Livermore, IA

2018 Urban Forest Management Plan
Prepared by Emma Hanigan
Iowa Department of Natural Resources

Table of Contents

Executive Summary

Overview

This plan was developed to assist the City of Livermore with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 22% of Livermore'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 2017, 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 263 trees inventoried.

- Livermore's trees provide $45,756 of benefits annually, an average of $174 a tree
- There are over 26 species of trees
- The top three genera are: Maple 53%, Ash 22%, and Spruce 8%
- 8% of trees are in need of some type of management
- 16 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 16 trees needing removal, 1 tree is 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*
- 6 of the 58 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 37 years to remove ash – Suggestion: request a budget increase to $5,000 annually and apply for grants to plant replacement trees

Introduction

This plan was developed to assist Livermore 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 or treatment and replacement planting. With proper planning and management of the current canopy in Livermore, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

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

Inventory

In 2017, 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, 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 263 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Livermore's trees reduce energy related costs by approximately $13,424 annually (Appendix A, Table 1). These savings are both in Electricity (63 MWh) and in Natural Gas (8,820.6 Therms).

Annual Stormwater Benefits

Livermore's trees intercept about 652,992 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $17,696 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 Livermore, it is estimated that trees remove 835.1 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 $2,370 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Livermore, trees sequester about 112,748 lbs of carbon a year with an associated value of $1,552 (Appendix A, Table 5). In addition, the trees store 2,239,117 lbs of carbon, with a yearly benefit of $16,793 (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. Livermore receives $10,713 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STREETS analysis, Livermore's trees provide $45,756 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 263 trees in Livermore provide approximately $174 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Livermore has over 26 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genera is as follows:

Maple	140	53%

Ash	58	22%
Spruce	20	8%
Apple (crab)	14	5%
Hackberry	10	4%
Walnut	6	2%
Arborvitae	3	1%
Honey Locust	2	1%
Oak	2	1%
Linden	2	1%
Hickory	1	<1%
Catalpa	1	<1%
Cedar	1	<1%
Mulberry	1	<1%
Pine	1	<1%
Pear	1	<1%

Age Class

Most of Livermore's trees (37%) are between 12 and 12 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. Livermore's size curve peaks 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 Livermore indicate that 96% of the trees are in good health, with only 1% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Additionally, 28% of Livermore'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	5	2%
Crown Raising	0	0%
Tree Staking	0	0%
Tree Removal	16	6%
Crown Reduction	0	0%

Canopy Cover

The total canopy with both private and public trees is 21%, 95 acres. The canopy cover included in the Livermore inventory includes approximately 6 acres (Appendix A, Figure 4). The City's Canopy goal is to

increase canopy by 3%, in 30 years. To achieve this goal it is estimated that 33 additional trees need to be planted annually on public and private lands.

Land Use and Location

The majority of Livermore'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	70%
Park/vacant/other	0%
Industrial/Large commercial	25%
Small commercial	4%
Multifamily residential	0%

Location	
Planting strip	45%
Other maintained locations	0%
Cutout (surrounded by pavement)	0%
Front yard	55%

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

Livermore has no critical concern trees and 11 that need immediate removal. These trees 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, however there is only one tree 24 inches or larger. Please refer to the six year maintenance plan at the end of this section. After all of the immediate trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 10 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 16 removals, 2 are ash trees. There are a total of 58 ash trees, and 6 of those have one sign and symptom that have been associated with EAB. In addition, there are 5 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 Livermore.

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 (53%) (Appendix A, Figure 1). Maples 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 6-16-2 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 6-16-2 (Appendix C).

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.

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

Year 1

- Removal: 2 largest trees
- Planting and Replacement: 1 tree to be planted in open location
- Young Tree Pruning & Maintenance:
- Visual Survey for signs and symptoms of EAB

Year 2

- Removal: 1 critical concern trees and 4 additional ash trees with poor health
- Planting and Replacement: 2 trees in open locations from year one removals
- Young Tree Pruning & Maintenance: 2 trees
- Routine trimming: 1 tree

Visual Survey for signs and symptoms of EAB

Year 3
Removal: 2 largest trees
Planting and Replacement: 1 tree to be planted in open location
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 4
Removal: 1 critical concern trees and 4 additional ash trees with poor health
Planting and Replacement: 2 trees in open locations from year one removals
Young Tree Pruning & Maintenance: 2 trees
Routine trimming: 1 tree

Year 5
Removal: 2 largest trees
Planting and Replacement: 1 tree to be planted in open location
Young Tree Pruning & Maintenance:
Visual Survey for signs and symptoms of EAB

Year 6
Removal: 1 critical concern trees and 4 additional ash trees with poor health
Planting and Replacement: 2 trees in open locations from year one removals
Young Tree Pruning & Maintenance: 2 trees
Routine trimming: 1 tree

* It will take approximately 36 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 to 15 years of its arrival.
**To remove all ash trees within 6 years, the budget would need to be increased to $77,333 a year. If the budget were increased to $5,000 a year all ash could be removed in 18 years.

Emerald Ash Borer Plan

Ash Tree Removal

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

Treatment of Ash Trees

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

EAB Quarantines

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

A regulated article under the USDA's quarantine includes any of the following items:

- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

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

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance 6-16-2 (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Postponed Work

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

Monitoring

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

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used. City Code 6-16-6 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

Current Budget

Total $6,600 over 6 years ($1,100/year) – Not enough to cover the recommended maintenance (not including ash)

FY 2018 Budget

Removal: $1,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $100
Watering & Maintenance: $0

FY 2019 Budget

Removal: $500
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $100
Watering & Maintenance: $100

FY 2020 Budget

Removal: $1,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $100
Watering & Maintenance: $0

FY 2021 Budget

Removal: $500
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $100
Watering & Maintenance: $100

FY 2022 Budget

Removal: $1,000
*Or saving for ash tree treatment and/or future ash removal
Planting: $100
Watering & Maintenance: $0

FY 2023 Budget
Removal: $500
*Or saving for ash tree treatment and/or future ash removal
Planting: $300
Routine trimming: $100
Watering & Maintenance: $100

It will take approximately 37 years to remove all ash with the current budget.

Purposed Budget Increase
EAB could potentially kill all ash trees in Livermore within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to $77,333 a year. If the budget were increased to $5,000 a year all ash could be removed within 18 years. Additionally, it is recommended that Livermore 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.

Another option being considered by many communities is treating a number of selected trees, either to maintain those trees in the landscape or to delay their removal – to spread out the costs and number of trees needing removed all at once. Trunk injection is administered every two years for the life of the tree. If treatment is discontinued, the tree dies. For instance, in this treatment scenario, the average ash diameter is 20 inches and at $15 per inch, about 4 trees could be treated per year (every other year treatment). This would be 8 trees selected for treatment, and Livermore would still need to find $25,000 for removal. Alternatively, if there are 15 treatable trees, it would cost approximately $2,250 a year for treatment and leave $21,500 for removal. These are alternatives to straight removal of ash trees. However, whether or not the treatment option is selected, there will be an increased cost of dealing with ash trees if EAB is found in Livermore. It is suggested to consider increasing the budget to plan for this.

Works Cited

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

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

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

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

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

Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Livermore

Annual Energy Benefits of Public Trees

4/13/2018

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	31.3	2,378	4,482.8	4,393	6,771	(N/A)	43.7	50.4	58.88
Green ash	15.2	1,152	2,065.7	2,024	3,177	(N/A)	21.7	23.7	55.73
Apple	1.2	88	180.3	177	265	(N/A)	5.3	2.0	18.90
Silver maple	3.4	261	451.6	443	704	(N/A)	3.8	5.2	70.38
Northern hackberry	4.1	312	583.7	572	884	(N/A)	3.8	6.6	88.38
Black spruce	1.0	77	121.5	119	196	(N/A)	3.0	1.5	24.51
Norway spruce	0.4	29	60.1	59	88	(N/A)	2.7	0.7	12.57
Sugar maple	0.5	41	78.7	77	118	(N/A)	2.3	0.9	19.71
Maple	1.0	77	145.8	143	220	(N/A)	2.3	1.6	36.61
Black walnut	1.8	137	250.6	246	383	(N/A)	2.3	2.9	63.79
Northern white cedar	0.1	5	11.9	12	17	(N/A)	1.1	0.1	5.61
Spruce	0.1	10	16.0	16	26	(N/A)	1.1	0.2	8.66
Honeylocust	0.6	49	80.8	79	128	(N/A)	0.8	1.0	64.02
Red maple	0.0	1	1.5	1	2	(N/A)	0.8	0.0	1.03
Blue spruce	0.2	12	20.0	20	31	(N/A)	0.8	0.2	15.73
Pear	0.0	0	0.6	1	1	(N/A)	0.4	0.0	0.87
White ash	0.0	2	4.2	4	7	(N/A)	0.4	0.0	6.65
Eastern red cedar	0.1	8	16.4	16	25	(N/A)	0.4	0.2	24.57
Littleleaf linden	0.2	15	23.9	23	39	(N/A)	0.4	0.3	38.70
Mulberry	0.1	6	12.8	13	18	(N/A)	0.4	0.1	18.19
Boxelder	0.2	15	23.9	23	39	(N/A)	0.4	0.3	38.63
Catalpa	0.2	18	27.0	26	44	(N/A)	0.4	0.3	44.23
American basswood	0.3	23	44.7	44	67	(N/A)	0.4	0.5	66.72
Eastern white pine	0.2	14	24.6	24	38	(N/A)	0.4	0.3	38.17
Northern red oak	0.2	16	30.6	30	46	(N/A)	0.4	0.3	46.28
Hickory	0.1	7	13.7	13	21	(N/A)	0.4	0.2	20.64
Bur oak	0.3	25	46.9	46	71	(N/A)	0.4	0.5	70.91
Total	63.0	4,780	8,820.6	8,644	13,424	(N/A)	100.0	100.0	51.04

Table 2: Annual Stormwater Benefits

Livermore

Annual Stormwater Benefits of Public Trees

4/13/2018

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	308,550	8,362	(N/A)	43.7	47.3	72.71
Green ash	161,571	4,379	(N/A)	21.7	24.7	76.82
Apple	5,029	136	(N/A)	5.3	0.8	9.73
Silver maple	51,822	1,404	(N/A)	3.8	7.9	140.44
Northern hackberry	46,070	1,249	(N/A)	3.8	7.1	124.85
Black spruce	12,355	335	(N/A)	3.0	1.9	41.85
Norway spruce	5,394	146	(N/A)	2.7	0.8	20.88
Sugar maple	2,872	78	(N/A)	2.3	0.4	12.97
Maple	8,235	223	(N/A)	2.3	1.3	37.20
Black walnut	20,023	543	(N/A)	2.3	3.1	90.44
Northern white cedar	638	17	(N/A)	1.1	0.1	5.77
Spruce	1,636	44	(N/A)	1.1	0.3	14.78
Honeylocust	6,242	169	(N/A)	0.8	1.0	84.57
Red maple	23	1	(N/A)	0.8	0.0	0.32
Blue spruce	1,801	49	(N/A)	0.8	0.3	24.40
Pear	7	0	(N/A)	0.4	0.0	0.20
White ash	163	4	(N/A)	0.4	0.0	4.43
Eastern red cedar	1,635	44	(N/A)	0.4	0.3	44.30
Littleleaf linden	1,260	34	(N/A)	0.4	0.2	34.14
Mulberry	264	7	(N/A)	0.4	0.0	7.17
Boxelder	1,456	39	(N/A)	0.4	0.2	39.46
Catalpa	1,466	40	(N/A)	0.4	0.2	39.72
American basswood	3,285	89	(N/A)	0.4	0.5	89.02
Eastern white pine	4,605	125	(N/A)	0.4	0.7	124.79
Northern red oak	2,039	55	(N/A)	0.4	0.3	55.25
Hickory	608	16	(N/A)	0.4	0.1	16.47
Bur oak	3,943	107	(N/A)	0.4	0.6	106.85
Citywide total	652,992	17,696	(N/A)	100.0	100.0	67.29

Table 3: Annual Air Quality Benefits

Livermore

Annual Air Quality Benefits of Public Trees

4/13/2018

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								
Norway maple	65.5	11.3	31.9	2.9	353	151.6	21.9	20.9	142.1	940	-15.1	-57	433.0	1,236	(N/A)	43.7	10.75
Green ash	19.2	3.1	9.3	0.9	103	72.4	10.5	10.1	68.8	451	0.0	0	194.3	554	(N/A)	21.7	9.72
Apple	1.5	0.2	0.7	0.1	8	5.7	0.8	0.8	5.2	35	0.0	0	15.1	43	(N/A)	5.3	3.07
Silver maple	9.0	1.5	4.4	0.4	49	16.2	2.4	2.3	15.6	101	-4.5	-17	47.3	133	(N/A)	3.8	13.33
Northern hackberry	7.8	1.4	3.9	0.4	42	19.8	2.9	2.7	18.6	123	0.0	0	57.5	166	(N/A)	3.8	16.55
Black spruce	1.5	0.3	1.3	0.2	10	4.7	0.7	0.7	4.6	30	-4.4	-17	9.5	23	(N/A)	3.0	2.89
Norway spruce	0.5	0.1	0.5	0.1	4	1.9	0.3	0.3	1.7	12	-2.0	-8	3.3	8	(N/A)	2.7	1.08
Sugar maple	0.2	0.0	0.1	0.0	1	2.6	0.4	0.4	2.5	16	-0.2	-1	6.0	17	(N/A)	2.3	2.77
Maple	1.8	0.3	0.9	0.1	10	4.9	0.7	0.7	4.6	30	-0.6	-2	13.3	38	(N/A)	2.3	6.27
Black walnut	2.4	0.4	1.2	0.1	13	8.7	1.3	1.2	8.2	54	0.0	0	23.4	67	(N/A)	2.3	11.13
Northern white cedar	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	2	(N/A)	1.1	0.56
Spruce	0.2	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.6	-2	1.2	3	(N/A)	1.1	0.97
Honeylocust	1.2	0.2	0.5	0.1	6	3.0	0.4	0.4	2.9	19	-0.9	-3	7.9	22	(N/A)	0.8	10.89
Red maple	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)	0.8	0.13
Blue spruce	0.2	0.0	0.2	0.0	1	0.7	0.1	0.1	0.7	5	-0.6	-2	1.5	4	(N/A)	0.8	1.82
Pear	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)	0.4	0.11
White ash	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.1	1	0.0	0	0.4	1	(N/A)	0.4	0.99
Eastern red cedar	0.3	0.1	0.3	0.0	2	0.5	0.1	0.1	0.5	3	-0.9	-3	1.0	2	(N/A)	0.4	2.19
Littleleaf linden	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	-0.1	0	2.3	6	(N/A)	0.4	6.42
Mulberry	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	3	(N/A)	0.4	2.55
Boxelder	0.1	0.0	0.1	0.0	1	0.9	0.1	0.1	0.9	6	-0.1	0	2.3	6	(N/A)	0.4	6.37
Catalpa	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)	0.4	7.42
American basswood	0.4	0.1	0.2	0.0	2	1.5	0.2	0.2	1.4	9	-0.4	-1	3.6	10	(N/A)	0.4	10.02
Eastern white pine	0.6	0.1	0.4	0.1	4	0.9	0.1	0.1	0.8	5	-2.9	-11	0.3	-2	(N/A)	0.4	-1.58
Northern red oak	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	1.0	6	-0.6	-2	2.4	7	(N/A)	0.4	6.50
Hickory	0.0	0.0	0.0	0.0	0	0.5	0.1	0.1	0.4	3	0.0	0	1.1	3	(N/A)	0.4	2.99
Bur oak	0.5	0.1	0.2	0.0	3	1.6	0.2	0.2	1.5	10	0.0	0	4.4	12	(N/A)	0.4	12.48
Citywide total	113.8	19.4	56.7	5.3	617	302.6	43.9	41.9	285.5	1,881	-34.0	-128	835.1	2,370	(N/A)	100.0	9.01

Table 4: Annual Carbon Stored

Livermore

Stored CO2 Benefits of Public Trees

4/13/2018

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	1,080,880	8,107	(N/A)	43.7	48.3	70.49
Green ash	624,984	4,687	(N/A)	21.7	27.9	82.23
Apple	23,930	179	(N/A)	5.3	1.1	12.82
Silver maple	191,644	1,437	(N/A)	3.8	8.6	143.73
Northern hackberry	121,793	913	(N/A)	3.8	5.4	91.34
Black spruce	8,946	67	(N/A)	3.0	0.4	8.39
Norway spruce	4,227	32	(N/A)	2.7	0.2	4.53
Sugar maple	5,722	43	(N/A)	2.3	0.3	7.15
Maple	20,293	152	(N/A)	2.3	0.9	25.37
Black walnut	78,076	586	(N/A)	2.3	3.5	97.59
Northern white cedar	115	1	(N/A)	1.1	0.0	0.29
Spruce	1,175	9	(N/A)	1.1	0.1	2.94
Honeylocust	15,282	115	(N/A)	0.8	0.7	57.31
Red maple	34	0	(N/A)	0.8	0.0	0.13
Blue spruce	1,161	9	(N/A)	0.8	0.1	4.35
Pear	14	0	(N/A)	0.4	0.0	0.10
White ash	185	1	(N/A)	0.4	0.0	1.39
Eastern red cedar	1,102	8	(N/A)	0.4	0.0	8.27
Littleleaf linden	3,595	27	(N/A)	0.4	0.2	26.96
Mulberry	908	7	(N/A)	0.4	0.0	6.81
Boxelder	3,624	27	(N/A)	0.4	0.2	27.18
Catalpa	3,672	28	(N/A)	0.4	0.2	27.54
American basswood	15,239	114	(N/A)	0.4	0.7	114.29
Eastern white pine	7,490	56	(N/A)	0.4	0.3	56.18
Northern red oak	8,218	62	(N/A)	0.4	0.4	61.63
Hickory	1,035	8	(N/A)	0.4	0.0	7.76
Bur oak	15,773	118	(N/A)	0.4	0.7	118.30
Citywide total	2,239,117	16,793	(N/A)	100.0	100.0	63.85

Table 5: Annual Carbon Sequestered

Livermore

Annual CO Benefits of Public Trees

4/13/2018

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
Norway maple	39,494	296	-5,189	-329	-41	52,556	394	86,532	649 (N/A)	43.7	41.8	5.64
Green ash	36,113	271	-3,000	-157	-24	25,464	191	58,420	438 (N/A)	21.7	28.2	7.69
Apple	1,638	12	-115	-18	-1	1,943	15	3,449	26 (N/A)	5.3	1.7	1.85
Silver maple	14,428	108	-920	-38	-7	5,772	43	19,242	144 (N/A)	3.8	9.3	14.43
Northern hackberry	5,760	43	-585	-41	-5	6,891	52	12,027	90 (N/A)	3.8	5.8	9.02
Black spruce	726	5	-43	-16	0	1,703	13	2,370	18 (N/A)	3.0	1.1	2.22
Norway spruce	399	3	-20	-8	0	643	5	1,014	8 (N/A)	2.7	0.5	1.09
Sugar maple	804	6	-28	-6	0	909	7	1,679	13 (N/A)	2.3	0.8	2.10
Maple	2,508	19	-97	-10	-1	1,696	13	4,096	31 (N/A)	2.3	2.0	5.12
Black walnut	4,438	33	-375	-19	-3	3,030	23	7,075	53 (N/A)	2.3	3.4	8.84
Northern white cedar	54	0	-1	-2	0	113	1	165	1 (N/A)	1.1	0.1	0.41
Spruce	123	1	-6	-2	0	229	2	343	3 (N/A)	1.1	0.2	0.86
Honeylocust	1,960	15	-73	-5	-1	1,081	8	2,963	22 (N/A)	0.8	1.4	11.11
Red maple	6	0	0	0	0	14	0	19	0 (N/A)	0.8	0.0	0.07
Blue spruce	103	1	-6	-3	0	261	2	356	3 (N/A)	0.8	0.2	1.33
Pear	9	0	0	0	0	6	0	14	0 (N/A)	0.4	0.0	0.10
White ash	65	0	-1	-1	0	55	0	119	1 (N/A)	0.4	0.1	0.89
Eastern red cedar	0	0	-5	-2	0	187	1	180	1 (N/A)	0.4	0.1	1.35
Littleleaf linden	514	4	-17	-2	0	337	3	832	6 (N/A)	0.4	0.4	6.24
Mulberry	114	1	-4	-1	0	124	1	232	2 (N/A)	0.4	0.1	1.74
Boxelder	418	3	-17	-2	0	336	3	735	6 (N/A)	0.4	0.4	5.51
Catalpa	445	3	-18	-2	0	393	3	819	6 (N/A)	0.4	0.4	6.14
American basswood	925	7	-73	-4	-1	505	4	1,353	10 (N/A)	0.4	0.7	10.15
Eastern white pine	256	2	-36	-4	0	311	2	528	4 (N/A)	0.4	0.3	3.96
Northern red oak	382	3	-39	-3	0	360	3	700	5 (N/A)	0.4	0.3	5.25
Hickory	209	2	-5	-1	0	159	1	361	3 (N/A)	0.4	0.2	2.71
Bur oak	857	6	-76	-4	-1	552	4	1,330	10 (N/A)	0.4	0.6	9.97
Citywide total	112,748	846	-10,750	-677	-86	105,631	792	206,951	1,552 (N/A)	100.0	100.0	5.90

Table 6: Annual Social and Aesthetic Benefits

Livermore

Annual Aesthetic/Other Benefits of Public Trees

4/13/2018

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	3,672	(N/A)	43.7	34.3	31.93
Green ash	3,044	(N/A)	21.7	28.4	53.40
Apple	94	(N/A)	5.3	0.9	6.69
Silver maple	1,114	(N/A)	3.8	10.4	111.37
Northern hackberry	694	(N/A)	3.8	6.5	69.38
Black spruce	202	(N/A)	3.0	1.9	25.23
Norway spruce	114	(N/A)	2.7	1.1	16.26
Sugar maple	114	(N/A)	2.3	1.1	18.98
Maple	337	(N/A)	2.3	3.2	56.25
Black walnut	359	(N/A)	2.3	3.4	59.84
Northern white cedar	21	(N/A)	1.1	0.2	6.83
Spruce	44	(N/A)	1.1	0.4	14.61
Honeylocust	492	(N/A)	0.8	4.6	245.80
Red maple	0	(N/A)	0.8	0.0	0.04
Blue spruce	38	(N/A)	0.8	0.4	18.77
Pear	0	(N/A)	0.4	0.0	0.03
White ash	13	(N/A)	0.4	0.1	12.76
Eastern red cedar	0	(N/A)	0.4	0.0	0.00
Littleleaf linden	55	(N/A)	0.4	0.5	55.09
Mulberry	6	(N/A)	0.4	0.1	6.40
Boxelder	39	(N/A)	0.4	0.4	39.36
Catalpa	46	(N/A)	0.4	0.4	45.86
American basswood	70	(N/A)	0.4	0.7	69.73
Eastern white pine	26	(N/A)	0.4	0.2	26.25
Northern red oak	27	(N/A)	0.4	0.3	27.47
Hickory	29	(N/A)	0.4	0.3	28.56
Bur oak	66	(N/A)	0.4	0.6	65.59
Citywide total	10,713	(N/A)	100.0	100.0	40.74

Table 7: Summary of Benefits in Dollars

Livermore

Total Annual Benefits of Public Trees by Species ($)

4/13/2018

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Norway maple	6,771	649	1,236	8,362	3,672	20,689	(N/A)	45.2
Green ash	3,177	438	554	4,379	3,044	11,591	(N/A)	25.3
Apple	265	26	43	136	94	564	(N/A)	1.2
Silver maple	704	144	133	1,404	1,114	3,500	(N/A)	7.6
Northern hackberry	884	90	166	1,249	694	3,082	(N/A)	6.7
Black spruce	196	18	23	335	202	774	(N/A)	1.7
Norway spruce	88	8	8	146	114	363	(N/A)	0.8
Sugar maple	118	13	17	78	114	339	(N/A)	0.7
Maple	220	31	38	223	337	849	(N/A)	1.9
Black walnut	383	53	67	543	359	1,404	(N/A)	3.1
Northern white cedar	17	1	2	17	21	58	(N/A)	0.1
Spruce	26	3	3	44	44	120	(N/A)	0.3
Honeylocust	128	22	22	169	492	833	(N/A)	1.8
Red maple	2	0	0	1	0	3	(N/A)	0.0
Blue spruce	31	3	4	49	38	124	(N/A)	0.3
Pear	1	0	0	0	0	1	(N/A)	0.0
White ash	7	1	1	4	13	26	(N/A)	0.1
Eastern red cedar	25	1	2	44	0	72	(N/A)	0.2
Littleleaf linden	39	6	6	34	55	141	(N/A)	0.3
Mulberry	18	2	3	7	6	36	(N/A)	0.1
Boxelder	39	6	6	39	39	129	(N/A)	0.3
Catalpa	44	6	7	40	46	143	(N/A)	0.3
American basswood	67	10	10	89	70	246	(N/A)	0.5
Eastern white pine	38	4	-2	125	26	192	(N/A)	0.4
Northern red oak	46	5	7	55	27	141	(N/A)	0.3
Hickory	21	3	3	16	29	71	(N/A)	0.2
Bur oak	71	10	12	107	66	266	(N/A)	0.6
Citywide Total	13,424	1,552	2,370	17,696	10,713	45,756	(N/A)	100.0

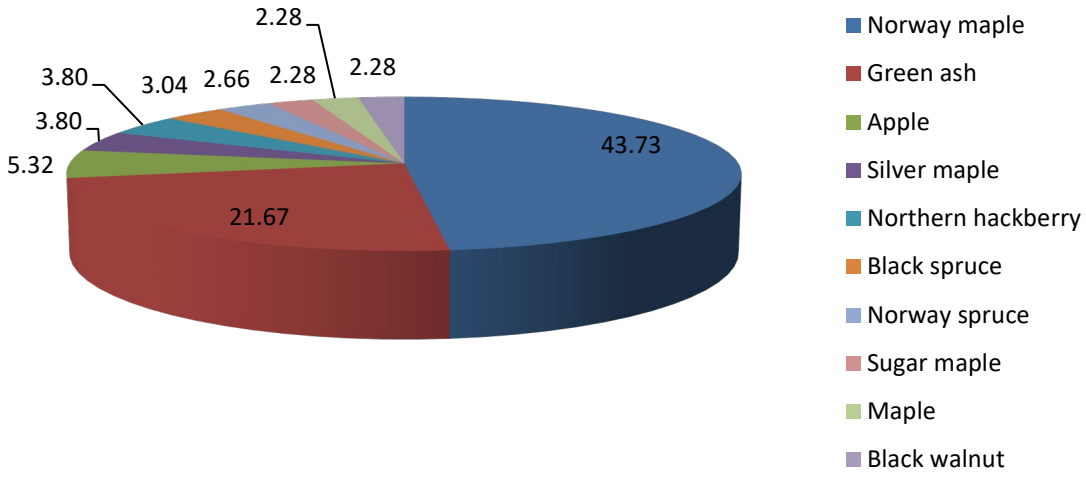

Figure 1: Species Distribution

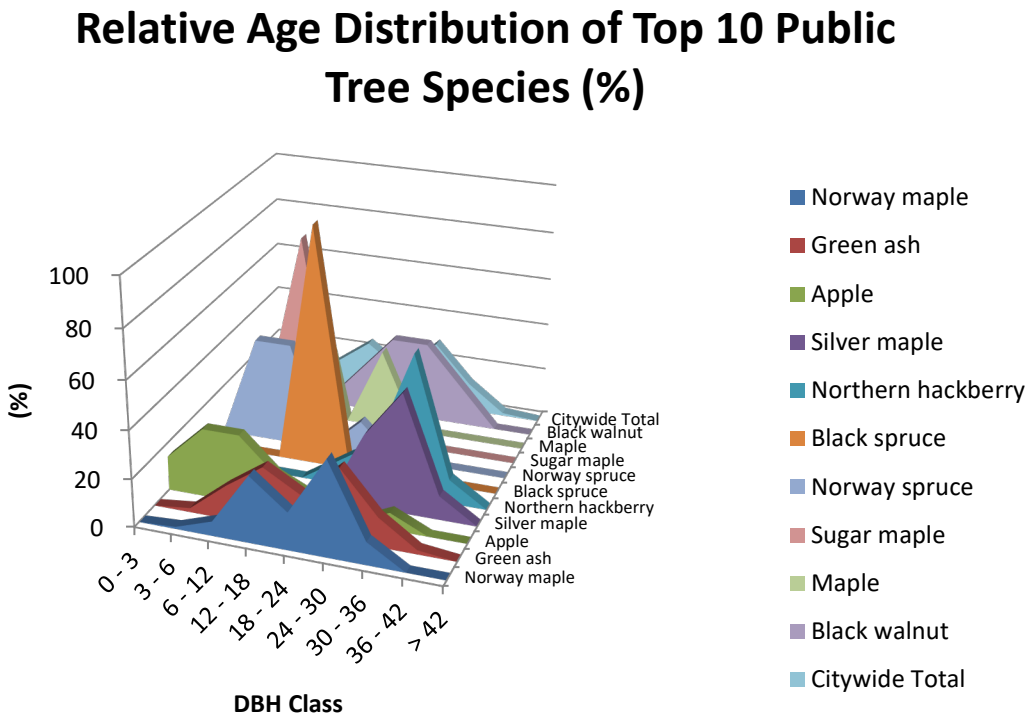

Figure 2: Relative Age Class

Figure 3: Foliage Condition

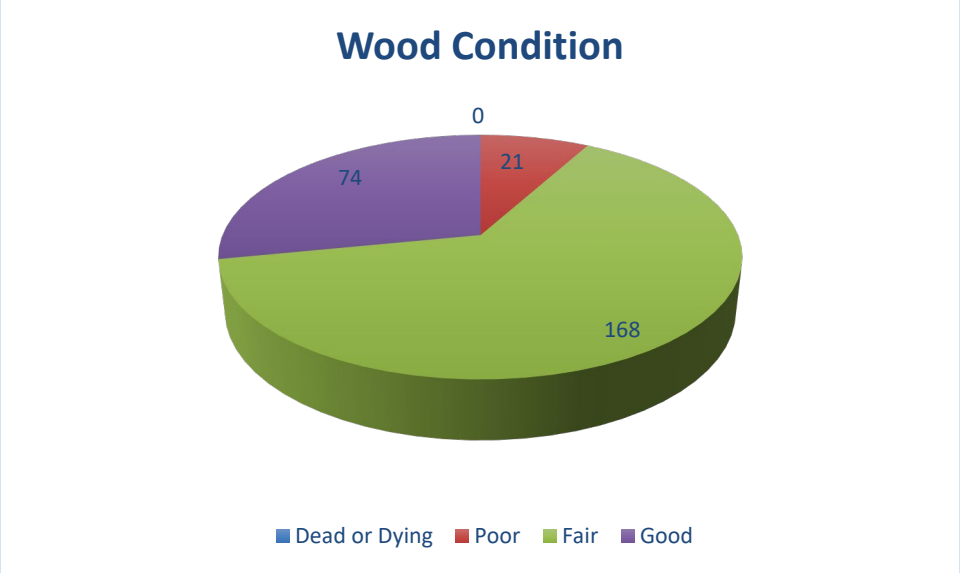

Figure 4: Wood Condition

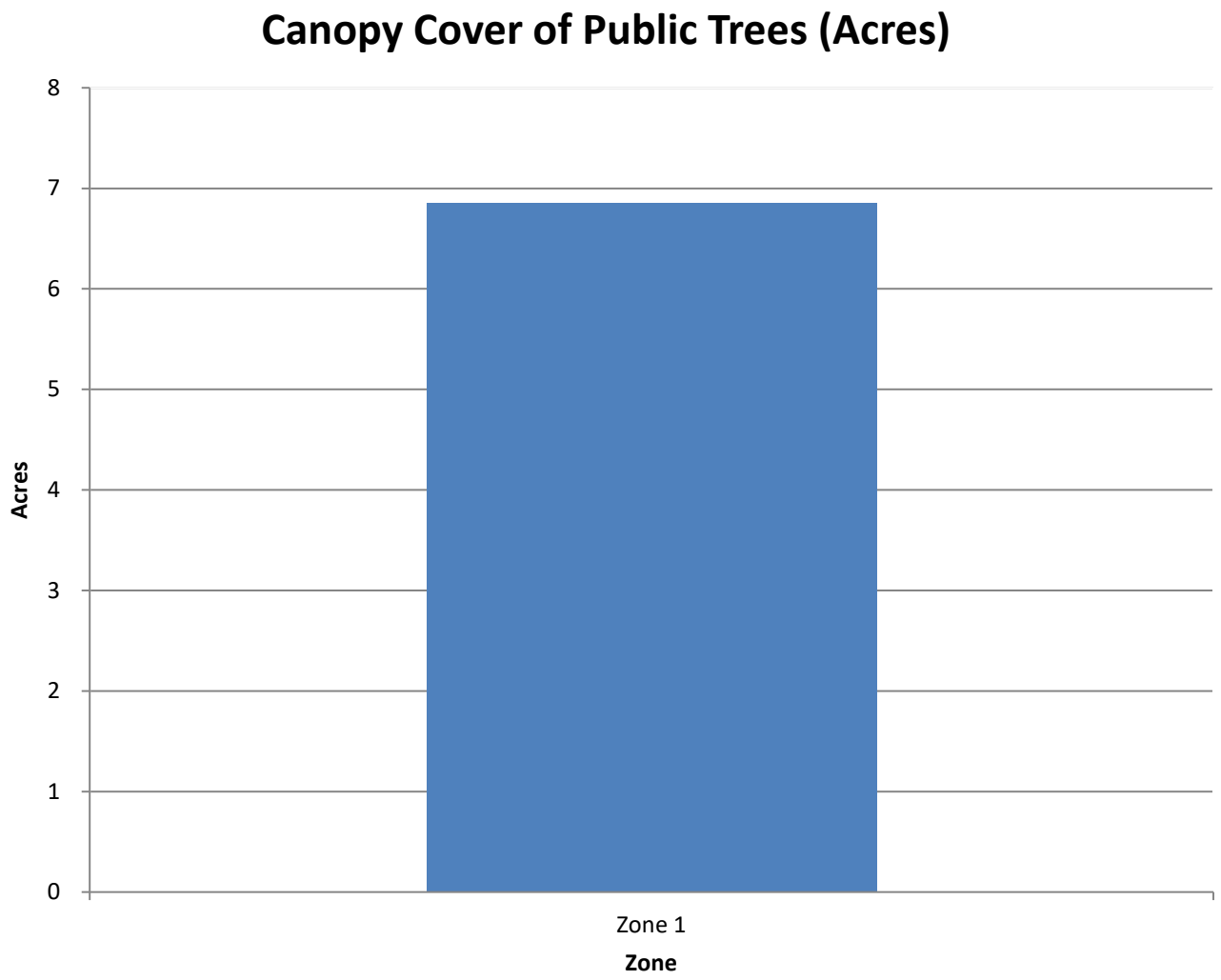

Figure 5: Canopy Cover in Acres

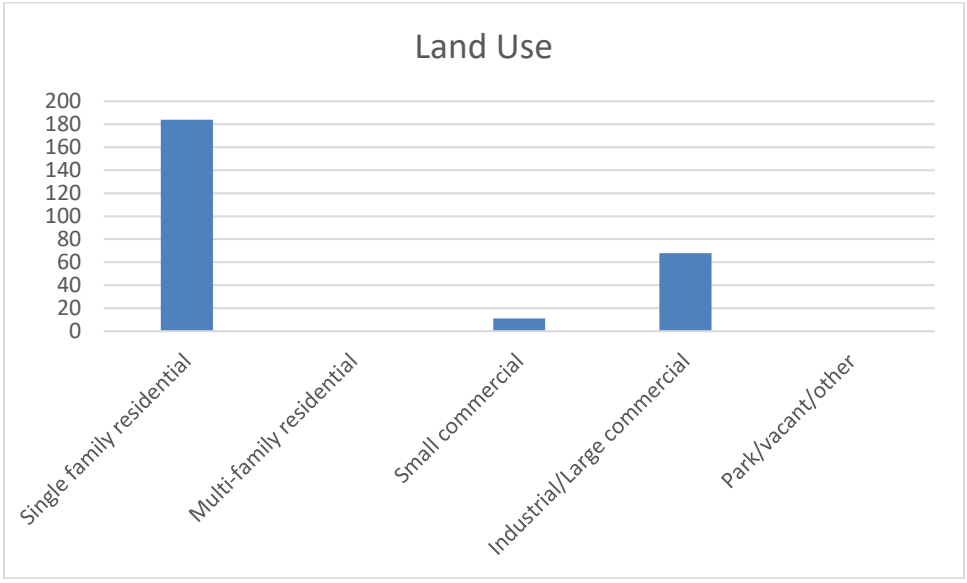

Figure 6: Land Use of city/park trees

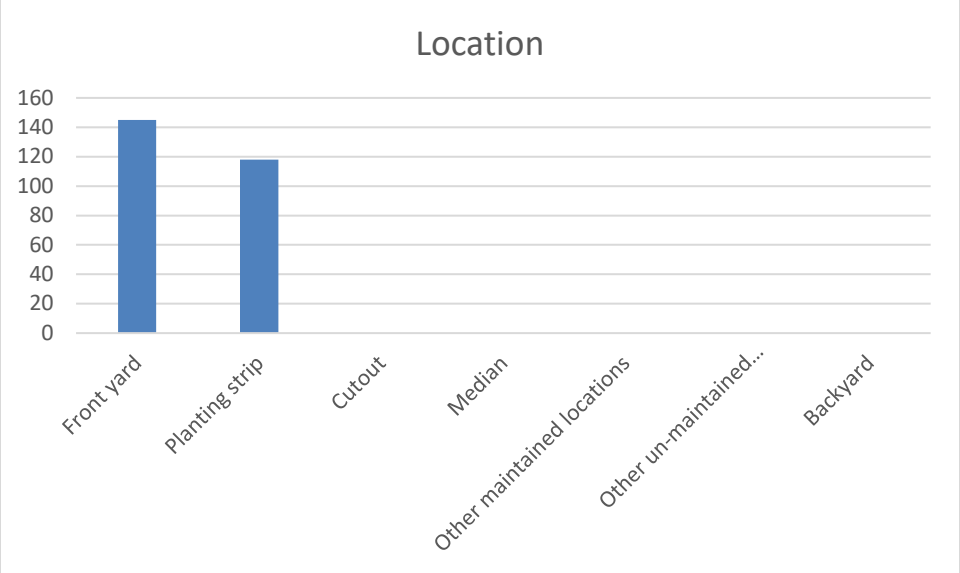

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

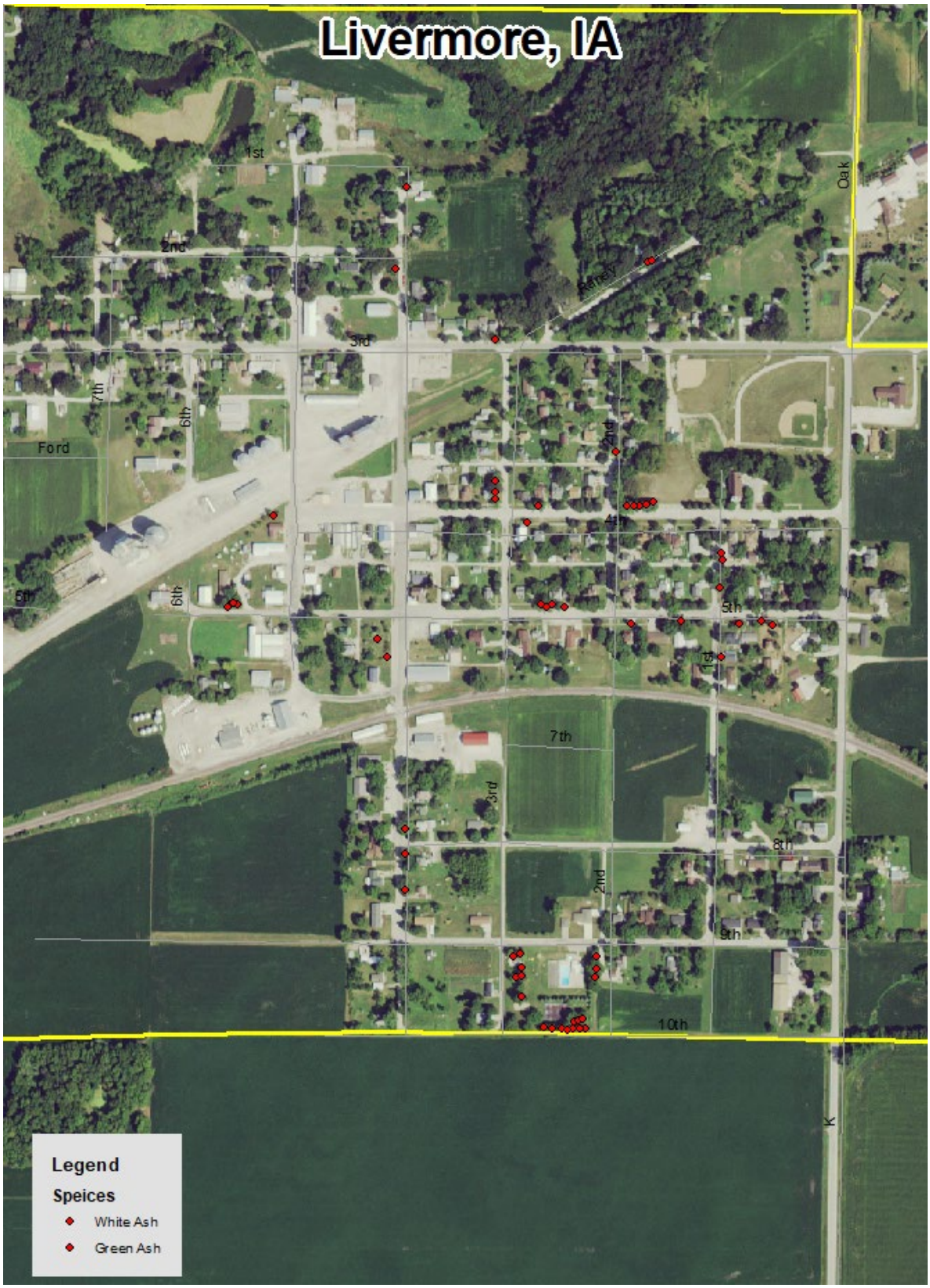

Figure 1: Location of Ash Trees

Figure 2: Location of EAB symptoms

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

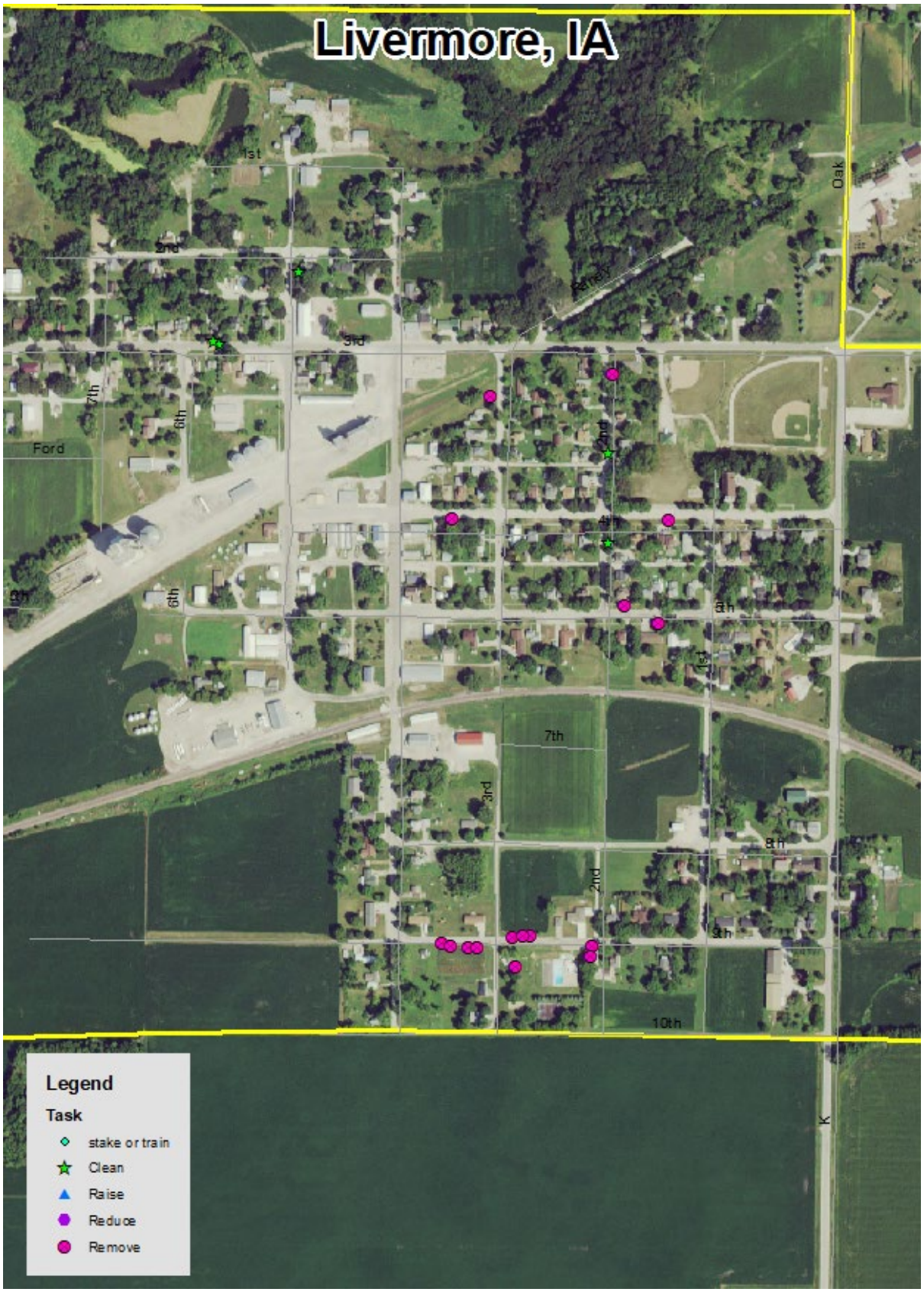

Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

TITLE VI PHYSICAL ENVIRONMENT

CHAPTER 16 TREES

6-16-1 DEFINITION. For use in this chapter, "parking" means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

6-16-2 PLANTING RESTRICTIONS. No tree shall be planted in any parking or street except in accordance with the following:

1. Alignment. All trees planted in any street shall be planted in the parking midway between the outer line of the sidewalk and the curb. 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 parking 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.

6-16-3 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least fifteen (15) feet above the surface of the street and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

6-16-4 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 6-16-3, 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.

6-16-5 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.

6-16-6 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:

1. Removal from City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, and that danger to other trees within the City is imminent, the Council shall immediately cause such condition to be corrected by treatment or removal so as to destroy or prevent as fully as possible the spread of the disease or the insect or disease pests. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.

2. Removal from Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees within the City is imminent, the Council shall immediately notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within fourteen (14) days of receipt of notice, the Council may cause the nuisance to be removed and the cost assessed against the property.

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

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

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