Pleasant Hill, IA

2016 Urban Forest Management Plan
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Executive Summary

Overview

This plan was developed to indicate how Pleasant Hill Parks and Recreation will manage its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows communities to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that all of the city-owned trees (ash) will die once EAB becomes established in the community.

EAB is only one of several other emerging threats to Iowa's forest communities. In a 2012 Iowa Forest Health Report the DNR identified five key pests that have emerged and a severe threat to Iowa's native woodlands and community trees. The key pests identified in addition to EAB are:

- Gypsy Moth - feed on leaves of over 300 species of trees during the summer growing season.
- Bur Oak Blight (BOB *Tubakia spp.*) – a newly named disease that can cause severe defoliation, leading to mortality of branches or entire trees, caused by a species of the fungus Tubakia.
- Thousand Cankers Disease of Black Walnut (TCD) – a walnut twig beetle (*Pityophthorus juglandis*) that carries a fungus (*Geosmithia morbida*) with is spread as the beetle tunnels through tree tissues. Some experts believe that TCD has the potential to decimate black walnut in the same way Dutch elm disease and emerald ash borer has destroyed their hosts.
- Asian Longhorned Beetle (ALB) – is and exotic pest native to China. The larva of this beetle kills trees by tunneling through the tree, which girdles stems and branches. The beetle prefers to attack maple species (*Acer spp.*). In some cases they will also attack birch, elm, horsechestnut, and Ohio buckeye.

Proper woodland and community tree management is the best defense against these threats. The best insurance is to maintain a diversity of tree species; while assuring an appropriate number of trees are growing on each acre. The best management tool is for communities to create diversity by not having more than 10 percent of any one species represented. This management plan provides the best defense against emerging forest health threats.

Historical Inventories and Results

Private Ash Tree Inventory Sampling:

In 2008 the Parks and Recreation Department conducted a community ash tree inventory sampling. An estimated 920 ash trees are located on private property in Pleasant Hill (excluding commercial sites). The diameter-at-breast-height (DBH) of these ash trees vary upon location in the city.

- Approximately 773 ash trees with DBH between 12 and 18 inches are primarily located south of University Avenue and west of the 65 Bypass.
- Approximately 143 ash trees (with smaller DBH) are in the newer developments of the city.
- An estimated cost for tree removal and replacement ranges from $2000 to $500, depending and size and location.

Public Ash Tree Inventory:

An ash tree inventory on public property was also conducted by city staff in 2008. The city had 48 ash trees averaging 16 inch DBH. The majority of these trees (22) were located in Sunrise Park and Oakwood

Cemetery. In preparation for an EAB infestation department has incrementally removed 3 ash trees per year since 2008 (24 total). As of 2016 there are 24 ash trees remaining on public property.

Inventory and Results

In 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 1541 trees inventoried.

- Pleasant Hill's trees provide $163,017 of benefits annually, an average of $105 a tree
- There are over 65 species of trees
- The top three genera are: apple 13%, northern hackberry 11%, and northern red oak 6%
- 21% of trees are in need of some type of management
- 76 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 76 trees needing removal, 11 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*
- 19 of the 49 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- With the current budget it could take 4 years to remove ash and trees recommended for removal – Suggestion: request a budget of $18,000 annually and apply for grants to plant replacement trees

Introduction

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

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

Inventory

In 2015, a tree inventory was conducted that included 100% of the city owned trees on both streets and 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, and 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 1541 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. Pleasant Hill's trees reduce energy related costs by approximately $49,182 annually (Appendix A, Table 1). These savings are both in Electricity (233.1 MWh) and in Natural Gas (32,134.2 Therms).

Annual Stormwater Benefits

Pleasant Hill's trees intercept about 2,132,898 gallons of rainfall or snowmelt a year (Appendix A, Table 2). This interception provides $57,802 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 Pleasant Hill, it is estimated that trees remove 2,862 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 $8,014 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Pleasant Hill, trees sequester about 396,521 lbs of carbon a year with an associated value of $2,974 (Appendix A, Table 4). In addition, the trees store 7,665,419 lbs of carbon, with a yearly benefit of $57,491 (Appendix A, Table 5).

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. Pleasant Hill receives $45,045 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, Pleasant Hill's trees provide $163,017 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 1541 trees in Pleasant Hill provide approximately $105 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Pleasant Hill has over 65 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of the top 10 tree species follows:

Species	Percent	# of Trees
Apple	12.98%	200
Northern hackberry	10.90%	168
Northern red oak	5.91%	91
Bur oak	5.84%	90
Eastern white pine	5.19%	80
Broadleaf Deciduous Small	5.06%	78
Hickory	3.11%	48
American basswood	2.92%	45
Green ash	2.86%	44
Catalpa	2.40%	37
Other species	42.83%	660

Age Class

Most of Pleasant Hill's trees (43%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Pleasant Hill's size curve is weighted in the middle, indicating a middle aged stand.

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 Pleasant Hill indicate that 71% of the trees are in good health, with only 5% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 68% of Pleasant Hill'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 3).

Crown Cleaning	135	9%
Crown Raising	103	7%
Tree Staking	8	<1%
Tree Removal	76	5%
Crown Reduction	9	<1%

Canopy Cover

The total canopy with both private and public trees is 19%, 303 acres. The canopy cover included in the Pleasant Hill inventory includes approximately 24 acres (Appendix A, Figure 4). The City's Canopy goal is 23%, in 30 years. To achieve this goal it is estimated that 158 trees need to be planted annually.

Land Use and Location

The majority of Pleasant Hill'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	12%
Park/vacant/other	79%
Industrial/Large commercial	9%

Location	
Planting strip	16%
Median	6%
Cutout (surrounded by pavement)	<1%
Front yard	77%

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

Pleasant Hill has 1 critical concern tree that needs immediate removal. This tree can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There are 18 trees over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 42 trees with these needs.

Poor tree species

After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 9 removals, 0 are ash trees. There are a total of 49 ash trees, and 19 of those have signs and symptoms that have been associated with EAB. In addition, there are 123 trees that are in poor health. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising 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. 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. 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 Pleasant Hill.

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. Industry professionals are strongly recommending that these percentages be 10% / 5% respectively. Ash trees have not been recommended since 2002, due to the threat of EAB.

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.

Maintenance Plan

The following maintenance needs to be addressed in the next two years.

Crown Cleaning	135	9%
Crown Raising	103	7%
Tree Staking	8	<1%
Tree Removal	76	5%
Crown Reduction	9	<1%

It's recommended that routine trimming be conducted every six years and due to tree mortality 1.2 trees be planted for every 1 tree removed.

Emerald Ash Borer Plan

There are almost 1000 private ash trees in Pleasant Hill that are at risk from the Emerald Ash Borer. In the near future, urban forestry professionals expect to see Central Iowa ash trees infested with EAB. Widespread declining and dying trees may not be noticed for several years. Owners of ash trees should take action and plan for either removal or treatment.

In 2014 the Iowa DNR and IDALS announced a quarantine for the entire state of Iowa. All unprocessed ash, such as hardwood firewood, wood chips, ash logs and ash trees for planting are not permitted to leave the quarantine area. For residents, if you cut down your own tree and plan to use it for firewood, do not transport it outside of the quarantine area. The DNR discourages transporting firewood across county lines, since moving firewood poses the greatest threat to quickly spreading EAB or possibly other pests even further.

In anticipation for the EAB outbreak Parks & Recreation has implemented a tree removal and replacement program for the last several years, replacing trees with a diverse species selection.

Treatment or Removal of Public Trees

Parks & Recreation Department will utilize a trunk injected insecticide to treat some of the remaining public ash trees, depending on the location and quality of the tree according to the conditions below. The remaining public trees will be removed as they become infested.

Public ash trees receive treatment if they:

- Do not have cracks or holes in their trunk and if 70 percent or more of their upper branches are healthy. If a tree is unhealthy or has cracks or holes, treatment is unlikely to prevent it from dying from EAB infestation.

- Are at least 8 inches in diameter at the point on their trunk, about 4.5 feet from the ground (diameter-at-breast-height or DBH). The department has determined that it is more cost-effective to remove and replace ash trees that are less than 8 inches DBH than to treat them.

Private Ash Trees

Ninety-six percent of the ash tree canopy in Pleasant Hill is located on private property. Ash trees that are still healthy and structurally sound may be saved if treated. Ash tree owners should consider two options:

- Treatment (typically applied once every two years, for the life of the tree). Chemical treatment can be effective, spreading removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended until EAB is within a 15 miles radius of the community.
- Remove and replace the tree with a different species.

Doing nothing creates a hazard to people and property. Dead and dying trees become high risk and may constitute a violation of the City Ordinance.

Signs of EAB usually only become apparent once a tree is heavily infested, at which point treatment becomes much less effective. Ash trees have minimal noticeable decline for the first few years of infestation. Due to the threat of EAB, it is important to continuously check the health of ash trees with a visual survey every year for tree death or any of the following signs and symptoms: Canopy dieback, Epicormic shoots, Bark splitting, D-shaped borer exit holes, Wood pecker damage.

Treatment Considerations:
Once an ash tree is infested with EAB there are limited opportunities for an effective treatment program. Iowa State University suggests that several steps must be considered before using insecticides. Please refer to Iowa State University Publication below:
http://www.iowaagriculture.gov/Entomology/pdf/2016/FAQEABFEB92016.pdf

It is recommended that property owners contact a certified arborist to assess whether your tree is suitable for treatment. If a tree is structurally sound, and more than 70 percent of its upper branches are healthy, treatment is likely still an option. Many treatments can only be administered by a qualified service provider.

Removal Considerations:
If more than 30 percent of your ash tree's upper branches are dying back, it is likely infested beyond effective treatment. The tree will die within one to two years. If a tree is removed citizens are encouraged to plant a new tree to replace the lost tree canopy.

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

To sustain a tree canopy goal of 23% the city will need to plant 1.2 trees for every tree removed. To effectively hedge against major canopy loss from disease or insect infestation it would be reasonable for the city to sustain a diversity standard of no more that 12% of any on genus and 6% of any one species. The new plantings will be a diverse mix and will not include ash, silver maple, cottonwood, poplar, box elder, Chinese elm, willow or black walnut. To meet canopy goals 158 number of trees need to be planted annually.

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.

Budget

For 11 years Pleasant Hill has been certified as an official Tree City USA community. This certification is positive proof of the community's long-term commitment to tree planting and conservation efforts, which will offer multiple benefits to present and future citizens. Pleasant Hill is one of over 130 Iowa communities and over 3000 nationwide that receive the Tree City USA award from the National Arbor Day Foundation, the Iowa Department of Natural Resources, and the Iowa Urban Tree Council. To receive the award a city must meet four minimum requirements:

1. The city must possess either an urban forester or an active city tree board
2. The city must have a tree ordinance
3. The city must annually spend at least $2 per capita for its community forestry program*
4. The mayor must issue a proclamation naming a day as Arbor Day.

Below are historical Community Forestry Expenditures for the City of Pleasant Hill.

Historical Expenditures	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Total Community Forestry Expenditures	$28,800	$29,560	$35,311	$28,278	$37,840	$38,353
Community Population	7,000	7,000	8,785	8,785	9,009	9,009
*Per Capita Expenditures	$4.11	$4.22	$4.02	$3.22	$4.20	$4.04
Tree Planting and Initial Care	$1,000	$2,500	$6,400	$7,312	$9,622	$11,199
Number of Trees Planted	20	50	50	65	71	107
Tree Maintenance	$5,000	$5,000	$10,580	$3,862	$15,893	$5,125
Number of Trees Pruned	200	200	250	180	180	250
Tree Removal	$16,000	$18,560	$18,331	$12,702	$12,325	$20,875
Number Trees Removed	35	41	35	45	24	44
Management						$819
Volunteer Time ($16/hour)	$3,000	$2,250	$3,800	$4,402	$2,400	$335

Below are recommended Community Forestry Expenditures for the City of Pleasant Hill.

Future Budgets: (Includes Recommended Percent of Total Budget)	**2015**	**FY15/16**	**FY16/17**	**FY17/18**	**FY18/19**
Total Community Forestry Expenditures	$36,000	$37,000	$38,000	$39,000	$40,000
Estimated Community Population	9,750	10,000	10,250	10,500	10,750
Per Capita Expenditures*	$3.69	$3.70	$3.71	$3.71	$3.72
Tree Planting and Initial Care (National Avg. =10%)**	$11,000	$6,000	$7,000	$8,000	$9,000
Trees Planted	100	100	100	100	100
Tree Pruning & Maintenance (National Avg. =35%)**	$13,000	$10,000	$11,000	$12,000	$13,000
Trees Pruned	250	300	300	300	300
Tree Removal (National Avg. =25%)**	$12,000	$18,000	$17,000	$16,000	$15,000

Trees Removed	30	30	30	30	30
Administration & Inspections (National Avg. =15%)		$3,000	$3,000	$3,000	$3,000
Storm & Litter Cleanup (National Avg. =5%)					
Hardscape Repair (National Avg. =10%)					
Volunteer Time (Hours)	100	100	125	125	150
Number of Public Trees	730	1217	1300	1450	1600
Number of Street Trees	311	324	324	344	360
Acres of Forest Remnant	88	88	88	88	88

*Tree City USA Standard: Annual Budget of at least $2 Per Capita. This requirement was established in 1976. In 2015 dollars, the value of $2 is $9.60

Annual Costs Per Tree:

**According to the Piedmont Community Tree Guide a survey of municipal foresters in Charlotte, NC, Richmond, VA,Cumming, GA, Columbus, GA, and Chattanooga, TN, indicates that they are spending about $22 per tree annually. Most of this amount is for pruning ($8 per tree), planting ($6 per tree), removal and disposal ($5 per tree) and administration ($3 per tree). Other municipal departments incur costs for infrastructure repair and trip-and-fall claims that average about $5 per tree annually.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Pleasant Hill

Annual Energy Benefits of Public Trees

2/4/2016

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	16.9	1,282	2,594.2	2,542	3,824	(N/A)	13.0	7.8	19.12
Northern hackberry	38.9	2,949	5,395.8	5,288	8,237	(N/A)	10.9	16.7	49.03
Northern red oak	14.6	1,111	1,979.6	1,940	3,051	(N/A)	5.9	6.2	33.52
Bur oak	26.6	2,021	3,627.8	3,555	5,577	(N/A)	5.8	11.3	61.96
Eastern white pine	6.6	502	892.8	875	1,377	(N/A)	5.2	2.8	17.22
Broadleaf Deciduous Small	0.7	49	116.1	114	163	(N/A)	5.1	0.3	2.09
Hickory	8.4	640	1,117.6	1,095	1,735	(N/A)	3.1	3.5	36.14
American basswood	13.3	1,012	1,904.2	1,866	2,878	(N/A)	2.9	5.9	63.96
Green ash	11.2	848	1,506.8	1,477	2,324	(N/A)	2.9	4.7	52.82
Catalpa	6.1	460	760.0	745	1,205	(N/A)	2.4	2.5	32.57
Swamp white oak	1.7	127	262.1	257	384	(N/A)	2.4	0.8	10.37
Black walnut	8.8	669	1,207.7	1,184	1,853	(N/A)	2.3	3.8	51.46
Red maple	1.9	142	245.0	240	382	(N/A)	1.9	0.8	12.73
Silver maple	7.2	544	952.9	934	1,478	(N/A)	1.7	3.0	56.84
American elm	6.1	462	780.1	764	1,226	(N/A)	1.7	2.5	47.17
Broadleaf Deciduous Mediu	1.8	137	249.8	245	382	(N/A)	1.7	0.8	14.68
White oak	4.9	370	655.8	643	1,013	(N/A)	1.6	2.1	40.52
Eastern redbud	0.5	40	85.8	84	125	(N/A)	1.6	0.3	4.98
Eastern red cedar	2.5	186	361.8	355	541	(N/A)	1.4	1.1	24.57
Conifer Evergreen Large	1.8	137	212.7	208	345	(N/A)	1.4	0.7	15.70
American sycamore	2.0	150	249.3	244	394	(N/A)	1.3	0.8	19.71
Honeylocust	5.7	431	751.0	736	1,167	(N/A)	1.2	2.4	61.40
Norway maple	1.8	136	288.2	282	419	(N/A)	1.2	0.9	22.03
Japanese tree lilac	0.1	6	15.0	15	21	(N/A)	1.2	0.0	1.11
Eastern cottonwood	5.7	433	765.9	751	1,183	(N/A)	1.2	2.4	65.74
Siberian elm	5.2	393	658.7	646	1,038	(N/A)	1.2	2.1	57.68
Chinese elm	3.4	261	436.5	428	689	(N/A)	1.0	1.4	43.08
Pin oak	5.4	408	703.0	689	1,097	(N/A)	1.0	2.2	73.11
Oak	0.0	3	6.5	6	9	(N/A)	0.9	0.0	0.66
Common chokecherry	2.6	200	373.2	366	566	(N/A)	0.9	1.2	40.42
Blue spruce	0.8	59	126.7	124	184	(N/A)	0.9	0.4	13.12
River birch	2.0	150	272.9	267	417	(N/A)	0.8	0.8	32.09
Amur maple	1.6	123	237.8	233	356	(N/A)	0.8	0.7	27.40
Black cherry	1.9	142	276.1	271	412	(N/A)	0.8	0.8	34.37
Austrian pine	1.4	108	194.3	190	298	(N/A)	0.7	0.6	27.13
Callery pear	0.4	27	57.0	56	83	(N/A)	0.7	0.2	7.50
Boxelder	1.8	133	235.2	230	364	(N/A)	0.7	0.7	33.06
Ohio buckeye	0.5	42	88.4	87	128	(N/A)	0.6	0.3	12.82
Elm	2.6	200	342.9	336	537	(N/A)	0.6	1.1	53.65
Eastern hophornbeam	0.1	10	22.1	22	31	(N/A)	0.6	0.1	3.13
Kentucky coffeetree	0.9	66	103.5	101	167	(N/A)	0.6	0.3	18.55
Spruce	0.1	9	21.4	21	30	(N/A)	0.6	0.1	3.37
Tulip tree	0.2	17	33.0	32	50	(N/A)	0.5	0.1	7.10
Ginkgo	0.0	1	2.9	3	4	(N/A)	0.5	0.0	0.57
Littleleaf linden	0.5	38	78.7	77	115	(N/A)	0.5	0.2	16.48
Willow	1.2	92	182.1	178	270	(N/A)	0.4	0.5	45.07
Northern pin oak	1.9	142	276.6	271	413	(N/A)	0.4	0.8	68.81
Ash	1.2	89	174.0	170	259	(N/A)	0.3	0.5	64.76
Conifer Evergreen Medium	0.0	4	8.4	8	12	(N/A)	0.3	0.0	2.97
Scarlet oak	0.0	1	1.9	2	3	(N/A)	0.3	0.0	0.66
Sugar maple	0.5	41	71.4	70	111	(N/A)	0.3	0.2	27.70
Cherry plum	0.2	15	33.3	33	47	(N/A)	0.3	0.1	11.80
Broadleaf Deciduous Large	0.0	1	1.9	2	3	(N/A)	0.3	0.0	0.66
Eastern hemlock	0.0	1	2.0	2	3	(N/A)	0.2	0.0	0.93
Sweetgum	0.0	1	1.4	1	2	(N/A)	0.2	0.0	0.66
Conifer Evergreen Small	0.0	1	2.0	2	3	(N/A)	0.2	0.0	0.93

Southern magnolia	0.1	6	14.0	14	20 (N/A)	0.2	0.0	6.72
Quaking aspen	0.1	7	11.1	11	17 (N/A)	0.2	0.0	5.82
Norway spruce	0.2	11	20.4	20	31 (N/A)	0.1	0.1	15.70
Pear	0.0	2	3.8	4	5 (N/A)	0.1	0.0	5.40
Plum	0.0	2	3.8	4	5 (N/A)	0.1	0.0	5.40
Mulberry	0.2	15	31.6	31	46 (N/A)	0.1	0.1	46.14
Birch	0.1	8	16.9	17	24 (N/A)	0.1	0.0	24.47
Pussy willow	0.0	0	0.6	1	1 (N/A)	0.1	0.0	0.87
White ash	0.3	20	28.4	28	48 (N/A)	0.1	0.1	48.12
Total	233.1	17,691	32,134.2	31,492	49,182 (N/A)	100.0	100.0	31.92

Table 2: Annual Stormwater Benefits

Pleasant Hill

Annual Stormwater Benefits of Public Trees

2/4/2016

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	64,803	1,756	(N/A)	13.0	3.0	8.78
Northern hackberry	263,407	7,138	(N/A)	10.9	12.3	42.49
Northern red oak	132,932	3,602	(N/A)	5.9	6.2	39.59
Bur oak	338,804	9,182	(N/A)	5.8	15.9	102.02
Eastern white pine	84,335	2,285	(N/A)	5.2	4.0	28.57
Broadleaf Deciduous Small	1,989	54	(N/A)	5.1	0.1	0.69
Hickory	75,477	2,045	(N/A)	3.1	3.5	42.61
American basswood	153,810	4,168	(N/A)	2.9	7.2	92.63
Green ash	109,324	2,963	(N/A)	2.9	5.1	67.33
Catalpa	40,968	1,110	(N/A)	2.4	1.9	30.01
Swamp white oak	8,545	232	(N/A)	2.4	0.4	6.26
Black walnut	88,680	2,403	(N/A)	2.3	4.2	66.76
Red maple	10,193	276	(N/A)	1.9	0.5	9.21
Silver maple	99,204	2,688	(N/A)	1.7	4.7	103.40
American elm	48,707	1,320	(N/A)	1.7	2.3	50.77
Broadleaf Deciduous Medium	10,321	280	(N/A)	1.7	0.5	10.76
White oak	50,303	1,363	(N/A)	1.6	2.4	54.53
Eastern redbud	1,800	49	(N/A)	1.6	0.1	1.95
Eastern red cedar	35,960	975	(N/A)	1.4	1.7	44.30
Conifer Evergreen Large	21,261	576	(N/A)	1.4	1.0	26.19
American sycamore	16,385	444	(N/A)	1.3	0.8	22.20
Honeylocust	56,829	1,540	(N/A)	1.2	2.7	81.06
Norway maple	9,863	267	(N/A)	1.2	0.5	14.07
Japanese tree lilac	203	5	(N/A)	1.2	0.0	0.29
Eastern cottonwood	84,001	2,276	(N/A)	1.2	3.9	126.47
Siberian elm	47,831	1,296	(N/A)	1.2	2.2	72.01
Chinese elm	25,376	688	(N/A)	1.0	1.2	42.98
Pin oak	67,406	1,827	(N/A)	1.0	3.2	121.78
Oak	250	7	(N/A)	0.9	0.0	0.48
Common chokecherry	11,361	308	(N/A)	0.9	0.5	21.99
Blue spruce	9,079	246	(N/A)	0.9	0.4	17.57
River birch	12,479	338	(N/A)	0.8	0.6	26.01
Amur maple	5,851	159	(N/A)	0.8	0.3	12.20
Black cherry	8,565	232	(N/A)	0.8	0.4	19.34
Austrian pine	21,855	592	(N/A)	0.7	1.0	53.84
Callery pear	1,733	47	(N/A)	0.7	0.1	4.27
Boxelder	15,080	409	(N/A)	0.7	0.7	37.15
Ohio buckeye	2,869	78	(N/A)	0.6	0.1	7.77
Elm	25,255	684	(N/A)	0.6	1.2	68.44
Eastern hophornbeam	381	10	(N/A)	0.6	0.0	1.03
Kentucky coffeetree	5,401	146	(N/A)	0.6	0.3	16.26
Spruce	1,313	36	(N/A)	0.6	0.1	3.96
Tulip tree	1,459	40	(N/A)	0.5	0.1	5.65
Ginkgo	50	1	(N/A)	0.5	0.0	0.19
Littleleaf linden	2,857	77	(N/A)	0.5	0.1	11.06
Willow	12,628	342	(N/A)	0.4	0.6	57.03
Northern pin oak	21,301	577	(N/A)	0.4	1.0	96.21
Ash	12,487	338	(N/A)	0.3	0.6	84.60
Conifer Evergreen Medium	371	10	(N/A)	0.3	0.0	2.51

Scarlet oak	72	2 (N/A)	0.3	0.0	0.48
Sugar maple	3,006	81 (N/A)	0.3	0.1	20.37
Cherry plum	666	18 (N/A)	0.3	0.0	4.51
Broadleaf Deciduous Large	72	2 (N/A)	0.3	0.0	0.48
Eastern hemlock	146	4 (N/A)	0.2	0.0	1.32
Sweetgum	54	1 (N/A)	0.2	0.0	0.48
Conifer Evergreen Small	73	2 (N/A)	0.2	0.0	0.66
Southern magnolia	367	10 (N/A)	0.2	0.0	3.31
Quaking aspen	515	14 (N/A)	0.2	0.0	4.65
Norway spruce	3,018	82 (N/A)	0.1	0.1	40.89
Pear	69	2 (N/A)	0.1	0.0	1.86
Plum	69	2 (N/A)	0.1	0.0	1.86
Mulberry	1,174	32 (N/A)	0.1	0.1	31.82
Birch	586	16 (N/A)	0.1	0.0	15.88
Pussy willow	7	0 (N/A)	0.1	0.0	0.20
White ash	1,663	45 (N/A)	0.1	0.1	45.05
Citywide total	2,132,898	57,802 (N/A)	100.0	100.0	37.51

Table 3: Annual Air Quality Benefits

Pleasant Hill

Annual Air Quality Benefits of Public Trees

2/4/2016

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							
Apple	17.0	2.8	8.4	0.8	92	83.1	11.9	11.3	76.5	512	-0.1	0	211.8	603 (N/A)	13.0	3.01
Northern hackberry	30.5	5.3	17.6	1.4	172	186.5	27.1	25.8	176.3	1,160	0.0	0	470.4	1,332 (N/A)	10.9	7.93
Northern red oak	27.2	4.7	13.4	1.2	147	69.6	10.1	9.7	66.3	434	-38.7	-145	163.4	436 (N/A)	5.9	4.79
Bur oak	51.1	8.2	23.3	2.3	269	127.0	18.5	17.6	120.7	791	0.0	0	368.7	1,060 (N/A)	5.8	11.78
Eastern white pine	8.8	1.7	7.9	1.1	60	31.4	4.6	4.4	30.0	196	-31.0	-116	58.8	139 (N/A)	5.2	1.74
Broadleaf Deciduous Small	0.2	0.0	0.2	0.0	1	3.4	0.5	0.4	3.0	20	0.0	0	7.7	22 (N/A)	5.1	0.28
Hickory	7.7	1.2	4.0	0.3	42	39.9	5.8	5.6	38.2	249	0.0	0	102.8	291 (N/A)	3.1	6.07
American basswood	21.5	3.7	10.5	1.0	116	64.5	9.3	8.9	60.5	400	-18.2	-68	161.7	448 (N/A)	2.9	9.95
Green ash	12.6	2.0	6.3	0.6	68	53.1	7.7	7.4	50.6	331	0.0	0	140.3	399 (N/A)	2.9	9.07
Catalpa	3.0	0.5	1.8	0.1	17	28.3	4.2	4.0	27.5	178	0.0	0	69.4	195 (N/A)	2.4	5.27
Swamp white oak	0.8	0.1	0.5	0.0	5	8.3	1.2	1.1	7.6	51	-0.3	-1	19.4	55 (N/A)	2.4	1.47
Black walnut	9.9	1.6	4.9	0.4	53	42.1	6.1	5.8	40.0	262	0.0	0	110.9	316 (N/A)	2.3	8.76
Red maple	1.6	0.3	0.9	0.1	9	8.8	1.3	1.2	8.5	55	-0.6	-2	22.0	62 (N/A)	1.9	2.06
Silver maple	16.7	2.8	8.3	0.7	90	33.9	5.0	4.7	32.4	212	-8.9	-33	95.6	269 (N/A)	1.7	10.33
American elm	6.8	1.2	3.6	0.3	38	28.6	4.2	4.0	27.6	179	0.0	0	76.3	217 (N/A)	1.7	8.34
Broadleaf Deciduous Medium	1.4	0.2	0.8	0.1	8	8.7	1.3	1.2	8.2	54	-0.4	-1	21.4	60 (N/A)	1.7	2.32
White oak	6.3	1.0	3.1	0.3	34	23.2	3.4	3.2	22.1	145	0.0	0	62.6	179 (N/A)	1.6	7.14
Eastern redbud	0.4	0.1	0.2	0.0	2	2.7	0.4	0.4	2.4	16	0.0	0	6.4	18 (N/A)	1.6	0.73
Eastern red cedar	7.6	1.5	6.0	0.9	49	11.9	1.7	1.6	11.1	74	-19.9	-75	22.4	48 (N/A)	1.4	2.19
Conifer Evergreen Large	2.2	0.4	2.0	0.3	15	8.3	1.2	1.2	8.2	52	-7.4	-28	16.4	40 (N/A)	1.4	1.80
American sycamore	1.6	0.3	0.9	0.1	9	9.2	1.4	1.3	8.9	58	0.0	0	23.7	67 (N/A)	1.3	3.35
Honeylocust	10.9	1.8	5.0	0.5	58	26.8	3.9	3.7	25.7	168	-8.1	-30	70.2	195 (N/A)	1.2	10.25
Norway maple	0.9	0.2	0.6	0.0	5	9.0	1.3	1.2	8.1	55	-0.3	-1	21.0	59 (N/A)	1.2	3.11
Japanese tree lilac	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	3	0.0	0	0.9	3 (N/A)	1.2	0.14
Eastern cottonwood	14.1	2.3	6.3	0.6	74	27.1	4.0	3.8	25.8	169	0.0	0	83.9	243 (N/A)	1.2	13.49
Siberian elm	7.4	1.3	3.7	0.3	40	24.2	3.6	3.4	23.4	152	0.0	0	67.4	192 (N/A)	1.2	10.68
Chinese elm	2.1	0.3	1.2	0.1	12	16.1	2.4	2.3	15.6	101	0.0	0	40.1	113 (N/A)	1.0	7.07
Pin oak	12.9	2.3	6.5	0.6	70	25.3	3.7	3.5	24.3	159	-23.6	-89	55.5	140 (N/A)	1.0	9.34
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)	0.9	0.08
Common chokecherry	3.8	0.6	1.8	0.2	20	12.7	1.8	1.8	12.0	79	0.0	0	34.6	99 (N/A)	0.9	7.07
Blue spruce	0.8	0.2	0.8	0.1	6	3.9	0.6	0.5	3.5	24	-2.8	-10	7.6	19 (N/A)	0.9	1.37
River birch	1.9	0.3	1.0	0.1	10	9.5	1.4	1.3	9.0	59	-0.5	-2	23.9	67 (N/A)	0.8	5.18
Amur maple	1.6	0.3	0.8	0.1	8	7.9	1.1	1.1	7.4	49	0.0	0	20.1	57 (N/A)	0.8	4.40
Black cherry	2.9	0.5	1.3	0.1	15	9.1	1.3	1.2	8.5	56	0.0	0	24.9	71 (N/A)	0.8	5.95
Austrian pine	3.4	0.7	2.7	0.4	22	6.8	1.0	0.9	6.4	42	-8.2	-31	14.1	34 (N/A)	0.7	3.05
Callery pear	0.1	0.0	0.1	0.0	1	1.8	0.3	0.2	1.6	11	-0.1	0	4.1	11 (N/A)	0.7	1.04
Boxelder	1.6	0.3	0.8	0.1	9	8.3	1.2	1.2	7.9	52	-0.8	-3	20.7	58 (N/A)	0.7	5.27
Ohio buckeye	0.2	0.0	0.2	0.0	1	2.7	0.4	0.4	2.5	17	-0.1	0	6.4	18 (N/A)	0.6	1.79
Elm	2.8	0.5	1.4	0.1	15	12.4	1.8	1.7	12.0	78	0.0	0	32.8	93 (N/A)	0.6	9.32
Eastern hophornbeam	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.6	4	0.0	0	1.5	4 (N/A)	0.6	0.41
Kentucky coffeetree	0.4	0.1	0.2	0.0	2	4.0	0.6	0.6	3.9	25	0.0	0	9.7	27 (N/A)	0.6	3.03
Spruce	0.1	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.4	-1	1.1	3 (N/A)	0.6	0.32
Tulip tree	0.1	0.0	0.0	0.0	0	1.1	0.2	0.2	1.0	7	0.0	0	2.6	7 (N/A)	0.5	1.03
Ginkgo	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	0	0.0	0	0.2	0 (N/A)	0.5	0.07
Littleleaf linden	0.2	0.0	0.2	0.0	1	2.5	0.4	0.3	2.3	15	-0.2	-1	5.7	16 (N/A)	0.5	2.30
Willow	2.7	0.5	1.3	0.1	15	5.9	0.9	0.8	5.5	37	-0.6	-2	17.1	49 (N/A)	0.4	8.15
Northern pin oak	4.8	0.8	2.3	0.2	26	9.1	1.3	1.2	8.5	56	-1.1	-4	27.2	78 (N/A)	0.4	13.01
Ash	2.7	0.5	1.3	0.1	15	5.7	0.8	0.8	5.3	35	-0.6	-2	16.6	47 (N/A)	0.3	11.87
Conifer Evergreen Medium	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.2	1	-0.1	0	0.5	1 (N/A)	0.3	0.32
Scarlet oak	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.3	0.08
Sugar maple	0.2	0.0	0.2	0.0	1	2.5	0.4	0.4	2.4	16	-0.2	-1	5.9	16 (N/A)	0.3	4.11
Cherry plum	0.1	0.0	0.1	0.0	1	1.0	0.1	0.1	0.9	6	0.0	0	2.3	7 (N/A)	0.3	1.63
Broadleaf Deciduous Large	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.3	0.08
Eastern hemlock	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.0	0	-0.1	0	0.1	0 (N/A)	0.2	0.05
Sweetgum	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)	0.2	0.08
Conifer Evergreen Small	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.0	0	0.0	0	0.1	0 (N/A)	0.2	0.09
Southern magnolia	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	3	0.0	0	0.9	3 (N/A)	0.2	0.86
Quaking aspen	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.4	3	0.0	0	0.9	3 (N/A)	0.2	0.87
Norway spruce	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)	0.1	0.75
Pear	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)	0.1	0.71
Plum	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)	0.1	0.71
Mulberry	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8 (N/A)	0.1	8.35
Birch	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)	0.1	3.47
Pussy willow	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)	0.1	0.11
White ash	0.1	0.0	0.1	0.0	1	1.2	0.2	0.2	1.2	8	0.0	0	3.0	8 (N/A)	0.1	8.32
Citywide total	314.6	53.1	164.9	15.9	1,729	1,114.9	162.2	154.6	1,056.5	6,941	-174.7	-655	2,861.9	8,014 (N/A)	100.0	5.20

Table 4: Annual Carbon Stored

Pleasant Hill

Stored CO2 Benefits of Public Trees

2/4/2016

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	278,292	2,087	(N/A)	13.0	3.6	10.44
Northern hackberry	417,877	3,134	(N/A)	10.9	5.5	18.66
Northern red oak	572,330	4,292	(N/A)	5.9	7.5	47.17
Bur oak	1,714,919	12,862	(N/A)	5.8	22.4	142.91
Eastern white pine	65,501	491	(N/A)	5.2	0.9	6.14
Broadleaf Deciduous	5,874	44	(N/A)	5.1	0.1	0.56
Hickory	255,207	1,914	(N/A)	3.1	3.3	39.88
American basswood	803,594	6,027	(N/A)	2.9	10.5	133.93
Green ash	415,255	3,114	(N/A)	2.9	5.4	70.78
Catalpa	101,638	762	(N/A)	2.4	1.3	20.60
Swamp white oak	15,724	118	(N/A)	2.4	0.2	3.19
Black walnut	320,478	2,404	(N/A)	2.3	4.2	66.77
Red maple	20,807	156	(N/A)	1.9	0.3	5.20
Silver maple	383,018	2,873	(N/A)	1.7	5.0	110.49
American elm	163,535	1,227	(N/A)	1.7	2.1	47.17
Broadleaf Deciduous	24,095	181	(N/A)	1.7	0.3	6.95
White oak	211,258	1,584	(N/A)	1.6	2.8	63.38
Eastern redbud	6,542	49	(N/A)	1.6	0.1	1.96
Eastern red cedar	24,246	182	(N/A)	1.4	0.3	8.27
Conifer Evergreen La	15,414	116	(N/A)	1.4	0.2	5.25
American sycamore	54,114	406	(N/A)	1.3	0.7	20.29
Honeylocust	137,608	1,032	(N/A)	1.2	1.8	54.32
Norway maple	18,266	137	(N/A)	1.2	0.2	7.21
Japanese tree lilac	426	3	(N/A)	1.2	0.0	0.17
Eastern cottonwood	480,189	3,601	(N/A)	1.2	6.3	200.08
Siberian elm	184,120	1,381	(N/A)	1.2	2.4	76.72
Chinese elm	69,981	525	(N/A)	1.0	0.9	32.80
Pin oak	354,482	2,659	(N/A)	1.0	4.6	177.24
Oak	170	1	(N/A)	0.9	0.0	0.09
Common chokecherry	57,342	430	(N/A)	0.9	0.7	30.72
Blue spruce	3,255	24	(N/A)	0.9	0.0	1.74
River birch	31,603	237	(N/A)	0.8	0.4	18.23
Amur maple	24,578	184	(N/A)	0.8	0.3	14.18
Black cherry	43,986	330	(N/A)	0.8	0.6	27.49
Austrian pine	26,587	199	(N/A)	0.7	0.3	18.13
Callery pear	2,958	22	(N/A)	0.7	0.0	2.02
Boxelder	45,664	342	(N/A)	0.7	0.6	31.13
Ohio buckeye	5,109	38	(N/A)	0.6	0.1	3.83
Elm	92,655	695	(N/A)	0.6	1.2	69.49
Eastern hophornbeam	958	7	(N/A)	0.6	0.0	0.72
Kentucky coffeetree	12,457	93	(N/A)	0.6	0.2	10.38
Spruce	348	3	(N/A)	0.6	0.0	0.29
Tulip tree	2,303	17	(N/A)	0.5	0.0	2.47
Ginkgo	32	0	(N/A)	0.5	0.0	0.03
Littleleaf linden	6,334	48	(N/A)	0.5	0.1	6.79
Willow	45,260	339	(N/A)	0.4	0.6	56.58
Northern pin oak	79,346	595	(N/A)	0.4	1.0	99.18
Ash	44,451	333	(N/A)	0.3	0.6	83.35
Conifer Evergreen M	50	0	(N/A)	0.3	0.0	0.09
Scarlet oak	49	0	(N/A)	0.3	0.0	0.09
Sugar maple	6,926	52	(N/A)	0.3	0.1	12.99
Cherry plum	2,171	16	(N/A)	0.3	0.0	4.07
Broadleaf Deciduous	49	0	(N/A)	0.3	0.0	0.09
Eastern hemlock	7	0	(N/A)	0.2	0.0	0.02
Sweetgum	36	0	(N/A)	0.2	0.0	0.09

Conifer Evergreen Sn	8	0	(N/A)	0.2	0.0	0.02
Southern magnolia	150	1	(N/A)	0.2	0.0	0.37
Quaking aspen	556	4	(N/A)	0.2	0.0	1.39
Norway spruce	3,345	25	(N/A)	0.1	0.0	12.54
Pear	178	1	(N/A)	0.1	0.0	1.33
Plum	178	1	(N/A)	0.1	0.0	1.33
Mulberry	6,743	51	(N/A)	0.1	0.1	50.57
Birch	1,101	8	(N/A)	0.1	0.0	8.26
Pussy willow	14	0	(N/A)	0.1	0.0	0.10
White ash	3,672	28	(N/A)	0.1	0.0	27.54
Citywide total	7,665,419	57,491	(N/A)	100.0	100.0	37.31

Table 5: Annual Carbon Sequestered

Pleasant Hill

Annual CO Benefits of Public Trees

2/4/2016

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
Apple	27,299	205	-1,337	-236	-2	0	0	25,727	193 (N/A)	13.0	6.5	0.96
Northern hackberry	36,342	273	-2,008	-331	-2	0	0	34,003	255 (N/A)	10.9	8.6	1.52
Northern red oak	15,363	115	-2,748	-182	-1	0	0	12,434	93 (N/A)	5.9	3.1	1.02
Bur oak	56,749	426	-8,232	-293	-2	0	0	48,224	362 (N/A)	5.8	12.2	4.02
Eastern white pine	6,367	48	-314	-117	-1	0	0	5,936	45 (N/A)	5.2	1.5	0.56
Broadleaf Deciduous Smal	1,262	9	-31	-21	0	0	0	1,210	9 (N/A)	5.1	0.3	0.12
Hickory	18,912	142	-1,225	-87	-1	0	0	17,600	132 (N/A)	3.1	4.4	2.75
American basswood	45,673	343	-3,857	-155	-1	0	0	41,660	312 (N/A)	2.9	10.5	6.94
Green ash	25,192	189	-1,993	-113	-1	0	0	23,085	173 (N/A)	2.9	5.8	3.94
Catalpa	12,418	93	-488	-58	0	0	0	11,872	89 (N/A)	2.4	3.0	2.41
Swamp white oak	3,592	27	-86	-22	0	0	0	3,484	26 (N/A)	2.4	0.9	0.71
Black walnut	21,109	158	-1,538	-90	-1	0	0	19,480	146 (N/A)	2.3	4.9	4.06
Red maple	2,960	22	-100	-21	0	0	0	2,839	21 (N/A)	1.9	0.7	0.71
Silver maple	29,007	218	-1,839	-79	-1	0	0	27,089	203 (N/A)	1.7	6.8	7.81
American elm	6,719	50	-785	-56	0	0	0	5,878	44 (N/A)	1.7	1.5	1.70
Broadleaf Deciduous Medi	3,226	24	-117	-19	0	0	0	3,090	23 (N/A)	1.7	0.8	0.89
White oak	10,765	81	-1,014	-52	0	0	0	9,699	73 (N/A)	1.6	2.4	2.91
Eastern redbud	879	7	-32	-11	0	0	0	836	6 (N/A)	1.6	0.2	0.25
Eastern red cedar	129	1	-116	-43	0	0	0	-31	0 (N/A)	1.4	0.0	-0.01
Conifer Evergreen Large	1,606	12	-74	-29	0	0	0	1,503	11 (N/A)	1.4	0.4	0.51
American sycamore	4,157	31	-260	-21	0	0	0	3,877	29 (N/A)	1.3	1.0	1.45
Honeylocust	18,075	136	-661	-46	0	0	0	17,368	130 (N/A)	1.2	4.4	6.86
Norway maple	3,870	29	-90	-20	0	0	0	3,760	28 (N/A)	1.2	0.9	1.48
Japanese tree lilac	194	1	-3	-4	0	0	0	187	1 (N/A)	1.2	0.0	0.07
Eastern cottonwood	10,951	82	-2,305	-66	0	0	0	8,580	64 (N/A)	1.2	2.2	3.58
Siberian elm	8,856	66	-884	-51	0	0	0	7,920	59 (N/A)	1.2	2.0	3.30
Chinese elm	7,273	55	-336	-32	0	0	0	6,905	52 (N/A)	1.0	1.7	3.24
Pin oak	20,905	157	-1,702	-59	0	0	0	19,145	144 (N/A)	1.0	4.8	9.57
Oak	36	0	-1	-3	0	0	0	32	0 (N/A)	0.9	0.0	0.02
Common chokecherry	3,155	24	-275	-33	0	0	0	2,847	21 (N/A)	0.9	0.7	1.53
Blue spruce	461	3	-16	-15	0	0	0	431	3 (N/A)	0.9	0.1	0.23
River birch	3,530	26	-152	-19	0	0	0	3,360	25 (N/A)	0.8	0.8	1.94
Amur maple	2,403	18	-118	-20	0	0	0	2,265	17 (N/A)	0.8	0.6	1.31
Black cherry	3,010	23	-211	-24	0	0	0	2,775	21 (N/A)	0.8	0.7	1.73
Austrian pine	1,356	10	-128	-27	0	0	0	1,202	9 (N/A)	0.7	0.3	0.82
Callery pear	767	6	-17	-5	0	0	0	745	6 (N/A)	0.7	0.2	0.51
Boxelder	4,462	33	-220	-20	0	0	0	4,222	32 (N/A)	0.7	1.1	2.88
Ohio buckeye	1,199	9	-27	-7	0	0	0	1,165	9 (N/A)	0.6	0.3	0.87
Elm	5,966	45	-445	-26	0	0	0	5,495	41 (N/A)	0.6	1.4	4.12
Eastern hophornbeam	233	2	-5	-4	0	0	0	224	2 (N/A)	0.6	0.1	0.17
Kentucky coffeetree	1,701	13	-60	-9	0	0	0	1,632	12 (N/A)	0.6	0.4	1.36
Spruce	110	1	-2	-4	0	0	0	105	1 (N/A)	0.6	0.0	0.09
Tulip tree	502	4	-11	-4	0	0	0	487	4 (N/A)	0.5	0.1	0.52
Ginkgo	15	0	0	-1	0	0	0	14	0 (N/A)	0.5	0.0	0.01
Littleleaf linden	1,399	10	-31	-8	0	0	0	1,361	10 (N/A)	0.5	0.3	1.46
Willow	914	7	-218	-15	0	0	0	681	5 (N/A)	0.4	0.2	0.85
Northern pin oak	840	6	-381	-23	0	0	0	436	3 (N/A)	0.4	0.1	0.54
Ash	1,680	13	-213	-12	0	0	0	1,454	11 (N/A)	0.3	0.4	2.73
Conifer Evergreen Mediun	17	0	0	-1	0	0	0	16	0 (N/A)	0.3	0.0	0.03
Scarlet oak	10	0	0	-1	0	0	0	9	0 (N/A)	0.3	0.0	0.02
Sugar maple	767	6	-33	-5	0	0	0	729	5 (N/A)	0.3	0.2	1.37
Cherry plum	304	2	-10	-4	0	0	0	290	2 (N/A)	0.3	0.1	0.54
Broadleaf Deciduous Largı	10	0	0	-1	0	0	0	9	0 (N/A)	0.3	0.0	0.02
Eastern hemlock	11	0	0	-1	0	0	0	10	0 (N/A)	0.2	0.0	0.02
Sweetgum	8	0	0	-1	0	0	0	7	0 (N/A)	0.2	0.0	0.02
Conifer Evergreen Small	2	0	0	-1	0	0	0	1	0 (N/A)	0.2	0.0	0.00
Southern magnolia	33	0	-1	-1	0	0	0	31	0 (N/A)	0.2	0.0	0.08
Quaking aspen	223	2	-3	-2	0	0	0	218	2 (N/A)	0.2	0.1	0.55
Norway spruce	191	1	-16	-3	0	0	0	172	1 (N/A)	0.1	0.0	0.64
Pear	38	0	-1	-1	0	0	0	37	0 (N/A)	0.1	0.0	0.27
Plum	38	0	-1	-1	0	0	0	37	0 (N/A)	0.1	0.0	0.27
Mulberry	0	0	-32	-4	0	0	0	-36	0 (N/A)	0.1	0.0	-0.27
Birch	224	2	-5	-1	0	0	0	217	2 (N/A)	0.1	0.1	1.63
Pussy willow	9	0	0	0	0	0	0	8	0 (N/A)	0.1	0.0	0.06
White ash	494	4	-18	-2	0	0	0	474	4 (N/A)	0.1	0.1	3.56
Citywide total	435,967	3,270	-36,828	-2,619	-20	0	0	396,521	2,974 (N/A)	100.0	100.0	1.93

Table 6: Annual Social and Aesthetic Benefits

Pleasant Hill

Annual Aesthetic/Other Benefits of Public Trees

2/4/2016

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Apple	1,559	(N/A)	13.0	3.5	7.79
Northern hackberry	6,461	(N/A)	10.9	14.3	38.46
Northern red oak	1,272	(N/A)	5.9	2.8	13.98
Bur oak	4,399	(N/A)	5.8	9.8	48.88
Eastern white pine	1,768	(N/A)	5.2	3.9	22.10
Broadleaf Deciduous Small	39	(N/A)	5.1	0.1	0.49
Hickory	1,845	(N/A)	3.1	4.1	38.44
American basswood	3,215	(N/A)	2.9	7.1	71.44
Green ash	2,239	(N/A)	2.9	5.0	50.88
Catalpa	1,364	(N/A)	2.4	3.0	36.86
Swamp white oak	468	(N/A)	2.4	1.0	12.64
Black walnut	1,838	(N/A)	2.3	4.1	51.05
Red maple	448	(N/A)	1.9	1.0	14.94
Silver maple	2,334	(N/A)	1.7	5.2	89.76
American elm	1,004	(N/A)	1.7	2.2	38.63
Broadleaf Deciduous Medium	381	(N/A)	1.7	0.8	14.65
White oak	979	(N/A)	1.6	2.2	39.16
Eastern redbud	41	(N/A)	1.6	0.1	1.66
Eastern red cedar	41	(N/A)	1.4	0.1	1.87
Conifer Evergreen Large	477	(N/A)	1.4	1.1	21.70
American sycamore	455	(N/A)	1.3	1.0	22.74
Honeylocust	4,237	(N/A)	1.2	9.4	223.02
Norway maple	458	(N/A)	1.2	1.0	24.12
Japanese tree lilac	3	(N/A)	1.2	0.0	0.14
Eastern cottonwood	768	(N/A)	1.2	1.7	42.69
Siberian elm	696	(N/A)	1.2	1.5	38.64
Chinese elm	729	(N/A)	1.0	1.6	45.57
Pin oak	1,556	(N/A)	1.0	3.5	103.71
Oak	74	(N/A)	0.9	0.2	5.26
Common chokecherry	184	(N/A)	0.9	0.4	13.12
Blue spruce	269	(N/A)	0.9	0.6	19.20
River birch	375	(N/A)	0.8	0.8	28.88
Amur maple	138	(N/A)	0.8	0.3	10.59
Black cherry	177	(N/A)	0.8	0.4	14.72
Austrian pine	216	(N/A)	0.7	0.5	19.65
Callery pear	108	(N/A)	0.7	0.2	9.77
Boxelder	414	(N/A)	0.7	0.9	37.66
Ohio buckeye	152	(N/A)	0.6	0.3	15.18
Elm	521	(N/A)	0.6	1.2	52.12
Eastern hophornbeam	10	(N/A)	0.6	0.0	1.05
Kentucky coffeetree	211	(N/A)	0.6	0.5	23.49
Spruce	64	(N/A)	0.6	0.1	7.07
Tulip tree	93	(N/A)	0.5	0.2	13.27
Ginkgo	3	(N/A)	0.5	0.0	0.37
Littleleaf linden	198	(N/A)	0.5	0.4	28.25
Willow	97	(N/A)	0.4	0.2	16.13
Northern pin oak	75	(N/A)	0.4	0.2	12.42
Ash	149	(N/A)	0.3	0.3	37.26

Conifer Evergreen Medium	27 (N/A)	0.3	0.1	6.85
Scarlet oak	21 (N/A)	0.3	0.0	5.26
Sugar maple	103 (N/A)	0.3	0.2	25.87
Cherry plum	17 (N/A)	0.3	0.0	4.23
Broadleaf Deciduous Large	21 (N/A)	0.3	0.0	5.26
Eastern hemlock	17 (N/A)	0.2	0.0	5.76
Sweetgum	16 (N/A)	0.2	0.0	5.26
Conifer Evergreen Small	13 (N/A)	0.2	0.0	4.27
Southern magnolia	19 (N/A)	0.2	0.0	6.31
Quaking aspen	44 (N/A)	0.2	0.1	14.73
Norway spruce	53 (N/A)	0.1	0.1	26.42
Pear	2 (N/A)	0.1	0.0	2.06
Plum	2 (N/A)	0.1	0.0	2.06
Mulberry	0 (N/A)	0.1	0.0	0.00
Birch	26 (N/A)	0.1	0.1	26.22
Pussy willow	0 (N/A)	0.1	0.0	0.03
White ash	64 (N/A)	0.1	0.1	63.74
Citywide total	45,045 (N/A)	100.0	100.0	29.23

Table 7: Summary of Benefits in Dollars

Pleasant Hill

Total Annual Benefits of Public Trees by Species ($)

2/4/2016

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Apple	3,824	193	603	1,756	1,559	7,935	(N/A)	4.9
Northern hackberry	8,237	255	1,332	7,138	6,461	23,423	(N/A)	14.4
Northern red oak	3,051	93	436	3,602	1,272	8,454	(N/A)	5.2
Bur oak	5,577	362	1,060	9,182	4,399	20,579	(N/A)	12.6
Eastern white pine	1,377	45	139	2,285	1,768	5,615	(N/A)	3.4
Broadleaf Deciduous Sn	163	9	22	54	39	286	(N/A)	0.2
Hickory	1,735	132	291	2,045	1,845	6,049	(N/A)	3.7
American basswood	2,878	312	448	4,168	3,215	11,021	(N/A)	6.8
Green ash	2,324	173	399	2,963	2,239	8,098	(N/A)	5.0
Catalpa	1,205	89	195	1,110	1,364	3,963	(N/A)	2.4
Swamp white oak	384	26	55	232	468	1,164	(N/A)	0.7
Black walnut	1,853	146	316	2,403	1,838	6,555	(N/A)	4.0
Red maple	382	21	62	276	448	1,189	(N/A)	0.7
Silver maple	1,478	203	269	2,688	2,334	6,972	(N/A)	4.3
American elm	1,226	44	217	1,320	1,004	3,812	(N/A)	2.3
Broadleaf Deciduous M	382	23	60	280	381	1,126	(N/A)	0.7
White oak	1,013	73	179	1,363	979	3,606	(N/A)	2.2
Eastern redbud	125	6	18	49	41	239	(N/A)	0.1
Eastern red cedar	541	0	48	975	41	1,604	(N/A)	1.0
Conifer Evergreen Large	345	11	40	576	477	1,450	(N/A)	0.9
American sycamore	394	29	67	444	455	1,389	(N/A)	0.9
Honeylocust	1,167	130	195	1,540	4,237	7,269	(N/A)	4.5
Norway maple	419	28	59	267	458	1,231	(N/A)	0.8
Japanese tree lilac	21	1	3	5	3	33	(N/A)	0.0
Eastern cottonwood	1,183	64	243	2,276	768	4,535	(N/A)	2.8
Siberian elm	1,038	59	192	1,296	696	3,282	(N/A)	2.0
Chinese elm	689	52	113	688	729	2,271	(N/A)	1.4
Pin oak	1,097	144	140	1,827	1,556	4,763	(N/A)	2.9
Oak	9	0	1	7	74	91	(N/A)	0.1
Common chokecherry	566	21	99	308	184	1,178	(N/A)	0.7
Blue spruce	184	3	19	246	269	721	(N/A)	0.4
River birch	417	25	67	338	375	1,223	(N/A)	0.8
Amur maple	356	17	57	159	138	727	(N/A)	0.4
Black cherry	412	21	71	232	177	913	(N/A)	0.6
Austrian pine	298	9	34	592	216	1,149	(N/A)	0.7
Callery pear	83	6	11	47	108	254	(N/A)	0.2
Boxelder	364	32	58	409	414	1,276	(N/A)	0.8
Ohio buckeye	128	9	18	78	152	384	(N/A)	0.2
Elm	537	41	93	684	521	1,877	(N/A)	1.2
Eastern hophornbeam	31	2	4	10	10	58	(N/A)	0.0
Kentucky coffeetree	167	12	27	146	211	564	(N/A)	0.3
Spruce	30	1	3	36	64	133	(N/A)	0.1
Tulip tree	50	4	7	40	93	193	(N/A)	0.1
Ginkgo	4	0	0	1	3	9	(N/A)	0.0
Littleleaf linden	115	10	16	77	198	417	(N/A)	0.3
Willow	270	5	49	342	97	763	(N/A)	0.5
Northern pin oak	413	3	78	577	75	1,146	(N/A)	0.7
Ash	259	11	47	338	149	805	(N/A)	0.5

Conifer Evergreen Medi	12	0	1	10	27	51 (N/A)	0.0
Scarlet oak	3	0	0	2	21	26 (N/A)	0.0
Sugar maple	111	5	16	81	103	318 (N/A)	0.2
Cherry plum	47	2	7	18	17	91 (N/A)	0.1
Broadleaf Deciduous La	3	0	0	2	21	26 (N/A)	0.0
Eastern hemlock	3	0	0	4	17	24 (N/A)	0.0
Sweetgum	2	0	0	1	16	20 (N/A)	0.0
Conifer Evergreen Smal	3	0	0	2	13	18 (N/A)	0.0
Southern magnolia	20	0	3	10	19	52 (N/A)	0.0
Quaking aspen	17	2	3	14	44	80 (N/A)	0.0
Norway spruce	31	1	1	82	53	169 (N/A)	0.1
Pear	5	0	1	2	2	10 (N/A)	0.0
Plum	5	0	1	2	2	10 (N/A)	0.0
Mulberry	46	0	8	32	0	86 (N/A)	0.1
Birch	24	2	3	16	26	72 (N/A)	0.0
Pussy willow	1	0	0	0	0	1 (N/A)	0.0
White ash	48	4	8	45	64	169 (N/A)	0.1
Citywide Total	49,182	2,974	8,014	57,802	45,045	163,017 (N/A)	100.0

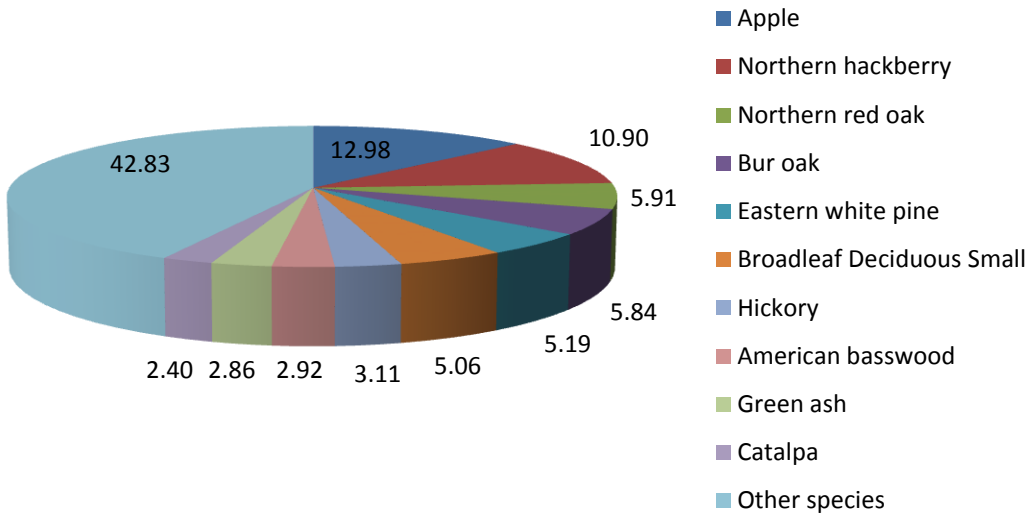

Figure 1: Species Distribution

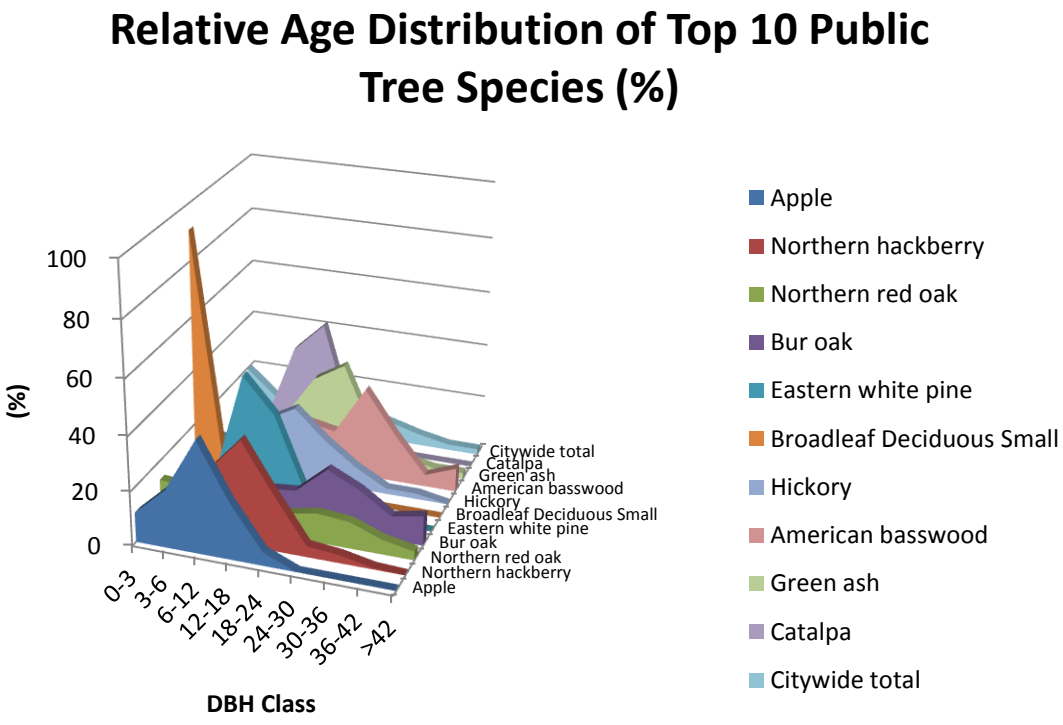

Figure 2: Relative Age Class

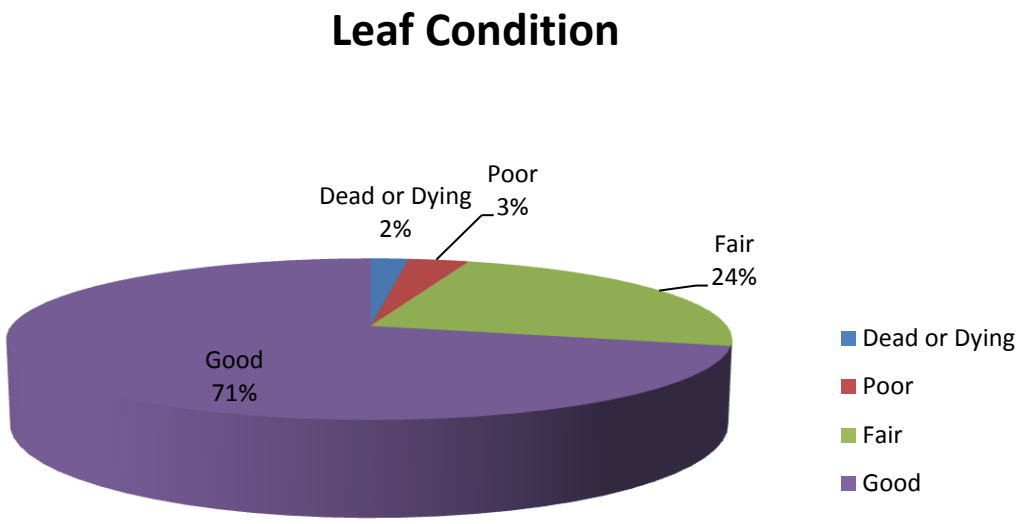

Figure 3: Foliage Condition

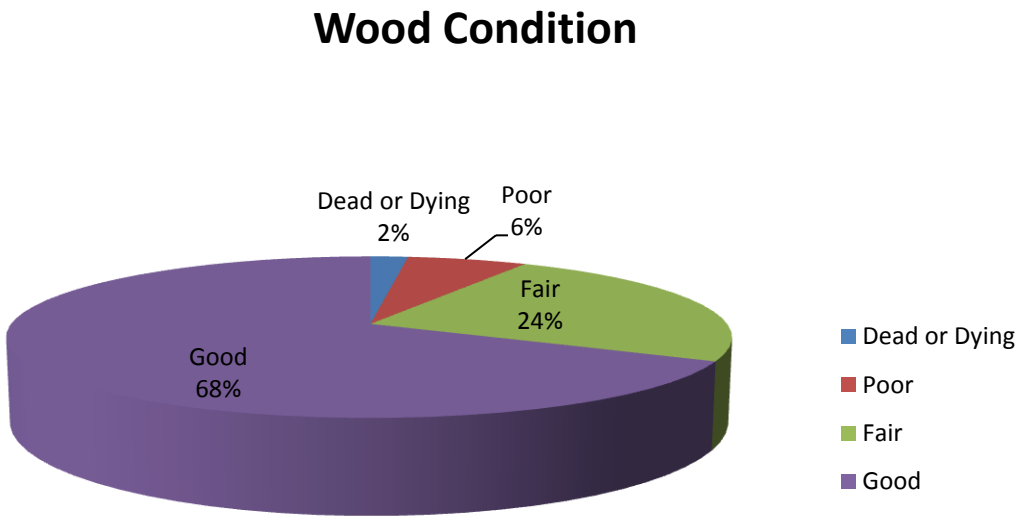

Figure 4: Wood Condition

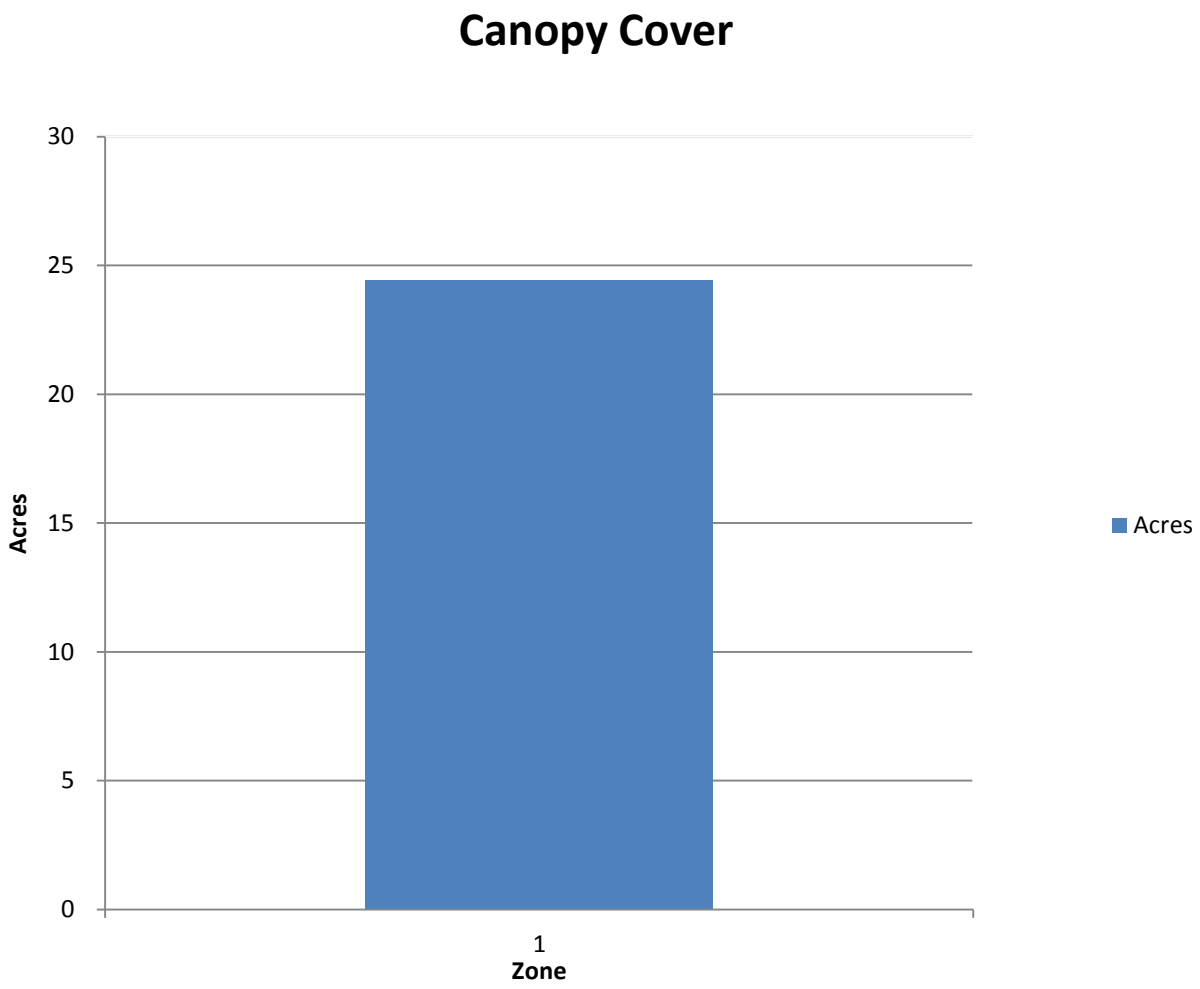

Figure 5: Canopy Cover in Acres

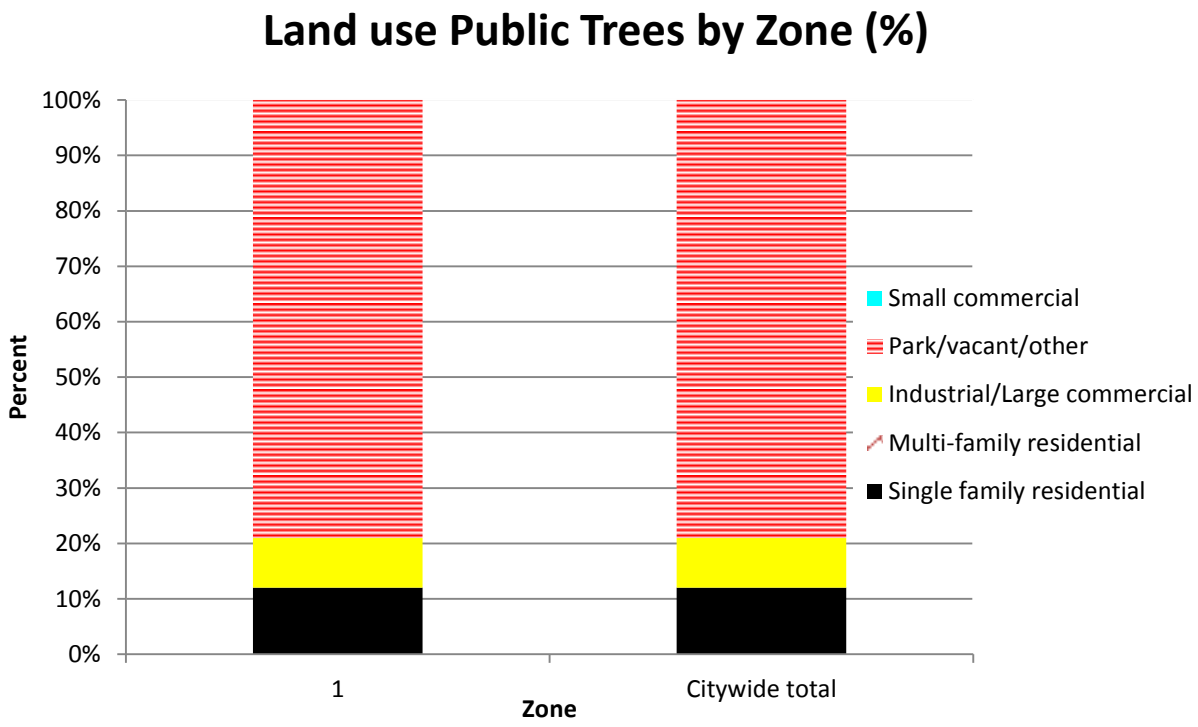

Figure 6: Land Use of city/park trees

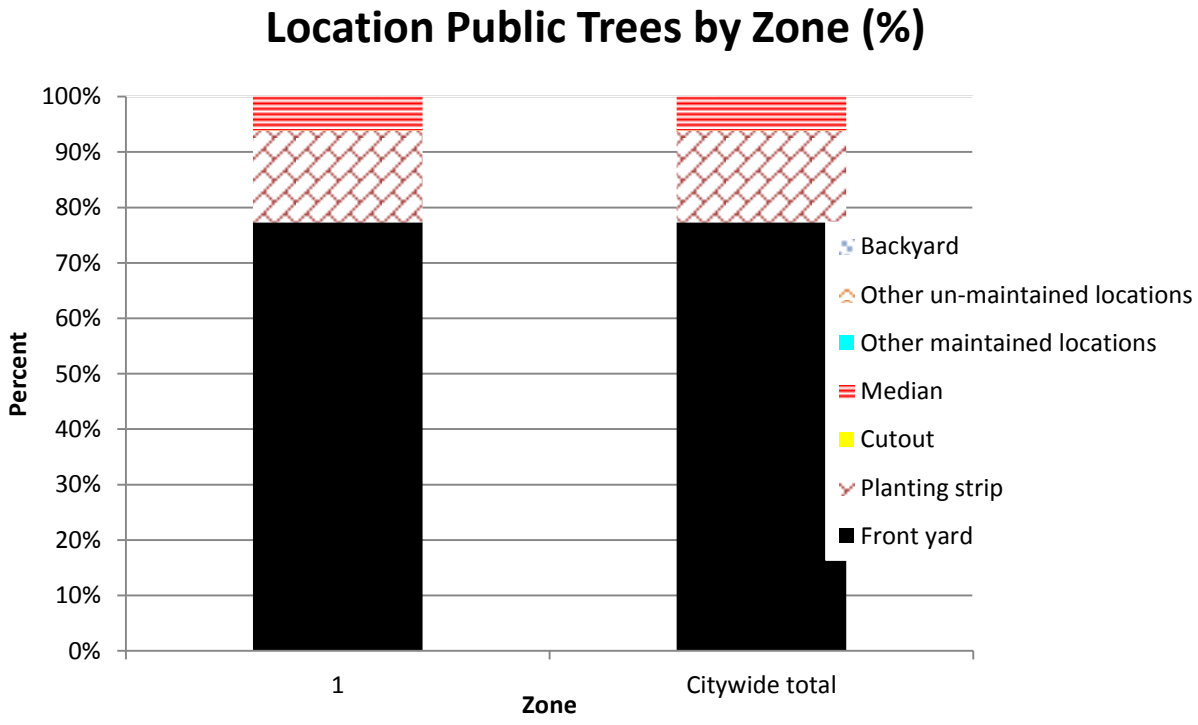

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

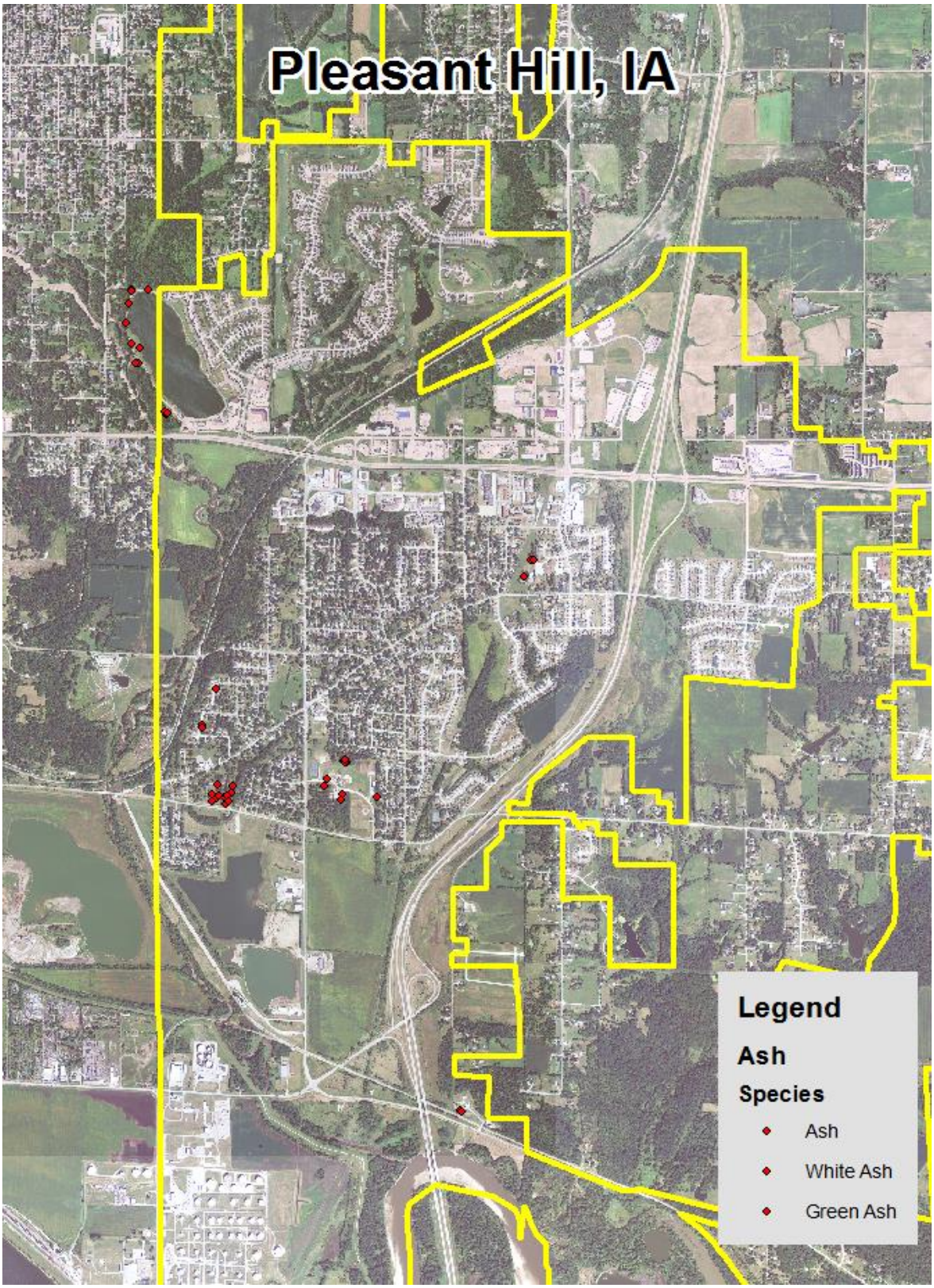

Figure 1: Location of Ash Trees

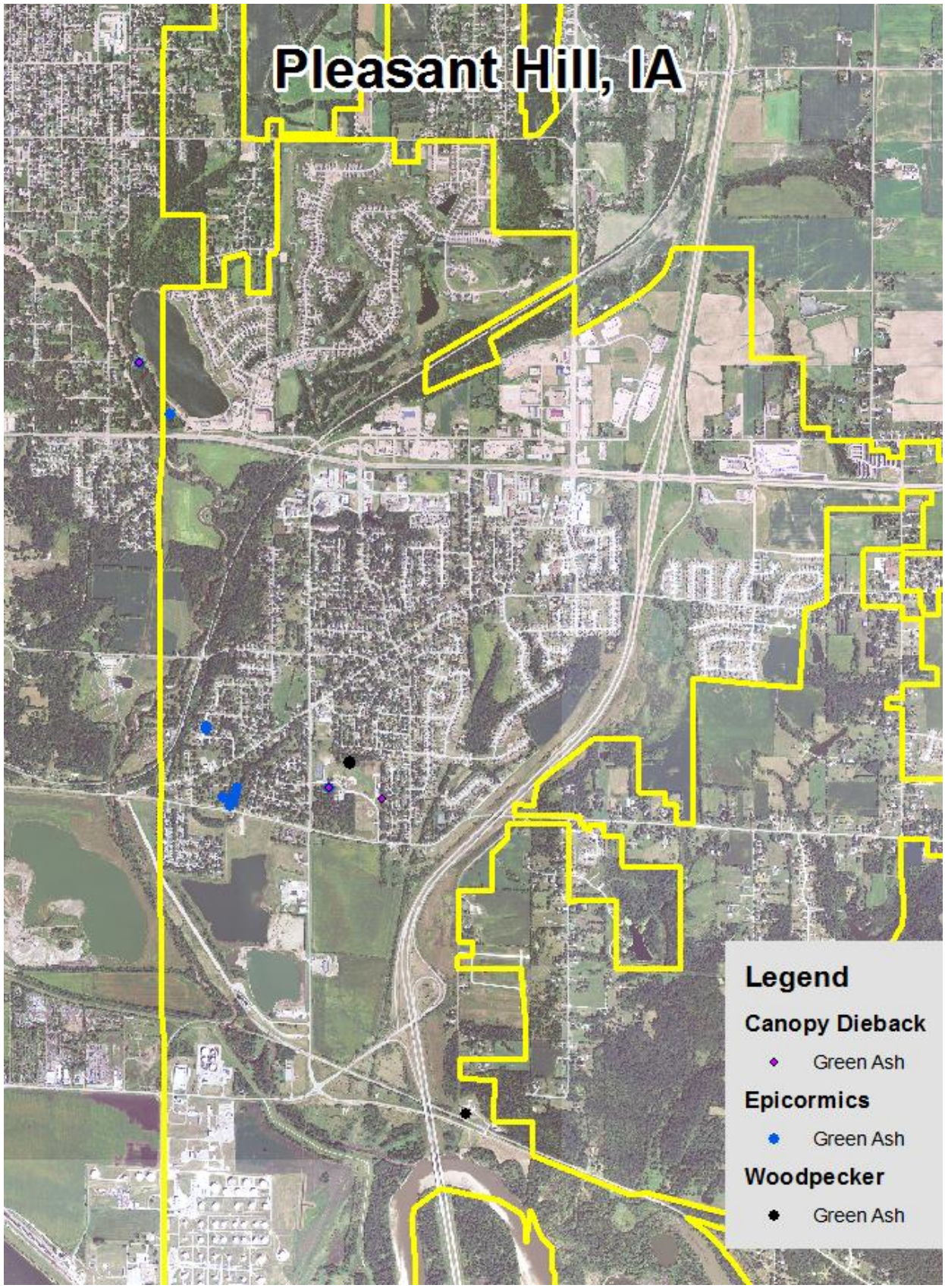

Figure 2: Location of EAB symptoms

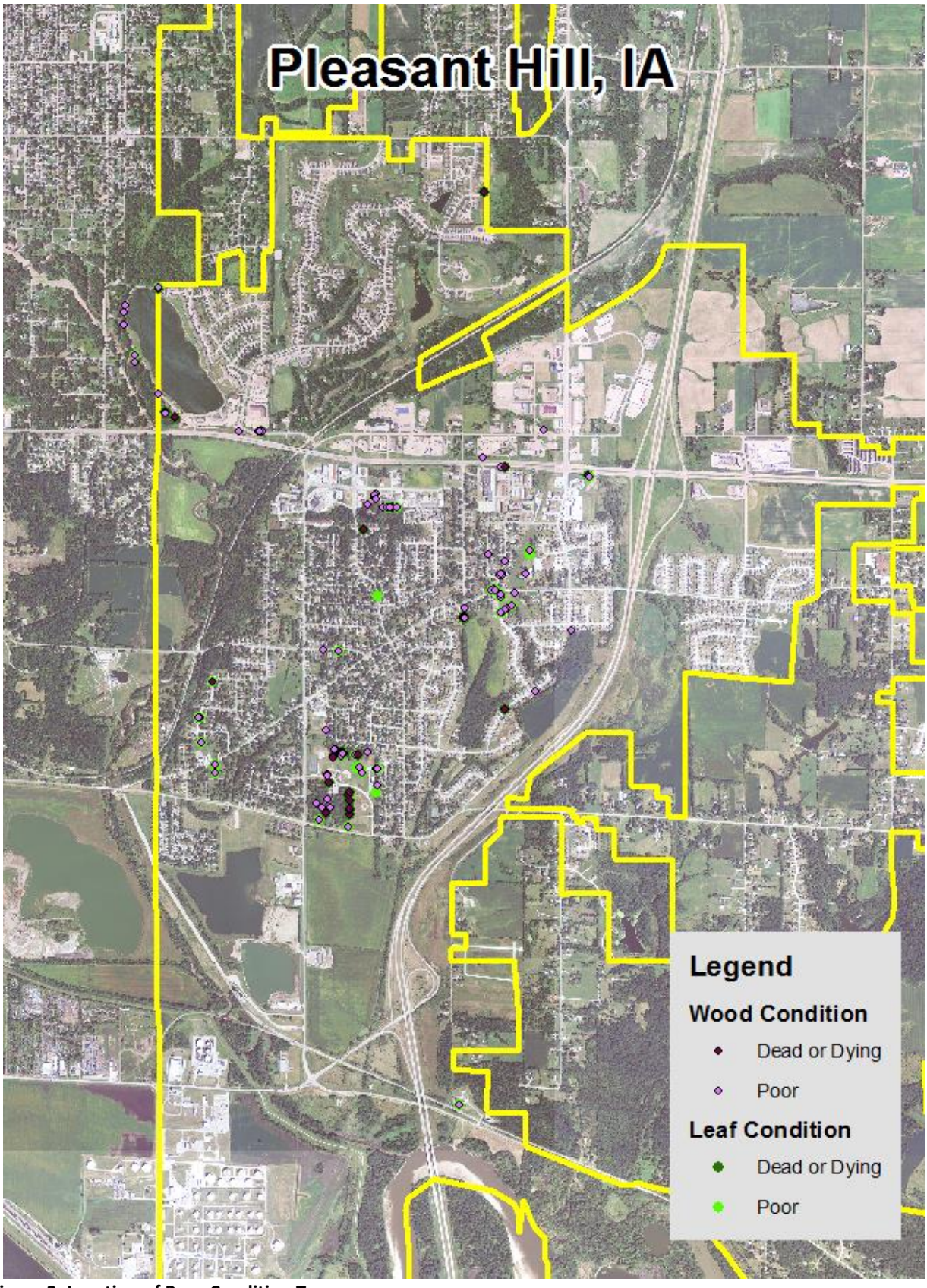

Figure 3: Location of Poor Condition Trees

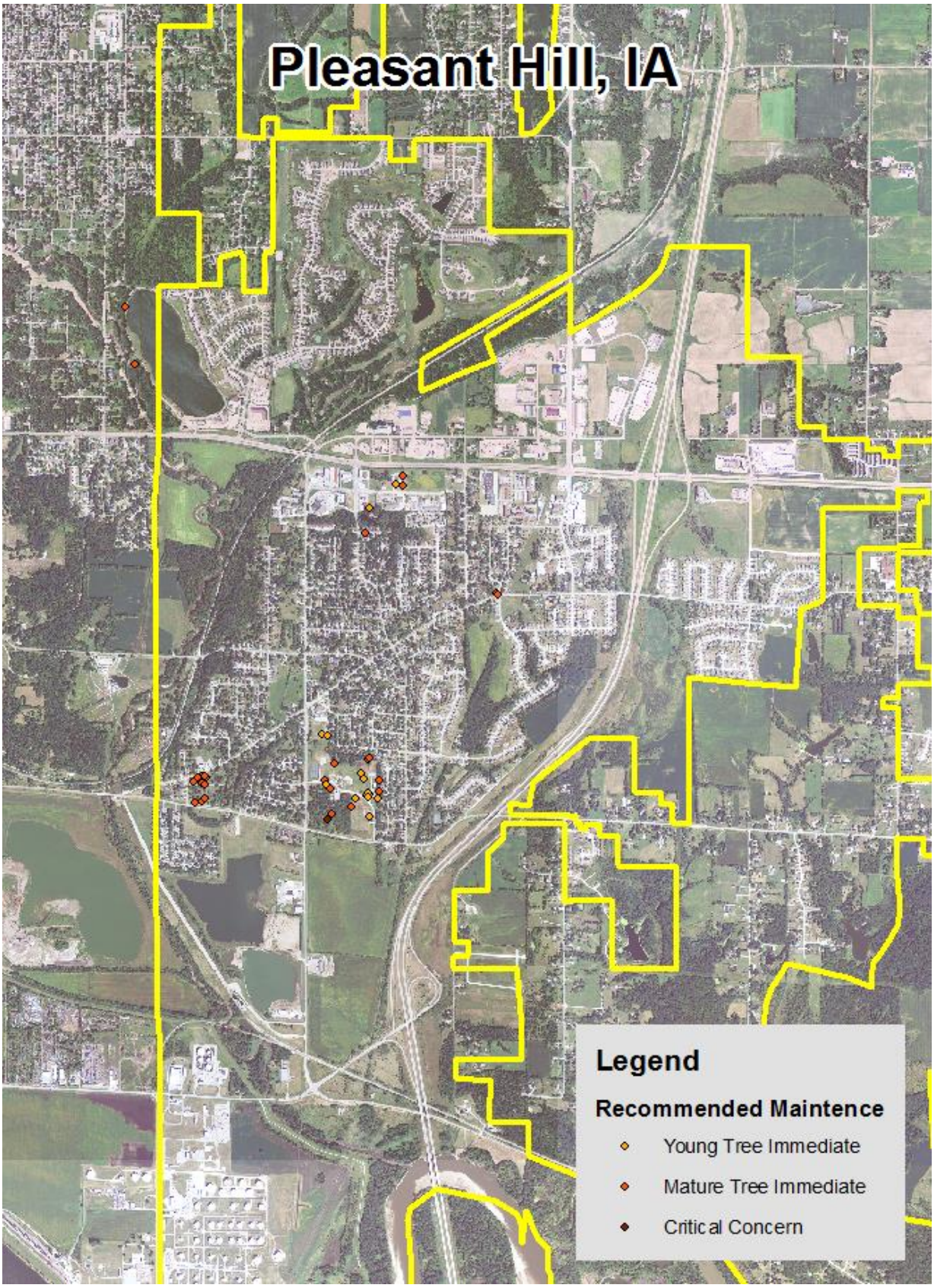

Figure 4: Location of Trees with Recommended Maintenance

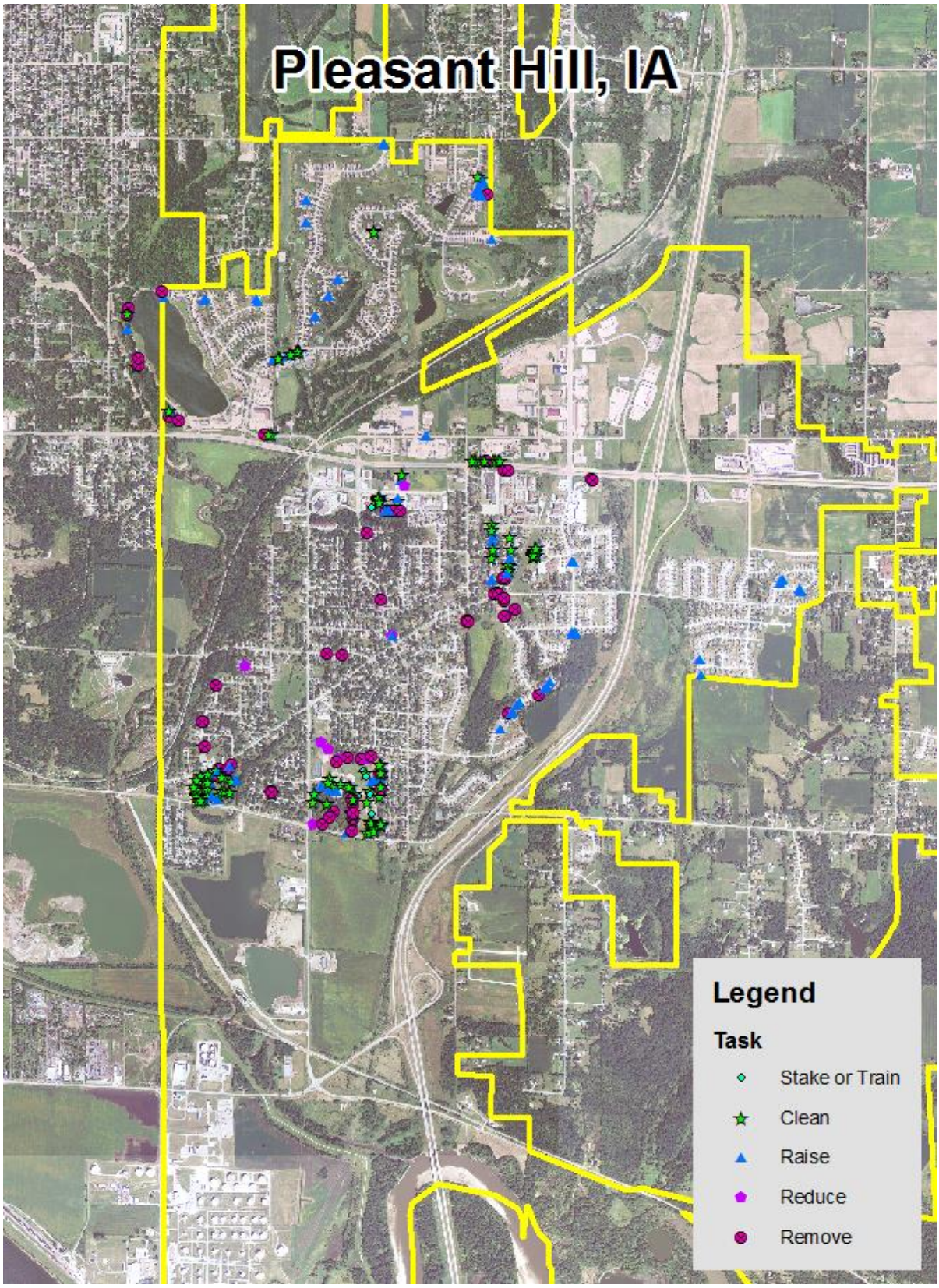

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

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

Appendix C: Pleasant Hill Tree Ordinances

CHAPTER 151
TREES AND GRASS

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

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