

2014 Urban Forest Management Plan
 Prepared by Copper Tree Consulting
 In Partnership with the Iowa DNR



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Executive Summary

Overview

This plan was developed to assist the City of Madrid 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 14% of Madrid's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2014, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 1082 trees inventoried.

- Madrid's trees provide \$165,074 of benefits annually, an average of \$153 a tree
- There are over 50 species of trees
- The top three genera are: Maple 38.3%, Ash 13.9%, and Apple 15.1%
- 9% of trees are in need of some type of management
- 34 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 34 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*
- 3 of the 136 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation
- 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 24 years to remove ash – Suggestion: request a budget increase to \$10,000 annually and apply for grants to plant replacement trees

Introduction

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

Trees are an important component of Madrid'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, storm water 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 Madrid 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 Madrid's urban forestry goals.

Inventory

In 2014, 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 1082city 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. Findings

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Madrid's trees reduce energy related costs by approximately \$16,383 annually (Appendix A, Table 1). These savings are both in Electricity (215.9 MWh) and in Natural Gas (29,568 Therms).

Annual Stormwater Benefits

Madrid's trees intercept about 2,252,172 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$61,034 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 Madrid, it is estimated that trees remove 2,785 lbs of air pollution (ozone (O₃), particulate matter less than 10 microns (PM₁₀), carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂)) per year with a net value of \$7,869 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Madrid, trees sequester about 479,161 lbs of carbon a year with an associated value of \$3,594 (Appendix A, Table 4). In addition, the trees store 9,134,167 lbs of carbon, with a yearly benefit of \$68,506 (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. Madrid receives \$44,850 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, Madrid's trees provide \$165,074 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 1,082 trees in Madrid provide approximately \$153 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Madrid has over 50 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees is as follows:

Species	Number of Trees	% of Total Trees
Apple	163	15.06
Green ash	150	13.86
Silver maple	114	10.54
Sugar maple	95	8.78
Norway maple	88	8.13
Red maple	75	6.93

Northern red oak	44	4.07
Northern hackberry	43	3.97
Maple	43	3.97
Black walnut	22	2.03
Pear	21	1.94
Bur oak	18	1.66
Chinese elm	18	1.66
Hickory	16	1.48
Honeylocust	16	1.48
Black maple	14	1.29
American basswood	13	1.20
Spruce	13	1.20
Catalpa	13	1.20
American sycamore	10	0.92
Blue spruce	9	0.83
American elm	8	0.74
Conifer Evergreen Large	7	0.65
Pin oak	7	0.65
Swamp white oak	6	0.55
White ash	6	0.55
Eastern hophornbeam	5	0.46
Littleleaf linden	5	0.46
Siberian elm	5	0.46
Mulberry	4	0.37
Ohio buckeye	4	0.37
Northern pin oak	3	0.28
Amur maple	2	0.18
Black poplar	2	0.18
Broadleaf Deciduous Large	2	0.18
Boxelder	2	0.18
Oak	2	0.18
Tulip tree	1	0.09
Eastern redbud	1	0.09
Birch	1	0.09
Norway spruce	1	0.09
Cherry plum	1	0.09
Conifer Evergreen Small	1	0.09
Willow	1	0.09
Broadleaf Deciduous Medi	1	0.09
Eastern red cedar	1	0.09
Eastern white pine	1	0.09
Cottonwood	1	0.09
Broadleaf Deciduous Small	1	0.09
Ginkgo	1	0.09
Black spruce	1	0.09
Total	1,082	100.00

Age Class

Most of Madrid's trees (45.56%) 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. Madrid's size curve is on the smaller side, indicating a younger than average 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 Madrid indicate that 94% of the trees are in good health, with <1% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 86% of Madrid'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 5% of the population. This 5% 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	926	85%
Crown Raising	49	5%
Tree Removal	33	3%
Crown Reduction	15	1%

Canopy Cover

The total canopy with both private and public trees is 24%, 181.77 acres. The canopy cover included in the Madrid inventory includes approximately 24 acres (Appendix A, Figure 4).

Land Use and Location

The majority of Madrid’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

See Graph

Location

Planting strip	40%
Other maintained locations	1%
Front yard	60%

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

Madrid has 1 critical concern tree that need immediate removal. This 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. There are 6 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 40 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 7 removals, 1 is an ash tree. There are a total of 156 ash trees, and 11 of those have signs and symptoms that have been associated with EAB. In addition, there are 50 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 Madrid.

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 (38.3%) (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 151.02 of the city ordinance (Appendix C). All trees planted must meet the restrictions in city ordinance 151.02 (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

Year 1

Removal: 2 largest critical concern trees

Planting and Replacement: 9 trees to be planted in open locations

Visual Survey for signs and symptoms of EAB

Year 2

Removal: 7 additional ash trees with poor health

*Or saving for ash tree treatment

Planting and Replacement: 9 trees in open locations from year one removals

Routine trimming: Contract to trim city trees

Visual Survey for signs and symptoms of EAB

Year 3

Removal: 7 trees - removal of any new critical concern trees and ash in poor health

*Or saving for ash tree treatment

Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals

Visual Survey for signs and symptoms of EAB

Year 4

Removal: 7 trees - removal of any new critical concern trees and ash in poor health

*Or saving for ash tree treatment

Planting and Replacement: 9 trees in open locations from previous removals

Routine trimming: Contract to trim city trees

Visual Survey for signs and symptoms of EAB

Year 5

Removal: 7 trees - removal of any new critical concern trees and ash in poor health

*Or saving for ash tree treatment

Planting and Replacement: 9 trees to be planted in open locations and locations from previous removals

Visual Survey for signs and symptoms of EAB

Year 6

Removal: 6 trees - removal of any new critical concern trees and ash in poor health

*Or saving for ash tree treatment

Planting and Replacement: 7 trees in open locations from previous removals

Routine trimming: Contract to trim city trees

Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: Approximately 39 ash trees removed (approximately 25% of ash). It will take approximately 24 years to remove all ash with the current budget. EAB could potentially kill all ash within 4 years of its arrival.

** To remove all ash trees within 6 years, the budget would need to be increased to \$15,600 a year. If the budget were increased to \$7,200 a year all ash could be removed in 13 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 151.02 (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. City Code 151.06 states "If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or

insect or disease pests) on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.”

Budget

Current Budget

Total \$30,000 over 6 years (\$5,000/year)

FY 2015 Budget

Removal: \$4,200

*Or saving for ash tree treatment

\$800 for crown cleaning those needing immediate attention

FY 2016 Budget

Removal: \$4,200

*Or saving for ash tree treatment

Planting: \$200

Save \$300 for trimming in 2017

Watering & Maintenance: \$300

FY 2017 Budget

Removal: \$4,200

*Or saving for ash tree treatment

Trimming \$600 (\$300 from 2016)

Watering & Maintenance: \$500

FY 2018 Budget

Removal: \$4,200

*Or saving for ash tree treatment

Planting: \$200

Save \$300 for trimming in 2019

Watering & Maintenance: \$500

FY 2019 Budget

Removal: \$4,200

*Or saving for ash tree treatment

Trimming: \$600

Watering & Maintenance: \$500

FY 2020 Budget

Removal: \$4,200

*Or saving for ash tree treatment

Planting: \$200

Watering: \$400

***Reduction of ash over 6 years: approximately 39 ash trees removed (approximately 25% of ash). It will take approximately 24 years to remove all ash with the current budget.**

Purposed Budget Increase

EAB could potentially kill all ash trees in Madrid within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to \$15,600 a year. If the budget were increased to \$7,200 a year all ash could be removed within 13 years. Additionally, it is recommended that Madrid apply for grants to fund replacement trees. Utility Company grants are usually between \$500 and \$10,000 for community-based, tree-planting projects that include parks, gateways, cemeteries, nature trails, libraries, nursing homes, and schools.

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Madrid

Annual Energy Benefits of Public Trees

3/1/2015

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total Standard (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Apple	14.0	1,060	2,149.3	2,106	3,166	(N/A)	15.1	7.0	19.42
Green ash	37.0	2,810	4,952.1	4,853	7,663	(N/A)	13.9	16.9	51.08
Silver maple	30.5	2,315	3,990.3	3,910	6,226	(N/A)	10.5	13.7	54.61
Sugar maple	25.4	1,929	3,414.8	3,346	5,275	(N/A)	8.8	11.6	55.53
Norway maple	13.9	1,058	1,990.4	1,951	3,009	(N/A)	8.1	6.6	34.19
Red maple	9.3	708	1,278.9	1,253	1,961	(N/A)	6.9	4.3	26.15
Northern red oak	6.9	524	962.1	943	1,467	(N/A)	4.1	3.2	33.34
Northern hackberry	14.0	1,064	1,993.0	1,953	3,017	(N/A)	4.0	6.7	70.15
Maple	3.6	274	525.8	515	789	(N/A)	4.0	1.7	18.35
Black walnut	4.4	332	582.8	571	904	(N/A)	2.0	2.0	41.07
Pear	2.9	221	422.9	414	635	(N/A)	1.9	1.4	30.25
Bur oak	6.6	499	894.5	877	1,376	(N/A)	1.7	3.0	76.45
Chinese elm	6.6	504	894.9	877	1,381	(N/A)	1.7	3.0	76.73
Hickory	3.3	251	450.0	441	692	(N/A)	1.5	1.5	43.23
Honeylocust	4.2	322	558.7	548	870	(N/A)	1.5	1.9	54.35
Black maple	3.3	253	457.4	448	701	(N/A)	1.3	1.5	50.08
American basswood	3.5	269	494.8	485	754	(N/A)	1.2	1.7	58.00
Spruce	1.1	83	149.1	146	229	(N/A)	1.2	0.5	17.64
Catalpa	5.1	390	690.2	676	1,066	(N/A)	1.2	2.4	82.00
American sycamore	3.6	276	508.0	498	774	(N/A)	0.9	1.7	77.37
Blue spruce	0.7	54	100.5	98	152	(N/A)	0.8	0.3	16.92
American elm	2.8	214	356.7	350	564	(N/A)	0.7	1.2	70.46
Conifer Evergreen Large	0.9	70	107.5	105	175	(N/A)	0.6	0.4	25.04
Pin oak	1.7	127	227.1	223	349	(N/A)	0.6	0.8	49.87
Swamp white oak	0.7	53	103.1	101	154	(N/A)	0.6	0.3	25.61
White ash	1.1	82	125.1	123	205	(N/A)	0.6	0.5	34.11
Eastern hophornbeam	0.5	36	76.0	74	111	(N/A)	0.5	0.2	22.18
Littleleaf linden	0.5	41	74.6	73	114	(N/A)	0.5	0.3	22.74
Siberian elm	1.7	128	224.4	220	348	(N/A)	0.5	0.8	69.60
Mulberry	0.6	49	93.8	92	141	(N/A)	0.4	0.3	35.15
Ohio buckeye	1.1	84	153.8	151	235	(N/A)	0.4	0.5	58.81
Northern pin oak	0.2	16	34.5	34	50	(N/A)	0.3	0.1	16.68
Amur maple	0.4	28	49.3	48	76	(N/A)	0.2	0.2	38.13
Black poplar	0.8	63	112.7	110	173	(N/A)	0.2	0.4	86.52
Broadleaf Deciduous Large	0.2	14	27.5	27	41	(N/A)	0.2	0.1	20.64
Boxelder	0.6	46	83.5	82	128	(N/A)	0.2	0.3	63.97
Oak	0.1	7	14.2	14	21	(N/A)	0.2	0.0	10.65
Tulip tree	0.2	18	27.0	26	44	(N/A)	0.1	0.1	44.23
Eastern redbud	0.0	2	3.8	4	5	(N/A)	0.1	0.0	5.40
Birch	0.1	8	16.9	17	24	(N/A)	0.1	0.1	24.47
Norway spruce	0.2	14	24.6	24	38	(N/A)	0.1	0.1	38.17
Cherry plum	0.0	2	3.8	4	5	(N/A)	0.1	0.0	5.40
Conifer Evergreen Small	0.0	0	0.7	1	1	(N/A)	0.1	0.0	0.93
Willow	0.1	8	16.9	17	24	(N/A)	0.1	0.1	24.47
Broadleaf Deciduous Medium	0.3	20	39.6	39	59	(N/A)	0.1	0.1	58.69
Eastern red cedar	0.1	8	16.4	16	25	(N/A)	0.1	0.1	24.57
Eastern white pine	0.1	10	14.6	14	24	(N/A)	0.1	0.1	24.14
Cottonwood	0.4	29	53.7	53	82	(N/A)	0.1	0.2	82.02
Broadleaf Deciduous Small	0.1	6	12.8	13	18	(N/A)	0.1	0.0	18.19
Ginkgo	0.0	2	3.0	3	5	(N/A)	0.1	0.0	4.50
Black spruce	0.1	5	10.2	10	15	(N/A)	0.1	0.0	14.80
Total	215.9	16,383	29,568.0	28,977	45,360	(N/A)	100.0	100.0	41.92

Table 1: Annual Energy Benefits

Madrid

Annual Stormwater Benefits of Public Trees

3/1/2015

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Apple	55,647	1,508	(N/A)	15.1	2.5	9.25
Green ash	426,023	11,545	(N/A)	13.9	18.9	76.97
Silver maple	435,278	11,796	(N/A)	10.5	19.3	103.47
Sugar maple	289,766	7,853	(N/A)	8.8	12.9	82.66
Norway maple	104,483	2,831	(N/A)	8.1	4.6	32.18
Red maple	63,365	1,717	(N/A)	6.9	2.8	22.90
Northern red oak	62,207	1,686	(N/A)	4.1	2.8	38.31
Northern hackberry	126,884	3,439	(N/A)	4.0	5.6	79.97
Maple	20,821	564	(N/A)	4.0	0.9	13.12
Black walnut	39,511	1,071	(N/A)	2.0	1.8	48.67
Pear	11,850	321	(N/A)	1.9	0.5	15.29
Bur oak	92,280	2,501	(N/A)	1.7	4.1	138.93
Chinese elm	95,495	2,588	(N/A)	1.7	4.2	143.77
Hickory	29,191	791	(N/A)	1.5	1.3	49.44
Honeylocust	38,541	1,044	(N/A)	1.5	1.7	65.28
Black maple	30,398	824	(N/A)	1.3	1.3	58.84
American basswood	44,044	1,194	(N/A)	1.2	2.0	91.81
Spruce	12,457	338	(N/A)	1.2	0.6	25.97
Catalpa	71,847	1,947	(N/A)	1.2	3.2	149.77
American sycamore	48,916	1,326	(N/A)	0.9	2.2	132.56
Blue spruce	9,330	253	(N/A)	0.8	0.4	28.09
American elm	23,863	647	(N/A)	0.7	1.1	80.84
Conifer Evergreen Large	12,201	331	(N/A)	0.6	0.5	47.23
Pin oak	14,669	398	(N/A)	0.6	0.7	56.79
Swamp white oak	3,916	106	(N/A)	0.6	0.2	17.69
White ash	6,829	185	(N/A)	0.6	0.3	30.84
Eastern hophornbeam	1,724	47	(N/A)	0.5	0.1	9.35
Littleleaf linden	4,187	113	(N/A)	0.5	0.2	22.69
Siberian elm	17,363	471	(N/A)	0.5	0.8	94.11
Mulberry	2,772	75	(N/A)	0.4	0.1	18.78
Ohio buckeye	10,347	280	(N/A)	0.4	0.5	70.10
Northern pin oak	1,184	32	(N/A)	0.3	0.1	10.70
Amur maple	1,333	36	(N/A)	0.2	0.1	18.06
Black poplar	12,729	345	(N/A)	0.2	0.6	172.48
Broadleaf Deciduous Large	1,216	33	(N/A)	0.2	0.1	16.47
Boxelder	9,231	250	(N/A)	0.2	0.4	125.08
Oak	626	17	(N/A)	0.2	0.0	8.48
Tulip tree	1,466	40	(N/A)	0.1	0.1	39.72
Eastern redbud	69	2	(N/A)	0.1	0.0	1.86
Birch	586	16	(N/A)	0.1	0.0	15.88
Norway spruce	4,605	125	(N/A)	0.1	0.2	124.79
Cherry plum	69	2	(N/A)	0.1	0.0	1.86
Conifer Evergreen Small	24	1	(N/A)	0.1	0.0	0.66
Willow	586	16	(N/A)	0.1	0.0	15.88
Broadleaf Deciduous Medium	2,479	67	(N/A)	0.1	0.1	67.19
Eastern red cedar	1,635	44	(N/A)	0.1	0.1	44.30
Eastern white pine	1,539	42	(N/A)	0.1	0.1	41.70
Cottonwood	5,491	149	(N/A)	0.1	0.2	148.79
Broadleaf Deciduous Small	264	7	(N/A)	0.1	0.0	7.17

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Table 2: Annual Stormwater Benefits

Madrid

Annual Air Quality Benefits of Public Trees

3/1/2015

Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total Standard (\$ Error)	% of Total Trees	Avg. \$/tree
	O ₃	NO ₂	PM ₁₀	SO ₂		NO ₂	PM ₁₀	VOC	SO ₂							
Apple	15.2	2.5	7.4	0.7	82	68.8	9.9	9.4	63.3	423	-0.1	0	177.0	504 (N/A)	15.1	3.09
Green ash	59.1	9.4	27.6	2.6	313	175.7	25.7	24.5	167.8	1,097	0.0	0	492.3	1,410 (N/A)	13.9	9.40
Silver maple	74.7	12.7	36.7	3.3	403	143.6	21.0	20.1	138.0	899	-39.4	-148	410.6	1,154 (N/A)	10.5	10.12
Sugar maple	39.3	6.7	19.5	1.7	212	120.6	17.6	16.8	115.1	753	-30.8	-116	306.5	850 (N/A)	8.8	8.95
Norway maple	18.2	3.1	9.4	0.8	99	67.4	9.8	9.3	63.3	418	-4.5	-17	176.7	500 (N/A)	8.1	5.69
Red maple	12.2	2.1	6.1	0.5	66	44.5	6.5	6.2	42.2	277	-4.5	-17	115.8	327 (N/A)	6.9	4.35
Northern red oak	12.5	2.2	6.2	0.6	68	33.1	4.8	4.6	31.3	206	-17.8	-67	77.3	206 (N/A)	4.1	4.69
Northern hackberry	19.7	3.4	10.2	0.9	108	67.7	9.8	9.3	63.6	420	0.0	0	184.6	528 (N/A)	4.0	12.28
Maple	3.0	0.5	1.7	0.1	17	17.5	2.5	2.4	16.3	108	-1.2	-5	42.8	120 (N/A)	4.0	2.80
Black walnut	4.6	0.7	2.3	0.2	25	20.8	3.0	2.9	19.8	130	0.0	0	54.3	154 (N/A)	2.0	7.01
Pear	3.7	0.6	1.7	0.2	19	14.1	2.0	1.9	13.2	87	0.0	0	37.4	107 (N/A)	1.9	5.08
Bur oak	14.9	2.4	6.6	0.7	78	31.4	4.6	4.4	29.8	196	0.0	0	94.7	273 (N/A)	1.7	15.18
Chinese elm	16.1	2.6	7.1	0.7	84	31.6	4.6	4.4	30.1	197	0.0	0	97.2	281 (N/A)	1.7	15.62
Hickory	2.8	0.5	1.5	0.1	16	15.7	2.3	2.2	15.0	98	0.0	0	40.1	114 (N/A)	1.5	7.11
Honeylocust	7.2	1.2	3.4	0.3	38	20.0	2.9	2.8	19.2	125	-5.2	-20	51.8	144 (N/A)	1.5	9.00
Black maple	7.6	1.3	3.5	0.3	40	15.9	2.3	2.2	15.1	99	-2.5	-9	45.7	130 (N/A)	1.3	9.27
American basswood	6.6	1.1	3.1	0.3	35	17.0	2.5	2.4	16.1	106	-5.5	-20	43.7	121 (N/A)	1.2	9.29
Spruce	1.3	0.2	1.2	0.2	9	5.2	0.8	0.7	5.0	33	-4.1	-15	10.4	26 (N/A)	1.2	1.99
Catalpa	12.4	2.0	5.5	0.6	65	24.4	3.6	3.4	23.3	152	0.0	0	75.1	217 (N/A)	1.2	16.70
American sycamore	6.8	1.1	3.1	0.3	36	17.4	2.5	2.4	16.5	108	0.0	0	50.2	144 (N/A)	0.9	14.43
Blue spruce	1.2	0.2	1.0	0.1	8	3.4	0.5	0.5	3.2	21	-3.3	-12	7.0	17 (N/A)	0.8	1.89
American elm	6.1	1.0	2.9	0.3	33	13.2	1.9	1.9	12.8	83	0.0	0	40.2	116 (N/A)	0.7	14.48
Conifer Evergreen Large	1.4	0.3	1.2	0.2	9	4.2	0.6	0.6	4.2	27	-4.7	-17	7.9	18 (N/A)	0.6	2.62
Pin oak	2.2	0.4	1.2	0.1	12	7.9	1.2	1.1	7.6	50	-4.3	-16	17.3	46 (N/A)	0.6	6.52
Swamp white oak	0.4	0.1	0.3	0.0	3	3.4	0.5	0.5	3.1	21	-0.1	-1	8.2	23 (N/A)	0.6	3.83
White ash	0.4	0.1	0.3	0.0	2	5.0	0.7	0.7	4.9	31	0.0	0	12.0	34 (N/A)	0.6	5.61
Eastern hophornbeam	0.4	0.1	0.2	0.0	2	2.4	0.3	0.3	2.2	15	0.0	0	5.9	17 (N/A)	0.5	3.35
Littleleaf linden	0.6	0.1	0.3	0.0	3	2.6	0.4	0.4	2.4	16	-0.3	-1	6.4	18 (N/A)	0.5	3.61
Siberian elm	2.9	0.5	1.4	0.1	15	8.0	1.2	1.1	7.6	50	0.0	0	22.8	65 (N/A)	0.5	13.06
Mulberry	0.9	0.1	0.4	0.0	5	3.1	0.4	0.4	2.9	19	0.0	0	8.4	24 (N/A)	0.4	6.00
Ohio buckeye	2.2	0.4	1.1	0.1	12	5.3	0.8	0.7	5.1	33	-0.5	-2	15.1	43 (N/A)	0.4	10.75
Northern pin oak	0.1	0.0	0.1	0.0	1	1.1	0.2	0.1	1.0	7	0.0	0	2.5	7 (N/A)	0.3	2.36
Alder maple	0.4	0.1	0.2	0.0	2	1.7	0.3	0.2	1.7	11	0.0	0	4.6	13 (N/A)	0.2	6.56
Black poplar	2.0	0.3	0.9	0.1	10	3.9	0.6	0.5	3.7	25	0.0	0	12.0	35 (N/A)	0.2	17.37
Broadleaf Deciduous Large	0.0	0.0	0.0	0.0	0	0.9	0.1	0.1	0.9	6	0.0	0	2.1	6 (N/A)	0.2	2.99
Bonelder	1.4	0.2	0.6	0.1	7	2.9	0.4	0.4	2.7	18	-0.4	-1	8.5	24 (N/A)	0.2	12.08

Table 3: Annual Air Quality Benefits

Madrid

Annual CO Benefits of Public Trees

3/1/2015

Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Avoided (lb)	Avoided (\$)	Net Total (lb)	Total Standard (\$ Error)	% of Total Trees	% of Total \$
Apple	21,523	161	-1,189	-200	-3	23,419	176	43,554	327 (N/A)	15.1	5.5
Green ash	78,029	585	-9,569	-399	-3	62,090	466	130,152	976 (N/A)	13.9	16.4
Silver maple	126,893	952	-8,292	-341	-3	51,168	384	169,428	1,271 (N/A)	10.5	21.3
Sugar maple	57,943	435	-5,487	-277	-2	42,629	320	94,807	711 (N/A)	8.8	11.9
Norway maple	22,597	169	-1,465	-143	-1	23,380	175	44,369	333 (N/A)	8.1	5.6
Red maple	15,066	113	-688	-92	-1	15,639	117	29,925	224 (N/A)	6.9	3.8
Northern red oak	7,098	53	-1,255	-87	-1	11,580	87	17,335	130 (N/A)	4.1	2.2
Northern hackberry	16,874	127	-1,425	-130	-1	23,503	176	38,822	291 (N/A)	4.0	4.9
Maple	5,761	43	-192	-41	0	6,048	45	11,577	87 (N/A)	4.0	1.5
Black walnut	9,153	69	-743	-45	0	7,346	55	15,711	118 (N/A)	2.0	2.0
Pear	4,363	33	-270	-36	0	4,877	37	8,934	67 (N/A)	1.9	1.1
Bur oak	13,609	102	-2,404	-74	-1	11,037	83	22,168	166 (N/A)	1.7	2.8
Chinese elm	12,804	96	-2,626	-76	-1	11,144	84	21,246	159 (N/A)	1.7	2.7
Hickory	7,679	58	-441	-33	0	5,540	42	12,745	96 (N/A)	1.5	1.6
Honeylocust	9,258	69	-435	-34	0	7,118	53	15,907	119 (N/A)	1.5	2.0
Black maple	6,876	52	-390	-31	0	5,586	42	12,041	90 (N/A)	1.3	1.5
American basswood	13,663	102	-1,220	-43	0	5,948	45	18,349	138 (N/A)	1.2	2.3
Spruce	999	7	-38	-19	0	1,838	14	2,779	21 (N/A)	1.2	0.3
Catalpa	9,437	71	-2,035	-58	0	8,609	65	15,953	120 (N/A)	1.2	2.0
American sycamore	9,035	68	-1,065	-40	0	6,096	46	14,026	105 (N/A)	0.9	1.8
Blue spruce	350	3	-40	-13	0	1,189	9	1,486	11 (N/A)	0.8	0.2
American elm	3,318	25	-602	-27	0	4,733	35	7,422	56 (N/A)	0.7	0.9
Conifer Evergreen Large	881	7	-50	-14	0	1,545	12	2,362	18 (N/A)	0.6	0.3
Pin oak	5,636	42	-265	-17	0	2,797	21	8,151	61 (N/A)	0.6	1.0
Swamp white oak	1,377	10	-40	-7	0	1,163	9	2,493	19 (N/A)	0.6	0.3
White ash	2,027	15	-68	-9	0	1,813	14	3,763	28 (N/A)	0.6	0.5
Eastern hophornbeam	723	5	-32	-7	0	805	6	1,490	11 (N/A)	0.5	0.2
Littleleaf linden	1,605	12	-63	-7	0	898	7	2,432	18 (N/A)	0.5	0.3
Siberian elm	3,189	24	-331	-18	0	2,830	21	5,670	43 (N/A)	0.5	0.7
Mulberry	649	5	-66	-9	0	1,076	8	1,651	12 (N/A)	0.4	0.2
Ohio buckeye	1,142	9	-172	-12	0	1,867	14	2,826	21 (N/A)	0.4	0.4
Northern pin oak	453	3	-11	-3	0	359	3	799	6 (N/A)	0.3	0.1
Amur maple	535	4	-29	-4	0	617	5	1,119	8 (N/A)	0.2	0.1

Table 5: Annual Carbon Sequestered

Madrid

Stored CO2 Benefits of Public Trees

3/1/2015

Species	Total Stored CO2 (lbs)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Apple	247,499	1,856	(N/A)	15.1	2.7	11.39
Green ash	1,993,448	14,951	(N/A)	13.9	21.8	99.67
Silver maple	1,725,928	12,944	(N/A)	10.5	18.9	113.55
Sugar maple	1,142,868	8,572	(N/A)	8.8	12.5	90.23
Norway maple	303,976	2,280	(N/A)	8.1	3.3	25.91
Red maple	143,162	1,074	(N/A)	6.9	1.6	14.32
Northern red oak	261,494	1,961	(N/A)	4.1	2.9	44.57
Northern hackberry	296,850	2,226	(N/A)	4.0	3.2	51.78
Maple	40,011	300	(N/A)	4.0	0.4	6.98
Black walnut	154,706	1,160	(N/A)	2.0	1.7	52.74
Pear	56,239	422	(N/A)	1.9	0.6	20.09
Bur oak	500,840	3,756	(N/A)	1.7	5.5	208.68
Chinese elm	547,115	4,103	(N/A)	1.7	6.0	227.96
Hickory	91,757	688	(N/A)	1.5	1.0	43.01
Honeylocust	90,439	678	(N/A)	1.5	1.0	42.39
Black maple	81,176	609	(N/A)	1.3	0.9	43.49
American basswood	254,145	1,906	(N/A)	1.2	2.8	146.62
Spruce	7,905	59	(N/A)	1.2	0.1	4.56
Catalpa	423,949	3,180	(N/A)	1.2	4.6	244.59
American sycamore	221,895	1,664	(N/A)	0.9	2.4	166.42
Blue spruce	8,312	62	(N/A)	0.8	0.1	6.93
American elm	125,211	939	(N/A)	0.7	1.4	117.38
Conifer Evergreen La	10,364	78	(N/A)	0.6	0.1	11.10
Pin oak	55,250	414	(N/A)	0.6	0.6	59.20
Swamp white oak	8,245	62	(N/A)	0.6	0.1	10.31
White ash	14,119	106	(N/A)	0.6	0.2	17.65
Eastern hophornbeam	6,669	50	(N/A)	0.5	0.1	10.00
Littleleaf linden	13,037	98	(N/A)	0.5	0.1	19.56
Siberian elm	68,964	517	(N/A)	0.5	0.8	103.45
Mulberry	13,725	103	(N/A)	0.4	0.2	25.73
Ohio buckeye	35,809	269	(N/A)	0.4	0.4	67.14
Northern pin oak	2,218	17	(N/A)	0.3	0.0	5.55
Amur maple	6,074	46	(N/A)	0.2	0.1	22.78
Black poplar	65,202	489	(N/A)	0.2	0.7	244.51
Broadleaf Deciduous :	2,069	16	(N/A)	0.2	0.0	7.76
Boxelder	61,300	460	(N/A)	0.2	0.7	229.88
Oak	1,047	8	(N/A)	0.2	0.0	3.93
Tulip tree	3,672	28	(N/A)	0.1	0.0	27.54
Eastern redbud	178	1	(N/A)	0.1	0.0	1.33
Birch	1,101	8	(N/A)	0.1	0.0	8.26
Norway spruce	7,490	56	(N/A)	0.1	0.1	56.18
Cherry plum	178	1	(N/A)	0.1	0.0	1.33
Conifer Evergreen Str	3	0	(N/A)	0.1	0.0	0.02
Willow	1,101	8	(N/A)	0.1	0.0	8.26
Broadleaf Deciduous :	7,945	60	(N/A)	0.1	0.1	59.59
Eastern red cedar	1,102	8	(N/A)	0.1	0.0	8.27
Eastern white pine	1,170	9	(N/A)	0.1	0.0	8.78
Cottonwood	25,943	195	(N/A)	0.1	0.3	194.57
Broadleaf Deciduous :	908	7	(N/A)	0.1	0.0	6.81
Ginkgo	77	1	(N/A)	0.1	0.0	0.58
Black spruce	284	2	(N/A)	0.1	0.0	2.13
Citywide total	9,134,167	68,506	(N/A)	100.0	100.0	63.31

The value of stored carbon dioxide is calculated as the total amount of carbon dioxide sequestered annually over the life of each tree, summed for the population. This value should not be added to the Replacement Value or double-counting of the carbon dioxide storage benefit will occur.

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Table 4: Annual Carbon Stored

Madrid

Annual Aesthetic/Other Benefits of Public Trees

3/1/2015

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Apple	1,232	(N/A)	15.1	2.7	7.56
Green ash	6,694	(N/A)	13.9	14.9	44.63
Silver maple	10,108	(N/A)	10.5	22.5	88.67
Sugar maple	5,999	(N/A)	8.8	13.4	63.15
Norway maple	2,364	(N/A)	8.1	5.3	26.87
Red maple	2,255	(N/A)	6.9	5.0	30.07
Northern red oak	623	(N/A)	4.1	1.4	14.16
Northern hackberry	2,347	(N/A)	4.0	5.2	54.57
Maple	963	(N/A)	4.0	2.1	22.40
Black walnut	902	(N/A)	2.0	2.0	41.00
Pear	253	(N/A)	1.9	0.6	12.04
Bur oak	966	(N/A)	1.7	2.2	53.66
Chinese elm	901	(N/A)	1.7	2.0	50.05
Hickory	720	(N/A)	1.5	1.6	45.03
Honeylocust	2,007	(N/A)	1.5	4.5	125.43
Black maple	853	(N/A)	1.3	1.9	60.94
American basswood	906	(N/A)	1.2	2.0	69.73
Spruce	285	(N/A)	1.2	0.6	21.92
Catalpa	665	(N/A)	1.2	1.5	51.19
American sycamore	653	(N/A)	0.9	1.5	65.27
Blue spruce	152	(N/A)	0.8	0.3	16.90
American elm	446	(N/A)	0.7	1.0	55.71
Conifer Evergreen Large	241	(N/A)	0.6	0.5	34.43
Pin oak	500	(N/A)	0.6	1.1	71.45
Swamp white oak	157	(N/A)	0.6	0.3	26.16
White ash	291	(N/A)	0.6	0.6	48.58
Eastern hophornbeam	41	(N/A)	0.5	0.1	8.22
Littleleaf linden	181	(N/A)	0.5	0.4	36.21
Siberian elm	224	(N/A)	0.5	0.5	44.79
Mulberry	37	(N/A)	0.4	0.1	9.34
Ohio buckeye	110	(N/A)	0.4	0.2	27.44
Northern pin oak	55	(N/A)	0.3	0.1	18.39
Amur maple	31	(N/A)	0.2	0.1	15.48
Black poplar	125	(N/A)	0.2	0.3	62.47
Broadleaf Deciduous Large	57	(N/A)	0.2	0.1	28.56
Boxelder	177	(N/A)	0.2	0.4	88.28
Oak	34	(N/A)	0.2	0.1	16.91
Tulip tree	46	(N/A)	0.1	0.1	45.86
Eastern redbud	2	(N/A)	0.1	0.0	2.06
Birch	26	(N/A)	0.1	0.1	26.22
Norway spruce	0	(N/A)	0.1	0.0	0.00
Cherry plum	2	(N/A)	0.1	0.0	2.06
Conifer Evergreen Small	4	(N/A)	0.1	0.0	4.27
Willow	26	(N/A)	0.1	0.1	26.22
Broadleaf Deciduous Medium	43	(N/A)	0.1	0.1	43.05
Eastern red cedar	14	(N/A)	0.1	0.0	13.68
Eastern white pine	32	(N/A)	0.1	0.1	32.32
Cottonwood	67	(N/A)	0.1	0.1	66.60

Table 6: Annual Social and Aesthetic Benefits

Madrid

Total Annual Benefits, Net Benefits, and Costs for Public Trees

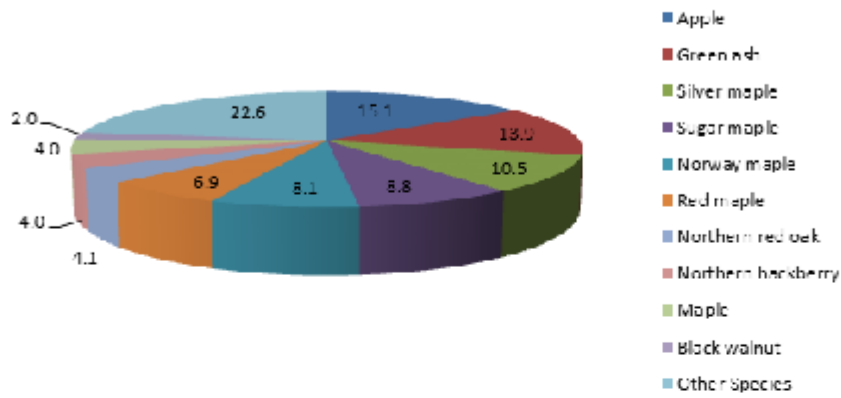
3/1/2015

Benefits	Total (\$)	Standard Error	\$/tree	Standard Error	\$/capita	Standard Error
Energy	45,360	(N/A)	41.92	(N/A)	0.00	(N/A)
CO2	5,962	(N/A)	5.51	(N/A)	0.00	(N/A)
Air Quality	7,869	(N/A)	7.27	(N/A)	0.00	(N/A)
Stormwater	61,034	(N/A)	56.41	(N/A)	0.00	(N/A)
Aesthetic/Other	44,850	(N/A)	41.45	(N/A)	0.00	(N/A)
Total Benefits	165,074	(N/A)	152.56	(N/A)	0.00	(N/A)
Costs						
Planting	0		0.00		0.00	
Contract Pruning	0		0.00		0.00	
Pest Management	0		0.00		0.00	
Irrigation	0		0.00		0.00	
Removal	0		0.00		0.00	
Administration	0		0.00		0.00	
Inspection/Service	0		0.00		0.00	
Infrastructure Repairs	0		0.00		0.00	
Litter Clean-up	0		0.00		0.00	
Liability/Claims	0		0.00		0.00	
Other Costs	0		0.00		0.00	
Total Costs	0		0.00		0.00	
Net Benefits	165,074	(N/A)	152.56	(N/A)	0.00	(N/A)
Benefit-cost ratio	0.00	(N/A)				

Table 7: Summary of Benefits in Dollars

Species Distribution of Public Trees

3/1/2015

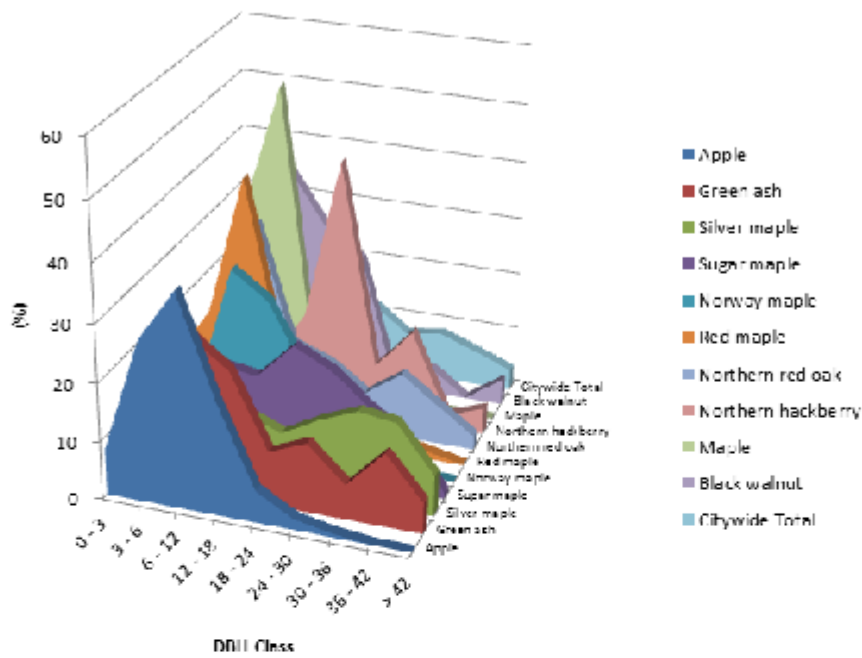


Species	Percent
Apple	15.1
Green ash	13.9
Silver maple	10.5
Sugar maple	8.8
Norway maple	8.1
Red maple	6.9
Northern red oak	4.1
Northern hackberry	4.0
Maple	4.0
Black walnut	2.0
Other Species	22.6
Total	100.0

Figure 1: Species Distribution

Relative Age Distribution of Top 10 Public Tree Species for All Zones (%)

3/1/2015



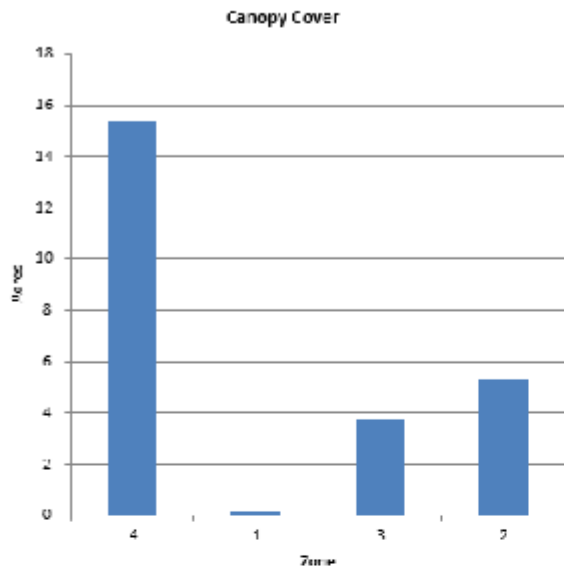
Species	DBH class (m)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Apple	7.98	27.61	36.81	19.63	5.52	1.84	0.61	0.00	0.00
Green ash	1.33	4.67	26.67	22.00	9.33	12.00	6.00	12.67	5.33
Silver maple	8.77	8.77	9.65	12.28	9.65	13.16	15.79	14.91	7.02
Sugar maple	0.00	2.11	16.84	15.79	22.11	18.95	13.68	9.47	1.05
Norway maple	12.50	9.09	30.68	26.14	14.77	2.27	4.55	0.00	0.00
Red maple	10.67	20.00	44.00	14.67	5.33	1.33	2.67	1.33	0.00
Northern red oak	6.82	6.82	34.09	13.64	11.36	6.82	11.36	6.82	2.27
Northern hackberry	0.00	0.00	6.98	16.28	44.19	9.30	16.28	2.33	4.65
Maple	9.30	32.56	53.49	2.33	2.33	0.00	0.00	0.00	0.00
Black walnut	0.00	4.55	36.36	27.27	22.73	0.00	4.55	0.00	4.55
Citywide Total	5.64	10.72	26.52	19.04	12.38	7.49	8.41	6.19	3.60

Figure 2: Relative Age Class

Madrid

Canopy Cover of Public Trees (Acres)

3/1/2015



Zone	Acres	% of Total Canopy Cover
4	15	62.7
1	0	0.5
3	4	15.3
2	5	21.5
Citywide total	24	100.0

	Total Land Area	Total Street and Sidewalk Area	Total Canopy Cover	Canopy Cover as % of Total Land Area	Canopy Cover as % of Total Streets and Sidewalks
Citywide Total	0	0	24	0.00	0.00

Figure 5: Canopy Cover in Acres

Land Use of Public Trees by Zone

3/1/2015

Zone	Land Use	Tree Count	Standard Error	% of Zone	% of Public Trees
1	Single family residential	24	(N/A)	100.00	2.22
	Multi-family residential	0	(N/A)	0.00	0.00
	Small commercial	0	(N/A)	0.00	0.00
	Industrial/Large commercial	0	(N/A)	0.00	0.00
	Park/vacant/other	0	(N/A)	0.00	0.00
	Total		24	(N/A)	100.00
4	Single family residential	633	(N/A)	99.84	58.50
	Multi-family residential	0	(N/A)	0.00	0.00
	Small commercial	0	(N/A)	0.00	0.00
	Industrial/Large commercial	0	(N/A)	0.00	0.00
	Park/vacant/other	1	(N/A)	0.16	0.09
	Total		634	(N/A)	100.00
3	Single family residential	169	(N/A)	100.00	15.62
	Multi-family residential	0	(N/A)	0.00	0.00
	Small commercial	0	(N/A)	0.00	0.00
	Industrial/Large commercial	0	(N/A)	0.00	0.00
	Park/vacant/other	0	(N/A)	0.00	0.00
	Total		169	(N/A)	100.00
2	Single family residential	255	(N/A)	100.00	23.57
	Multi-family residential	0	(N/A)	0.00	0.00
	Small commercial	0	(N/A)	0.00	0.00
	Industrial/Large commercial	0	(N/A)	0.00	0.00
	Park/vacant/other	0	(N/A)	0.00	0.00
	Total		255	(N/A)	100.00
Citywide	Single family residential	1,081	(N/A)	99.91	99.91
	Multi-family residential	0	(N/A)	0.00	0.00
	Small commercial	0	(N/A)	0.00	0.00
	Industrial/Large commercial	0	(N/A)	0.00	0.00
	Park/vacant/other	1	(N/A)	0.09	0.09
	Total		1,082	(N/A)	100.00

Figure 6: Land Use of city/park trees

Appendix B: ArcGIS Mapping



Figure 1: Location of Ash Trees

Madrid, Iowa



Data and map created by:
COPPER TREE CONSULTING LLC.
515-559-4152
CopperTreeConsulting@gmail.com
www.coppertreeconsulting.com

0 0.1 0.2 0.4 Miles
Date: 10/1/2014

- ▲ Epicormic Shoots (1)
- Bark Split (0)



Figure 2: Location of EAB symptoms

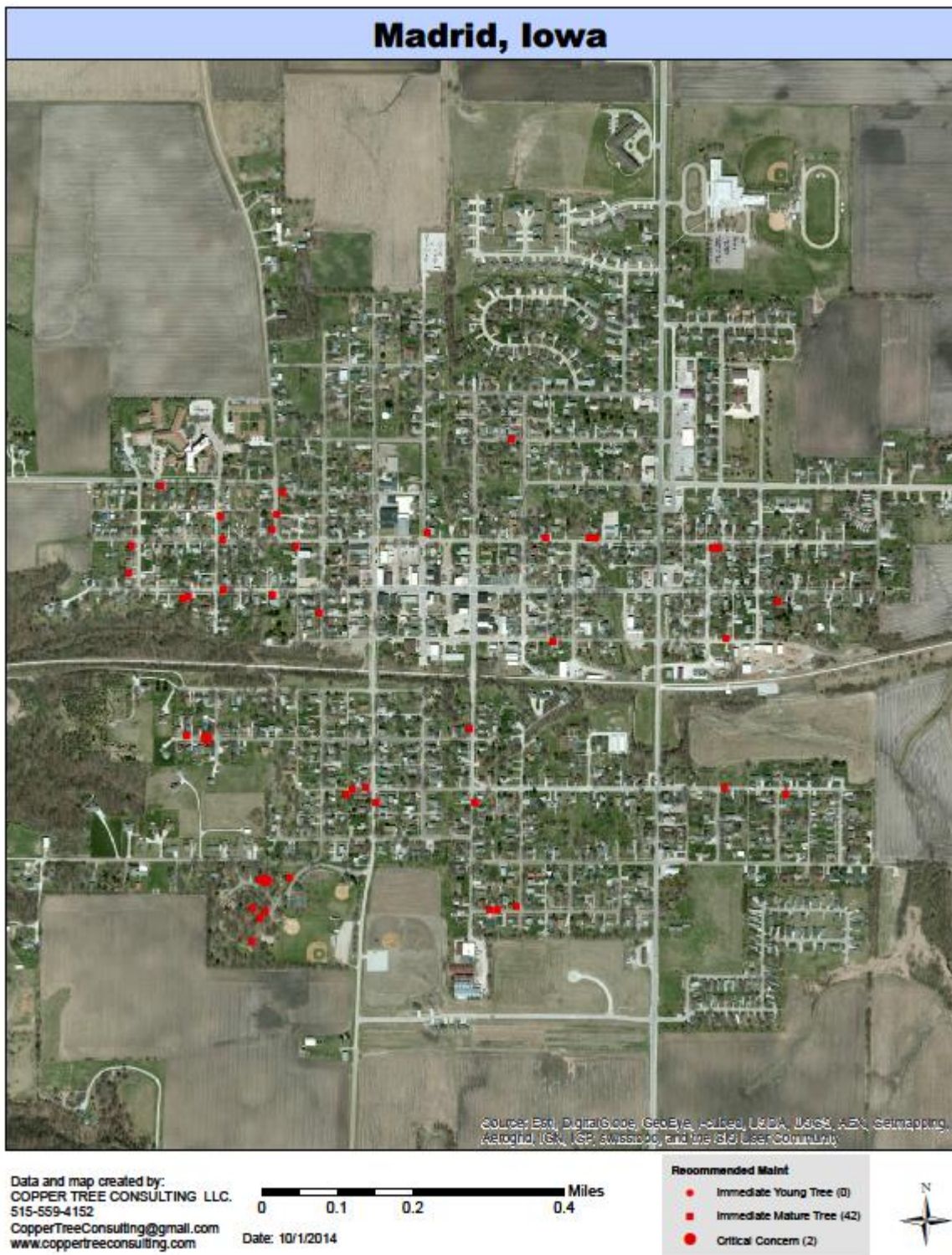


Figure 3: Location of Poor Condition Trees with Recommended Maintenance

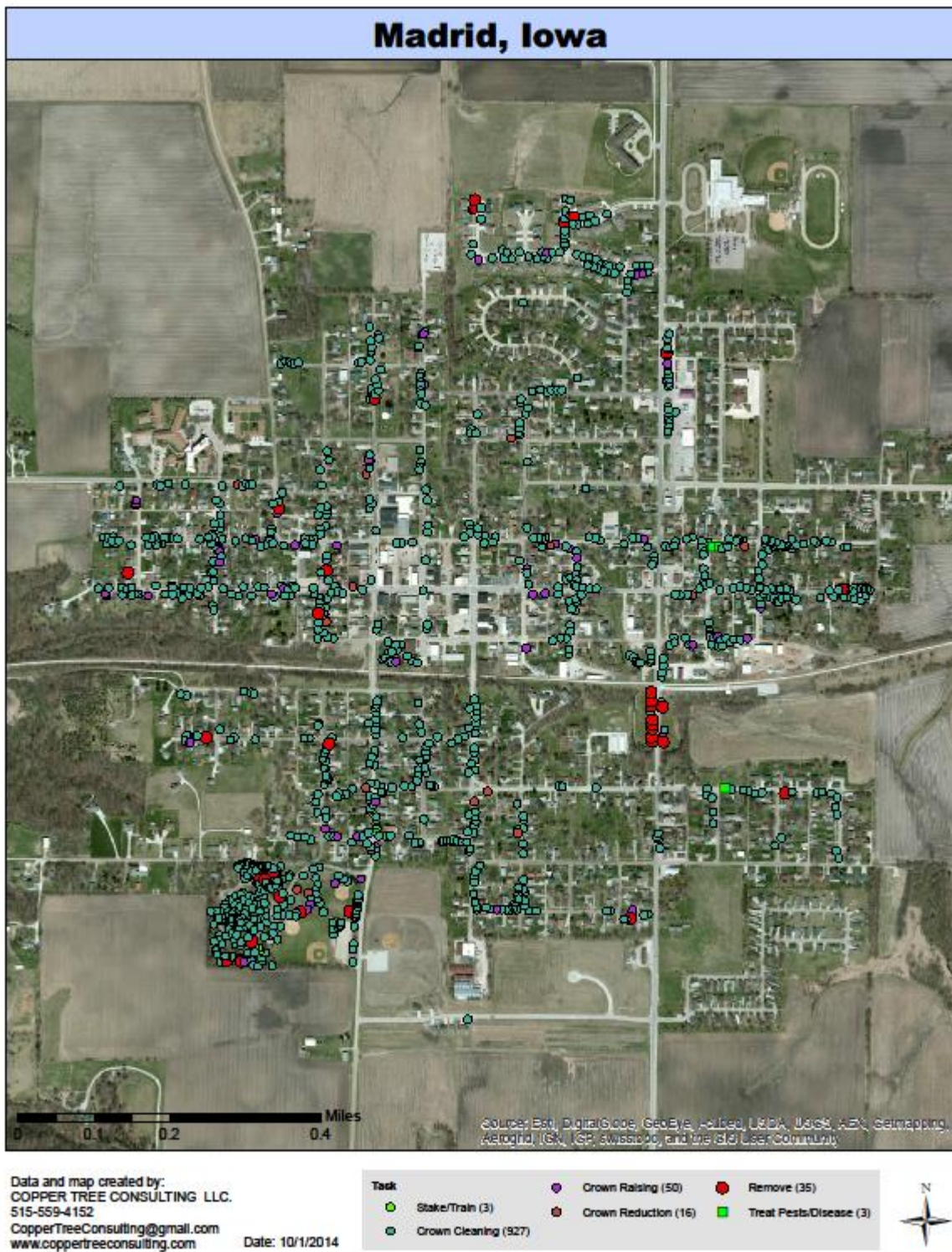


Figure 4: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

Appendix C: Madrid Tree Ordinances

CHAPTER 151 TREES AND GRASS

151.01 Definition 151.05 Disease Control
151.02 Planting Restrictions 151.06 Inspection and Removal
151.03 Duty to Trim Trees 151.07 Cutting or Mowing of Grass
151.04 Trimming Trees to be Supervised

151.01 DEFINITION. For use in this chapter, “boulevard” means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

151.02 PLANTING RESTRICTIONS. No tree shall be planted in any boulevard or street except in accordance with the following:

1. Alignment. All trees planted in any street shall be planted in the boulevard midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any boulevard which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

151.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least eighteen (18) feet above the surface of a street, twenty (20) feet above the surface of a primary highway, and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.

(Code of Iowa, Sec. 364.12[2c, d, & e])

151.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 151.03, it is unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

151.05 DISEASE CONTROL. Any dead, diseased or damaged tree or shrub which may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance.

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

1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.

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

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

151.07 CUTTING OR MOWING OF GRASS.

1. Duty to Cut and Mow Lawns and Lots. The owner of any property shall cut and mow all lawns and lots so that such growth shall be less than four (4) inches at all times.

2. Cutting and Mowing by City. If a property owner refuses or fails to cut and mow lawns and lots within forty-eight (48) hours after being delivered a notice from the City to perform such action, the Council may require said work to be done and the cost and expenses thereof shall be assessed to the property owner after due notice is given. The amount of such assessment shall be certified to the County Auditor as provided by law and the same shall be collected with and in the same manner as general property taxes.

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

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

If you need accommodations because of disability to access the services of this Agency, please contact the Director at 515-281-5918.