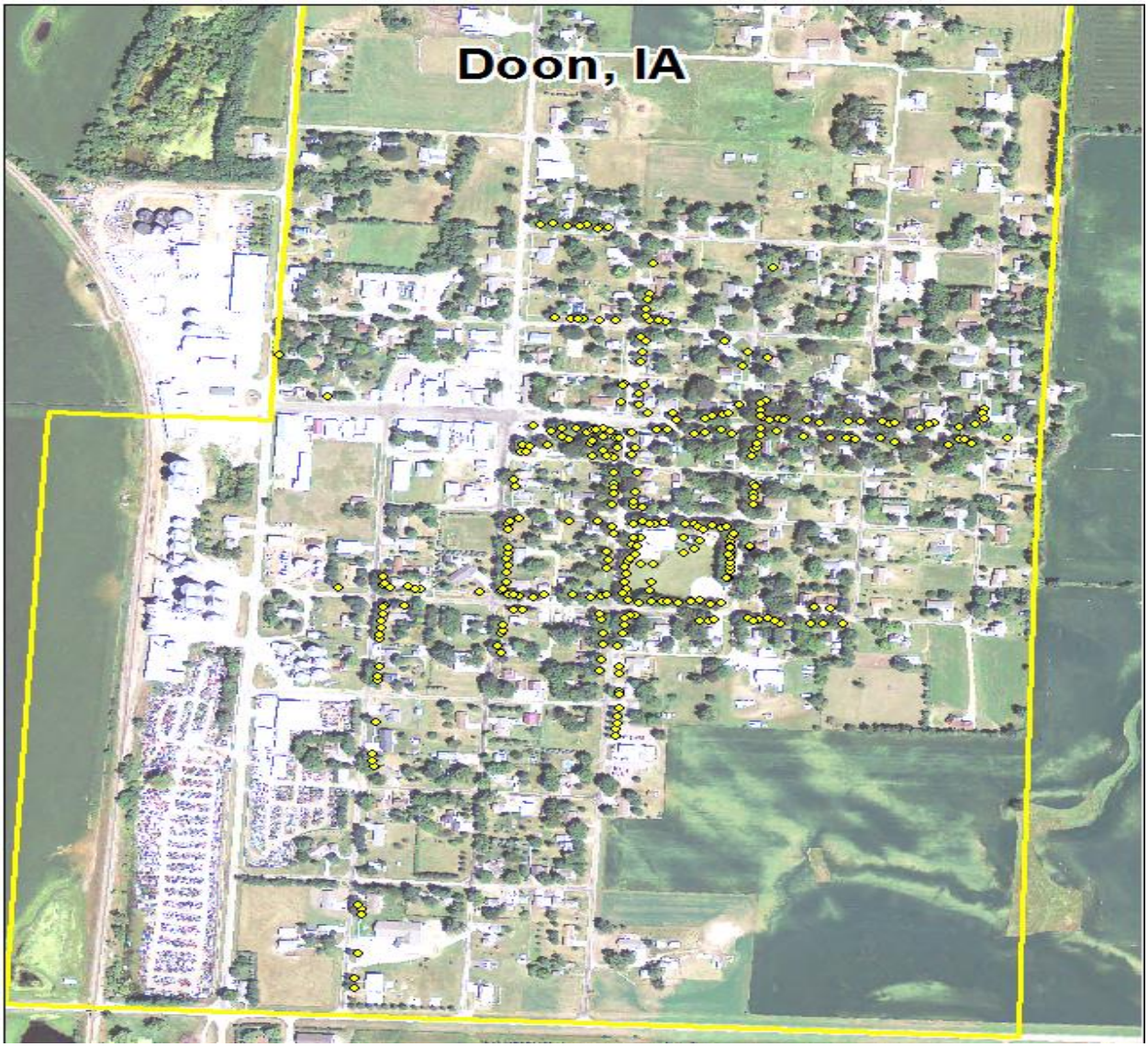
Emerald Ash Borer/Urban Plan
Doon, IA



2014 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to assist the City of Doon with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to Doon, and sound management allows you to 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 27% of Doon'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 300 trees inventoried.

- Doon's trees provide $61,216 of benefits annually, an average of $204 a tree.
- There are over 25 species of trees.
- The top three genera are: Maple 45%, Ash 27%, and Hackberry 8%.
- 22% of trees are in need of some type of management.
- 6 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 6 trees needing removal, 2 trees are over 24 inches in diameter at 4.5 ft and must be addressed immediately. *City ownership of the trees recommended for removal should be verified prior to any removal*.
- 26 of the 81 ash trees should be carefully examined, as they have three or more symptoms that could be related to an EAB infestation.
- All trees should be pruned on a routine schedule- one fifth of the city every five years.
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.
- Check every ash tree yearly, visually.

Introduction

This plan was developed to assist Doon with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with more money being 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 Doon, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2014, a tree inventory was conducted that included 100% of the city-owned trees along streets and in 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 300 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. Doon's trees reduce energy related costs by approximately $15,858 annually (Appendix A, Table 1). These savings are both in Electricity (76.7 MWh) and in Natural Gas (10,240 Therms).

Annual Stormwater Benefits

Doon's trees intercept about 838,851 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $22,733 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 Doon, it is estimated that trees remove 986 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 $2,784 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Doon, trees sequester about 195,306 lbs. of carbon a year with an associated value of $1,465 (Appendix A, Table 5). In addition, the trees store 3,080,694 lbs of carbon, with a yearly benefit of $23,105 (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. Doon receives $18,376 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, Doon's trees provide $61,216 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 300 trees in Doon provide approximately $204 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Doon has over 25 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera (not tree species) is as follows:

Maple	135	45%
Ash	81	27%
Hackberry	23	8%
Linden	13	4%
Apple	9	3%
Cottonwood	7	2%
Oak	6	2%
Spruce	6	2%
Cherry Plum	5	<2%
Elm	4	<2%
Walnut	3	1%
Locust	3	1%
Mountain ash	2	<1%
Birch	1	<1%
Buckthorn (noxious bush)	1	<1%

Age Class

Most of Doon's trees (61%) are between 6 and 24 inches in diameter at 4.5 ft (Appendix A, Figure 2). With regard to age/size, it is preferred that the highest number of trees have smaller trunk diameters, so younger and smaller trees will replace natural mortality and to maintain canopy cover. Doon's size curve is average to above average indicating that Doon does not have enough young trees to replace those reaching over-maturity and dying out.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition of 92% of the trees is good to fair with only 8% of the foliage in poor health, dead or dying (Appendix A, Figure 3). Similarly, the wood condition of 92% of the trees is good to fair with only 8% in poor health, dead or dying. The 8% is an estimate of the number of trees that need management follow up.

Management Needs

The following outlines the specific management needs of the street and park trees by number of trees and percent of canopy (Appendix B, Figure 3).

No Work	233	78%
Tree Staking	5	<2%
Crown Cleaning	46	15%
Crown Raising	1	<1%
Crown Reduction	9	3%
Tree Removal	6	2%

Canopy Cover

The canopy cover of Doon is approximately 8.74 acres (Appendix B, Figure 5). According to the 2010 census, Doon occupies 367 acres. Thus the canopy cover is about 9%.

Land Use and Location

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

Land Use	
Single family residential	72%
Park/vacant/other	23%
Industrial/Large commercial	4%
Small commercial	0%
Multifamily residential	<2%

Location	
Planting strip	97%
Other maintained locations	0%
Cutout (surrounded by pavement)	0%
Front yard	3%

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 24 inches should be removed. Forked trees with open splits exposing interior wood 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

Doon has 1 'critical concern' tree that needs immediate appraisal for maintenance or removal. This single tree is shown on Figure 4, of Appendix B along with young and mature trees needing immediate maintenance. Doon has 6 trees needing 'removal' regardless of the tree species. They are shown on Figure 5, Appendix B as red circles with black X's in them. Also shown on Figure 5, trees needing staking, cleaning, raising the crown, and reducing the crown as different shaped and colored symbols.

Poor tree species

After the removal of the 'removal' trees and appraising the 'critical concern' tree, Doon has 13 ash trees whose wood condition is considered poor, dead or dying. The thirteen trees are broken as 10 in poor condition, and 3 are dead or dying. However, there is a total 25 trees in Doon rated as poor, dead, or dying.

Doon has 13 ash trees whose foliage condition is rated as poor, dead, or dying. This breaks down into 7 ash trees with poor foliage and 6 with dead or dying foliage. Once again, there is a total of 25 trees in Doon with foliage of these categories. All of the trees with poor, dead, or dying foliage or wood are shown on Figure 3, Appendix B in color. Of the 81 ash trees, 26 ash trees have three or more signs and symptoms that have been associated with EAB. *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 trees be pruned on a routine schedule every five to seven years.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. 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 Doon.

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 (45%) and ash (27%) (Appendix A, Figure 1). Maples and ash 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, Box elder, Chinese elm, evergreen, willow or Black walnut, as outlined in section 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in your adopted city ordinance.

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.

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized first with 'removal' trees shown on Figure 5, Appendix B with the red circles and black X's within them. Then move on to those trees needing 'immediate care' shown on Figures 4 in Appendix b. This work is followed by appraising and dealing with poor, dead and dying (Appendix B, Figure 3). *City ownership of the tree recommended for removal should be verified prior to any removal*

Treatment of Ash Trees

Chemical treatment can be effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. Doon has the added benefits of not finding any infestations of EAB. Chemical 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 forests 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.

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 since Doon is not affected by EAB. At this time, the entire State of Iowa is under quarantine for EAB, and the moving of all types of firewood, nursery stock, and ash logs.

Canopy Replacement

As budget permits, all removed trees will be replaced. An updated, sample city tree code can be found in Appendix C covering public and private tree, past and present insect and disease problems, and sampling of trees for insect and disease problems. The new plantings will be a diverse mixture and should not include ash, maple, cottonwood, poplar, Box elder, Chinese elm, evergreens, willow or Black walnut.

Postponed Work

While finances, staffing and equipment may be focused on the management of ash, usual services may be delayed. Tree removal requests on genera other than ash can 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 upon arrival of EAB. City Code 151.06 states “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 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."

Budget

Past and current budget information was not available at the time of the street survey. Each year, the number of trees and the cost of removal or trimming will vary. Costs become extremely high during and after severe winter storms, spring ice storms as we had in 2013, and after tornadoes. The following annual expenditures for tree removal are based on a cost of $550 per tree, average.

Current Budget

FY 2016 Budget

Removal: $3,000
Planting: $400
Watering & Maintenance: $300

FY 2017 Budget

Removal: $3,000
Planting: $300
Routine trimming: $500 to trim ash crowns and park trees.
Watering & Maintenance: $300

FY 2018 Budget

Removal and/or maintenance: $3,000
Planting: $400
Watering & Maintenance: $400

FY 2019 Budget

Removal: $3,000
Planting: $600
Routine trimming: $600 for anticipated storms.
Watering & Maintenance: $400

FY 2020 Budget

Removal and/or maintenance: $4,000
Planting: $600
Watering & Maintenance: $500

FY 2021 Budget

Removal and/or maintenance: $3,000
Planting: $500
Routine trimming: $1,000 for unexpected storm damage.
Watering & Maintenance: $500

Purposed Budget Increase

EAB could potentially kill all ash trees in Doon within 4 years of its arrival. To remove all 81 public ash trees within 6 years the annual budget would need to be increased by $7,500 a year. If the budget were increased to $10,000 a year all ash could be removed within 4 to 5 years. It

is recommended that Doon 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.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Doon

Annual Energy Benefits of Public Trees

1/16/2015

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	28.7	2,176	3,756.6	3,681	5,857	(N/A)	29.7	36.9	65.81
Green ash	20.7	1,573	2,737.6	2,683	4,256	(N/A)	26.7	26.8	53.19
Norway maple	6.7	510	907.8	890	1,400	(N/A)	10.7	8.8	43.74
Northern hackberry	7.8	593	1,082.4	1,061	1,653	(N/A)	7.7	10.4	71.88
Sugar maple	2.3	172	314.8	309	481	(N/A)	4.0	3.0	40.06
Apple	0.6	44	93.9	92	136	(N/A)	3.0	0.9	15.14
Littleleaf linden	1.2	92	175.6	172	264	(N/A)	2.3	1.7	37.73
American basswood	1.5	112	217.0	213	325	(N/A)	2.0	2.0	54.11
Cottonwood	2.1	162	288.9	283	446	(N/A)	2.0	2.8	74.26
Cherry plum	0.5	35	66.6	65	101	(N/A)	1.7	0.6	20.15
Spruce	0.5	39	58.5	57	97	(N/A)	1.3	0.6	24.14
American elm	0.9	71	123.7	121	193	(N/A)	1.3	1.2	48.14
Amur maple	0.4	34	62.2	61	94	(N/A)	1.0	0.6	31.49
Black walnut	0.6	43	67.7	66	109	(N/A)	1.0	0.7	36.36
Northern red oak	0.4	29	51.7	51	80	(N/A)	1.0	0.5	26.65
Honeylocust	0.7	52	87.0	85	137	(N/A)	1.0	0.9	45.83
Mountain ash	0.0	3	7.6	7	11	(N/A)	0.7	0.1	5.40
Swamp white oak	0.2	16	33.7	33	49	(N/A)	0.7	0.3	24.47
Quaking aspen	0.2	18	27.0	26	44	(N/A)	0.3	0.3	44.23
White ash	0.1	7	13.3	13	20	(N/A)	0.3	0.1	20.10
Bur oak	0.2	18	27.0	26	44	(N/A)	0.3	0.3	44.23
Blue spruce	0.1	10	15.2	15	25	(N/A)	0.3	0.2	24.51
Birch	0.0	0	0.8	1	1	(N/A)	0.3	0.0	1.10
Buckthorn	0.0	2	3.8	4	5	(N/A)	0.3	0.0	5.40
Conifer Evergreen Large	0.1	11	19.7	19	30	(N/A)	0.3	0.2	30.47
Total	76.7	5,822	10,240.0	10,035	15,858	(N/A)	100.0	100.0	52.86

Table 2: Annual Stormwater Benefits

Doon

Annual Stormwater Benefits of Public Trees

1/16/2015

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	392,966	10,649	(N/A)	29.7	46.8	119.66
Green ash	196,458	5,324	(N/A)	26.7	23.4	66.55
Norway maple	49,070	1,330	(N/A)	10.7	5.8	41.56
Northern hackberry	77,184	2,092	(N/A)	7.7	9.2	90.94
Sugar maple	25,333	687	(N/A)	4.0	3.0	57.21
Apple	2,073	56	(N/A)	3.0	0.2	6.24
Littleleaf linden	11,279	306	(N/A)	2.3	1.3	43.67
American basswood	17,070	463	(N/A)	2.0	2.0	77.10
Cottonwood	29,716	805	(N/A)	2.0	3.5	134.22
Cherry plum	1,674	45	(N/A)	1.7	0.2	9.07
Spruce	6,154	167	(N/A)	1.3	0.7	41.70
American elm	9,297	252	(N/A)	1.3	1.1	62.99
Amur maple	1,598	43	(N/A)	1.0	0.2	14.43
Black walnut	3,539	96	(N/A)	1.0	0.4	31.97
Northern red oak	2,251	61	(N/A)	1.0	0.3	20.33
Honeylocust	3,741	101	(N/A)	1.0	0.4	33.79
Mountain ash	137	4	(N/A)	0.7	0.0	1.86
Swamp white oak	1,172	32	(N/A)	0.7	0.1	15.88
Quaking aspen	1,466	40	(N/A)	0.3	0.2	39.72
White ash	614	17	(N/A)	0.3	0.1	16.63
Bur oak	1,466	40	(N/A)	0.3	0.2	39.72
Blue spruce	1,544	42	(N/A)	0.3	0.2	41.85
Birch	12	0	(N/A)	0.3	0.0	0.33
Buckthorn	69	2	(N/A)	0.3	0.0	1.86
Conifer Evergreen Large	2,969	80	(N/A)	0.3	0.4	80.46
Citywide total	838,851	22,733	(N/A)	100.0	100.0	75.78

Table 3: Annual Air Quality Benefits

Doon

Annual Air Quality Benefits of Public Trees

1/16/2015

Species	Deposition (lb) O_3	NO_2	PM_{10}	SO_2	Total Depos. ($)	Avoided (lb) NO_2	PM_{10}	VOC	SO_2	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
Silver maple	67.0	11.4	33.1	3.0	362	135.0	19.8	18.9	129.7	845	-35.7	-134	382.0	1,073	(N/A)	29.7	12.05
Green ash	22.1	3.5	11.0	1.0	119	98.1	14.3	13.7	93.9	613	0.0	0	257.6	732	(N/A)	26.7	9.15
Norway maple	8.7	1.5	4.5	0.4	48	32.0	4.7	4.5	30.5	200	-2.2	-8	84.6	239	(N/A)	10.7	7.48
Northern hackberry	12.4	2.2	6.3	0.6	68	37.5	5.4	5.2	35.4	233	0.0	0	104.9	301	(N/A)	7.7	13.07
Sugar maple	3.3	0.6	1.7	0.1	18	10.9	1.6	1.5	10.3	68	-2.6	-10	27.3	76	(N/A)	4.0	6.31
Apple	0.4	0.1	0.2	0.0	2	2.9	0.4	0.4	2.6	18	0.0	0	7.1	20	(N/A)	3.0	2.25
Littleleaf linden	1.8	0.3	0.9	0.1	10	5.9	0.9	0.8	5.5	36	-0.9	-3	15.2	43	(N/A)	2.3	6.10
American basswood	2.4	0.4	1.2	0.1	13	7.2	1.0	1.0	6.7	44	-2.0	-8	17.9	50	(N/A)	2.0	8.28
Cottonwood	4.3	0.7	2.0	0.2	23	10.2	1.5	1.4	9.7	64	0.0	0	30.0	86	(N/A)	2.0	14.39
Cherry plum	0.5	0.1	0.2	0.0	2	2.3	0.3	0.3	2.1	14	0.0	0	5.8	16	(N/A)	1.7	3.29
Spruce	0.7	0.1	0.6	0.1	5	2.4	0.4	0.3	2.3	15	-2.2	-8	4.7	11	(N/A)	1.3	2.82
American elm	2.0	0.3	1.0	0.1	11	4.4	0.7	0.6	4.3	28	0.0	0	13.4	39	(N/A)	1.3	9.66
Amur maple	0.5	0.1	0.2	0.0	2	2.1	0.3	0.3	2.0	13	0.0	0	5.5	16	(N/A)	1.0	5.22
Black walnut	0.2	0.0	0.2	0.0	1	2.6	0.4	0.4	2.6	16	0.0	0	6.4	18	(N/A)	1.0	5.95
Northern red oak	0.3	0.1	0.2	0.0	2	1.8	0.3	0.3	1.8	11	-0.5	-2	4.2	12	(N/A)	1.0	3.86
Honeylocust	0.6	0.1	0.3	0.0	3	3.2	0.5	0.5	3.1	20	-0.3	-1	7.9	22	(N/A)	1.0	7.36
Mountain ash	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	0.0	0	0.5	1	(N/A)	0.7	0.71
Swamp white oak	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)	0.7	3.47
Quaking aspen	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7	(N/A)	0.3	7.42
White ash	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)	0.3	2.91
Bur oak	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7	(N/A)	0.3	7.42
Blue spruce	0.2	0.0	0.2	0.0	1	0.6	0.1	0.1	0.6	4	-0.6	-2	1.2	3	(N/A)	0.3	2.89
Birch	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	(N/A)	0.3	0.14
Buckthorn	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)	0.3	0.71
Conifer Evergreen Large	0.3	0.1	0.3	0.0	2	0.7	0.1	0.1	0.7	4	-1.4	-5	0.9	1	(N/A)	0.3	1.45
Citywide total	128.1	21.6	64.1	5.8	694	363.7	53.1	50.7	347.5	2,272	-48.4	-181	986.3	2,784	(N/A)	100.0	9.28

Table 4: Annual Carbon Stored

Doon

Stored CO2 Benefits of Public Trees

1/16/2015

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	1,547,219	11,604	(N/A)	29.7	50.2	130.38
Green ash	722,819	5,421	(N/A)	26.7	23.5	67.76
Norway maple	145,085	1,088	(N/A)	10.7	4.7	34.00
Northern hackberry	192,812	1,446	(N/A)	7.7	6.3	62.87
Sugar maple	96,161	721	(N/A)	4.0	3.1	60.10
Apple	7,782	58	(N/A)	3.0	0.3	6.49
Littleleaf linden	37,678	283	(N/A)	2.3	1.2	40.37
American basswood	88,074	661	(N/A)	2.0	2.9	110.09
Cottonwood	145,678	1,093	(N/A)	2.0	4.7	182.10
Cherry plum	7,174	54	(N/A)	1.7	0.2	10.76
Spruce	4,681	35	(N/A)	1.3	0.2	8.78
American elm	41,954	315	(N/A)	1.3	1.4	78.66
Amur maple	6,982	52	(N/A)	1.0	0.2	17.46
Black walnut	8,378	63	(N/A)	1.0	0.3	20.95
Northern red oak	5,644	42	(N/A)	1.0	0.2	14.11
Honeylocust	6,982	52	(N/A)	1.0	0.2	17.46
Mountain ash	356	3	(N/A)	0.7	0.0	1.33
Swamp white oak	2,201	17	(N/A)	0.7	0.1	8.26
Quaking aspen	3,672	28	(N/A)	0.3	0.1	27.54
White ash	1,035	8	(N/A)	0.3	0.0	7.76
Bur oak	3,672	28	(N/A)	0.3	0.1	27.54
Blue spruce	1,118	8	(N/A)	0.3	0.0	8.39
Birch	17	0	(N/A)	0.3	0.0	0.13
Buckthorn	178	1	(N/A)	0.3	0.0	1.33
Conifer Evergreen La	3,343	25	(N/A)	0.3	0.1	25.07
Citywide total	3,080,694	23,105	(N/A)	100.0	100.0	77.02

Table 5: Annual Carbon Sequestered

Doon

Annual CO Benefits of Public Trees

1/16/2015

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
Silver maple	116,459	873	-7,427	-312	-2	0	0	108,721	815	(N/A)	29.7	55.7	9.16
Green ash	46,444	348	-3,470	-204	-2	0	0	42,770	321	(N/A)	26.7	21.9	4.01
Norway maple	10,812	81	-697	-62	0	0	0	10,052	75	(N/A)	10.7	5.1	2.36
Northern hackberry	9,640	72	-926	-73	-1	0	0	8,641	65	(N/A)	7.7	4.4	2.82
Sugar maple	5,182	39	-463	-26	0	0	0	4,693	35	(N/A)	4.0	2.4	2.93
Apple	892	7	-37	-9	0	0	0	846	6	(N/A)	3.0	0.4	0.71
Littleleaf linden	3,954	30	-181	-15	0	0	0	3,758	28	(N/A)	2.3	1.9	4.03
American basswood	5,067	38	-423	-18	0	0	0	4,626	35	(N/A)	2.0	2.4	5.78
Cottonwood	4,698	35	-699	-23	0	0	0	3,976	30	(N/A)	2.0	2.0	4.97
Cherry plum	696	5	-34	-6	0	0	0	655	5	(N/A)	1.7	0.3	0.98
Spruce	462	3	-22	-8	0	0	0	432	3	(N/A)	1.3	0.2	0.81
American elm	1,198	9	-203	-10	0	0	0	986	7	(N/A)	1.3	0.5	1.85
Amur maple	649	5	-34	-5	0	0	0	611	5	(N/A)	1.0	0.3	1.53
Black walnut	1,099	8	-40	-5	0	0	0	1,054	8	(N/A)	1.0	0.5	2.64
Northern red oak	576	4	-27	-4	0	0	0	545	4	(N/A)	1.0	0.3	1.36
Honeylocust	1,150	9	-34	-5	0	0	0	1,111	8	(N/A)	1.0	0.6	2.78
Mountain ash	76	1	-2	-1	0	0	0	73	1	(N/A)	0.7	0.0	0.27
Swamp white oak	448	3	-11	-2	0	0	0	435	3	(N/A)	0.7	0.2	1.63
Quaking aspen	445	3	-18	-2	0	0	0	426	3	(N/A)	0.3	0.2	3.19
White ash	182	1	-5	-1	0	0	0	176	1	(N/A)	0.3	0.1	1.32
Bur oak	445	3	-18	-2	0	0	0	426	3	(N/A)	0.3	0.2	3.19
Blue spruce	91	1	-5	-2	0	0	0	83	1	(N/A)	0.3	0.0	0.63
Birch	5	0	0	0	0	0	0	5	0	(N/A)	0.3	0.0	0.04
Buckthorn	38	0	-1	-1	0	0	0	37	0	(N/A)	0.3	0.0	0.27
Conifer Evergreen Large	187	1	-16	-3	0	0	0	169	1	(N/A)	0.3	0.1	1.26
Citywide total	210,897	1,582	-14,792	-799	-6	0	0	195,306	1,465	(N/A)	100.0	100.0	4.88

Table 6: Annual Social and Aesthetic Benefits

Doon

Annual Aesthetic/Other Benefits of Public Trees

1/16/2015

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	9,124	(N/A)	29.7	49.6	102.51
Green ash	4,127	(N/A)	26.7	22.5	51.59
Norway maple	1,090	(N/A)	10.7	5.9	34.05
Northern hackberry	1,285	(N/A)	7.7	7.0	55.85
Sugar maple	542	(N/A)	4.0	2.9	45.15
Apple	50	(N/A)	3.0	0.3	5.51
Littleleaf linden	423	(N/A)	2.3	2.3	60.39
American basswood	357	(N/A)	2.0	1.9	59.50
Cottonwood	344	(N/A)	2.0	1.9	57.36
Cherry plum	39	(N/A)	1.7	0.2	7.89
Spruce	129	(N/A)	1.3	0.7	32.32
American elm	157	(N/A)	1.3	0.9	39.35
Amur maple	37	(N/A)	1.0	0.2	12.46
Black walnut	120	(N/A)	1.0	0.7	40.09
Northern red oak	57	(N/A)	1.0	0.3	18.86
Honeylocust	237	(N/A)	1.0	1.3	78.97
Mountain ash	4	(N/A)	0.7	0.0	2.06
Swamp white oak	52	(N/A)	0.7	0.3	26.22
Quaking aspen	46	(N/A)	0.3	0.2	45.86
White ash	33	(N/A)	0.3	0.2	33.42
Bur oak	46	(N/A)	0.3	0.2	45.86
Blue spruce	25	(N/A)	0.3	0.1	25.23
Birch	3	(N/A)	0.3	0.0	2.74
Buckthorn	2	(N/A)	0.3	0.0	2.06
Conifer Evergreen Large	47	(N/A)	0.3	0.3	47.08
Citywide total	18,376	(N/A)	100.0	100.0	61.25

Table 7: Summary of Benefits in Dollars

Doon

Total Annual Benefits of Public Trees by Species ($)

1/16/2015

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	5,857	815	1,073	10,649	9,124	27,519	(N/A)	45.0
Green ash	4,256	321	732	5,324	4,127	14,759	(N/A)	24.1
Norway maple	1,400	75	239	1,330	1,090	4,134	(N/A)	6.8
Northern hackberry	1,653	65	301	2,092	1,285	5,395	(N/A)	8.8
Sugar maple	481	35	76	687	542	1,820	(N/A)	3.0
Apple	136	6	20	56	50	269	(N/A)	0.4
Littleleaf linden	264	28	43	306	423	1,063	(N/A)	1.7
American basswood	325	35	50	463	357	1,229	(N/A)	2.0
Cottonwood	446	30	86	805	344	1,711	(N/A)	2.8
Cherry plum	101	5	16	45	39	207	(N/A)	0.3
Spruce	97	3	11	167	129	407	(N/A)	0.7
American elm	193	7	39	252	157	648	(N/A)	1.1
Amur maple	94	5	16	43	37	195	(N/A)	0.3
Black walnut	109	8	18	96	120	351	(N/A)	0.6
Northern red oak	80	4	12	61	57	213	(N/A)	0.3
Honeylocust	137	8	22	101	237	506	(N/A)	0.8
Mountain ash	11	1	1	4	4	21	(N/A)	0.0
Swamp white oak	49	3	7	32	52	143	(N/A)	0.2
Quaking aspen	44	3	7	40	46	140	(N/A)	0.2
White ash	20	1	3	17	33	74	(N/A)	0.1
Bur oak	44	3	7	40	46	140	(N/A)	0.2
Blue spruce	25	1	3	42	25	95	(N/A)	0.2
Birch	1	0	0	0	3	4	(N/A)	0.0
Buckthorn	5	0	1	2	2	10	(N/A)	0.0
Conifer Evergreen Large	30	1	1	80	47	161	(N/A)	0.3
Citywide Total	15,858	1,465	2,784	22,733	18,376	61,216	(N/A)	100.0

Table 8. Priority Task Summary for Public Trees

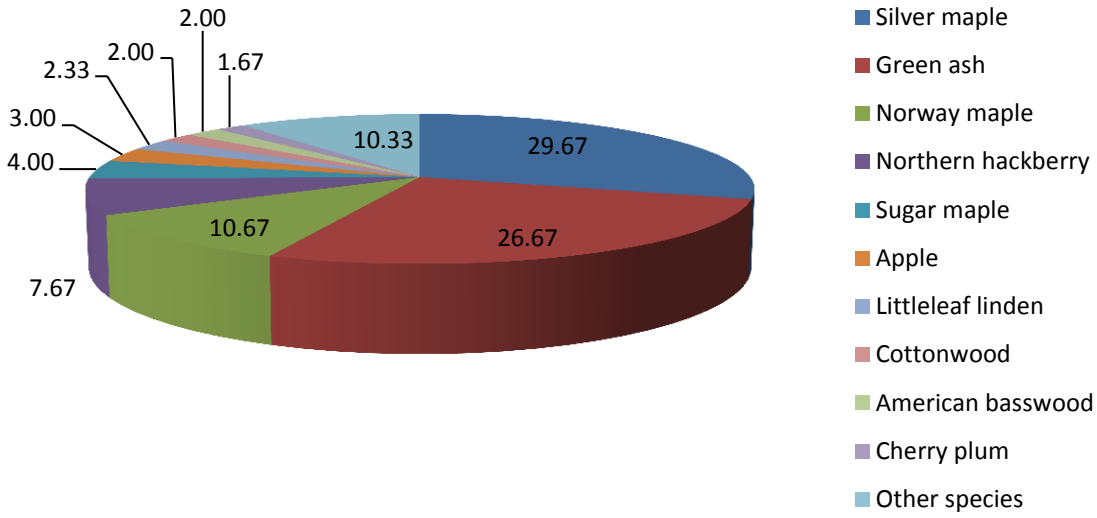
Doon											
	Priority Task Summary for Public Trees										
	DBH Class (DBH-tree diameter of chest/breast height)										
Maintenance	0 to 3	3 to 6	6 to 12	12 to 18	18 to24	24 to 30	30 to 36	36 to 42	>42	Total	% of Total
Type	inches	inches	inches	inches	inches	inches	inches	inches	inches	number	Population
No work	4	9	38	72	41	31	19	11	8	233	77.67
Stake or Train	1	0	1	0	1	1	0	1	0	5	1.67
Clean Crown	1	1	1	16	7	9	5	3	3	46	15.33
Raise Crown	0	0	0	0	0	1	0	0	0	1	0.33
Reduce Crown	0	0	0	1	2	1	4	1	0	9	3
Remove Tree	0	2	0	1	1	0	0	2	0	6	2
Treat Pest/	0	0	0	0	0	0	0	0	0	0	0
Disease											
City wide Total	6	12	40	90	52	43	28	18	11	300	100

Table 9. Recommended Maintenance for Public Trees

Doon											
	Recommended Maintenance for Public Trees										
	DBH Cla (DBH-tree diameter at chest/breast height)										
Maintenance	0 to 3	3 to 6	6 to 12	12 to 18	18 to 24	24 to 30	30 to 36	36 to 42	>42	Total	% of Total
Type	inches	inches	inches	inches	inches	inches	inches	inches	inches	number	Population
No work	0	0	0	0	0	0	0	0	0	0	0
Young Tree	1	9	30	21	0	0	0	0	0	61	20.33
(routine)											
Young Tree	2	1	1	2	1	0	0	0	0	7	2.33
(immediate)											
Mature Tree	3	1	9	60	45	40	22	14	11	205	68.33
(routine)											
Mature Tree	0	1	0	7	6	3	6	3	0	26	8.67
(immediate)											
Critical Concern	0	0	0	0	0	0	0	1	0	1	0.33
(Public safety)											
City wide Total	6	12	40	90	52	43	28	18	11	300	100

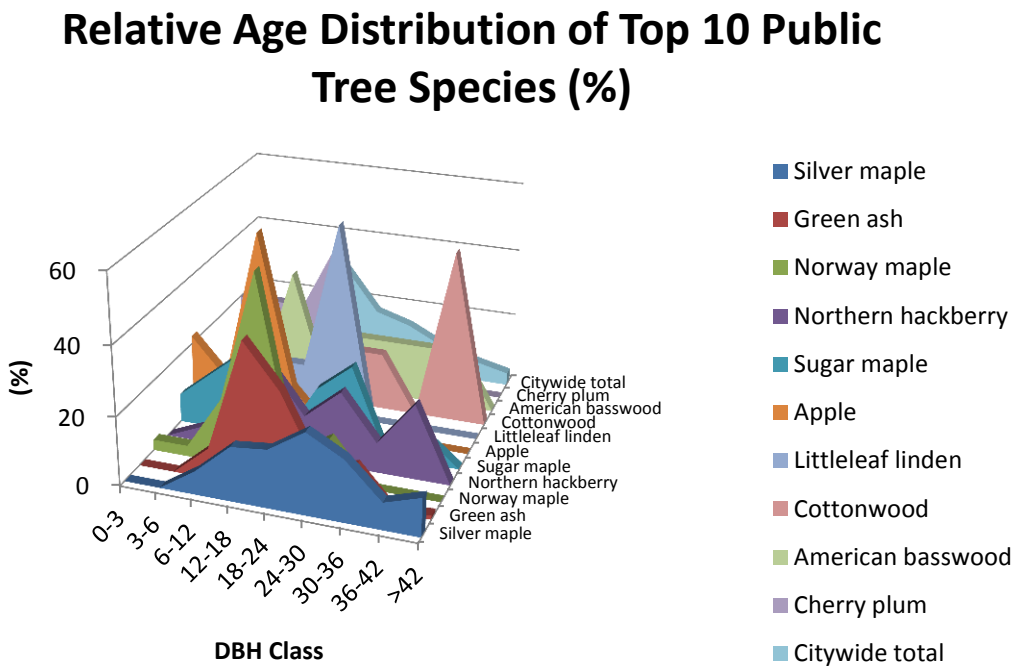
Appendix A, Figures

Figure 1: Species Distribution



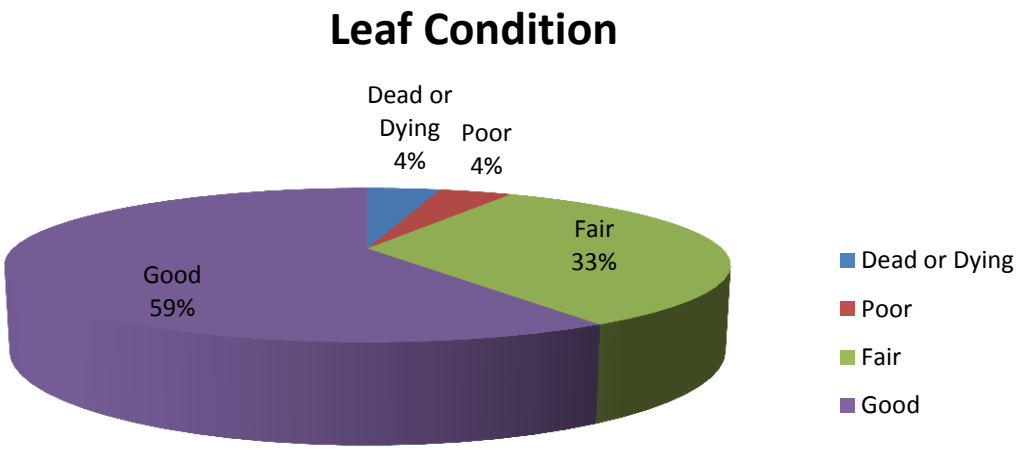
Doon		
Species Distribution of Public Trees (%)		
1/16/2015		
Species	Percent	
Silver maple	29.67	
Green ash	26.67	
Norway maple	10.67	
Northern hackberry	7.67	
Sugar maple	4.00	
Apple	3.00	
Littleleaf linden	2.33	
Cottonwood	2.00	
American basswood	2.00	
Cherry plum	1.67	
Other species	10.33	
Total	100.00	

Figure 2: Relative Age Class



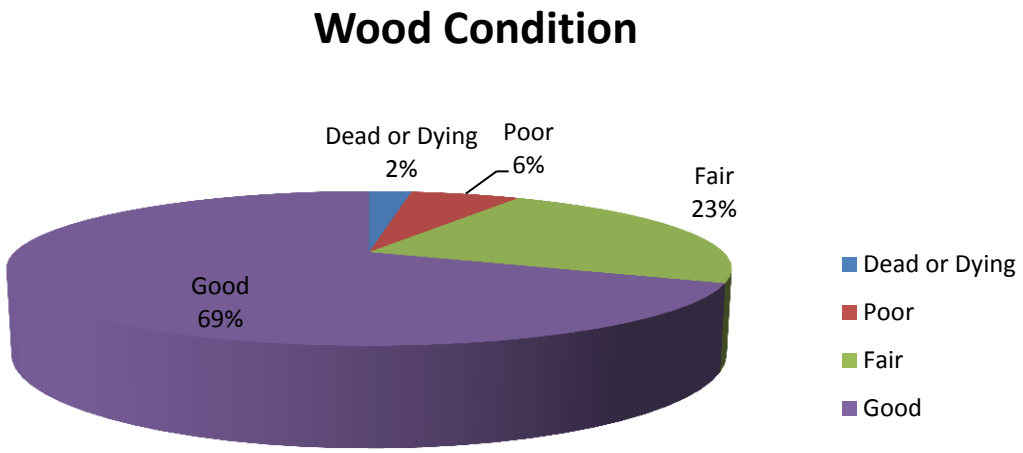
Doon									
Relative Age Distribution of Top 10 Public Tree Species (%)									
1/16/2015									
	DBH class (in)								
Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42
Silver maple	0.00	0.00	6.74	15.73	16.85	23.60	17.98	7.87	11.24
Green ash	0.00	0.00	8.75	41.25	28.75	8.75	11.25	0.00	1.25
Norway maple	3.13	3.13	18.75	56.25	6.25	12.50	0.00	0.00	0.00
Northern hackberry	0.00	4.35	4.35	26.09	13.04	21.74	8.70	21.74	0.00
Sugar maple	8.33	16.67	25.00	0.00	16.67	25.00	0.00	8.33	0.00
Apple	22.22	11.11	55.56	11.11	0.00	0.00	0.00	0.00	0.00
Littleleaf linden	0.00	14.29	14.29	14.29	57.14	0.00	0.00	0.00	0.00
Cottonwood	0.00	0.00	0.00	16.67	16.67	16.67	0.00	50.00	0.00
American basswood	0.00	0.00	33.33	0.00	16.67	16.67	16.67	16.67	0.00
Cherry plum	20.00	20.00	20.00	40.00	0.00	0.00	0.00	0.00	0.00
Citywide total	2.00	4.00	13.33	30.00	17.33	14.33	9.33	6.00	3.67

Figure 3: Foliage Condition



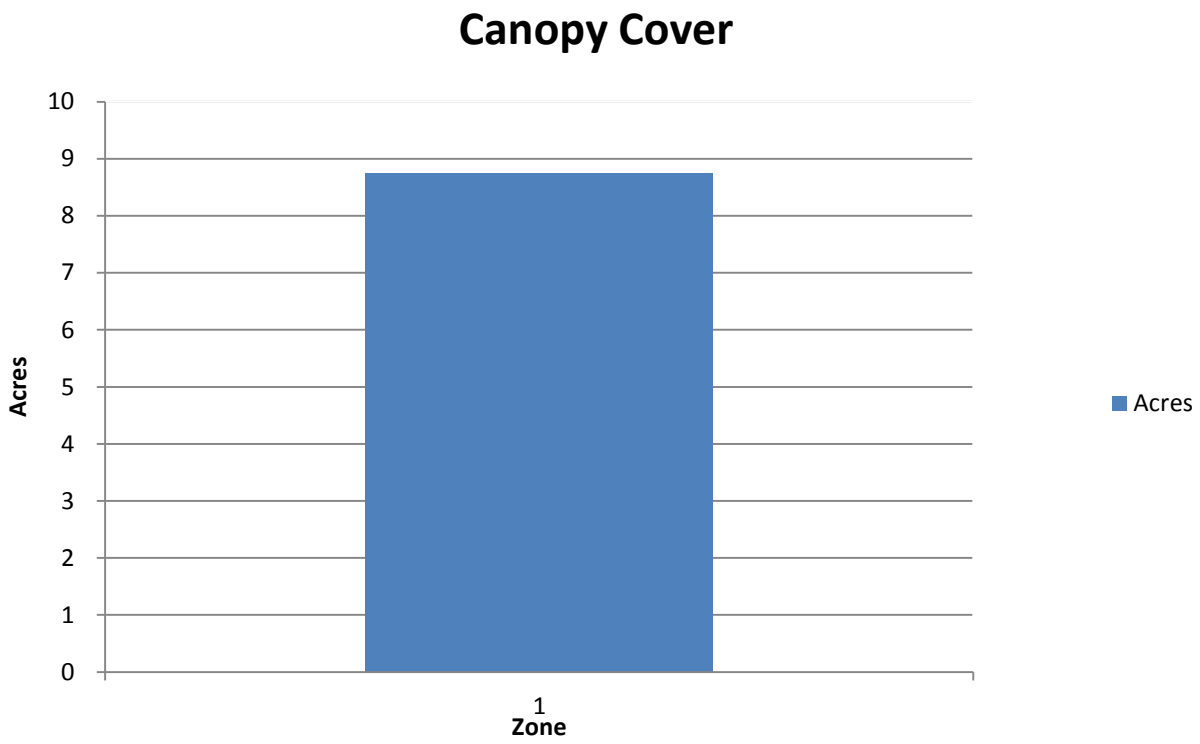
Doon				
Condition (Foliage) of Public Trees by Species (%)				
1/16/2015				
Species Name	Dead or Dying	Poor	Fair	Good
Silver maple	0.00	0.00	29.21	70.79
Green ash	7.50	8.75	45.00	38.75
Norway maple	3.13	0.00	12.50	84.38
Northern hackberry	0.00	13.04	43.48	43.48
Sugar maple	0.00	0.00	25.00	75.00
Apple	0.00	0.00	0.00	100.00
Littleleaf linden	0.00	0.00	28.57	71.43
Cottonwood	33.33	0.00	50.00	16.67
American basswood	0.00	0.00	0.00	100.00
Cherry plum	0.00	20.00	20.00	60.00
Spruce	0.00	0.00	100.00	0.00
American elm	0.00	0.00	50.00	50.00
Amur maple	33.33	0.00	66.67	0.00
Honeylocust	0.00	0.00	66.67	33.33
Black walnut	33.33	33.33	0.00	33.33
Northern red oak	0.00	0.00	0.00	100.00
Citywide total	4.00	4.00	33.00	59.00

Figure 4: Wood Condition



Condition (Woody) of Public Trees by Species (%)				
1/16/2015				
Species Name	Dead or Dying	Poor	Fair	Good
Silver maple	0.00	1.12	20.22	78.65
Green ash	3.75	12.50	32.50	51.25
Norway maple	0.00	6.25	18.75	75.00
Northern hackberry	0.00	4.35	17.39	78.26
Sugar maple	0.00	0.00	41.67	58.33
Apple	0.00	0.00	0.00	100.00
Littleleaf linden	0.00	0.00	28.57	71.43
Cottonwood	33.33	0.00	33.33	33.33
American basswood	0.00	0.00	0.00	100.00
Cherry plum	0.00	20.00	20.00	60.00
Spruce	0.00	0.00	0.00	100.00
American elm	0.00	0.00	0.00	100.00
Amur maple	33.33	0.00	66.67	0.00
Honeylocust	0.00	0.00	66.67	33.33
Black walnut	0.00	66.67	0.00	33.33
Northern red oak	0.00	0.00	0.00	100.00
Citywide total	2.33	6.00	23.00	68.67

Figure 5: Canopy Cover in Acres

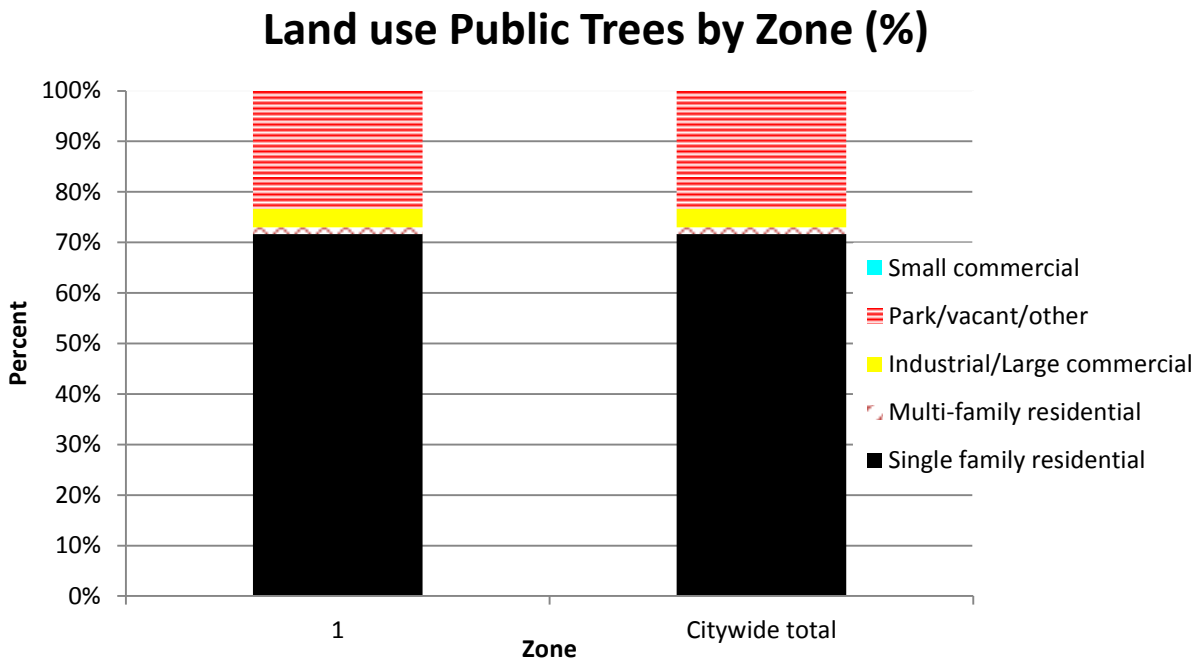


Canopy Cover of Public Trees (Acres)

1/16/2015

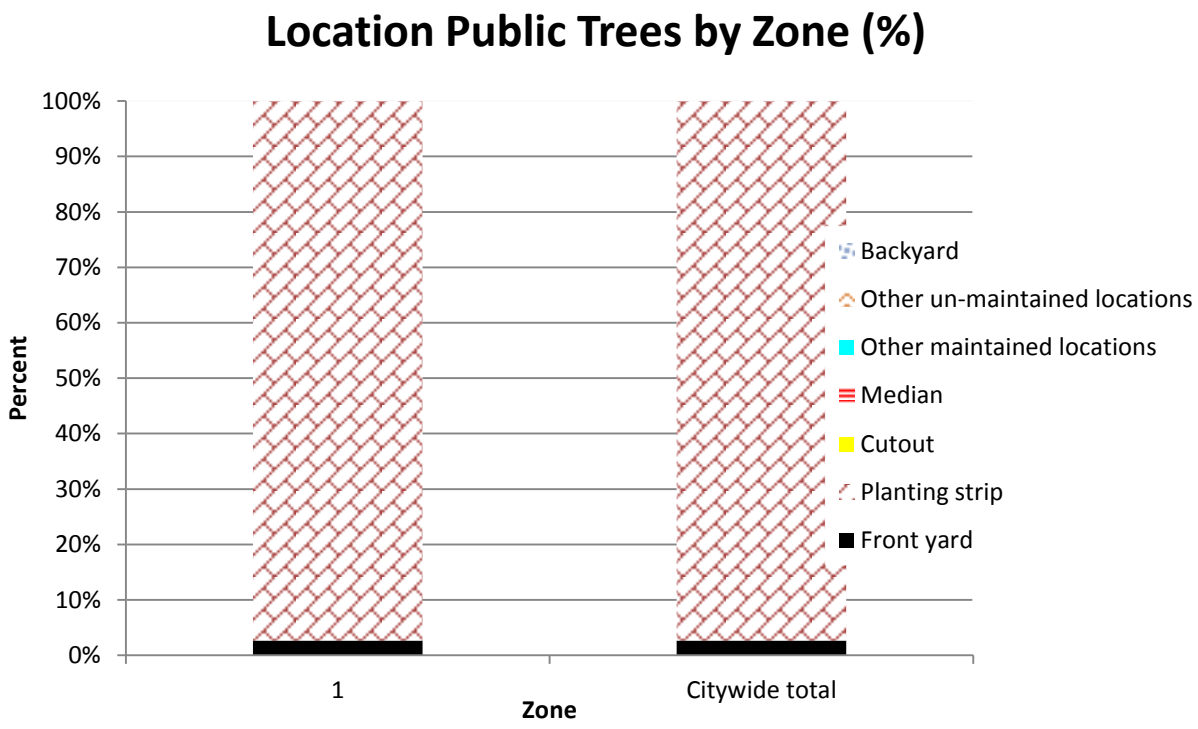
	Total Land Area	Total Canopy Cover	Canopy Cover as % of Total Land Area
Citywide total	367.00	8.74	2.30

Figure 6: Land Use of city/park trees



Land use Public Trees by Zone (%)					
1/16/2015					
Zone	Single family residential	Multi-family residential	Industrial/Large commercial	Park/vacant/other	Small commercial
1	71.67	1.33	3.67	23.33	0.00
Citywide total	71.67	1.33	3.67	23.33	0.00

Figure 7: Location of city/park trees



Location Public Trees by Zone (%)							
1/16/2015							
Zone	Front yard	Planting strip	Cutout	Median	Other maintained locations	Other un-maintained locations	Backyard
1	2.67	97.33	0.00	0.00	0.00	0.00	0.00
Citywide total	2.67	97.33	0.00	0.00	0.00	0.00	0.00

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

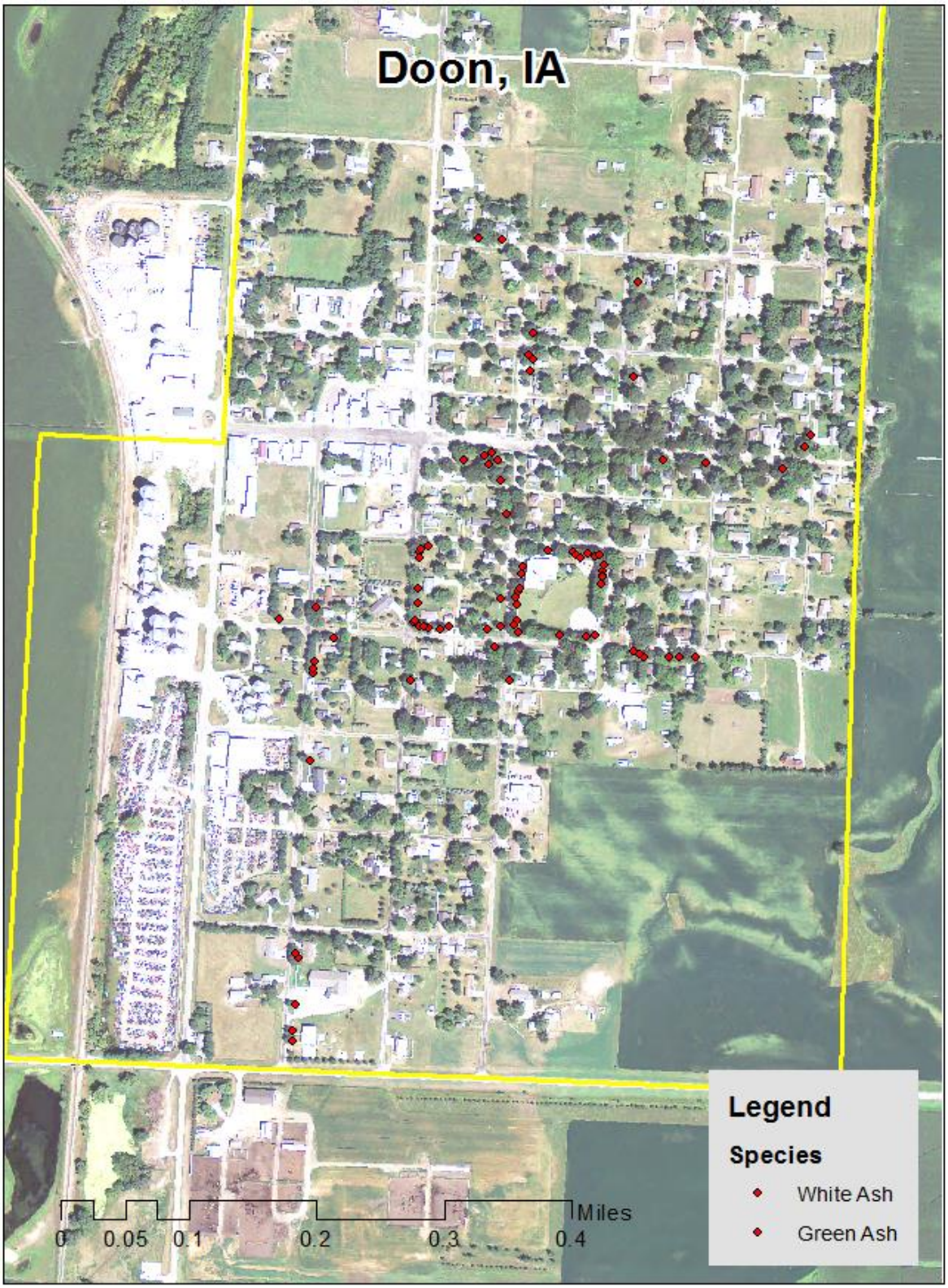


Figure 2: Location of EAB symptoms

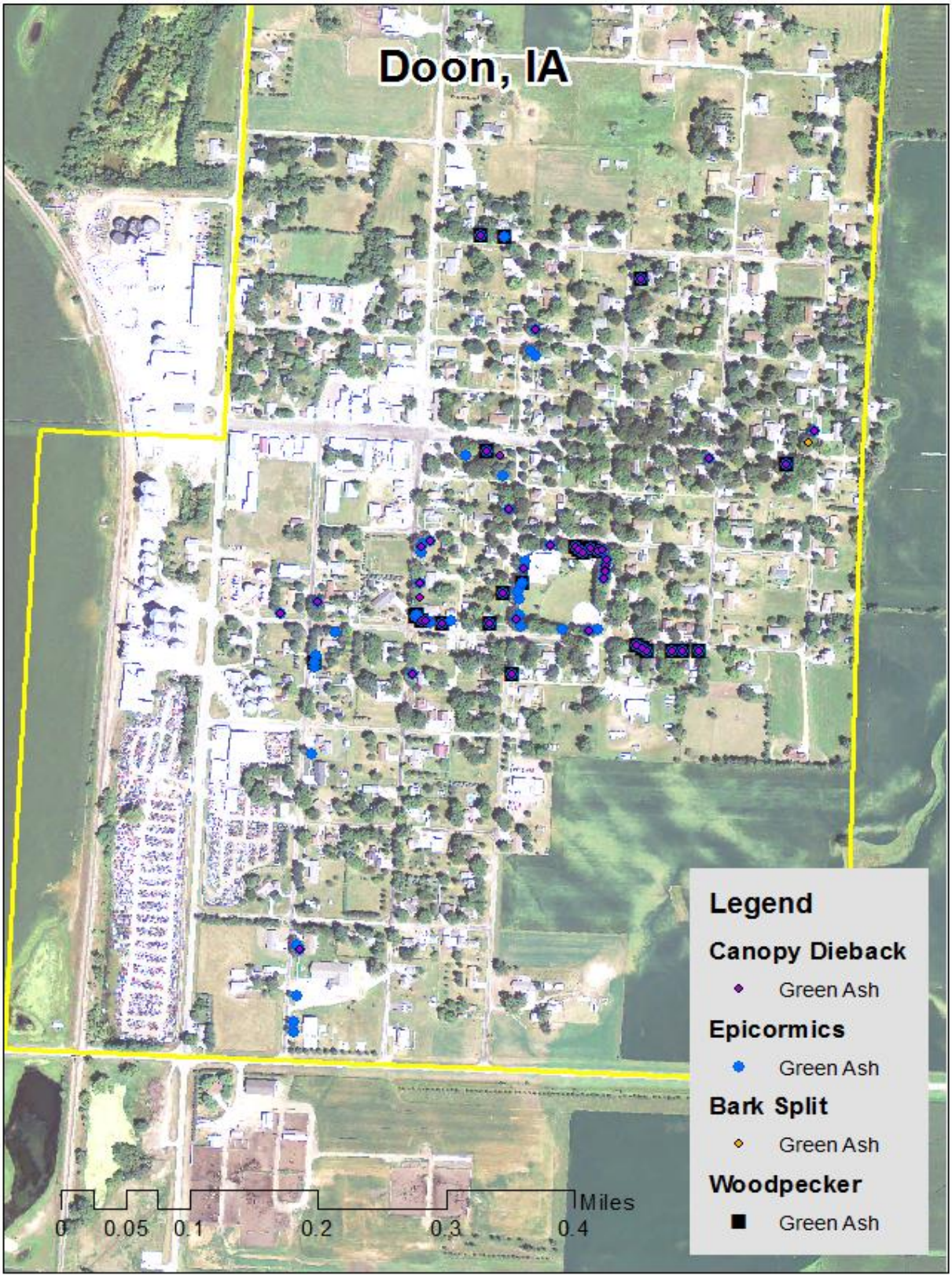


Figure 3: Location of Poor Condition Trees

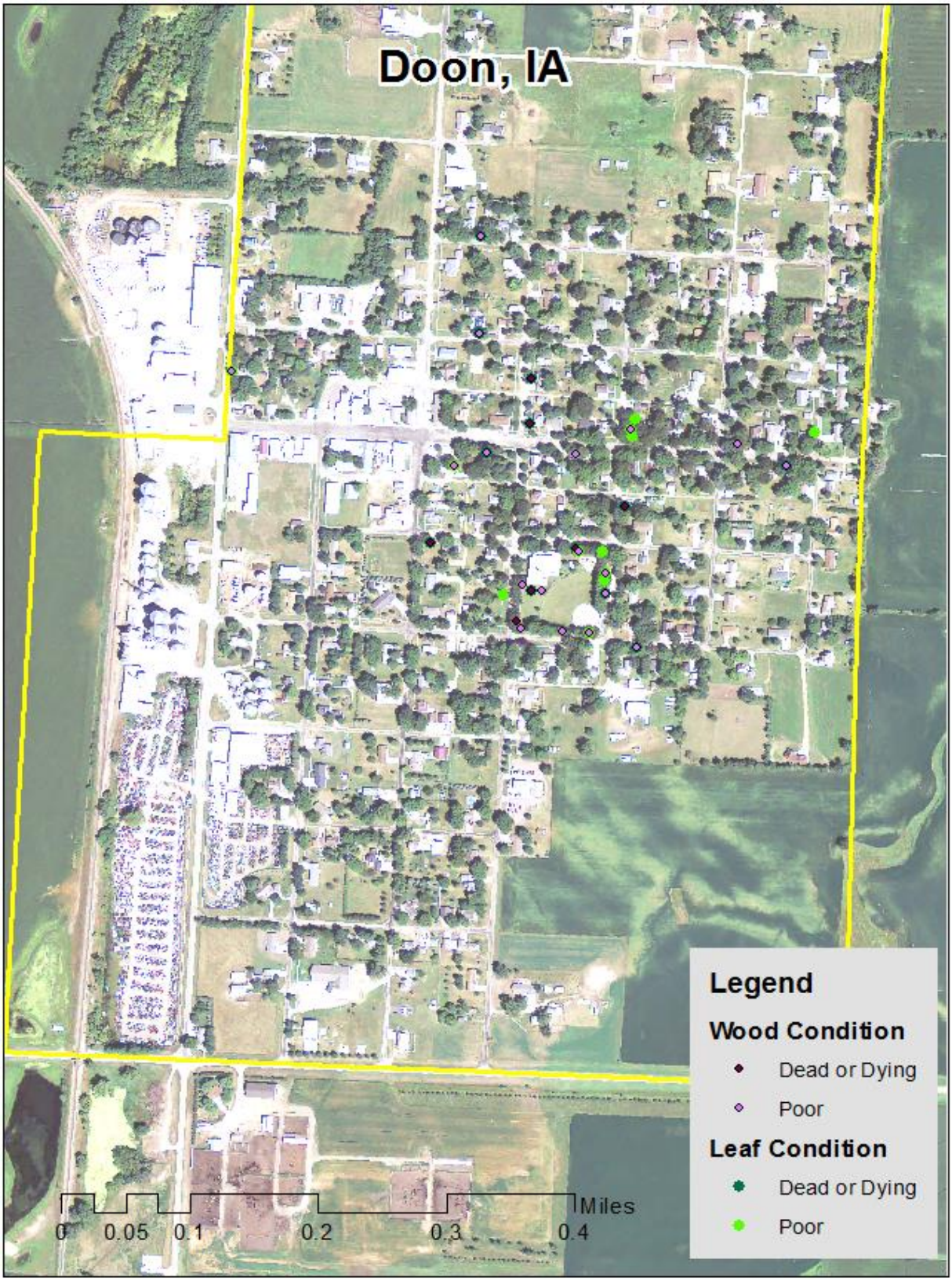


Figure 4: Location of Trees with Recommended Maintenance

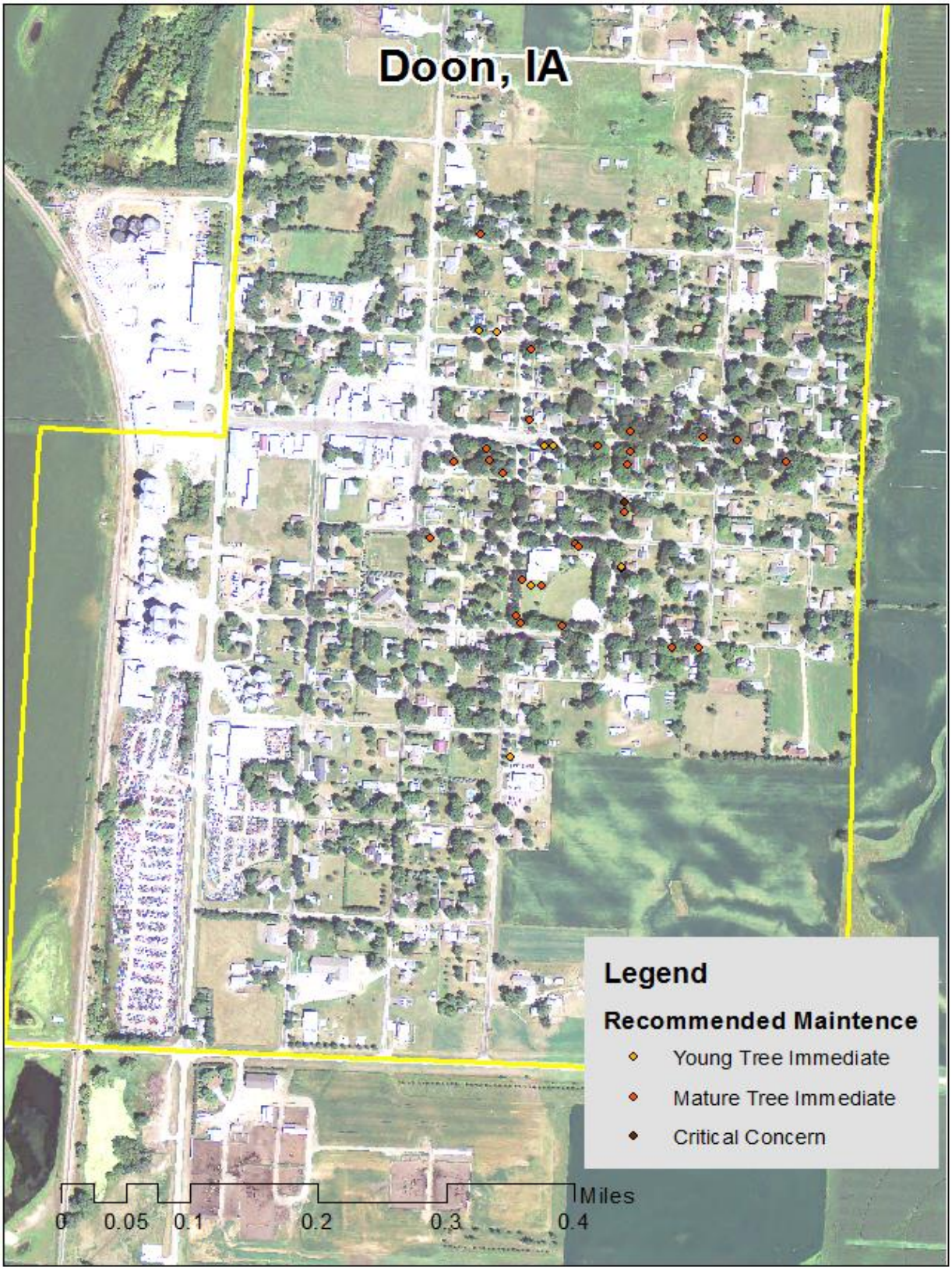
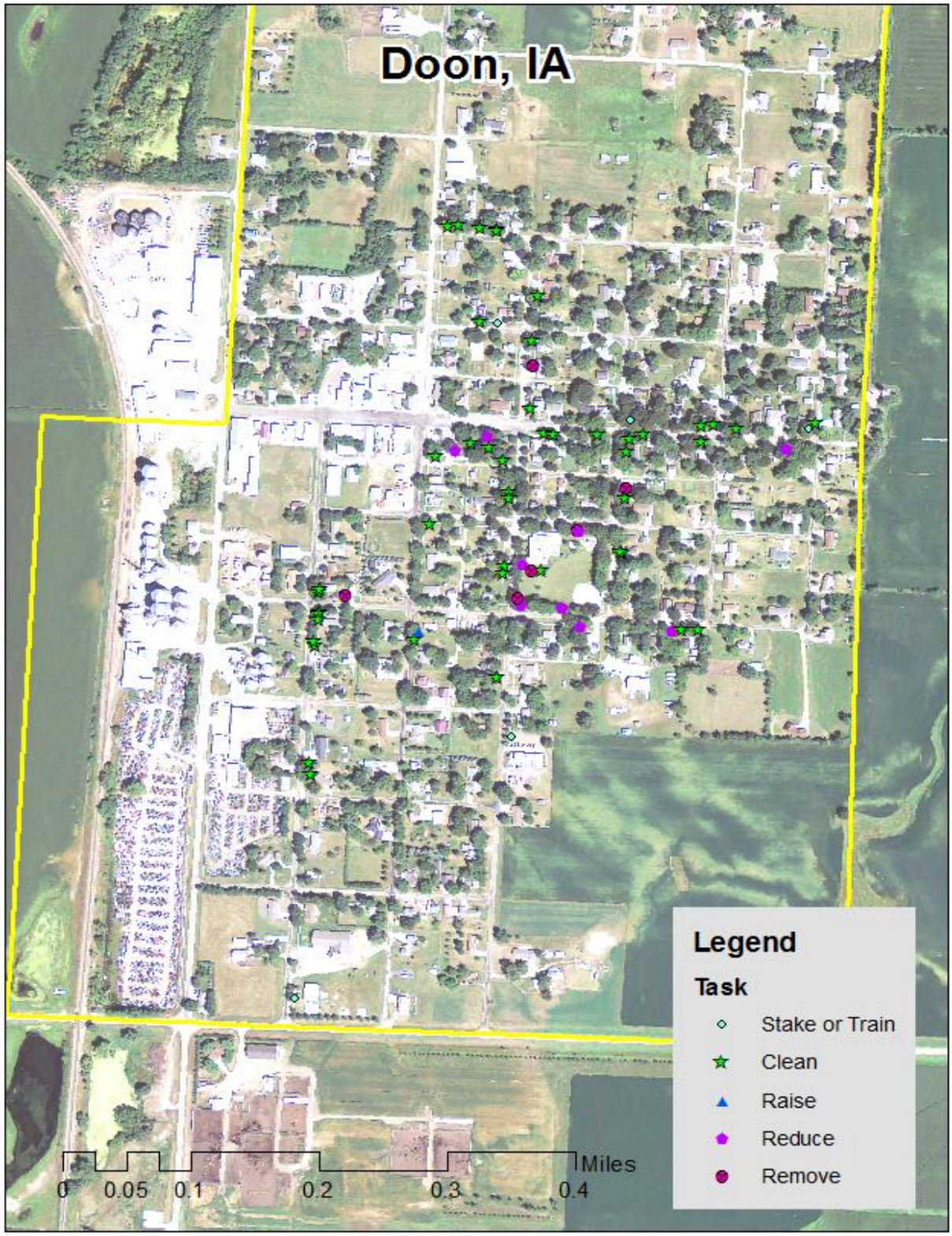


Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*



Appendix C: Doon Tree Ordinances

CHAPTER 151
TREES AND GRASS

151.01 DEFINITION. For use in this chapter, "boulevard" 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 boulevard or street except in accordance with the following:
1. Alignment. All tress planted in any street shall be planted in the boulevard midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any boulevard which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
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, evergreen, willow or black walnut.

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 eighteen (18) feet above the surface of a street, twenty (20) feet above the surface of a primary highway, 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 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. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that 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 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])

151.07 CUTTING OR MOWING OF GRASS.
1. Duty to Cut and Mow Lawns and Lots. The owner of any property shall cut and mow all lawns and lots so that such growth shall be less than four (4) inches at all times.
2. Cutting and Mowing by City. If a property owner refuses or fails to cut and mow lawns and lots within forty-eight (48) hours after being delivered a notice from the City to perform such action, the Council may require said work to be done and the cost and expenses thereof shall be assessed to the property owner after due notice is given. The amount of such assessment shall be certified to the County Auditor as provided by law and the same shall be collected with and in the same manner as general property taxes.

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 515-725-8282.