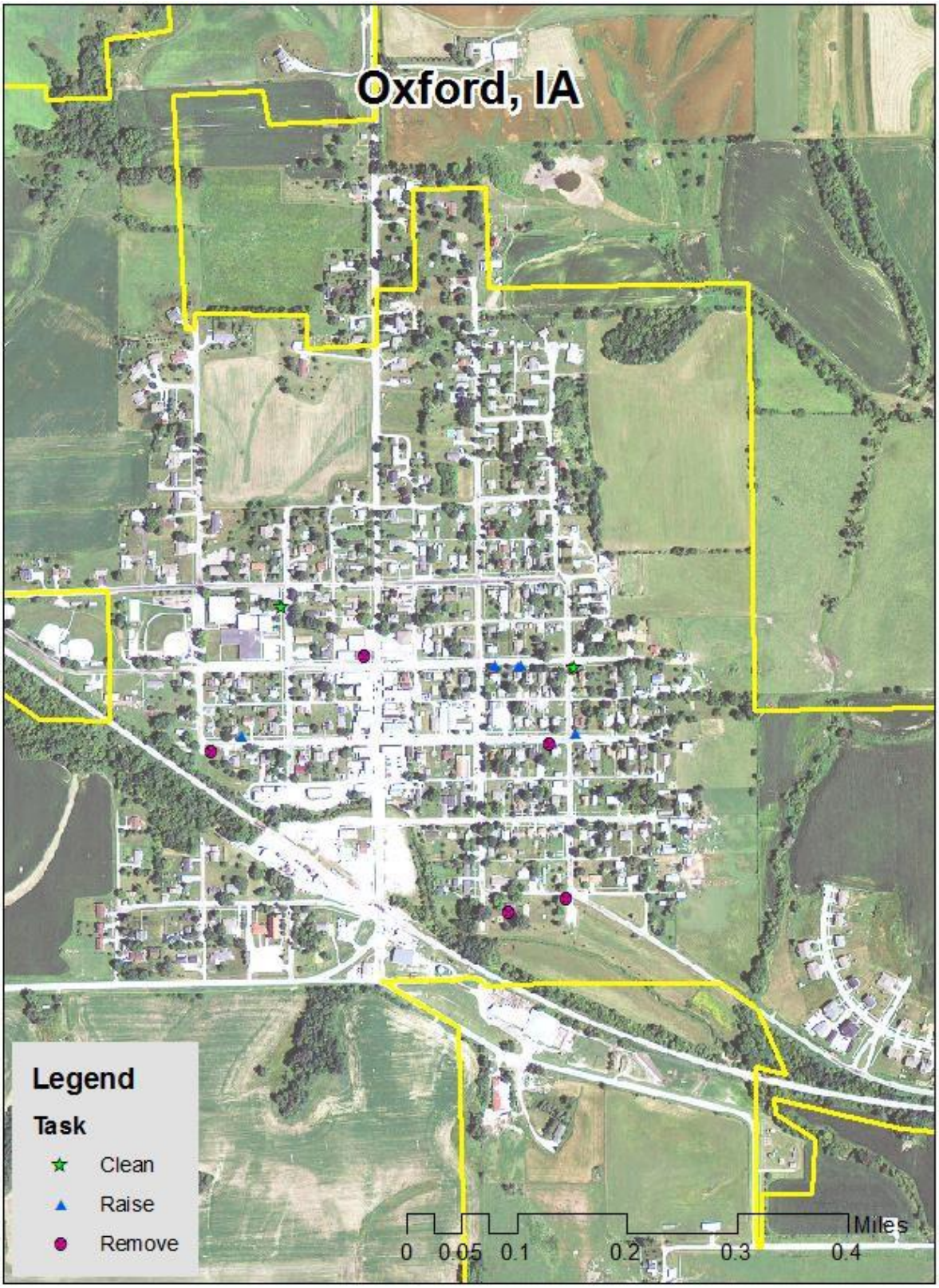


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Oxford Tree Ordinances

ORDINANCE XXXIX (39)

TREES

AN ORDINANCE REGULATING THE PLANTING, CARE AND TRIMMING OF TREES AND PRESCRIBING PENALTIES FOR VIOLATION THEREOF

Be it Ordained by the Town of Oxford, Iowa:

SECTION I. Purpose. The purpose of this Ordinance is to assume charge, custody and control of all trees and shrubbery upon the public streets and upon public property of the Town of Oxford, Iowa, and to provide rules and regulations for the planting, pruning, caring, removal and maintaining maintenance of such trees and shrubbery and for the granting of permits relative thereto; and to define tree nuisances and provide for their abatement in order to provide for the safety, preservation of health, and to promote the prosperity and improve the order, comfort and convenience of the town.

SECTION 2. All trees hereinafter planted in any street, avenue or highway shall be planted midway between the outer line of the sidewalk and the curb where the curb line is established and where the curb line is not established, on a line 10 feet from the property line. All trees now or hereafter planted in any street, alley, avenue or highway that interfere with the making of any improvements thereon, or with travel, or become dangerous, shall be removed by order of the Council and any tree planted in any street, avenue, or highway, shall be planted upon such condition and subject to such removal.

SECTION 3. No person except the Town or a person hired by the Town shall treat, trim, remove or otherwise disturb any tree or shrub on any street or other public property without first filing an application and procuring a permit from the Clerk of the Town Council. Prior to the issuance of a permit, and before any tree work of any sort can be done, the applicant must deposit with the Town Clerk a Liability Insurance Policy in the amount of $ 5000 for personal injuries and $ 10,000 per accident for bodily injury, liability, and $ 2000 aggregate for property damage liability. The insurance

+ injuries

110

policy shall also name the Town of Oxford, Iowa, as an additional insured in all liability insurance. In event the applicant is able to furnish proof of financial responsibility approved by the Town and enters into an agreement for Indemnification of the Town in the event of any damage caused by applicants obtaining a permit to do tree work, the insurance requirement may be waived.

SECTION 4. All permits will be issued by the Town Clerk and with approval of the Council.

SECTION 5. All trimming, pruning, or cutting of any trees or shrubs in any street, avenue, highway or public place, shall be done under the personal supervision of the Director of Public Works, except that the owner, agent or occupant of any lot or parcel of land shall keep the trees on and adjoining his property in the street, avenue or highway, trimmed so that the overhanging branches shall be at least 10 feet above the surface of the sidewalk or surface of the street, and in all cases, all trees shall be trimmed as high as the size and shape of the tree will permit.

No person shall plant or set out any tree or shrub in any street or public place of the Town of Oxford without first getting approval from the Town Council and should any one plant a tree or shrub without first getting approval, the Town may require its removal by the person who planted said tree or the Town may remove said tree or shrub.

SECTION 6. Any dead, diseased or damaged trees or shrubs, which may harbor serious insect or diseased pests or disease injurious to other trees, is hereby declared a nuisance and when any dead, diseased, damaged or healthy tree or shrub, which is in a state of deterioration, and in such a condition that said tree may fall and damage property or cause injury to persons, is hereby declared to be a nuisance and said nuisances may be abated in the same manner as any other nuisance as set forth in the provisions of the Ordinances of the Town of Oxford, Iowa, or the Code of Iowa.

SECTION 7. Any tree infected with Dutch Elm disease is hereby specifically declared to be a nuisance and the Town shall remove or cause to be removed any tree known to be contaminated.

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Any tree infected with Dutch Elm disease, and which is located on private property, shall be removed by the owner thereof after the owner has received a written notice requiring the removal of said tree and said tree shall be removed within 30 days after receipt of said notice. The notice may be served upon the property owner or on the occupant or person in charge of the property and the Town is hereby authorized to enter and inspect the trees growing on private property in an effort to enforce the application of this Ordinance.

If the tree is not removed on or before the date specified in the notice, the Town may remove or cause said tree to be removed and the exact cost of such work shall be certified and assessed against the property owner as specified in the Code of Iowa.

SECTION 8. No person shall hinder, prevent, delay or interfere with the Town or any of their assistants while engaged in carrying out the execution or enforcement of this Ordinance provided, however, that nothing herein shall be construed as an attempt to prohibit the pursuit of any remedy, legal or equitable, in any court of competent jurisdiction for the protection of property rights by the owner of any property within the city.

SECTION 9. Any person violating any of the provisions of this Ordinance shall upon conviction be subject to imprisonment not exceeding thirty (30) days, or a fine not exceeding One Hundred Dollars ($100.00).

SECTION 10. All ordinances, or parts of ordinances, in conflict with the provisions of this Ordinance are hereby repealed.

SECTION 11. This Ordinance shall be in force and effect from and after its passage and publication as provided by law.

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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 515-281-5918.