

# Battle Creek, Iowa



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# Executive Summary

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## Overview

This plan was developed to assist the City of Battle Creek 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 24% of Battle Creek'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 2015, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 397 trees inventoried.

- Battle Creek's trees provide \$86,087.00 of benefits annually, an average of \$226.04 a tree
- There are 31 species of trees
- Battle Creek has 61 ash trees owned by the city
- The top three genera are: Maple 40.6%, Ash 13.9%, and Blue spruce at 7.8%
- 10 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.

- 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

## Introduction

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

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

## Inventory

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In 2015, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, 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

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The data collected for the 397 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis. Findings



## **Annual Benefits**

### **Annual Energy Benefits**

Trees conserve energy by shading buildings and blocking winds. Battle Creek's trees reduce energy related costs by approximately \$19,963 annually (Appendix A, Table 1). These savings are both in Electricity (95.5 MWh) and in Natural Gas (12,974 Therms).

### **Annual Stormwater Benefits**

Battle Creek's trees intercept about 1,264,632 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides \$34,272.00 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 Battle Creek, it is estimated that trees remove 223.1 lbs of air pollution (ozone (O<sub>3</sub>), particulate matter less than 10 microns (PM<sub>10</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), and sulfur dioxide (SO<sub>2</sub>)) per year with a net value of \$3,566 (Appendix A, Table 3).

### **Annual Carbon Benefits**

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Battle Creek, trees sequester about 297,665 lbs of carbon a year with an associated value of \$2,232 (Appendix A, Table 4). In addition, the trees store 430,676 lbs of carbon, with a yearly benefit of \$3,230 (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. Battle Creek receives \$25,057.00 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, Battle Creek's trees provide \$86,087.00 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 397 trees in Battle Creek provide approximately \$216.84 annually (Appendix A, Table 7).

## **Forest Structure**

### **Species Distribution**

Battle Creek has over 30 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees is as follows:

Species	# of Standard Trees Error	% of Public
Silver maple	91 (N/A)	22.92
Green ash	55 (N/A)	13.85
Blue spruce	31 (N/A)	7.81
Norway maple	28 (N/A)	7.05
Spruce	26 (N/A)	6.55
Red maple	25 (N/A)	6.30
Northern hackberry	19 (N/A)	4.79
Sugar maple	17 (N/A)	4.28

Ponderosa pine	13 (N/A)	3.27
Black walnut	12 (N/A)	3.02
Apple	11 (N/A)	2.77
Pin oak	11 (N/A)	2.77
American basswood	10 (N/A)	2.52
Honeylocust	8 (N/A)	2.02
Scotch pine	7 (N/A)	1.76
White ash	6 (N/A)	1.51
Littleleaf linden	6 (N/A)	1.51
Swamp white oak	4 (N/A)	1.01
Birch	2 (N/A)	0.50
Black poplar	2 (N/A)	0.50
Mulberry	2 (N/A)	0.50
Broadleaf Evergreen Large	2 (N/A)	0.50
Cherry plum	1 (N/A)	0.25
Northern pin oak	1 (N/A)	0.25
American elm	1 (N/A)	0.25
Eastern white pine	1 (N/A)	0.25
Red pine	1 (N/A)	0.25
Black maple	1 (N/A)	0.25
American sycamore	1 (N/A)	0.25
Ohio buckeye	1 (N/A)	0.25
Catalpa	1 (N/A)	0.25
Citywide	397 (N/A)	100.00

### Age Class

A good portion of Battle Creek's trees (28.71%) 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. Battle Creek's size curve is about in the middle, indicating a stand that has a fair representation of young and mature trees .

### 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 Battle Creek indicate that over 99% of the trees are in good health. Similarly, over 99% of Battle Creek'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 less than 1% of the population. This 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	388	99%
Tree Removal	9	<1%

## Canopy Cover

The canopy cover included in the Battle Creek inventory includes approximately 12 acres.

## Land Use and Location

The majority of Battle Creek'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 Dwelling	67%
Park	33%

### Location

Planting strip	43%
Front yard	57%

## Recommendations

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### 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**

Battle Creek has 10 critical concern trees that need immediate removal. This tree can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. 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.

### 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 Battle Creek.

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 (40.6%) (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: 10 critical concern tree
- Planting and Replacement: 10 trees to be planted in open locations
- Visual Survey for signs and symptoms of EAB

### Year 2

- Removal: 10 ash trees with poor health
  - \*Or saving for ash tree treatment
- Planting and Replacement: plant 12 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: 3 trees - removal of any new critical concern trees and ash in poor health
  - \*Or saving for ash tree treatment
- Planting and Replacement: 3 trees to be planted in open locations and locations from previous removals
- Visual Survey for signs and symptoms of EAB

### Year 4

- Removal: 3 trees - removal of any new critical concern trees and ash in poor health
  - \*Or saving for ash tree treatment
- Planting and Replacement: 4 trees to be planted in open locations and locations from previous removals
- Visual Survey for signs and symptoms of EAB



## Year 5

Removal: 3 trees - removal of any new critical concern trees and ash in poor health

\*Or saving for ash tree treatment

Planting and Replacement: 3 trees to be planted in open locations and locations from previous removals

Visual Survey for signs and symptoms of EAB

## Year 6

Removal: 3 trees - removal of any new critical concern trees and ash in poor health

\*Or saving for ash tree treatment

Planting and Replacement: 4 trees to be planted in open locations and locations from previous removals

Visual Survey for signs and symptoms of EAB

\*Reduction of ash over 6 years: Approximately 3 ash trees removed (approximately 25% of ash). 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 \$8,000 a year. If the budget were increased to \$3,700.00 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](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

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## Current Budget

Total \$21,000 over 6 years (\$3,500/year)

### **FY 2017 Budget**

Removal: \$2,400

Replanting and associated maintenance: \$1,100.00

### **FY 2018 Budget**

Removal: \$2,400

Replanting and associated maintenance: \$1,100.00

### **FY 2019 Budget**

Removal: \$2,400

Replanting and associated maintenance: \$1,100.00

### **FY 2020 Budget**

Removal: \$2,400

Replanting and associated maintenance: \$1,100.00

### **FY 2021 Budget**

Removal: \$2,400

Replanting and associated maintenance: \$1,100.00

### **FY 2022 Budget**

Removal: \$2,400

Replanting and associated maintenance: \$1,100.00

**\* Reduction of ash over 6 years: Approximately 10 ash trees removed (approximately 25% of ash). EAB could potentially kill all ash within 4 years of its arrival). 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 Battle Creek within 4 years of its arrival. To remove all ash trees within 6 years the budget would need to be increased to \$8,100 a year. If the budget were increased to \$3,700 a year all ash could be removed within 13 years. Additionally, it is recommended that Battle Creek 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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## Battle Creek

### Annual Energy Benefits of Public Trees

6/27/2016

Species	Total Electricity (MWh)	Electricity (\$)	Total Natural Gas (Therms)	Natural Gas (\$)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	33.9	2,574	4,475.7	4,386	6,960	(N/A)	22.9	34.9	76.49
Green ash	15.0	1,141	2,035.9	1,995	3,136	(N/A)	13.9	15.7	57.02
Blue spruce	1.5	114	237.3	233	347	(N/A)	7.8	1.7	11.19
Norway maple	7.3	550	1,047.9	1,027	1,577	(N/A)	7.1	7.9	56.34
Spruce	1.2	94	191.2	187	281	(N/A)	6.5	1.4	10.82
Red maple	2.4	180	315.3	309	489	(N/A)	6.3	2.4	19.54
Northern hackberry	6.7	512	932.0	913	1,425	(N/A)	4.8	7.1	75.01
Sugar maple	4.4	337	598.6	587	924	(N/A)	4.3	4.6	54.35
Ponderosa pine	1.3	97	174.2	171	268	(N/A)	3.3	1.3	20.61
Black walnut	3.4	257	464.3	455	712	(N/A)	3.0	3.6	59.31
Apple	0.4	33	72.3	71	104	(N/A)	2.8	0.5	9.44
Pin oak	4.4	334	581.4	570	904	(N/A)	2.8	4.5	82.17
American basswood	3.5	266	506.2	496	762	(N/A)	2.5	3.8	76.22
Honeylocust	2.6	194	334.4	328	522	(N/A)	2.0	2.6	65.22
Scotch pine	0.6	46	81.9	80	127	(N/A)	1.8	0.6	18.10
White ash	1.2	94	151.2	148	242	(N/A)	1.5	1.2	40.30
Littleleaf linden	1.1	86	167.8	164	250	(N/A)	1.5	1.3	41.69
Swamp white oak	0.1	9	19.4	19	28	(N/A)	1.0	0.1	7.01
Broadleaf Evergreen Large	0.4	29	56.3	55	84	(N/A)	0.5	0.4	42.23
Mulberry	0.4	29	56.3	55	84	(N/A)	0.5	0.4	42.14
Black poplar	0.7	50	93.7	92	142	(N/A)	0.5	0.7	70.91
Birch	0.3	21	35.7	35	56	(N/A)	0.5	0.3	27.88
American sycamore	0.4	33	59.0	58	91	(N/A)	0.3	0.5	91.02
Black maple	0.3	19	30.1	29	49	(N/A)	0.3	0.2	48.95
Catalpa	0.5	37	63.1	62	99	(N/A)	0.3	0.5	98.63
Ohio buckeye	0.3	20	39.6	39	59	(N/A)	0.3	0.3	58.69
Northern pin oak	0.3	24	47.4	46	71	(N/A)	0.3	0.4	70.84
Cherry plum	0.0	0	0.6	1	1	(N/A)	0.3	0.0	0.87
American elm	0.6	45	71.2	70	114	(N/A)	0.3	0.6	114.45
Red pine	0.1	10	14.6	14	24	(N/A)	0.3	0.1	24.14
Eastern white pine	0.1	11	19.7	19	30	(N/A)	0.3	0.2	30.47
Total	95.5	7,248	12,974.4	12,715	19,963	(N/A)	100.0	100.0	50.28

# Annual Stormwater Benefits of Public Trees

6/27/2016

Species	Total rainfall interception (Gal)	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	560,287	15,184	(N/A)	22.9	44.3	166.85
Green ash	176,226	4,776	(N/A)	13.9	13.9	86.83
Blue spruce	17,687	479	(N/A)	7.8	1.4	15.46
Norway maple	71,708	1,943	(N/A)	7.1	5.7	69.40
Spruce	14,658	397	(N/A)	6.5	1.2	15.28
Red maple	16,067	435	(N/A)	6.3	1.3	17.42
Northern hackberry	79,922	2,166	(N/A)	4.8	6.3	113.99
Sugar maple	52,408	1,420	(N/A)	4.3	4.1	83.54
Ponderosa pine	19,532	529	(N/A)	3.3	1.5	40.72
Black walnut	37,870	1,026	(N/A)	3.0	3.0	85.52
Apple	1,934	52	(N/A)	2.8	0.2	4.76
Pin oak	58,895	1,596	(N/A)	2.8	4.7	145.10
American basswood	47,088	1,276	(N/A)	2.5	3.7	127.61
Honeylocust	31,195	845	(N/A)	2.0	2.5	105.67
Scotch pine	6,998	190	(N/A)	1.8	0.6	27.09
White ash	10,465	284	(N/A)	1.5	0.8	47.27
Littleleaf linden	12,775	346	(N/A)	1.5	1.0	57.70
Swamp white oak	500	14	(N/A)	1.0	0.0	3.39
Broadleaf Evergreen Large	5,727	155	(N/A)	0.5	0.5	77.61
Mulberry	1,841	50	(N/A)	0.5	0.1	24.94
Black poplar	7,886	214	(N/A)	0.5	0.6	106.85
Birch	1,572	43	(N/A)	0.5	0.1	21.30
American sycamore	7,239	196	(N/A)	0.3	0.6	196.17
Black maple	1,604	43	(N/A)	0.3	0.1	43.46
Catalpa	7,239	196	(N/A)	0.3	0.6	196.17
Ohio buckeye	2,479	67	(N/A)	0.3	0.2	67.19
Northern pin oak	3,764	102	(N/A)	0.3	0.3	102.01
Cherry plum	7	0	(N/A)	0.3	0.0	0.20
American elm	4,551	123	(N/A)	0.3	0.4	123.33
Red pine	1,539	42	(N/A)	0.3	0.1	41.70
Eastern white pine	2,969	80	(N/A)	0.3	0.2	80.46
Citywide total	1,264,632	34,272	(N/A)	100.0	100.0	86.33



# Annual Air Quality Benefits of Public Trees

6/27/2016

Species	Deposition (lb)				Total Depos. (\$)	Avoided (lb)				Total Avoided (\$)	BVOC Emissions (lb)	BVOC Emissions (\$)	Total (lb)	Total (\$)	Standard Error	% of Total Trees	Avg. \$/tree
	O <sub>3</sub>	NO <sub>2</sub>	PM <sub>10</sub>	SO <sub>2</sub>		NO <sub>2</sub>	PM <sub>10</sub>	VOC	SO <sub>2</sub>								
Silver maple	108.1	18.3	51.9	4.8	580	160.0	23.4	22.3	153.4	1,001	-56.5	-212	485.8	1,368	(N/A)	22.9	15.04
Green ash	24.8	4.0	11.5	1.1	131	71.6	10.4	10.0	68.1	446	0.0	0	201.5	578	(N/A)	13.9	10.50
Blue spruce	1.7	0.3	1.7	0.2	12	7.4	1.1	1.0	6.8	46	-5.6	-21	14.6	37	(N/A)	7.8	1.18
Norway maple	15.2	2.6	7.4	0.7	82	35.2	5.1	4.8	32.9	218	-3.5	-13	100.3	286	(N/A)	7.1	10.23
Spruce	1.3	0.3	1.3	0.2	9	6.1	0.9	0.8	5.6	37	-4.9	-18	11.6	29	(N/A)	6.5	1.10
Red maple	3.2	0.5	1.6	0.1	17	11.2	1.6	1.6	10.7	70	-1.2	-4	29.5	83	(N/A)	6.3	3.32
Northern hackberry	15.2	2.6	7.4	0.7	82	32.3	4.7	4.5	30.6	201	0.0	0	97.9	283	(N/A)	4.8	14.89
Sugar maple	7.1	1.2	3.5	0.3	38	21.1	3.1	2.9	20.1	132	-5.6	-21	53.9	149	(N/A)	4.3	8.79
Ponderosa pine	2.2	0.4	1.9	0.3	15	6.1	0.9	0.8	5.8	38	-9.1	-34	9.3	18	(N/A)	3.3	1.42
Black walnut	5.1	0.8	2.4	0.2	27	16.2	2.4	2.2	15.3	101	0.0	0	44.7	128	(N/A)	3.0	10.66
Apple	0.5	0.1	0.3	0.0	3	2.2	0.3	0.3	2.0	13	0.0	0	5.6	16	(N/A)	2.8	1.46
Pin oak	11.5	2.0	5.7	0.5	63	20.8	3.0	2.9	19.9	130	-20.9	-79	45.5	114	(N/A)	2.8	10.37
American basswood	7.1	1.2	3.4	0.3	38	17.0	2.5	2.3	15.9	105	-5.8	-22	43.8	121	(N/A)	2.5	12.14
Honeylocust	6.2	1.0	2.8	0.3	33	12.0	1.8	1.7	11.6	75	-4.9	-19	32.4	89	(N/A)	2.0	11.18
Scotch pine	0.7	0.1	0.7	0.1	5	2.9	0.4	0.4	2.8	18	-2.3	-9	5.8	14	(N/A)	1.8	2.05
White ash	1.2	0.2	0.6	0.1	6	5.7	0.8	0.8	5.6	36	0.0	0	15.0	43	(N/A)	1.5	7.09
Littleleaf linden	2.3	0.4	1.1	0.1	12	5.5	0.8	0.8	5.1	34	-1.1	-4	15.0	42	(N/A)	1.5	7.04
Swamp white oak	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.5	4	0.0	0	1.3	4	(N/A)	1.0	0.94
Broadleaf Evergreen Large	0.7	0.1	0.6	0.1	5	1.9	0.3	0.3	1.7	12	-2.5	-9	3.1	7	(N/A)	0.5	3.37
Mulberry	0.6	0.1	0.3	0.0	3	1.9	0.3	0.3	1.7	12	0.0	0	5.2	15	(N/A)	0.5	7.45
Black poplar	1.0	0.2	0.5	0.0	5	3.2	0.5	0.4	3.0	20	0.0	0	8.7	25	(N/A)	0.5	12.48
Birch	0.2	0.0	0.1	0.0	1	1.3	0.2	0.2	1.2	8	-0.1	0	3.2	9	(N/A)	0.5	4.56
American sycamore	1.2	0.2	0.5	0.1	6	2.1	0.3	0.3	2.0	13	0.0	0	6.6	19	(N/A)	0.3	19.04
Black maple	0.3	0.1	0.2	0.0	2	1.2	0.2	0.2	1.2	7	-0.1	0	3.1	9	(N/A)	0.3	8.75
Catalpa	1.6	0.3	0.7	0.1	8	2.3	0.3	0.3	2.2	14	0.0	0	7.7	23	(N/A)	0.3	22.55
Ohio buckeye	0.5	0.1	0.2	0.0	3	1.3	0.2	0.2	1.2	8	-0.1	0	3.6	10	(N/A)	0.3	10.16
Northern pin oak	0.9	0.1	0.4	0.0	5	1.6	0.2	0.2	1.5	10	-0.2	-1	4.7	14	(N/A)	0.3	13.58
Cherry plum	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	(N/A)	0.3	0.11
American elm	2.2	0.4	1.0	0.1	12	2.7	0.4	0.4	2.7	17	0.0	0	9.9	29	(N/A)	0.3	28.89
Red pine	0.2	0.0	0.1	0.0	1	0.6	0.1	0.1	0.6	4	-0.5	-2	1.2	3	(N/A)	0.3	2.82
Eastern white pine	0.3	0.1	0.3	0.0	2	0.7	0.1	0.1	0.7	4	-1.4	-5	0.9	1	(N/A)	0.3	1.45
Citywide total	223.1	37.8	110.0	10.5	1,206	454.6	66.3	63.2	432.4	2,834	-126.2	-473	1,271.7	3,566	(N/A)	100.0	8.98

## Battle Creek

### Annual CO<sub>2</sub> Benefits of Public Trees

6/27/2016

Species	Sequestered (lb)	Sequestered (\$)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released (\$)	Avoided (lb)	Avoided (\$)	Net Total (lb)	Total Standard (\$ Error)	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	170,842	1,281	-12,807	-410	-3	56,890	427	214,515	1,609 (N/A)	22.9	49.8	17.68
Green ash	32,406	243	-3,992	-162	-1	25,221	189	53,473	401 (N/A)	13.9	12.4	7.29
Blue spruce	934	7	-41	-28	0	2,526	19	3,391	25 (N/A)	7.8	0.8	0.82
Norway maple	7,283	55	-1,204	-81	-1	12,164	91	18,162	136 (N/A)	7.1	4.2	4.86
Spruce	1,170	9	-43	-25	0	2,076	16	3,178	24 (N/A)	6.5	0.7	0.92
Red maple	3,901	29	-179	-24	0	3,968	30	7,667	58 (N/A)	6.3	1.8	2.30
Northern hackberry	9,343	70	-1,196	-69	-1	11,309	85	19,387	145 (N/A)	4.8	4.5	7.65
Sugar maple	10,332	77	-988	-49	0	7,455	56	16,750	126 (N/A)	4.3	3.9	7.39
Ponderosa pine	1,343	10	-103	-23	0	2,149	16	3,365	25 (N/A)	3.3	0.8	1.94
Black walnut	7,541	57	-818	-36	0	5,675	43	12,363	93 (N/A)	3.0	2.9	7.73
Apple	397	3	-43	-9	0	730	5	1,075	8 (N/A)	2.8	0.2	0.73
Pin oak	20,488	154	-1,514	-50	0	7,384	55	26,309	197 (N/A)	2.8	6.1	17.94
American basswood	14,360	108	-1,283	-43	0	5,881	44	18,915	142 (N/A)	2.5	4.4	14.19
Honeylocust	3,953	30	-386	-20	0	4,288	32	7,835	59 (N/A)	2.0	1.8	7.35
Scotch pine	557	4	-22	-11	0	1,027	8	1,552	12 (N/A)	1.8	0.4	1.66
White ash	2,849	21	-126	-11	0	2,069	16	4,781	36 (N/A)	1.5	1.1	5.98
Littleleaf linden	2,980	22	-232	-15	0	1,892	14	4,626	35 (N/A)	1.5	1.1	5.78
Swamp white oak	292	2	-5	-2	0	201	2	486	4 (N/A)	1.0	0.1	0.91
Broadleaf Evergreen Large	851	6	-44	-4	0	647	5	1,450	11 (N/A)	0.5	0.3	5.44
Mulberry	268	2	-47	-5	0	643	5	859	6 (N/A)	0.5	0.2	3.22
Black poplar	1,714	13	-151	-7	0	1,105	8	2,660	20 (N/A)	0.5	0.6	9.97
Birch	482	4	-19	-3	0	460	3	919	7 (N/A)	0.5	0.2	3.45
American sycamore	912	7	-188	-5	0	734	6	1,453	11 (N/A)	0.3	0.3	10.90
Black maple	483	4	-17	-2	0	431	3	895	7 (N/A)	0.3	0.2	6.71
Catalpa	479	4	-269	-6	0	813	6	1,017	8 (N/A)	0.3	0.2	7.63
Ohio buckeye	470	4	-38	-3	0	440	3	869	7 (N/A)	0.3	0.2	6.52
Northern pin oak	0	0	-69	-4	0	539	4	466	3 (N/A)	0.3	0.1	3.49
Cherry plum	9	0	0	0	0	6	0	14	0 (N/A)	0.3	0.0	0.10
American elm	724	5	-198	-6	0	987	7	1,507	11 (N/A)	0.3	0.4	11.31
Red pine	116	1	-6	-2	0	216	2	324	2 (N/A)	0.3	0.1	2.43
Eastern white pine	187	1	-16	-3	0	246	2	415	3 (N/A)	0.3	0.1	3.11
Citywide total	297,665	2,232	-26,043	-1,117	-8	160,172	1,201	430,676	3,230 (N/A)	100.0	100.0	8.14

<b>Annual Aesthetic/Other Benefits of Public Trees</b>
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6/27/2016

Species	Total (\$)	Standard Error	% of Total Trees	% of Total \$	Avg. \$/tree
Silver maple	12,138	(N/A)	22.9	48.4	133.38
Green ash	2,683	(N/A)	13.9	10.7	48.78
Blue spruce	497	(N/A)	7.8	2.0	16.05
Norway maple	699	(N/A)	7.1	2.8	24.97
Spruce	360	(N/A)	6.5	1.4	13.85
Red maple	559	(N/A)	6.3	2.2	22.34
Northern hackberry	1,116	(N/A)	4.8	4.5	58.71
Sugar maple	1,065	(N/A)	4.3	4.3	62.65
Ponderosa pine	290	(N/A)	3.3	1.2	22.29
Black walnut	620	(N/A)	3.0	2.5	51.64
Apple	21	(N/A)	2.8	0.1	1.90
Pin oak	1,470	(N/A)	2.8	5.9	133.64
American basswood	956	(N/A)	2.5	3.8	95.56
Honeylocust	980	(N/A)	2.0	3.9	122.50
Scotch pine	159	(N/A)	1.8	0.6	22.66
White ash	354	(N/A)	1.5	1.4	59.02
Littleleaf linden	311	(N/A)	1.5	1.2	51.79
Swamp white oak	41	(N/A)	1.0	0.2	10.35
Broadleaf Evergreen Large	179	(N/A)	0.5	0.7	89.36
Mulberry	15	(N/A)	0.5	0.1	7.74
Black poplar	131	(N/A)	0.5	0.5	65.59
Birch	52	(N/A)	0.5	0.2	26.02
American sycamore	58	(N/A)	0.3	0.2	58.34
Black maple	66	(N/A)	0.3	0.3	65.89
Catalpa	29	(N/A)	0.3	0.1	28.57
Ohio buckeye	43	(N/A)	0.3	0.2	43.05
Northern pin oak	0	(N/A)	0.3	0.0	0.00
Cherry plum	0	(N/A)	0.3	0.0	0.03
American elm	87	(N/A)	0.3	0.3	86.69
Red pine	32	(N/A)	0.3	0.1	32.32
Eastern white pine	47	(N/A)	0.3	0.2	47.08
Citywide total	25,057	(N/A)	100.0	100.0	63.11

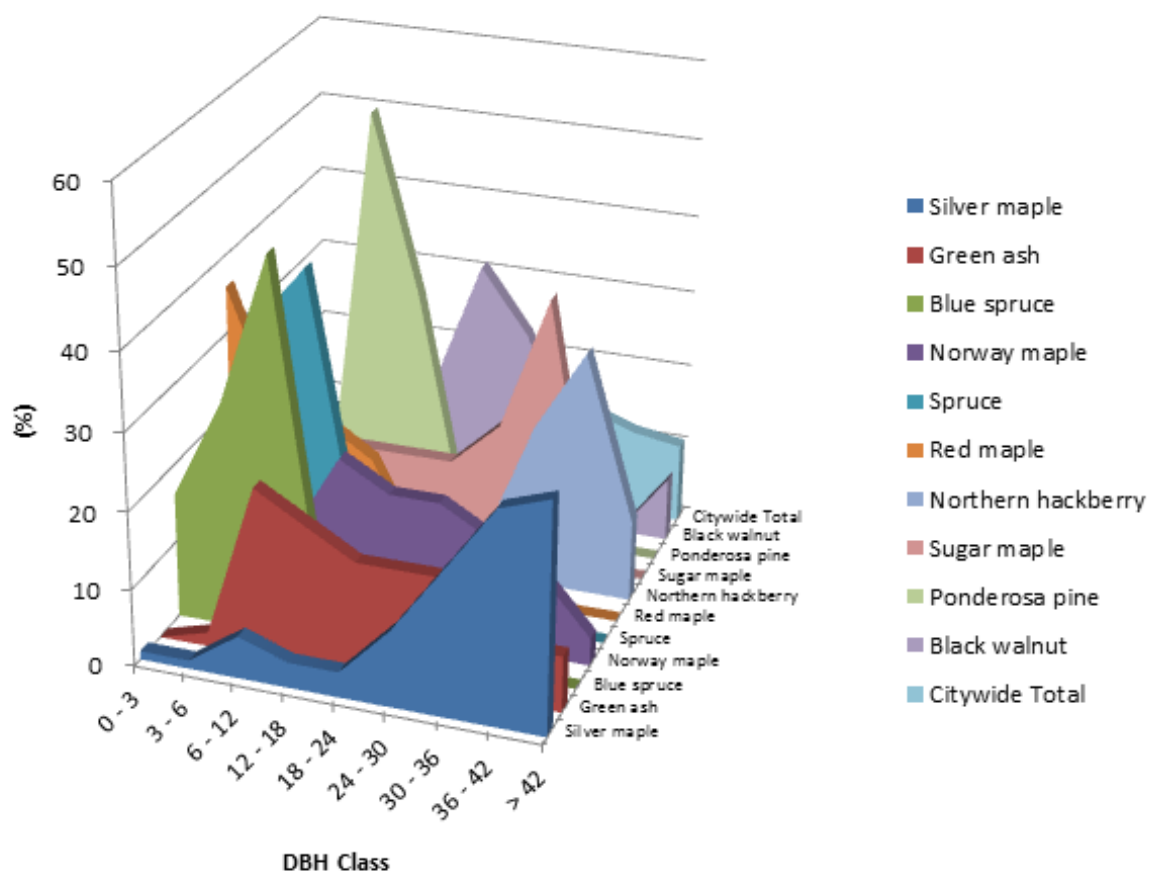
# Annual Benefits of Public Trees by Species (\$/tree)

6/27/2016

Species	Energy	CO <sub>2</sub>	Air Quality	Stormwater	Aesthetic/Other	Total (\$) Standard Error
Silver maple	76.49	17.68	15.04	166.85	133.38	409.45 (N/A)
Green ash	57.02	7.29	10.50	86.83	48.78	210.42 (N/A)
Blue spruce	11.19	0.82	1.18	15.46	16.05	44.70 (N/A)
Norway maple	56.34	4.86	10.23	69.40	24.97	165.80 (N/A)
Spruce	10.82	0.92	1.10	15.28	13.85	41.96 (N/A)
Red maple	19.54	2.30	3.32	17.42	22.34	64.92 (N/A)
Northern hackberry	75.01	7.65	14.89	113.99	58.71	270.26 (N/A)
Sugar maple	54.35	7.39	8.79	83.54	62.65	216.72 (N/A)
Ponderosa pine	20.61	1.94	1.42	40.72	22.29	86.98 (N/A)
Black walnut	59.31	7.73	10.66	85.52	51.64	214.87 (N/A)
Apple	9.44	0.73	1.46	4.76	1.90	18.30 (N/A)
Pin oak	82.17	17.94	10.37	145.10	133.64	389.21 (N/A)
American basswood	76.22	14.19	12.14	127.61	95.56	325.71 (N/A)
Honeylocust	65.22	7.35	11.18	105.67	122.50	311.92 (N/A)
Scotch pine	18.10	1.66	2.05	27.09	22.66	71.57 (N/A)
White ash	40.30	5.98	7.09	47.27	59.02	159.66 (N/A)
Littleleaf linden	41.69	5.78	7.04	57.70	51.79	163.99 (N/A)
Swamp white oak	7.01	0.91	0.94	3.39	10.35	22.61 (N/A)
Broadleaf Evergreen L	42.23	5.44	3.37	77.61	89.36	218.00 (N/A)
Mulberry	42.14	3.22	7.45	24.94	7.74	85.49 (N/A)
Black poplar	70.91	9.97	12.48	106.85	65.59	265.81 (N/A)
Birch	27.88	3.45	4.56	21.30	26.02	83.21 (N/A)
American sycamore	91.02	10.90	19.04	196.17	58.34	375.47 (N/A)
Black maple	48.95	6.71	8.75	43.46	65.89	173.77 (N/A)
Catalpa	98.63	7.63	22.55	196.17	28.57	353.55 (N/A)
Ohio buckeye	58.69	6.52	10.16	67.19	43.05	185.60 (N/A)
Northern pin oak	70.84	3.49	13.58	102.01	0.00	189.93 (N/A)
Cherry plum	0.87	0.10	0.11	0.20	0.03	1.31 (N/A)
American elm	114.45	11.31	28.89	123.33	86.69	364.67 (N/A)
Red pine	24.14	2.43	2.82	41.70	32.32	103.40 (N/A)
Eastern white pine	30.47	3.11	1.45	80.46	47.08	162.58 (N/A)
Citywide Total	50.28	8.14	8.98	86.33	63.11	216.84 (N/A)

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

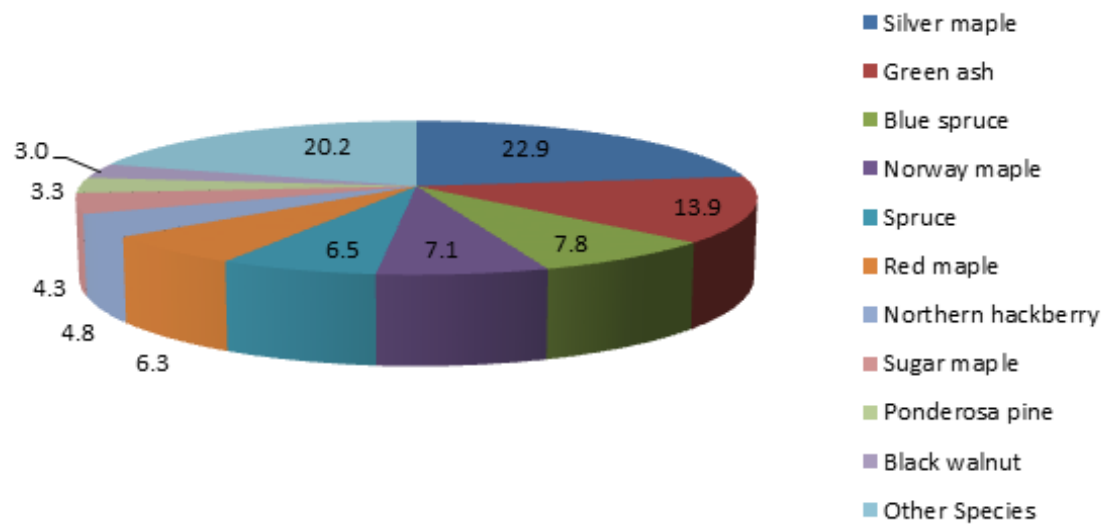
6/27/2016



Species	DBH class (in)								
	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Silver maple	1.10	1.10	5.49	3.30	3.30	9.89	18.68	27.47	29.67
Green ash	0.00	1.82	21.82	18.18	14.55	14.55	14.55	7.27	7.27
Blue spruce	16.13	29.03	48.39	3.23	3.23	0.00	0.00	0.00	0.00
Norway maple	0.00	3.57	10.71	21.43	17.86	17.86	14.29	10.71	3.57
Spruce	11.54	34.62	42.31	7.69	3.85	0.00	0.00	0.00	0.00
Red maple	36.00	20.00	20.00	16.00	4.00	4.00	0.00	0.00	0.00
Northern hackberry	5.26	15.79	0.00	5.26	5.26	5.26	21.05	31.58	10.53
Sugar maple	0.00	11.76	11.76	11.76	11.76	17.65	35.29	0.00	0.00
Ponderosa pine	0.00	0.00	53.85	30.77	0.00	15.38	0.00	0.00	0.00
Black walnut	8.33	0.00	0.00	16.67	33.33	25.00	8.33	0.00	8.33
Citywide Total	6.05	11.08	17.63	11.08	8.31	10.58	13.60	11.34	10.33

## Species Distribution of Public Trees

6/27/2016



Species	Percent
Silver maple	22.9
Green ash	13.9
Blue spruce	7.8
Norway maple	7.1
Spruce	6.5
Red maple	6.3
Northern hackberry	4.8
Sugar maple	4.3
Ponderosa pine	3.3
Black walnut	3.0
Other Species	20.2
Total	100.0



# Battle Creek, Iowa



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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

0 0.075 0.15 0.3 Miles  
Date: 1/25/2016

● WhiteAsh  
● Green Ash





# Battle Creek, Iowa



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

Date: 1/25/2016

- |                      |                         |
|----------------------|-------------------------|
| • Bark Split (0)     | • Woodpecker Damage (2) |
| • Epicormics (0)     | • D Exit Holes (0)      |
| • Canopy Dieback (8) |                         |





# Battle Creek, Iowa



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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www.coppertreeconsulting.com

0 0.075 0.15 0.3 Miles  
Date: 1/26/2016

Wood Condition		Leaf Condition	
Dead (1)	Poor (9)	Dead (0)	Poor (0)





# Battle Creek, Iowa



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

Date: 1/26/2016

## PRIORITY

<span style="color: green;">●</span> Stake/Train (0)	<span style="color: purple;">●</span> Crown Raising (1)	<span style="color: red;">●</span> Remove (9)
<span style="color: teal;">●</span> Crown Cleaning (0)	<span style="color: orange;">●</span> Crown Reduction (0)	<span style="color: green;">■</span> Treat Pests/Disease (0)



## Appendix C: Battle Creek 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. 9<sup>th</sup> 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.