Brooklyn, IA

2015 Urban Forest Management Plan

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Executive Summary

Overview

This plan was developed to assist the City of Brooklyn 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 21% (45 trees) of Brooklyn'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 the summer of 2015, 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 210 trees inventoried.

- Brooklyn's trees provide $49,915 of benefits annually, an average of $237 a tree
- There are 31 species of trees
- The top three genera are: Maple 46%, Ash 21%, and Hackberry 10% meaning 67% of the public trees in Brooklyn consist of maple and ash
- 9% of trees are in need of some type of management & 4 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 recommendations.

- Of the 4 trees suggested for removal all of them are 24 inches in diameter or over at 4.5 ft. On 6/17/2015 the city was sent a list of trees of concern observed during the inventory that need further evaluation. *City ownership of the trees recommended for removal should be verified prior to any removal*
- 15 of the 45 public ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation. Check all 45 public ash trees yearly for symptoms.
- All trees should be pruned on a routine schedule- one third of the city every other year
- If planting plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Siberian elm, evergreens (street trees only), willow (street trees only) or black walnut. Follow City Code 150.2 for planting guidelines.
- There are 45 ash trees present on public property and with an estimated tree removal cost between $600 to $1,000 per tree the cost to remove these trees could be between $27,000 and $45,000 total

Introduction

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

Trees are an important component of Brooklyn'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 Brooklyn 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 Brooklyn's urban forestry goals.

Inventory

In the summer of 2015, a tree inventory was conducted that included 100% of the city owned trees on both 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 210 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. Brooklyn's trees reduce energy related costs by approximately $13,150 annually (Appendix A, Table 1). These savings are both in Electricity (62.7 MWh) and in Natural Gas (8,570.7 Therms).

Annual Stormwater Benefits

Brooklyn's trees intercept about 740,288 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $20,062 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 Brooklyn, it is estimated that trees remove 821.3 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 $2,314 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Brooklyn, trees sequester about 149,219 lbs of carbon a year with an associated value of $1,004 (Appendix A, Table 5). In addition, the trees store 3,042,910 lbs of carbon, with a yearly benefit of $22,822 (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. Brooklyn receives $13,383 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, Brooklyn's trees provide $49,915 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 210 trees in Brooklyn provide approximately $237 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Brooklyn has 31 different tree species along city streets and parks (Appendix A, Figure 1). The top three genera are: Maple 46%, ash 21% and hackberry 9%

The distribution of the top five tree species is as follows:

Green Ash	45	21%
Norway Maple	31	15%
Sugar Maple	31	15%
Silver Maple	22	10%
Hackberry	19	9%

Age Class

In Brooklyn 25% of the public trees are less than 18 inches in diameter at 4.5 ft., and 75% are greater than 18 inches in diameter (Appendix A, Figure 2). Almost 53% of the trees are 24 inches in diameter or greater. Only 3 trees with diameters between 1 and 6 inches were found indicating very few new trees have been planted, and the current population is becoming mature.

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 Brooklyn indicate that 82% of the trees are in good health and 1% are in poor health or dead and dying. (Appendix A, Figure 3 & Appendix B, Figure 3). Additionally, only 36% of Brooklyn's trees are in good health for wood condition (Appendix A, Figure 4 & Appendix B, Figure 3). This data indicates there are a significant number of public trees with structural issues. Wood condition that is in poor health or dead and dying is about 9% of the population. This 9% is an estimate of trees that need management follow up related to poor wood condition.

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	38	18%
Crown Cleaning	30	14%
Crown Reduction	5	2%
Tree Removal	4	2%

Canopy Cover

The total canopy with both private and public trees is 21%. The canopy cover included in the Brooklyn inventory includes approximately 7.5 acres (Appendix A, Figure 5).

Land Use and Location

The public trees in Brooklyn are generally along the streets in residential neighborhoods and park areas. (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	84%
Park/vacant/other	15%
Small Commercial	1%

Location	
Planting strip	83%
Front Yard	17%

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

Brooklyn has 4 trees that need to be considered for removal. These trees are listed on the Maintenance Tasks Map (Appendix B, Figure 5). It is recommended to start with the large diameter trees first. On 6/17/2015 a letter was sent outlining a number of trees of concern that needed further evaluation.

Poor tree species

On 6/17/2015 the city was sent a letter listing a number of trees of concern in different parts of the community that need to be evaluated. A significant number of these trees are along the streets in the right-of-way, and some are in the Landes Park.

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. **With newly planted trees it will be critical that these trees are trained and maintained with pruning as they develop in the first 5 to 20 years.**

Planting

It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. 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 Brooklyn.

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 (46%) and ash (21%) (Appendix A, Figure 1). Maples should not be planted until this percentage falls below 20%. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Currently tree planting is guided by City Code 150.02 Planting Restrictions. Any new plantings within the parks or the streets should be a diverse mix of species and should not include ash, maple, cottonwood, poplar, box elder, Siberian elm, or any potentially non-native invasive tree species. Organizations like the Iowa DNR Forestry Bureau, ISU Extension Horticulture, and Trees Forever can provide a variety of information on tree selection.

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 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 Brooklyn 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 ~$3,000 is budgeted annually for tree removal. Below are activities that the community should consider when developing annual budgets:
Removal: 4 trees have been identified to be evaluated for removal now. Cost of tree removal is between $600 to $1,000 per tree which would be $2,400 to $4,000.
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 4 to 7 year rotation and evaluate newly planted trees annually for pruning

***EAB could potentially kill all ash within 4 to 10 years of its arrival to Brooklyn. Once ash trees begin to actually die they can decline quickly which will require immediate removal. If all 45 public 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 $27,000 to $45,000.** *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. Next will be all ash in poor condition and displaying signs and symptoms of EAB. *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. If considering any treatments Brooklyn should start in the spring of 2016. 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. ***At this point the entire state of Iowa is under Federal Quarantine, which does not allow the movement of regulated items outside of the state.**

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? Wood waste can be disposed of as you normally would if your county is not part of a separate quarantine which **Poweshiek County** is not.

Canopy Replacement

City Code 150.2 Planting Restrictions outlines the tree planting guidelines on public property in Brooklyn. Any new plantings within the parks or the streets should be a diverse mix of species and should not include ash, maple, cottonwood, poplar, box elder, Siberian elm, or any potentially non-native invasive tree species. Organizations like the Iowa DNR Forestry Bureau, ISU Extension Horticulture, and Trees Forever can provide a variety of information on tree selection.

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. **Once EAB arrives in Brooklyn it could potentially kill all ash within 4 to 10 years of its arrival.**

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB and as ash trees decline in health and become a concern. Currently City Codes 150.05 and .06 address these concerns.

Budget

According to information obtained from the community at this point ~$3,000 is budgeted annually for tree removal.

***EAB could potentially kill all ash within 4 to 10 years of its arrival to Brooklyn. Once ash trees begin to actually die they can decline quickly which will require immediate removal. If all 45 public 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 $27,000 to $45,000.** *City ownership of any tree (s) recommended for removal should be verified prior to any removal*

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Brooklyn

Annual Energy Benefits of Public Trees

6/12/2015

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	14.0	1,066	1,927.3	1,889	2,955	(N/A)	21.4	22.5	65.66
Norway maple	8.4	640	1,207.4	1,183	1,824	(N/A)	14.8	13.9	58.83
Sugar maple	10.5	797	1,409.2	1,381	2,178	(N/A)	14.8	16.6	70.26
Silver maple	8.0	606	1,047.9	1,027	1,633	(N/A)	10.5	12.4	74.21
Northern hackberry	7.1	539	1,000.4	980	1,519	(N/A)	9.0	11.6	79.96
Apple	1.3	99	179.6	176	275	(N/A)	3.3	2.1	39.28
Red maple	1.2	91	157.2	154	245	(N/A)	2.9	1.9	40.81
Black walnut	1.5	112	203.7	200	312	(N/A)	2.4	2.4	62.36
American basswood	1.5	113	219.1	215	328	(N/A)	2.4	2.5	65.51
Maple	0.8	58	103.0	101	159	(N/A)	1.9	1.2	39.70
Pin oak	1.4	110	195.6	192	302	(N/A)	1.9	2.3	75.38
Honeylocust	0.9	70	114.1	112	182	(N/A)	1.4	1.4	60.61
Conifer Evergreen Large	0.5	36	64.0	63	99	(N/A)	1.4	0.8	33.04
Eastern white pine	0.3	21	34.3	34	55	(N/A)	1.0	0.4	27.30
Bur oak	0.8	63	112.7	110	173	(N/A)	1.0	1.3	86.52
Siberian elm	0.9	71	120.5	118	190	(N/A)	1.0	1.4	94.77
Broadleaf Deciduous Small	0.1	7	16.6	16	24	(N/A)	1.0	0.2	11.80
Elm	0.7	54	100.5	99	153	(N/A)	1.0	1.2	76.46
Eastern redbud	0.1	11	25.7	25	36	(N/A)	1.0	0.3	18.19
Austrian pine	0.3	19	30.4	30	49	(N/A)	1.0	0.4	24.51
Boxelder	0.3	22	40.7	40	62	(N/A)	0.5	0.5	62.01
Swamp white oak	0.1	8	16.9	17	24	(N/A)	0.5	0.2	24.47
Kentucky coffeetree	0.5	37	63.1	62	99	(N/A)	0.5	0.8	98.63
Ginkgo	0.2	18	32.0	31	49	(N/A)	0.5	0.4	49.28
Broadleaf Evergreen Small	0.1	4	9.2	9	13	(N/A)	0.5	0.1	13.40
Northern white cedar	0.2	14	24.6	24	38	(N/A)	0.5	0.3	38.17
Scotch pine	0.1	10	14.6	14	24	(N/A)	0.5	0.2	24.14
Callery pear	0.1	8	16.9	17	24	(N/A)	0.5	0.2	24.47
Black maple	0.0	3	5.2	5	8	(N/A)	0.5	0.1	7.85
Broadleaf Deciduous Large	0.4	29	53.7	53	82	(N/A)	0.5	0.6	82.02
Norway spruce	0.2	14	24.6	24	38	(N/A)	0.5	0.3	38.17
Total	62.6	4,751	8,570.7	8,399	13,150	(N/A)	100.0	100.0	62.62

Table 2: Annual Stormwater Benefits

Brooklyn

Annual Stormwater Benefits of Public Trees

6/12/2015

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	168,693	4,572	(N/A)	21.4	22.8	101.59
Norway maple	80,753	2,188	(N/A)	14.8	10.9	70.59
Sugar maple	138,186	3,745	(N/A)	14.8	18.7	120.80
Silver maple	119,133	3,229	(N/A)	10.5	16.1	146.75
Northern hackberry	69,795	1,891	(N/A)	9.0	9.4	99.55
Apple	5,173	140	(N/A)	3.3	0.7	20.03
Red maple	9,579	260	(N/A)	2.9	1.3	43.26
Black walnut	16,080	436	(N/A)	2.4	2.2	87.16
American basswood	16,931	459	(N/A)	2.4	2.3	91.77
Maple	5,721	155	(N/A)	1.9	0.8	38.76
Pin oak	17,067	463	(N/A)	1.9	2.3	115.63
Honeylocust	7,799	211	(N/A)	1.4	1.1	70.45
Conifer Evergreen Large	10,543	286	(N/A)	1.4	1.4	95.24
Eastern white pine	4,508	122	(N/A)	1.0	0.6	61.08
Bur oak	12,729	345	(N/A)	1.0	1.7	172.48
Siberian elm	13,255	359	(N/A)	1.0	1.8	179.61
Broadleaf Deciduous Small	333	9	(N/A)	1.0	0.0	4.51
Elm	9,433	256	(N/A)	1.0	1.3	127.82
Eastern redbud	529	14	(N/A)	1.0	0.1	7.17
Austrian pine	3,089	84	(N/A)	1.0	0.4	41.85
Boxelder	4,024	109	(N/A)	0.5	0.5	109.04
Swamp white oak	586	16	(N/A)	0.5	0.1	15.88
Kentucky coffeetree	7,239	196	(N/A)	0.5	1.0	196.17
Ginkgo	1,857	50	(N/A)	0.5	0.3	50.33
Broadleaf Evergreen Small	289	8	(N/A)	0.5	0.0	7.83
Northern white cedar	4,605	125	(N/A)	0.5	0.6	124.79
Scotch pine	1,539	42	(N/A)	0.5	0.2	41.70
Callery pear	586	16	(N/A)	0.5	0.1	15.88
Black maple	137	4	(N/A)	0.5	0.0	3.72
Broadleaf Deciduous Large	5,491	149	(N/A)	0.5	0.7	148.79
Norway spruce	4,605	125	(N/A)	0.5	0.6	124.79
Citywide total	740,288	20,062	(N/A)	100.0	100.0	95.53

Table 3: Annual Air Quality Benefits

Brooklyn

Annual Air Quality Benefits of Public Trees

6/12/2015

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($) Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2							
Green ash	23.9	3.8	11.1	1.1	126	67.1	9.8	9.3	63.7	418	0.0	0	189.8	544 (N/A)	21.4	12.10
Norway maple	16.8	2.9	8.2	0.7	91	40.8	5.9	5.6	38.3	253	-3.9	-15	115.4	329 (N/A)	14.8	10.62
Sugar maple	22.1	3.8	10.5	1.0	118	49.8	7.3	6.9	47.5	311	-17.1	-64	131.8	365 (N/A)	14.8	11.78
Silver maple	21.2	3.6	10.3	0.9	114	37.6	5.5	5.3	36.1	235	-10.7	-40	109.7	309 (N/A)	10.5	14.04
Northern hackberry	12.4	2.1	6.2	0.6	67	34.2	5.0	4.7	32.2	212	0.0	0	97.4	280 (N/A)	9.0	14.72
Apple	1.7	0.3	0.8	0.1	9	6.2	0.9	0.9	5.9	39	0.0	0	16.7	48 (N/A)	3.3	6.81
Red maple	2.2	0.4	1.0	0.1	12	5.6	0.8	0.8	5.4	35	-0.8	-3	15.7	44 (N/A)	2.9	7.39
Black walnut	1.9	0.3	0.9	0.1	10	7.1	1.0	1.0	6.7	44	0.0	0	19.0	54 (N/A)	2.4	10.86
American basswood	2.3	0.4	1.1	0.1	12	7.3	1.0	1.0	6.7	45	-2.0	-7	18.0	50 (N/A)	2.4	9.97
Maple	1.2	0.2	0.6	0.1	7	3.6	0.5	0.5	3.5	23	-0.4	-2	9.8	28 (N/A)	1.9	6.89
Pin oak	3.1	0.5	1.6	0.1	17	6.9	1.0	1.0	6.6	43	-5.7	-21	15.1	38 (N/A)	1.9	9.62
Honeylocust	1.4	0.2	0.7	0.1	8	4.3	0.6	0.6	4.2	27	-1.1	-4	11.1	31 (N/A)	1.4	10.23
Conifer Evergreen Large	1.3	0.2	1.0	0.2	8	2.3	0.3	0.3	2.2	14	-5.6	-21	2.1	1 (N/A)	1.4	0.44
Eastern white pine	0.5	0.1	0.4	0.1	3	1.3	0.2	0.2	1.2	8	-1.9	-7	2.1	4 (N/A)	1.0	2.13
Bur oak	2.0	0.3	0.9	0.1	10	3.9	0.6	0.5	3.7	25	0.0	0	12.0	35 (N/A)	1.0	17.37
Siberian elm	2.9	0.5	1.3	0.1	15	4.4	0.6	0.6	4.3	28	0.0	0	14.8	43 (N/A)	1.0	21.50
Broadleaf Deciduous Small	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3 (N/A)	1.0	1.63
Elm	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)	1.0	14.09
Eastern redbud	0.1	0.0	0.1	0.0	1	0.8	0.1	0.1	0.7	5	0.0	0	1.8	5 (N/A)	1.0	2.55
Austrian pine	0.4	0.1	0.3	0.0	3	1.2	0.2	0.2	1.1	7	-1.1	-4	2.4	6 (N/A)	1.0	2.89
Boxelder	0.6	0.1	0.3	0.0	3	1.4	0.2	0.2	1.3	9	-0.2	-1	3.9	11 (N/A)	0.5	11.20
Swamp white 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)	0.5	3.47
Kentucky coffeetree	1.6	0.3	0.7	0.1	8	2.3	0.3	0.3	2.2	14	0.0	0	7.7	23 (N/A)	0.5	22.55
Ginkgo	0.5	0.1	0.3	0.0	3	1.1	0.2	0.2	1.1	7	-0.2	-1	3.3	9 (N/A)	0.5	9.29
Broadleaf Evergreen Small	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	0.0	0	0.7	2 (N/A)	0.5	2.06
Northern white cedar	0.6	0.1	0.4	0.1	4	0.9	0.1	0.1	0.8	5	-2.9	-11	0.3	-2 (N/A)	0.5	-1.58
Scotch pine	0.2	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.5	-2	1.2	3 (N/A)	0.5	2.82
Callery pear	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)	0.5	3.47
Black maple	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.4	1 (N/A)	0.5	1.12
Broadleaf Deciduous Large	0.8	0.1	0.4	0.0	4	1.9	0.3	0.3	1.8	12	0.0	0	5.5	16 (N/A)	0.5	15.71
Norway spruce	0.6	0.1	0.4	0.1	4	0.9	0.1	0.1	0.8	5	-2.9	-11	0.3	-2 (N/A)	0.5	-1.58
Citywide total	123.7	20.9	60.5	5.8	667	298.8	43.5	41.5	283.6	1,861	-56.9	-213	821.3	2,314 (N/A)	100.0	11.02

Table 4: Annual Carbon Stored

Brooklyn

Stored CO2 Benefits of Public Trees

6/12/2015

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	797,490	5,981	(N/A)	21.4	26.2	132.91
Norway maple	276,587	2,074	(N/A)	14.8	9.1	66.92
Sugar maple	660,887	4,957	(N/A)	14.8	21.7	159.89
Silver maple	471,837	3,539	(N/A)	10.5	15.5	160.85
Northern hackberry	194,211	1,457	(N/A)	9.0	6.4	76.66
Apple	24,966	187	(N/A)	3.3	0.8	26.75
Red maple	24,256	182	(N/A)	2.9	0.8	30.32
Black walnut	62,303	467	(N/A)	2.4	2.0	93.45
American basswood	84,530	634	(N/A)	2.4	2.8	126.79
Maple	13,771	103	(N/A)	1.9	0.5	25.82
Pin oak	80,381	603	(N/A)	1.9	2.6	150.71
Honeylocust	18,319	137	(N/A)	1.4	0.6	45.80
Conifer Evergreen La	14,176	106	(N/A)	1.4	0.5	35.44
Eastern white pine	4,513	34	(N/A)	1.0	0.1	16.92
Bur oak	65,202	489	(N/A)	1.0	2.1	244.51
Siberian elm	70,618	530	(N/A)	1.0	2.3	264.82
Broadleaf Deciduous	1,086	8	(N/A)	1.0	0.0	4.07
Elm	41,716	313	(N/A)	1.0	1.4	156.43
Eastern redbud	1,816	14	(N/A)	1.0	0.1	6.81
Austrian pine	2,236	17	(N/A)	1.0	0.1	8.39
Boxelder	22,806	171	(N/A)	0.5	0.7	171.04
Swamp white oak	1,101	8	(N/A)	0.5	0.0	8.26
Kentucky coffeetree	55,982	420	(N/A)	0.5	1.8	419.86
Ginkgo	7,800	59	(N/A)	0.5	0.3	58.50
Broadleaf Evergreen S	908	7	(N/A)	0.5	0.0	6.81
Northern white cedar	7,490	56	(N/A)	0.5	0.2	56.18
Scotch pine	1,170	9	(N/A)	0.5	0.0	8.78
Callery pear	1,101	8	(N/A)	0.5	0.0	8.26
Black maple	218	2	(N/A)	0.5	0.0	1.64
Broadleaf Deciduous	25,943	195	(N/A)	0.5	0.9	194.57
Norway spruce	7,490	56	(N/A)	0.5	0.2	56.18
Citywide total	3,042,910	22,822	(N/A)	100.0	100.0	108.68

Table 5: Annual Carbon Sequestered

Brooklyn

Annual CO Benefits of Public Trees

6/12/2015

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	31,050	233	-3,828	-151	-1	0	0	27,071	203 (N/A)	21.4	20.2	4.51
Norway maple	10,147	76	-1,328	-90	-1	0	0	8,729	65 (N/A)	14.8	6.5	2.11
Sugar maple	28,130	211	-3,172	-121	-1	0	0	24,836	186 (N/A)	14.8	18.5	6.01
Silver maple	34,356	258	-2,265	-89	-1	0	0	32,003	240 (N/A)	10.5	23.9	10.91
Northern hackberry	9,132	68	-932	-68	-1	0	0	8,132	61 (N/A)	9.0	6.1	3.21
Apple	2,084	16	-120	-14	0	0	0	1,950	15 (N/A)	3.3	1.5	2.09
Red maple	2,981	22	-116	-11	0	0	0	2,854	21 (N/A)	2.9	2.1	3.57
Black walnut	3,581	27	-299	-15	0	0	0	3,267	25 (N/A)	2.4	2.4	4.90
American basswood	4,984	37	-406	-18	0	0	0	4,560	34 (N/A)	2.4	3.4	6.84
Maple	1,737	13	-66	-7	0	0	0	1,664	12 (N/A)	1.9	1.2	3.12
Pin oak	7,374	55	-386	-16	0	0	0	6,972	52 (N/A)	1.9	5.2	13.07
Honeylocust	2,434	18	-88	-7	0	0	0	2,340	18 (N/A)	1.4	1.7	5.85
Conifer Evergreen Large	375	3	-68	-10	0	0	0	297	2 (N/A)	1.4	0.2	0.74
Eastern white pine	303	2	-22	-5	0	0	0	277	2 (N/A)	1.0	0.2	1.04
Bur oak	1,872	14	-313	-9	0	0	0	1,549	12 (N/A)	1.0	1.2	5.81
Siberian elm	1,894	14	-339	-11	0	0	0	1,544	12 (N/A)	1.0	1.2	5.79
Broadleaf Deciduous Smal	152	1	-5	-2	0	0	0	145	1 (N/A)	1.0	0.1	0.54
Elm	1,816	14	-200	-8	0	0	0	1,608	12 (N/A)	1.0	1.2	6.03
Eastern redbud	228	2	-9	-2	0	0	0	217	2 (N/A)	1.0	0.2	0.81
Austrian pine	181	1	-11	-4	0	0	0	167	1 (N/A)	1.0	0.1	0.63
Boxelder	1,454	11	-109	-4	0	0	0	1,340	10 (N/A)	0.5	1.0	10.05
Swamp white oak	224	2	-5	-1	0	0	0	217	2 (N/A)	0.5	0.2	1.63
Kentucky coffeetree	479	4	-269	-6	0	0	0	204	2 (N/A)	0.5	0.2	1.53
Ginkgo	319	2	-37	-4	0	0	0	278	2 (N/A)	0.5	0.2	2.09
Broadleaf Evergreen Small	81	1	-4	-1	0	0	0	76	1 (N/A)	0.5	0.1	0.57
Northern white cedar	256	2	-36	-4	0	0	0	217	2 (N/A)	0.5	0.2	1.62
Scotch pine	116	1	-6	-2	0	0	0	108	1 (N/A)	0.5	0.1	0.81
Callery pear	224	2	-5	-1	0	0	0	217	2 (N/A)	0.5	0.2	1.63
Black maple	39	0	-1	-1	0	0	0	37	0 (N/A)	0.5	0.0	0.28
Broadleaf Deciduous Large	960	7	-125	-4	0	0	0	831	6 (N/A)	0.5	0.6	6.23
Norway spruce	256	2	-36	-4	0	0	0	217	2 (N/A)	0.5	0.2	1.62
Citywide total	149,219	1,119	-14,606	-688	-5	0	0	133,925	1,004 (N/A)	100.0	100.0	4.78

Table 6: Annual Social and Aesthetic Benefits

Brooklyn

Annual Aesthetic/Other Benefits of Public Trees

6/12/2015

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Green ash	2,463	(N/A)	21.4	18.4	54.74
Norway maple	955	(N/A)	14.8	7.1	30.80
Sugar maple	2,715	(N/A)	14.8	20.3	87.58
Silver maple	2,596	(N/A)	10.5	19.4	117.98
Northern hackberry	1,174	(N/A)	9.0	8.8	61.81
Apple	122	(N/A)	3.3	0.9	17.38
Red maple	380	(N/A)	2.9	2.8	63.30
Black walnut	293	(N/A)	2.4	2.2	58.68
American basswood	354	(N/A)	2.4	2.6	70.79
Maple	235	(N/A)	1.9	1.8	58.66
Pin oak	547	(N/A)	1.9	4.1	136.70
Honeylocust	594	(N/A)	1.4	4.4	198.10
Conifer Evergreen Large	94	(N/A)	1.4	0.7	31.39
Eastern white pine	79	(N/A)	1.0	0.6	39.70
Bur oak	125	(N/A)	1.0	0.9	62.47
Siberian elm	108	(N/A)	1.0	0.8	53.77
Broadleaf Deciduous Small	8	(N/A)	1.0	0.1	4.23
Elm	132	(N/A)	1.0	1.0	66.10
Eastern redbud	13	(N/A)	1.0	0.1	6.40
Austrian pine	50	(N/A)	1.0	0.4	25.23
Boxelder	79	(N/A)	0.5	0.6	78.52
Swamp white oak	26	(N/A)	0.5	0.2	26.22
Kentucky coffeetree	29	(N/A)	0.5	0.2	28.57
Ginkgo	23	(N/A)	0.5	0.2	22.94
Broadleaf Evergreen Small	4	(N/A)	0.5	0.0	4.38
Northern white cedar	26	(N/A)	0.5	0.2	26.25
Scotch pine	32	(N/A)	0.5	0.2	32.32
Callery pear	26	(N/A)	0.5	0.2	26.22
Black maple	7	(N/A)	0.5	0.1	7.28
Broadleaf Deciduous Large	67	(N/A)	0.5	0.5	66.60
Norway spruce	26	(N/A)	0.5	0.2	26.25
Citywide total	13,383	(N/A)	100.0	100.0	63.73

Table 7: Summary of Benefits in Dollars

Brooklyn

Total Annual Benefits of Public Trees by Species ($)

6/12/2015

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Green ash	2,955	203	544	4,572	2,463	10,737	(N/A)	21.5
Norway maple	1,824	65	329	2,188	955	5,362	(N/A)	10.7
Sugar maple	2,178	186	365	3,745	2,715	9,189	(N/A)	18.4
Silver maple	1,633	240	309	3,229	2,596	8,006	(N/A)	16.0
Northern hackberry	1,519	61	280	1,891	1,174	4,926	(N/A)	9.9
Apple	275	15	48	140	122	599	(N/A)	1.2
Red maple	245	21	44	260	380	950	(N/A)	1.9
Black walnut	312	25	54	436	293	1,120	(N/A)	2.2
American basswood	328	34	50	459	354	1,224	(N/A)	2.5
Maple	159	12	28	155	235	589	(N/A)	1.2
Pin oak	302	52	38	463	547	1,402	(N/A)	2.8
Honeylocust	182	18	31	211	594	1,036	(N/A)	2.1
Conifer Evergreen Large	99	2	1	286	94	483	(N/A)	1.0
Eastern white pine	55	2	4	122	79	263	(N/A)	0.5
Bur oak	173	12	35	345	125	689	(N/A)	1.4
Siberian elm	190	12	43	359	108	711	(N/A)	1.4
Broadleaf Deciduous Sn	24	1	3	9	8	45	(N/A)	0.1
Elm	153	12	28	256	132	581	(N/A)	1.2
Eastern redbud	36	2	5	14	13	70	(N/A)	0.1
Austrian pine	49	1	6	84	50	190	(N/A)	0.4
Boxelder	62	10	11	109	79	271	(N/A)	0.5
Swamp white oak	24	2	3	16	26	72	(N/A)	0.1
Kentucky coffeetree	99	2	23	196	29	347	(N/A)	0.7
Ginkgo	49	2	9	50	23	134	(N/A)	0.3
Broadleaf Evergreen Sm	13	1	2	8	4	28	(N/A)	0.1
Northern white cedar	38	2	-2	125	26	189	(N/A)	0.4
Scotch pine	24	1	3	42	32	102	(N/A)	0.2
Callery pear	24	2	3	16	26	72	(N/A)	0.1
Black maple	8	0	1	4	7	20	(N/A)	0.0
Broadleaf Deciduous La	82	6	16	149	67	319	(N/A)	0.6
Norway spruce	38	2	-2	125	26	189	(N/A)	0.4
Citywide Total	13,150	1,004	2,314	20,062	13,383	49,915	(N/A)	100.0

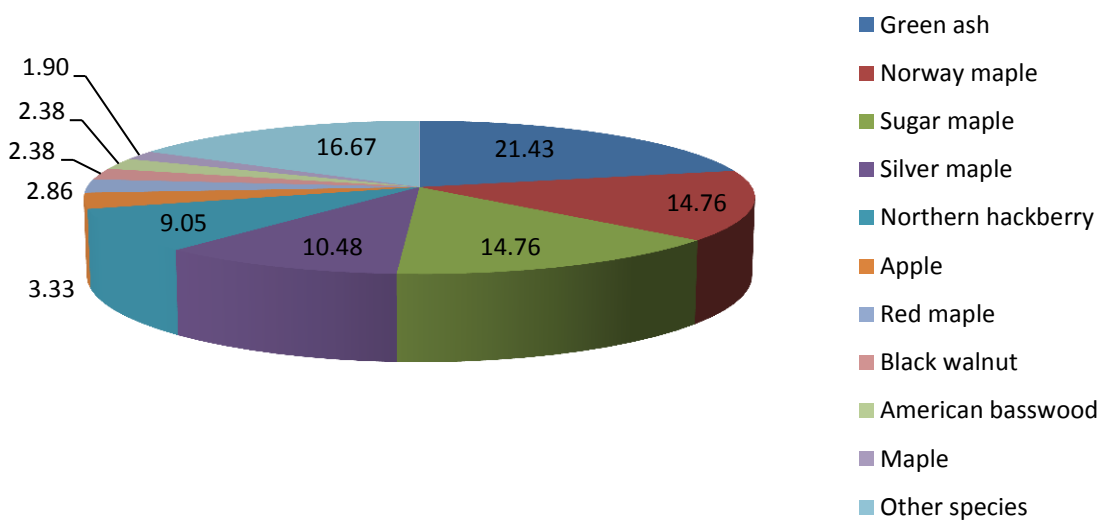


Figure 1: Species Distribution

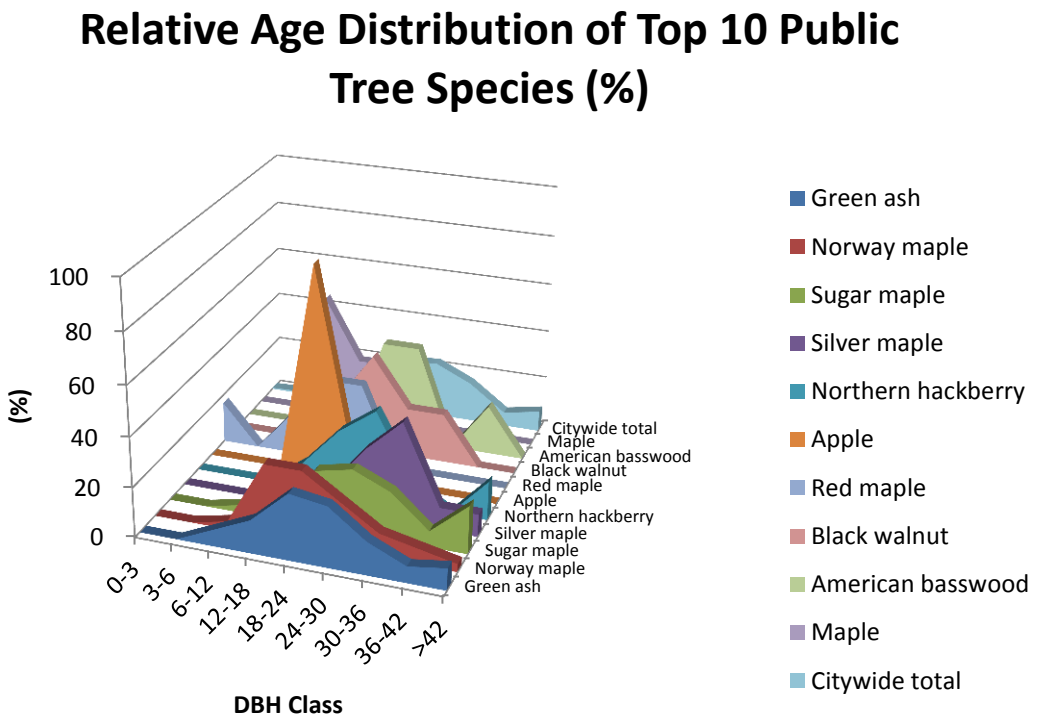


Figure 2: Relative Age Class

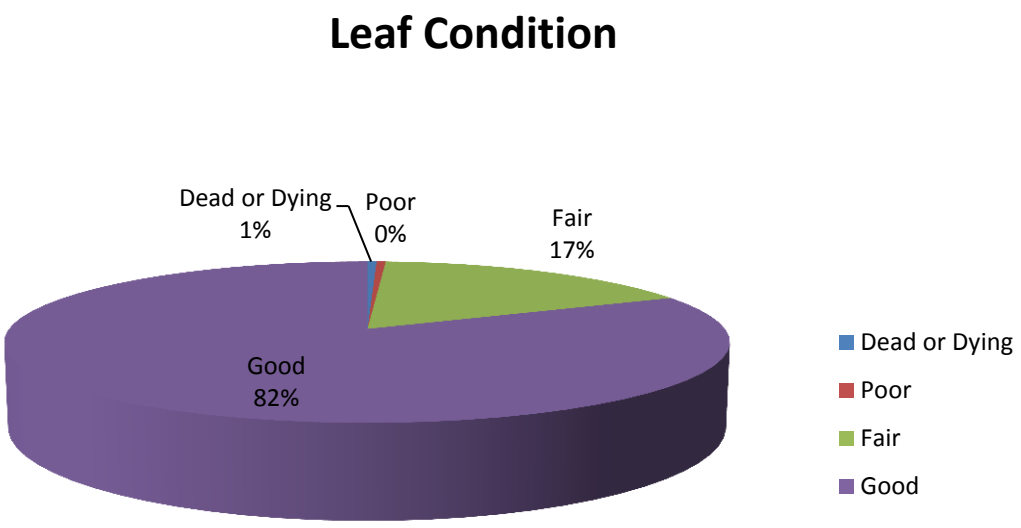


Figure 3: Foliage Condition

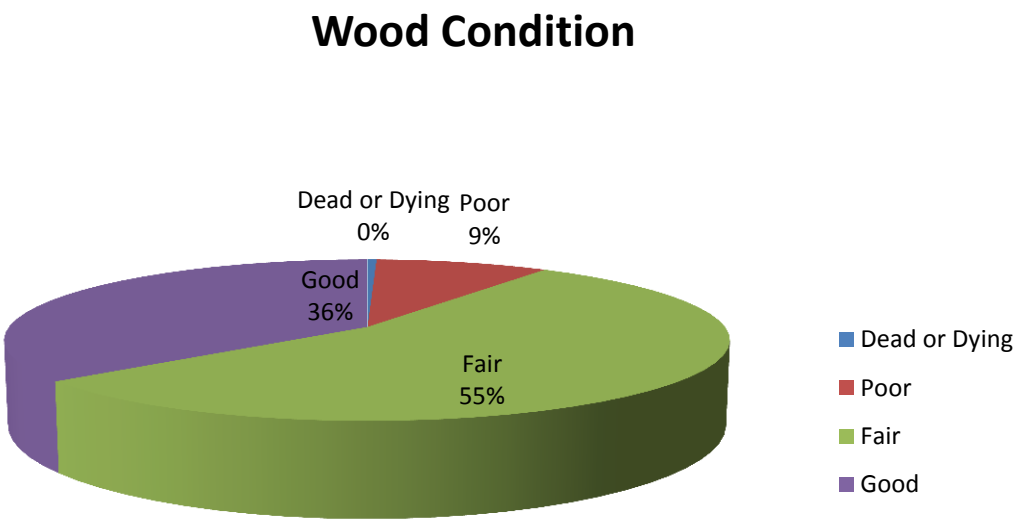


Figure 4: Wood Condition

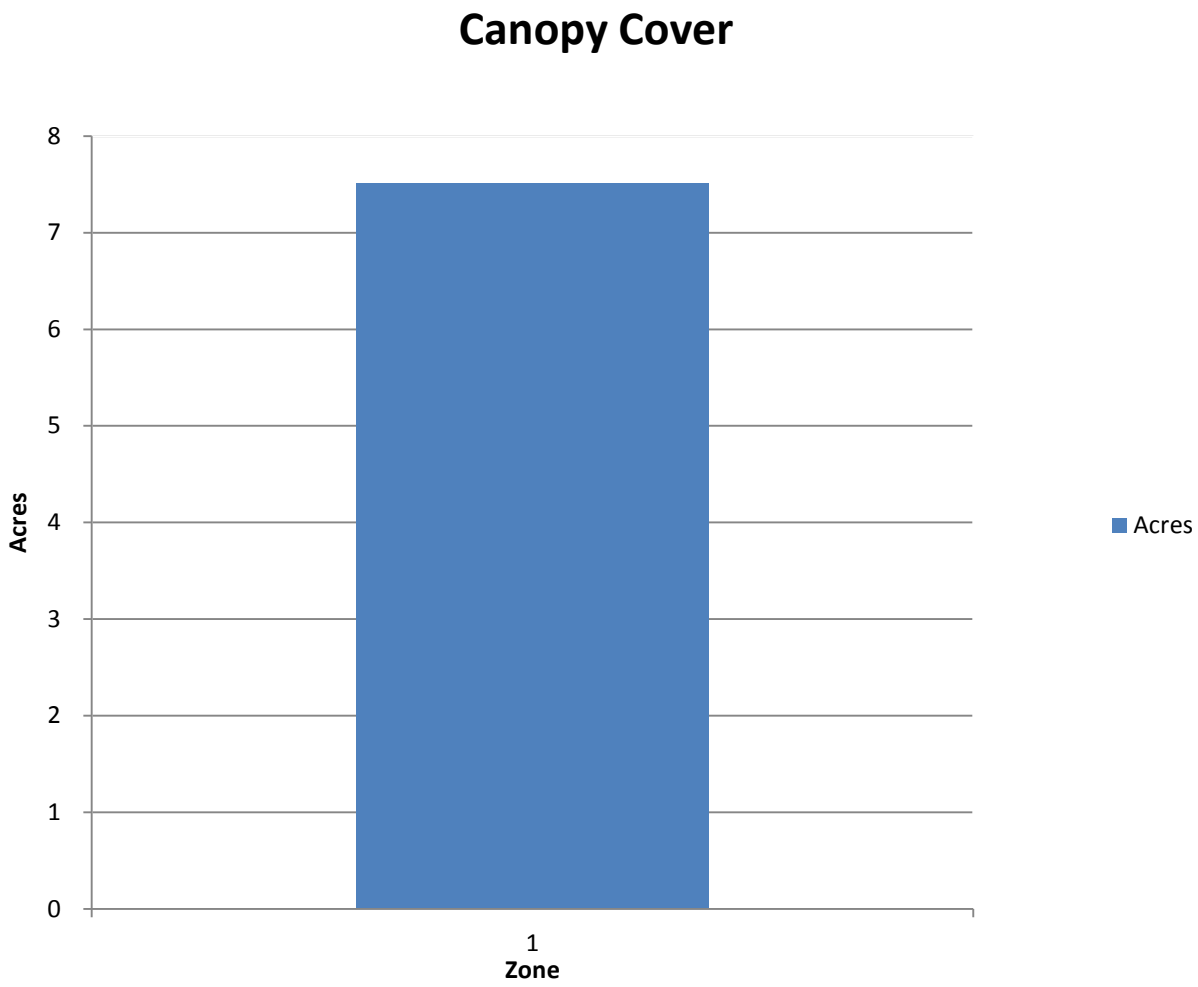


Figure 5: Canopy Cover in Acres

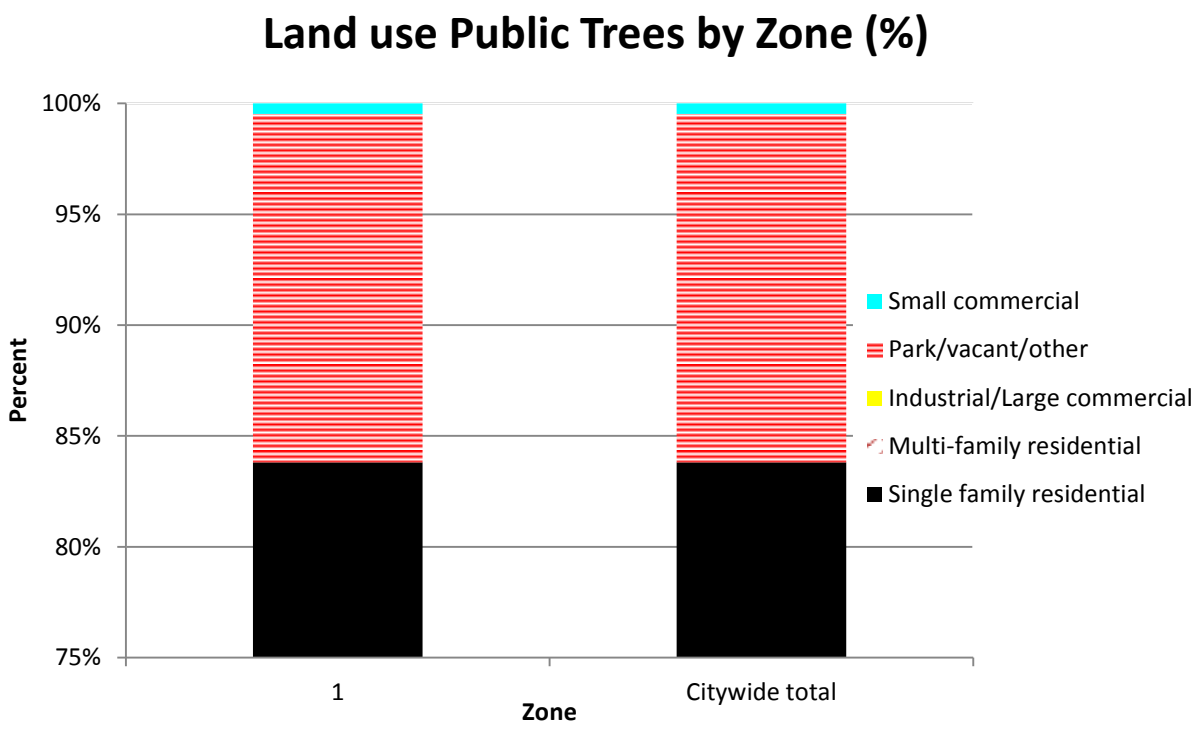


Figure 6: Land Use of city/park trees

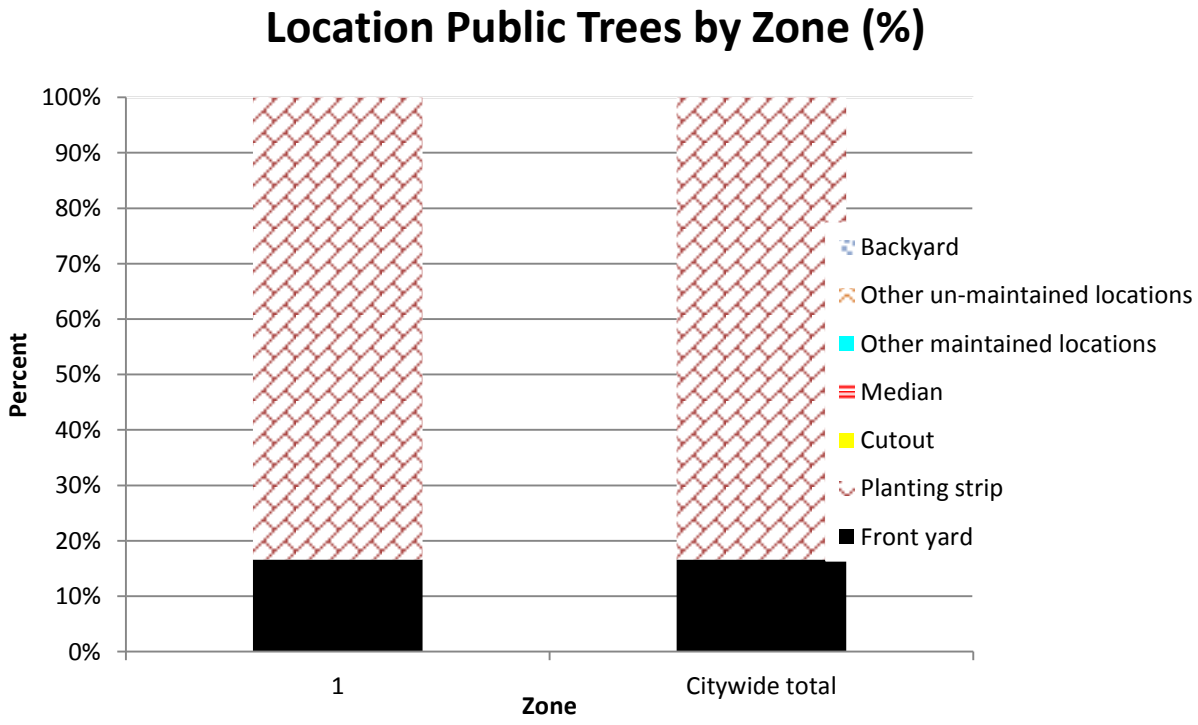
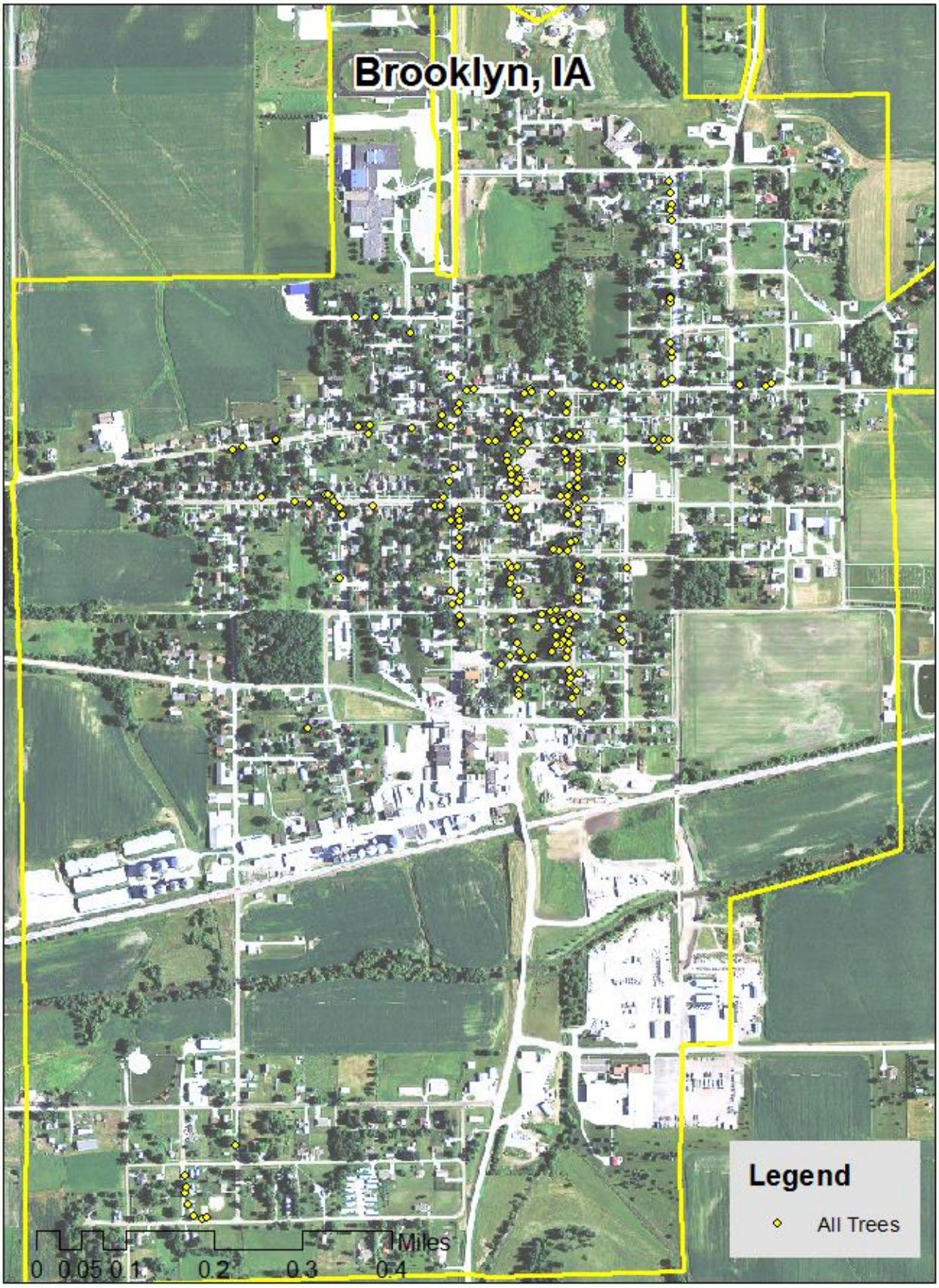


Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping



Public Trees in Brooklyn

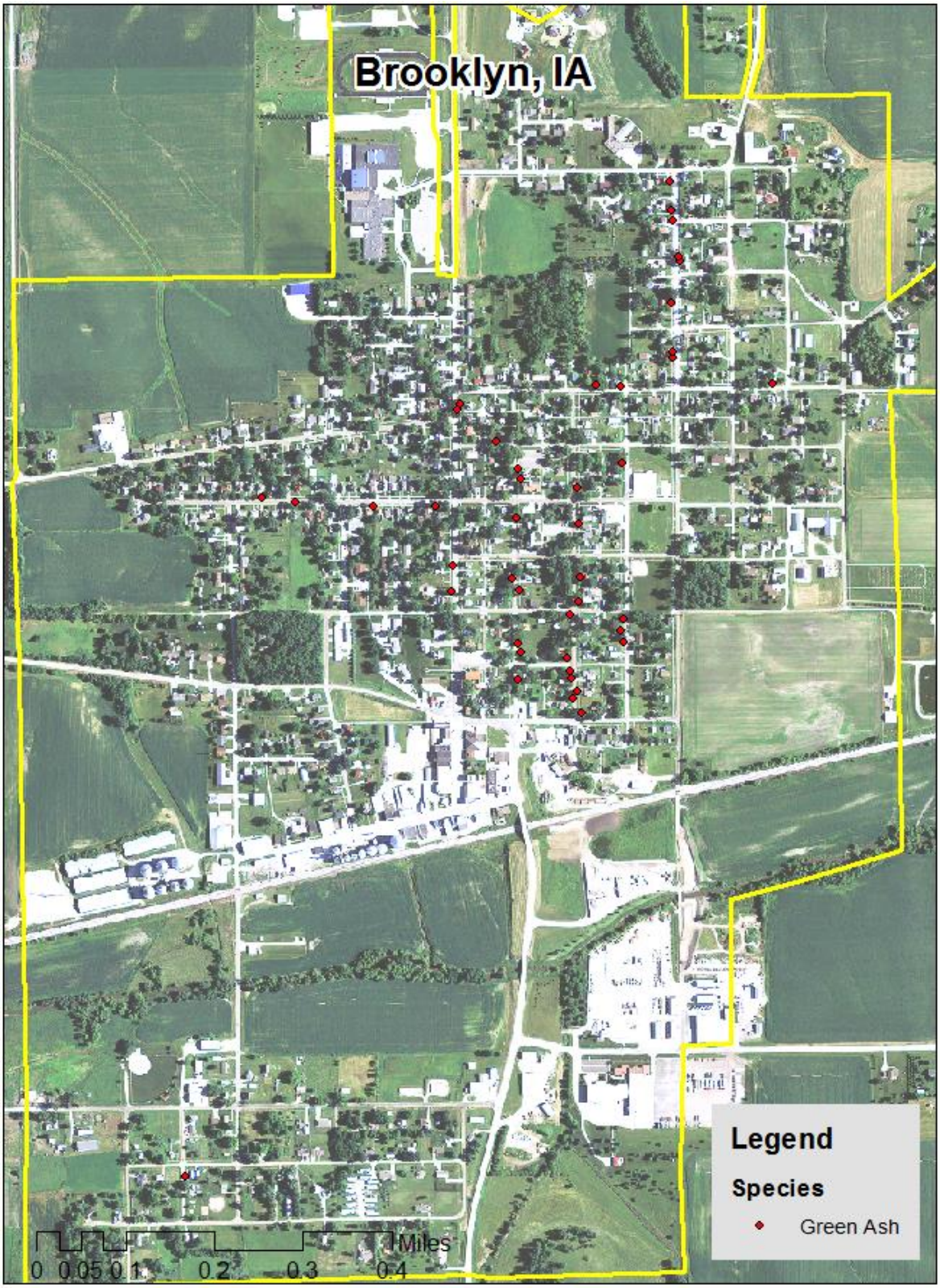


Figure 1: Location of Ash Trees

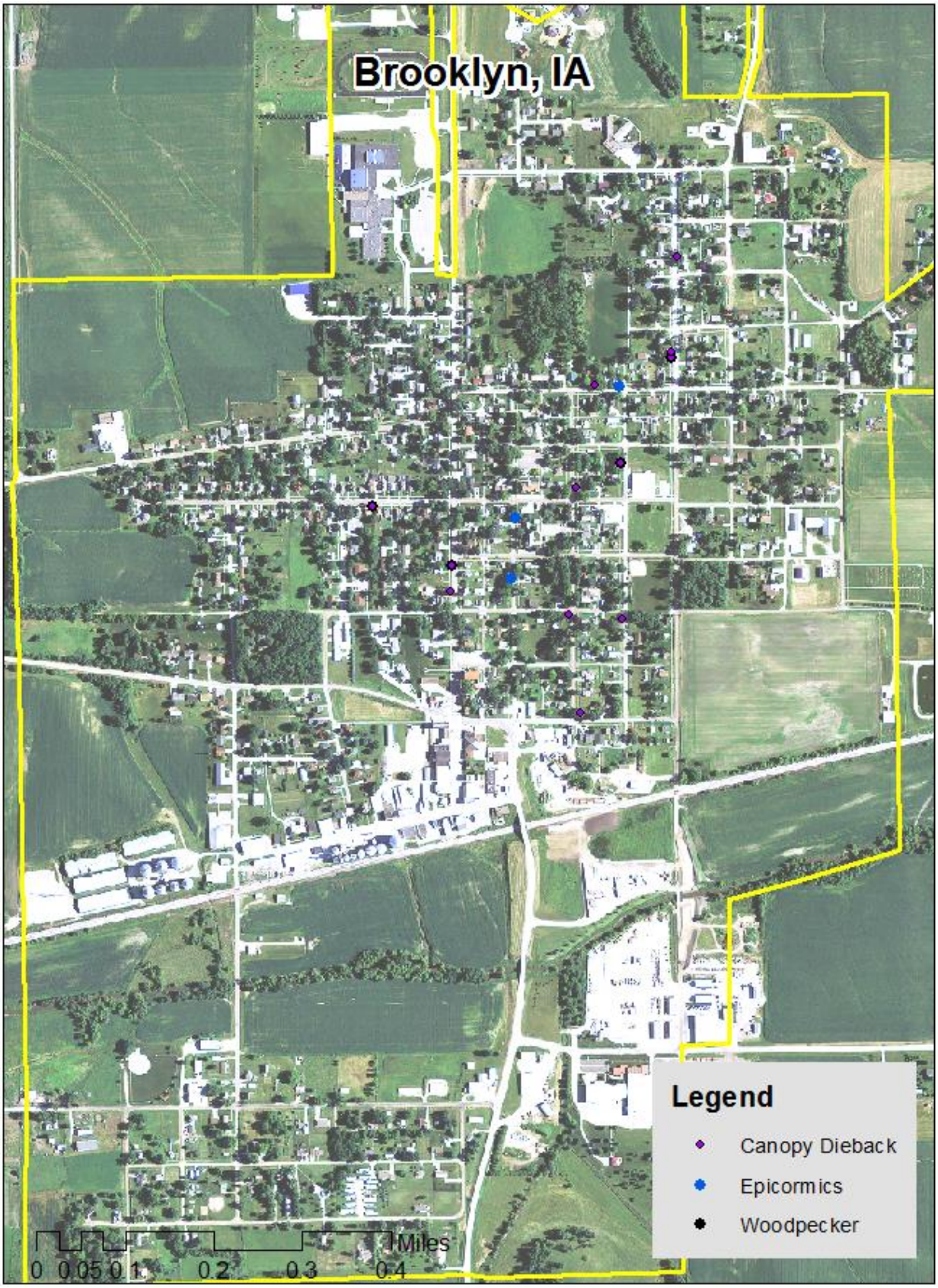


Figure 2: Location of EAB symptoms

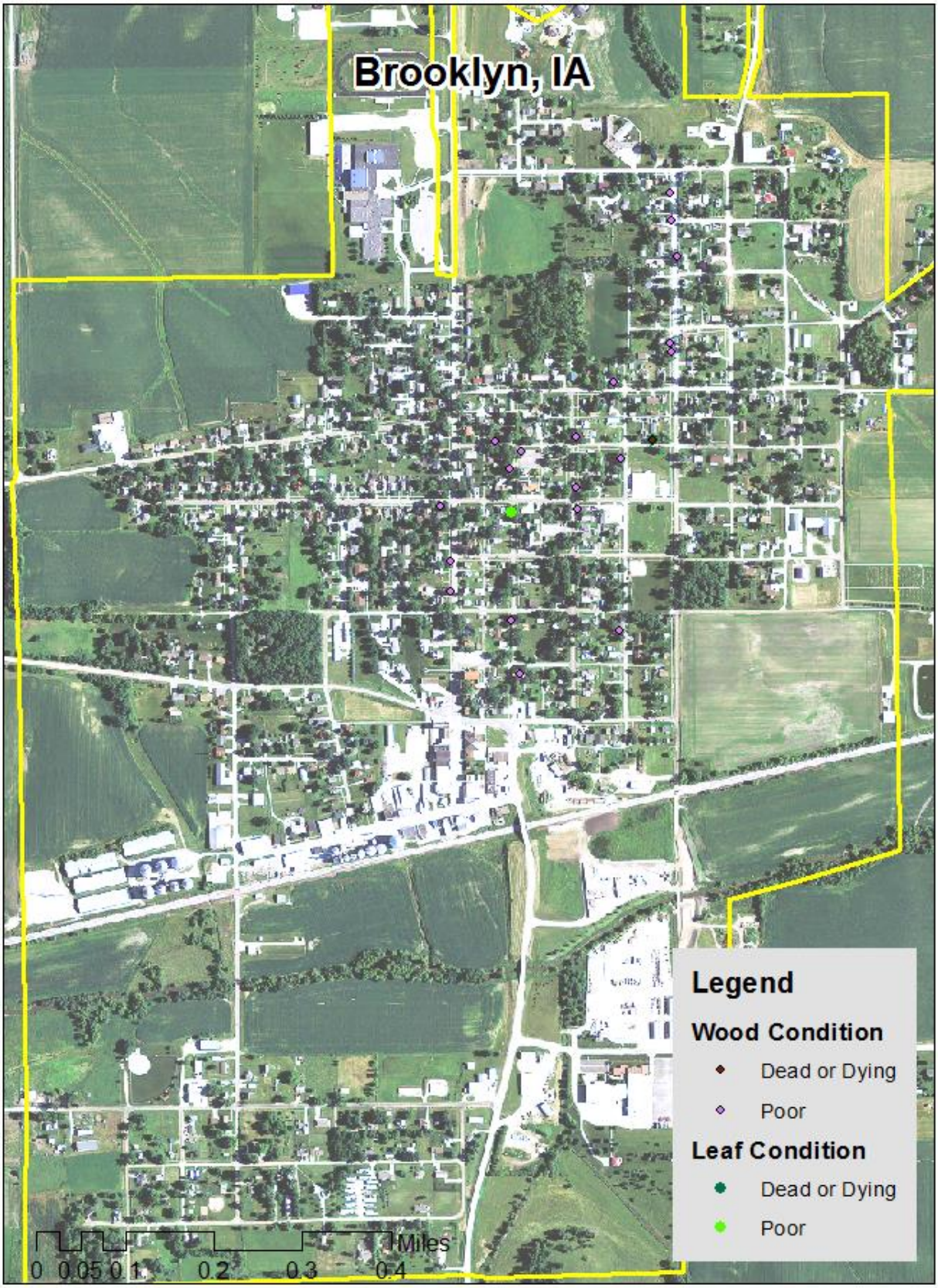


Figure 3: Location of Poor Condition Trees

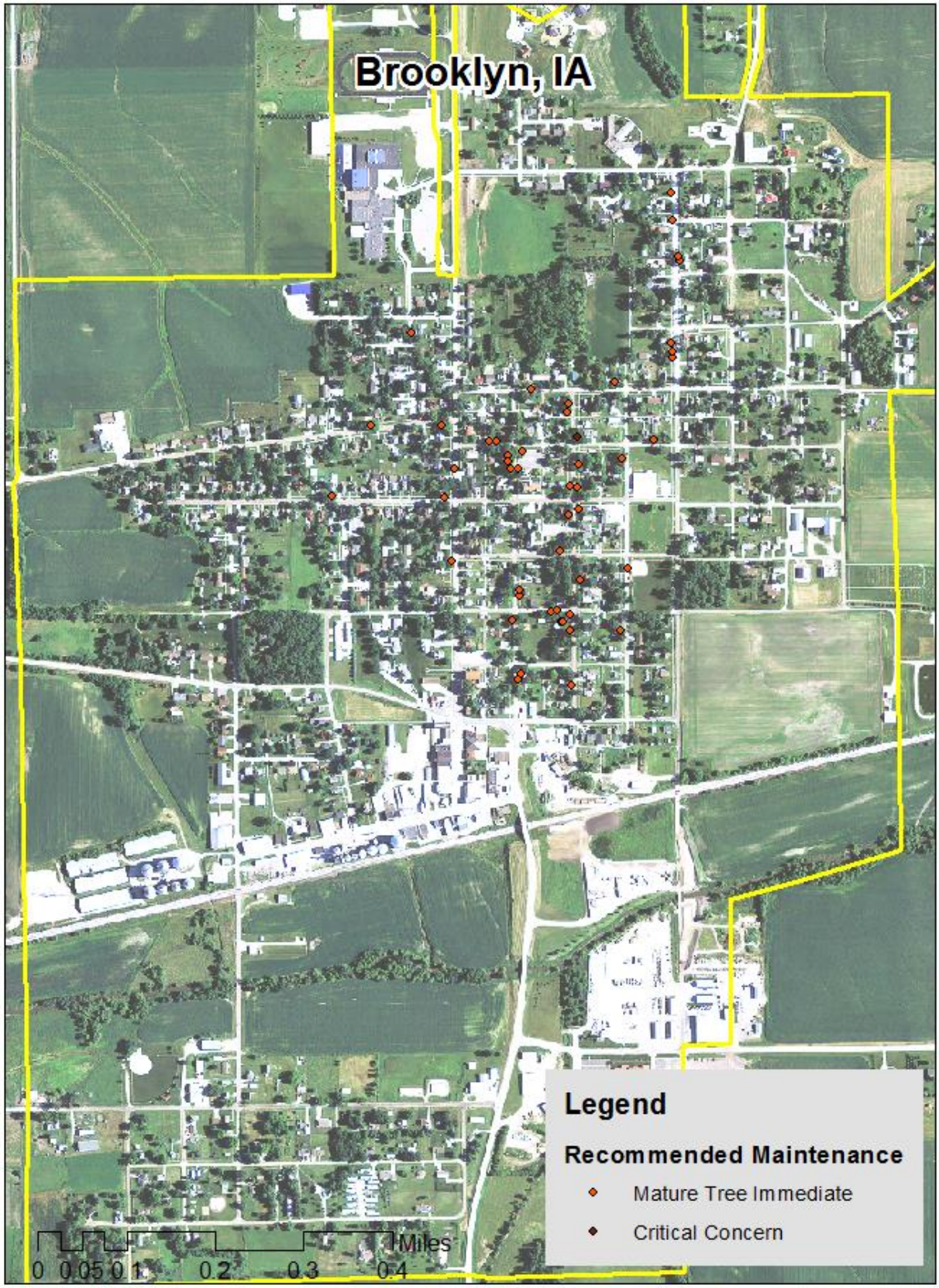


Figure 4: Location of Trees with Recommended Maintenance

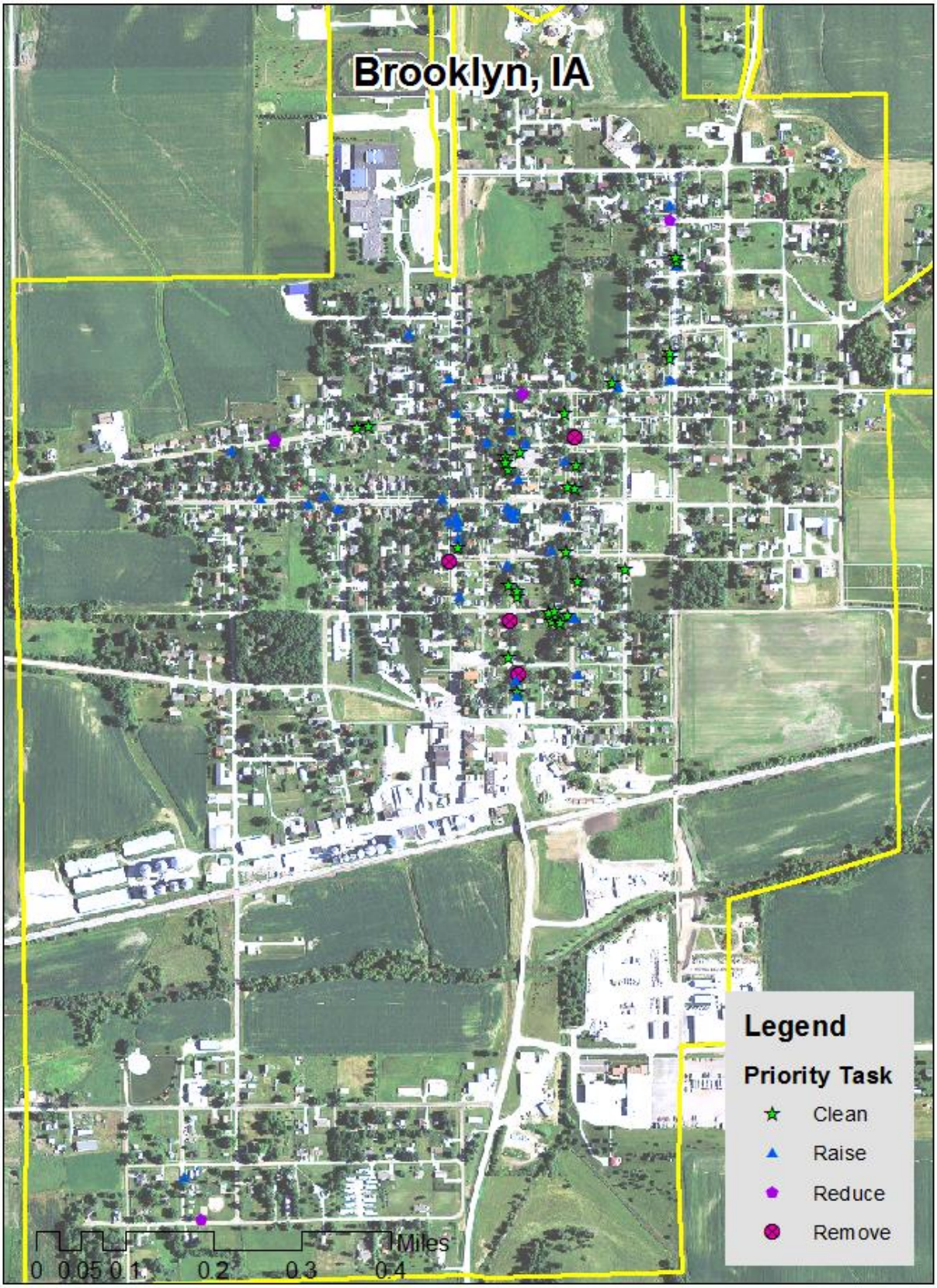


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Brooklyn Tree Ordinance

CHAPTER 150

TREES

150.01 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.

150.02 PLANTING RESTRICTIONS. No tree shall be planted in any parking or public right-of-way except in accordance with the following:

1. No person shall plant a tree within the parking or public right-of-way without first obtaining a permit therefor, which shall show the type of tree to be planted and the placement of the tree. The placement of the tree must be approved by the Superintendent of Public Works, and no permit shall be issued until the Superintendent of Public Works has actually viewed the site of said placement.

2. No person shall plant in any parking or public right-of-way any fruit-bearing or nut-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

3. No tree may be planted where there is less than 2½ feet of soil on all sides of said tree; and no tree may be planted closer than five (5) feet from any fire hydrant or closer than forty (40) feet to another tree on the parking.

4. No person may plant a shrub upon the public right-of-way or parking.

5. The Clerk may deny the issuance of a permit if the same would cause damage to the public right-of-way and parking, create a safety hazard or fail to conform to the scheme of planting of trees upon that particular public right-of-way or parking area.

6. Where overhead power lines still exist within the City, no permit for the planting of trees shall be issued.

150.03 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 fourteen (14) 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])

150.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 150.03, 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.

150.05 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.

150.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:

1. Removal from 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, and that danger to other trees within the City is imminent, the Council shall immediately cause such condition to be corrected by treatment or removal so as to destroy or prevent as fully as possible the spread of the disease or the insect or disease pests. 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. Removal from Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees within the City is imminent, the Council shall immediately notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within the time period set by the Council and stated in the notice. If the owner, occupant, or person in charge of said property fails to comply within such time period, the Council may cause the nuisance to be removed and the cost assessed against the property.

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

150.07 PERMIT TO REMOVE TREE FROM PARKING OR PUBLIC RIGHT-OF-WAY. Any person desiring to have a live tree removed from the public right-of-way or parking for the construction of a walk, drive, building, or any other reason shall first obtain a permit from the Clerk. If a permit is issued, the permittee must remove the tree at said person's own expense. No fee shall be charged for the permit to remove said tree.

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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.