



EMERALD ASH BORER MANAGEMENT PLAN

June 30, 2023

Prepared for:

City of Savage

6000 McColl Drive

Savage, MN 55378

WSB PROJECT NO. 022315-000



Table of Contents

Table of Contents

1.0	Purpose.....	1
2.0	Introduction	1
3.0	Emerald Ash Borer Biology	3
4.0	Current Emerald Ash Borer Status in City of Savage	5
5.0	Tree Inventory and Ash Population	6
6.0	Program Administration and Impact	9
7.0	Public Outreach and Education	9
8.0	Management of Public Ash Trees with Best Management Practices (BMPs).....	10
8.1	Monitoring and Inspection (Best Management Practice #1)	11
8.2	Insecticide Use (Best Management Practice #2)	11
8.3	Ash Tree Removal (Best Management Practice #3)	14
8.3.1	Proactive Structured Ash Removal	15
8.3.2	EAB Infested Ash Removal for Sanitation and Hazard Prevention – City Property.....	16
8.3.3	EAB Infested Ash Removal for Hazard Prevention – Private Property.....	16
9.0	Ash Wood Disposal.....	17
10.0	Reforestation and Canopy Replacement.....	18
10.1	Reforestation	20
11.0	Estimated Cost and Budget	23
12.0	Conclusion.....	25



Figures

Figure 1: City of Savage Ash Count

Figure 2: Ash Tree condition Count by Diameter Class

Figure 3: Percentage of Counties Infested with EAB by Years of Infestation

Figure 4: Tree Benefits from a 16" Diameter Ash Tree

Figure 5: Public Ash Trees Eligible for Injection of Emamectin Benzoate

Figure 6: Proactive Structured Ash Removals on City Property

Figure 7: Growing Shade Tool – Priority for Planting

Figure 8: Runoff Volumes will Increase Based on the Percent of Impervious Surface

Figure 9: Estimated Cost for Boulevard Ash Tree Removal and Stump Grinding

Figure 10: Estimated Cost for Park/Open Space Ash Tree Removal and Stump Grinding

Figure 11: Estimated Cost for Injection on City Property – All Fair and Good Condition Ash Trees >10" diameter

Figure 12: Estimated Cost for Ash Replacement (Replanting) on Park/Open Space (No Boulevard Replacement)

Maps

Map 1: USDA Approximate Range of Ash Species in the US with EAB Positives

Map 2: Status of EAB in Minnesota According to the MN Department of Agriculture.

Map 3: Savage Emerald Ash Borer Status-MN Department of Agriculture April

Map 4. South Metro Emerald Ash Borer Status - MN Department of Agriculture



1.0 Purpose

The purpose of the City of Savage Emerald Ash Borer Management Plan is to minimize the significant fiscal and environmental impacts of emerald ash borer (EAB). The loss of over 600 public ash trees and thousands of private ash trees in Savage will influence home values, quality of life and the environment over decades. The most effective way to handle EAB in Savage will require a mixed approach including tree preservation by injection, tree, and stump removals, replanting, and adding additional resources to assist with handling the pest in a systematic way.

The EAB Management Plan is consistent with the City's vision statement to be "...an inclusive community for all ages and stages of life. A safe, welcoming place with abundant natural amenities. We honor our unique history while simultaneously planning our growth and the creation of a dynamic, full-service City." One of the six principles that guides decisions is directly related to Natural Resources & Recreation: Savage will preserve and enhance our natural amenities and maximize recreational opportunities.

Trees serve as part of the City's green infrastructure: they clean the air, slow down and absorb stormwater, reduce erosion, save electricity by reducing air conditioning costs, enhance property values and provide habitat for wildlife. One figure provided by the Minnesota Shade Tree Advisory Council (MnSTAC) states the loss of all urban ash trees in the state will lead to 1.7 billion gallons of water entering our stormwater systems annually. A proactive and structured approach to managing the City's ash population will distribute the impacts over 10 years and help ensure an orderly response while maintaining as many tree benefits as possible. The City's plan is guided by the best management practices issued by the top three agencies researching and managing EAB in the state: the Minnesota Department of Agriculture, the Minnesota Department of Natural Resources, and the University of Minnesota. Since research is ongoing, management practices will be modified if new strategies are recommended.

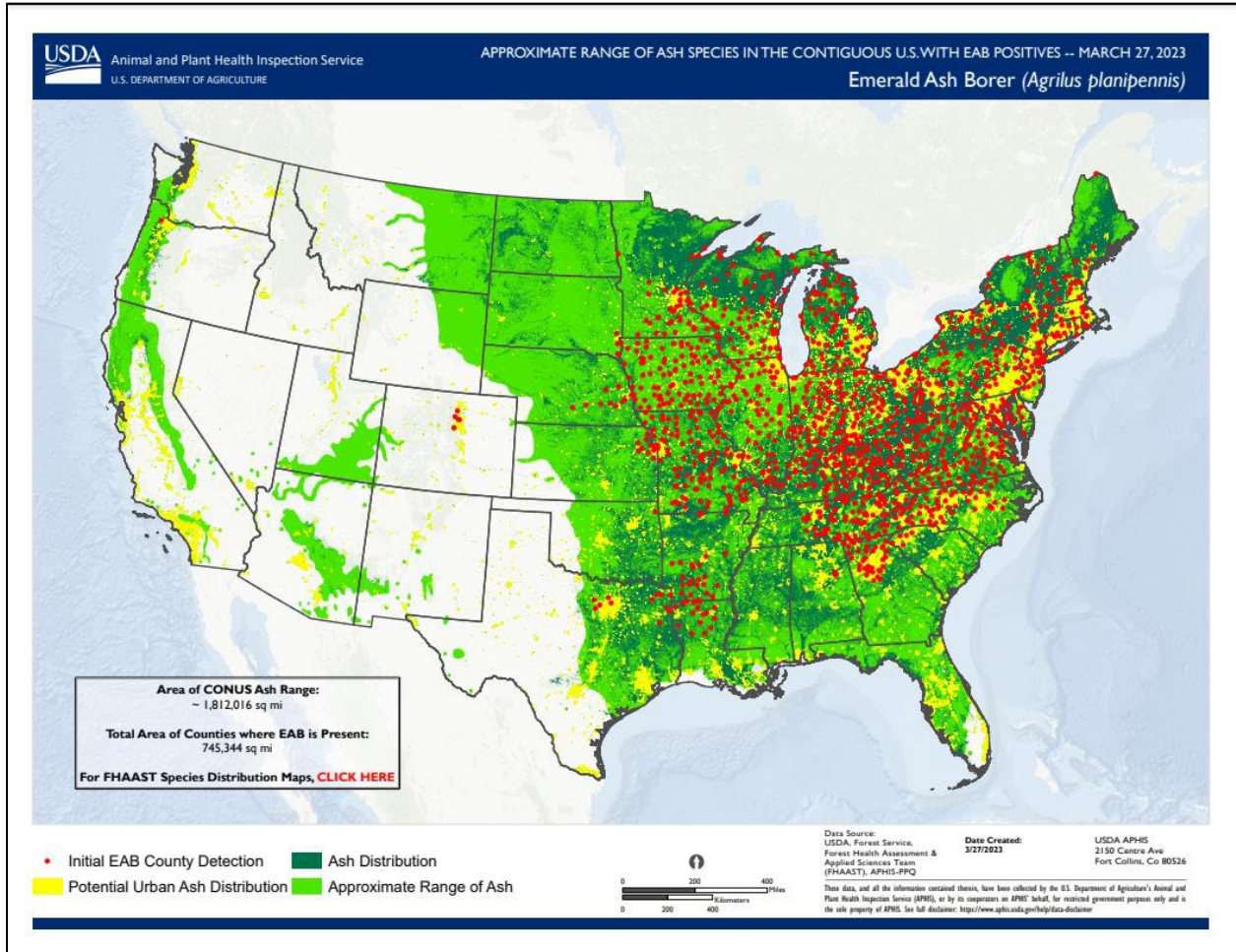
2.0 Introduction

EAB (*Agrilus planipennis* Fairmaire) is a non-native invasive wood boring beetle with larvae that tunnel under the bark in the living tissue, disrupting the tree's ability to transport water and nutrients. It was first detected in Detroit, Michigan in 2002, most likely introduced to North America on wood packing materials originating from Asia. Scientists believe it could have been introduced as early as 1990, so the insect had over ten years to build its population without any proactive management in that area. Since that time, EAB has spread to at least 35 states and 6 Canadian provinces. Emerald ash borer has killed hundreds of millions of ash trees where it becomes established.

The USDA Forest Service EAB website states "...emerald ash borer is the most destructive invasive forest insect ever to have invaded North America." Ash trees were frequently the default replacement for elm trees lost to Dutch elm disease in the late 1970's and 80s. They traditionally survive in soil conditions that many other trees cannot and are selected for difficult growing sites.



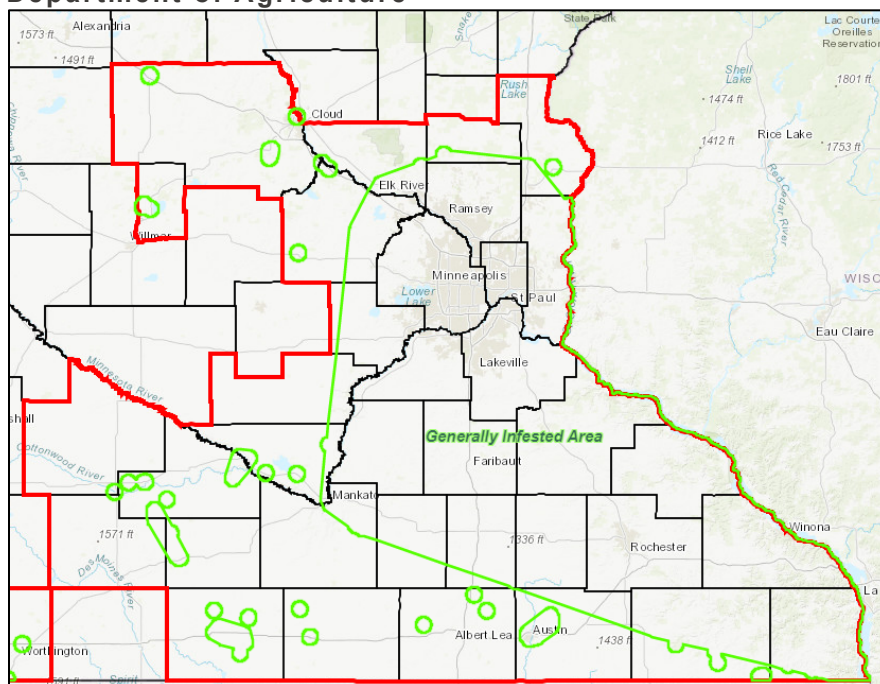
Map 1: USDA Approximate Range of Ash Species in the Continuous United States with EAB Positives, March 2023



According to the state’s Department of Natural Resources, Minnesota has 2.65 million ash trees in communities, and about 1.1 billion ash trees in total growing in forests and communities, the most of any state in the country. An organized and systematic approach helps distribute the impacts and ensures an orderly response while maintaining as many tree benefits as possible for the community.



Map 2: Status of EAB in Minnesota According to the MN Department of Agriculture



*Green indicates generally infested, red shows quarantined counties

EAB was first detected in Minnesota in 2009 within the City of St. Paul. Fourteen years since the first detection in the state, it has reached a critical state in the Twin Cities metropolitan area. The insect tends to follow an exponential curve; as the beetle population increases, ash tree death also accelerates. Beyond existing as a threat to forest health and canopy cover, emerald ash borer creates a significant public safety issue. The insect damage accelerates the wood drying that would normally happen as a tree dies, and due to the wood properties of ash, the infested trees become extremely brittle.

As trees become more dangerous to remove, there are fewer options for safe removal by appropriately trained staff and contractors. This is a relevant issue for private property tree owners in addition to the City. There is a direct relationship between the risk associated with removing a tree and the cost when contractors are hired to remove an infested tree. As the EAB population builds in a community, tree death increases and accelerates, often referred to as the “death curve” because it is an exponential relationship. Although it is not currently possible to eradicate EAB once found, there are research-based control measures that can slow and flatten out the “curve” to spread tree losses and costs over time, which will be proposed for implementation in the plan.

3.0 Emerald Ash Borer Biology

Ash trees are killed when EAB larvae (the immature stage) feeds under the bark of ash trees, disrupting the tree’s ability to transport water and nutrients throughout the tree. The feeding creates the iconic S-shaped galleries underneath the bark. The adults feed on ash leaves but are not the primary driver of tree mortality. Due to its



small size, and its inconspicuous location under the bark, it can be difficult to detect in the early stages and typically infests a tree for three to five years before visible signs and symptoms appear. During that time, one generation of beetles can emerge from an infested tree each year and fly to nearby ash trees.

The emerald ash borer adult is very small from 3/8-1/2 inches long, and the immature stage (larvae) is about one inch long.

Emerald ash borer spreads about one to two miles per year, which is the average flight distance of an adult beetle.

The insect has spread faster than one to two miles per year due to human movement of firewood, nursery stock and other ash products.

Photo 1: EAB Larva



Photo Credit: Pennsylvania Department of Conservation and Natural Resources -Forestry, Bugwood.org



Photo 2: Extensive Feeding by EAB Larvae, S-shaped Galleries under Bark



Photo Credit: Emily Ball

4.0 Current Emerald Ash Borer Status in City of Savage

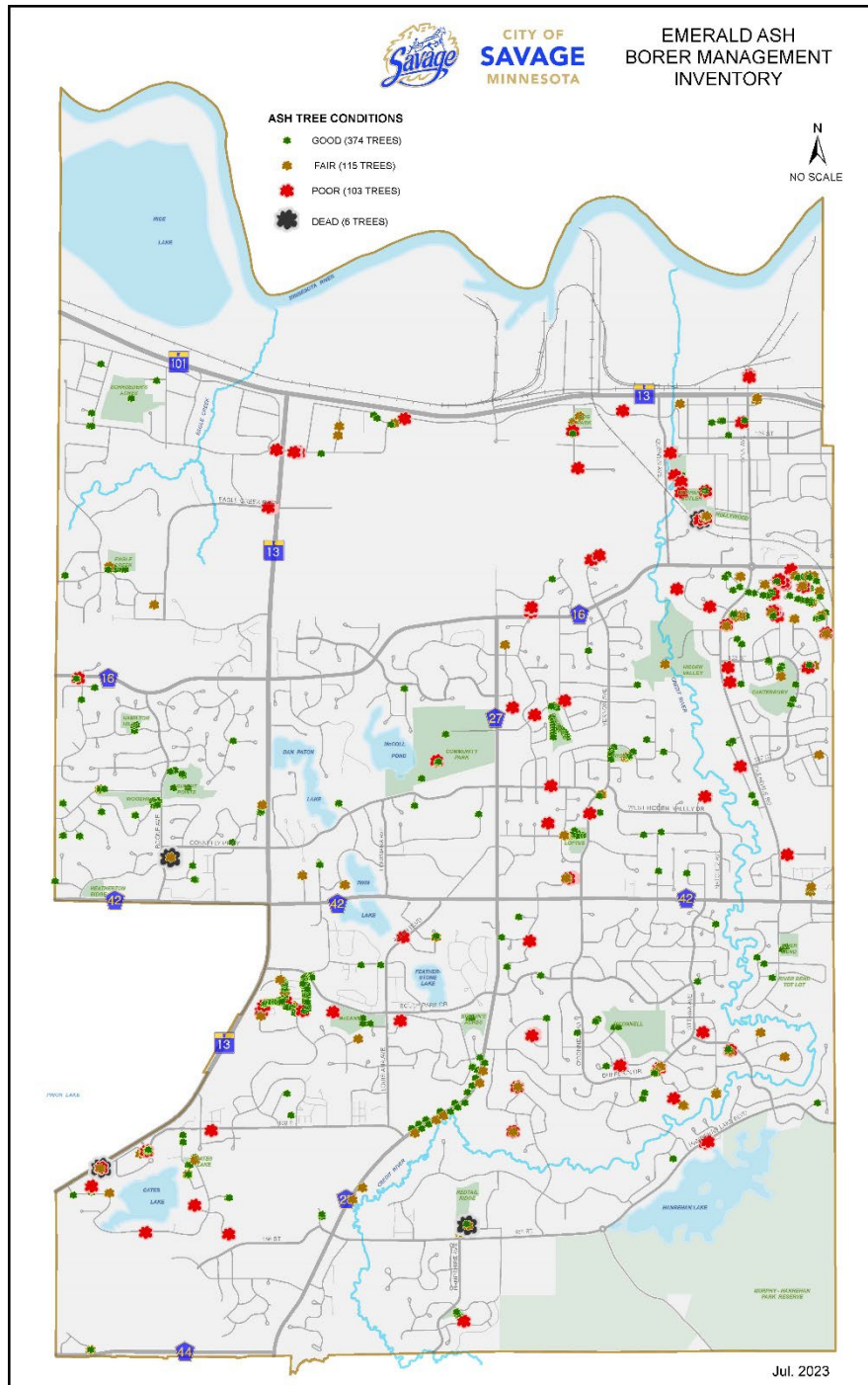
EAB was first detected in Savage in 2021; however, was discovered in a neighboring community in 2015 and was likely here at the same time. The City of Savage is a suburb approximately 20 miles south of the Twin Cities, Minnesota encompassing about 16.45 square miles and with a population of 33,137. Savage has 23 parks that range in size from small neighborhood parks to large, regional parks like Murphy-Hanrehan, along with 30 miles of paved trails and 60 miles of sidewalk. The community has plentiful wetlands, ponds, prairies, trees, and the Minnesota River. Residents rate the City's natural resources as one of the top reasons they appreciate living in Savage.

The City is located within the Minnesota Department of Agriculture's "generally infested area" (Map 2) within the Twin Cities, meaning most ash trees have some level of EAB infestation. Another way to interpret "generally infested" is that if an ash tree has not been injected to protect it from EAB, there is likely some level of infestation in the tree, whether you can detect it visually or not. When EAB levels are low within a tree, it can be hard to detect it by a visual inspection.



5.0 Tree Inventory and Ash Population

City of Savage Engineering staff finalized work with a contractor/certified arborist in Fall 2022 to complete an updated ash tree-only focused inventory effort on boulevards and public properties (Map 3).





Each ash tree was assigned a condition rating of “dead, poor, fair, or good” by the City’s contractor. The ratings consider tree health such as evidence of EAB, but also physical condition such as branch structure, presence of decay, wounds, presence of stem-girdling roots and more.

Figure 1 City of Savage Ash Tree Count by Condition Rating

Condition Rating	Total Ash
Unknown*	8
Dead	6
Poor	95
Fair	115
Good	374
TOTAL	598

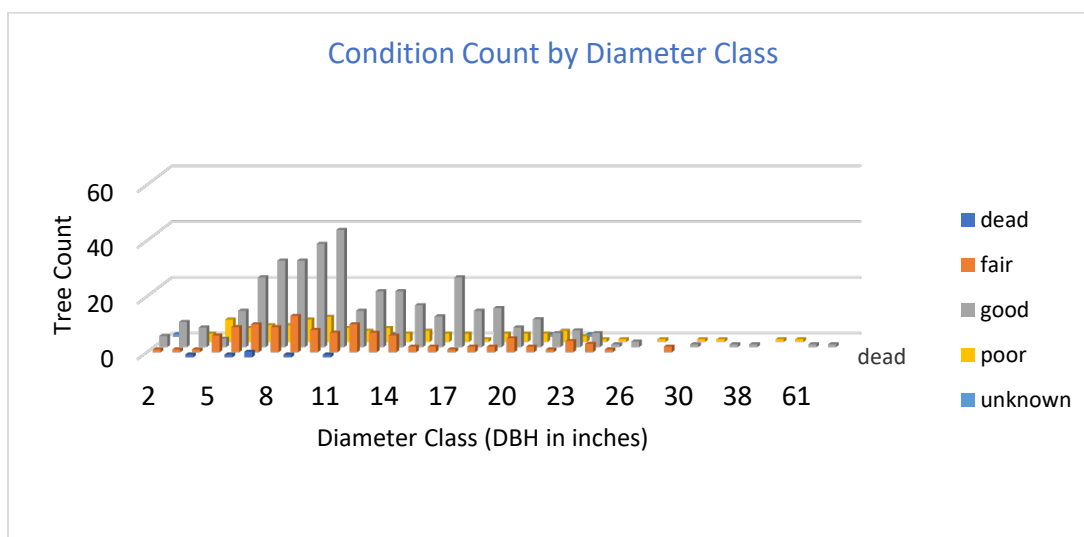
*no condition rating assigned, will need to be field checked



Some of the relevant findings related to the inventory are:

- There are 598 ash trees located on boulevards (public right-of-way) and maintained public spaces such as parks
- Most of the good condition ash trees are in the 8"-22" diameter classes
- All the dead ash trees are 11" diameter or smaller
- The poor condition ash trees range from 7"-53" diameter
- Most of the ash trees are 24" and smaller, with only 17 trees 25" and larger

Figure 2: Ash Tree Condition Count by Diameter Class



As budget or grant dollars are available, it would be useful to obtain a complete (full species) GIS-based tree inventory for all boulevard (right-of-way) and public property trees within Savage.

- Without a full inventory, it is hard to know what percentage ash trees comprise compared to total tree species composition on city property.
- A full tree inventory can also be used to create data-driven reforestation suggestions that will steadily improve tree species diversity within the community.
- Another helpful tool that could help provide guidance to residents and drive tree species recommendations or insect/disease risk assessments would include a statistical sample tree inventory on private property. This effort could be completed by following the research method in the "A Statistical Method for the Accurate and Rapid Sampling of Urban Street Tree Populations" (Journal of Arboriculture 18(4):July 1992).



6.0 Program Administration and Impact

The Public Works Department encompasses six divisions (engineering, parks maintenance, natural and water resources, recreation, street maintenance and utilities) and will take the lead role to implement the EAB plan and associated program. Staff will work collaboratively to implement public education, outreach, and the best management practices (BMPs) to handle emerald ash borer and ash trees throughout Savage. The Natural Resources Technician position will serve as the primary point person for EAB questions, concerns, and plan implementation (along with several other natural resource duties).

Implementing the EAB management plan will spread out the financial and staffing requirements over a ten-year period but will still require additional City resources. EAB management has financial and other implications that will exceed the City's current Public Works budget allocations.

7.0 Public Outreach and Education

The City of Savage has been a member of Tree City USA for 27 consecutive years and has made many advances in communicating information about EAB. There has been an effort to produce extensive website content that can be found cityofsavage.com, as well as ongoing City Connection newsletter articles and utility billing inserts. Education and empowering the public to act on their property is important due to the number of ash trees that are planted on private property, which are part of the overall community forest providing ecosystem services to Savage.

Methods that will be used to expand communication on EAB and the City's plan include:

- City Connection - newsletter articles
- Website
- Utility billing inserts
- Social media
- Public meetings
- Staff outreach at City events
- Staff provided informal education via resident phone calls or public tree inspection.

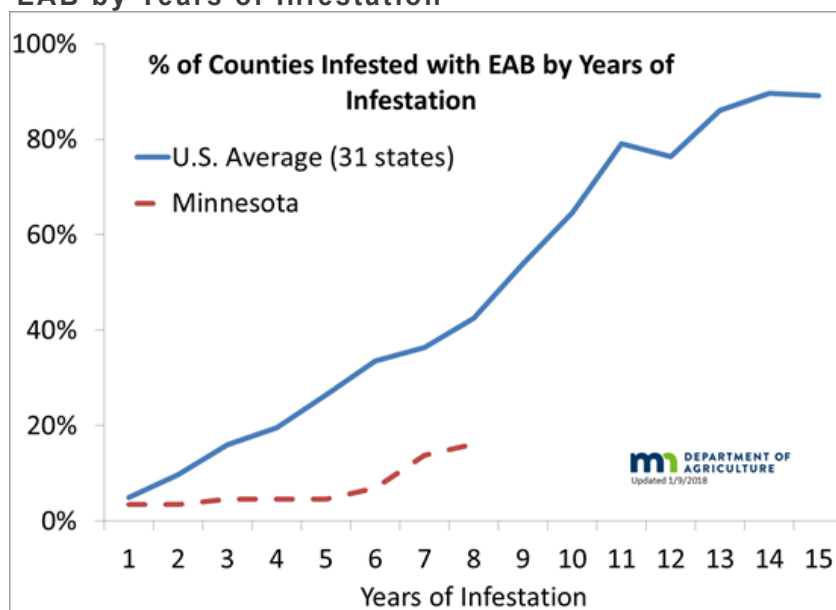
The City of Savage has maintained a list of "Registered Tree Contractors" since 2004. Contractors that provide tree maintenance service within the City are required to register annually with the City, provide proof of insurance and worker's compensation. This service provides a component of consumer protection and a starting point for residents who have ash trees and need to pursue injection or removal.



8.0 Management of Public Ash Trees with Best Management Practices (BMPs)

When EAB was first found in Michigan, several management strategies were attempted and failed. Since that time, several research-informed strategies have emerged and are now industry accepted best management practices (BMPs) for reducing the costs and preserving tree value during the peak of EAB infestation. Minnesota has benefitted from the early research, and as a result, done better than many of the initially infested states due to aggressive management, education, outreach, quarantines, sanitation, and cold weather.

Figure 3: Percentage of Counties Infested with EAB by Years of Infestation



There are several well-recognized BMPs that will help space out City funding dedicated to the mitigation efforts over time, preserve public safety, tree benefits, and aesthetics. In summary, these are the most powerful BMPs that Savage will utilize:

- Proactively monitor and inspect for the pest on City property.
- Use trunk-injected insecticide (emamectin benzoate or similar formulations) to preserve high value public ash trees and suppress the EAB population.
- Encourage private (non-City) property owners to proactively treat their high value ash through the City's "EAB Treatment Discount Program."
- Engage in structured removals of poor/fair condition ash trees and those too small to inject (less than 10"DBH) on public property before infestation and remove EAB infested trees when they are found.



This section describes each of these management practices accepted by the three main agencies researching EAB in Minnesota and how they apply to the City of Savage.

8.1 Monitoring and Inspection (Best Management Practice #1)

The most efficient way to detect EAB in a tree is visual inspection for woodpecker activity in the mid-to-upper canopy of ash trees during the winter months when leaves are off the tree.

- Woodpeckers flick off the outer darker bark while looking for EAB larvae. As the woodpecker works, the inner, lighter bark is exposed, referred to as “blonding” and dime sized oval holes appear along branches.
- February/March is the most prolific time for woodpecker activity, making it even easier to identify infested ash trees. Many of the woodpecker holes reveal galleries that can be seen from the ground.
- As the infestation progresses, the City could shift to year-round surveying and inspecting to keep up with the volume of trees showing woodpecker activity indicating EAB.

8.2 Insecticide Use (Best Management Practice #2)

Identifying ash trees that can be preserved with insecticides is an important step to halt any further EAB-driven ash mortality within the community. Insecticides are very effective in controlling insect populations when they are applied appropriately at the correct time of year in the appropriate dose (rate). There are several insecticides that are registered to kill EAB in ash trees. The method advocated by the City is the trunk injection of emamectin benzoate using the current industry standard injection system that has efficacy data supporting its use on trees ten inches or greater in diameter (DBH).

According to the United States Department of Agriculture (USDA) Forest Service EAB website in February 2018, emamectin benzoate was “...found to be the most effective product and provided two to three years of nearly complete EAB control. All EAB adults fed leaves from trees treated with emamectin benzoate died within four days and larval densities were reduced by 99 percent compared to untreated trees”. The insecticide is toxic to EAB larvae and adults upon ingestion.

- The applied injection is systemic, so the tree takes up the insecticide in its xylem tissues (water conducting system).
- The insecticide is injected where the root system and trunk interface, is pulled upward by the tree, spreads through the canopy in all the fine branches and can be detected inside the tree tissues and leaves.
- The insecticide has a two-year efficacy period, with early research indicating it might be possible to stretch treatments to every three years.

According to a handout created by the University of Minnesota and two other universities detailing *Frequently Asked Questions Regarding Potential Side Effects of Systemic Insecticides Used to Control EAB*, emamectin benzoate is “...derived



from a naturally occurring soil bacterium, has been registered for more than ten years as a foliar spray to control pests in vegetable and cotton fields...and similar products are used in veterinary medicine as wormers for dogs, horses and other animals.”

The trunk injection can be performed on a tree 8-10 times (20-year time period) for the price it would cost to:

- Remove the tree
- Grind the stump
- Replace the tree

At the end of the 20-year treatment cycle, a tree and all its ecosystem services and benefits to the community have been preserved.

- The average stem diameter (DBH) of Savage public trees slated for protection is about 16” or about 64 years old, planted in 1959. Average age estimates can be completed by multiplying an “age factor” by the tree’s DBH. A green ash’s age factor is 4 (Morton Arboretum).
- According to the USDA Forest Service’s i-Tree “My Tree” application, one 16” diameter ash tree in good condition growing in the City of Savage produces myriad benefits to the community that can be quantified and measured (itreetools.org).



Figure 4: Tree Benefits from a 16” Diameter Good Condition Ash Tree over 20 Years

Carbon Dioxide Uptake	\$66.97
Carbon Dioxide Sequestered(1)	785.36 pounds
Carbon Dioxide Equivalent (2)	2,879.64 pounds
Storm Water Mitigation	\$55.51
Runoff Avoided	6,212.17 gallons
Rainfall Intercepted	32,446.34 gallons
Air Pollution Removal	\$40.67
Carbon Monoxide	2.82 ounces
Ozone	256.88 ounces
Nitrogen Dioxide	35.05 ounces
Sulfur Dioxide	ounces
Particulate matter 2.5 microns or less	16.85 ounces
TOTAL DOLLARS OVER 20 YEARS	\$163.15

Benefits are based on USDA Forest Service research and are meant for guidance only. Visit www.itreetools.org
All monetary values are DISPLAYED in US dollars.

¹ For large trees sequestration is overtaken by CO₂ loss with decay/maintenance.

² CO₂ equivalent is estimated by calculating how much atmospheric CO₂ is taken in by trees to provide the carbon stored in the tissues of individual trees.

*Positive energy values indicate savings or reduced emissions occur when the tree is adjacent to a building. This location is supported by i-Tree. Localized data have been used to estimate its tree benefits.



The benefits include reductions in stormwater, electricity, natural gas, and uptake of carbon dioxide along with improved air quality, and property values. When there are thousands of ash trees lost in a community on public and private land during a short period of time before a canopy can rebound, the lost benefits can compound.

One example of that effect occurred in one of the first communities hit by EAB in Westland, Michigan. According to a study by Deborah McCollough published in the January-March 2012 *International Journal of Pest Management*; the removal of Westland's 3,000 municipal ash trees killed by EAB "led to a 33 percent increase in outdoor water consumption, which subsequently caused the regional water authority to levy a 10 percent surcharge on the City."

In summary, the trunk injection of emamectin benzoate is preferred to other trunk injections, spray, or soil-applied insecticides because:

- Research data indicates it is the most effective to kill EAB
- It can be done every-other year
- It is a restricted-use pesticide so only state licensed pesticide applicators can use it
- The insecticide is injected inside the tree, reducing the chance that children, pets or other wildlife will encounter it while playing in a yard or park
- Since it is inside the tree, it would not runoff in the soil or overland to lakes, creeks, or other water bodies

Many cities use trunk (stem) injected emamectin benzoate to:

- Preserve high-value good condition trees on a 20-year plan (10 injections)
- Preserve fair condition trees that are providing a unique aesthetic to a street corridor, or park where other trees would be hard to establish
- Stage tree removals in parks or boulevards by keeping primarily good condition ash trees from dying and becoming hazardous while cities move through a structured removal plan
- Encourage property owners and other non-city properties including commercial, high-density housing and school districts to preserve their ash trees and slow down widespread tree mortality, canopy loss, and wood-waste production at least until newly planted trees can establish.
 - Staff have offered an EAB Treatment Discount Program at no additional cost to the City which is available to any entity in Savage (town home associations, single family, etc.) since 2018.

Analyzing the 2022 ash inventory revealed the following ash trees were eligible for injection:



Figure 5: Public Ash Trees Eligible for Injection

Condition	Number of Ash Trees	Number of DBH inches
Good	251	3,980
Fair	65	1,024.5
TOTAL	316	5,004.5

*only trees 10"DBH or above were considered for injection, these numbers could increase if trees 9 or 9.5" are added to the cohort

- The City of Savage has a list of approximately 100 ash trees that have been injected since 2018 in select locations. Most of the protected ash trees were inspected by the Natural Resources Technician in 2023, and they appear healthy and unaffected by EAB, even when surrounded by other dying ash on private properties. The data now reveals there may be about three times that number that could be preserved. All trees will be inspected prior to injection to ensure they are appropriate candidates for preservation.

8.3 Ash Tree Removal (Best Management Practice #3)

It is a best-management practice (BMP) to remove ash trees that are infested with EAB during the next possible non-flight (dormant) time of October-April to eliminate a hazardous tree condition. Fall and winter is also an ideal time of removal to avoid damaging migratory bird nests and bat habitat. However, if the tree is imminently hazardous to the public, it should be removed as soon as possible – even if it is during the summer months.

- In a 2021/2022 EAB update, the MN Department of Agriculture Plant Protection Division updated their ash tree removal guidance for the Twin Cities: Dormant season-only ash removals will not slow the spread of EAB within the region, permitting communities to perform year-round ash removals if necessary to control the number of dead/dying ash. It is important to note that the BMP is still to remove ash trees in October-April, but if City resources are limited, and year-round removals are needed to protect public safety, then communities should do so. Removing ash trees year-round as needed can be logistically helpful for in-house crews instead of winter-only (dormant season) removals that often compete with winter snow plowing duties.
- Ash removals in sensitive natural resource corridors such as bluffs, along wetlands and larger contiguous woodlands may be subject to the Migratory Bird Treaty Act (MBTA) and newer northern long-eared bat regulations. These regulations require specifically time removals and/or surveys to ensure “taking” of these species does not inadvertently occur during tree removal.



In adopting this plan, City staff will be marking and removing ash in a series of ash reduction programs:

1. Proactive Structured Ash Removal
2. EAB Infested Ash Removal for Sanitation and Hazard Prevention – City Property
3. EAB Infested Ash Removal for Hazard Prevention – Private Property

8.3.1 Proactive Structured Ash Removal

Proactive structured ash removal is a program that removes trees that may not yet be infested on City boulevards and maintained public properties. The purpose of this BMP is to spread out the cost and number of removals instead of waiting for them to die, overwhelming City crews and budgets. Trees are usually selected geographically, in groups, which can save on mobilization costs and travel time.

- Geographic removal areas will likely be the same as the City plow routes. These routes are divided by landmarks in the City such as the Credit River, Eagle Creek, County Roads, and downtown area. This will help the contractor to work geographically in key regions where EAB damage is occurring.
- The trees that meet the structured removal criteria would be smaller than ten inches in diameter (ineligible to inject), in conflict with infrastructure, or in dead, poor or fair condition with significant structural defects.
- The program could also include reducing the number of ash trees on a City property that has an excessive number planted, with other established trees nearby to readily fill the canopy. The average DBH of ash trees slated for removal is 9.5” and with 282 trees identified initially, the City is well-prepared to carry out the task over a few years. The number of diameter inches slated for removal is about half of the ash that have been identified for protection at this time.
- The City will utilize Savage Public Works Staff to remove smaller trees as much as possible to reduce costs for the program. The number of in-house ash removals will vary from year-to-year due to other staff responsibilities.
- It is important to note here that the current ash inventory encompasses only trees in boulevards (rights-of-way), and mowed, maintained public property. There will be hundreds more ash to address in wooded natural areas adjacent to public trails, streets, and private properties that have been uncounted. Examples of those areas include wooded areas in Warren Butler and Hidden Valley Parks.

Since trees are living, dynamic organisms, they change over time, so some trees originally slated for injection may be moved to the “remove” list if they succumb to storm damage or otherwise become less desirable to treat due to EAB or other variables. These numbers provide a baseline to work from.



Figure 6: Structured Ash Removals on City Property

Condition/Size	Number of Ash Trees	Number of DBH inches
Ash Less than 10" DBH (too small for injection)	173	1,253
Unknown	8	104.5
Poor	95	1,283
Dead	6	45
TOTAL	282	2,685.5

8.3.2 EAB Infested Ash Removal for Sanitation and Hazard Prevention – City Property

The City will be monitored and inspected throughout the year for EAB infested ash trees on public property. Infested trees will be marked and removed by City staff or contractors. Trees in high-use areas of parks and boulevards will be prioritized for removal first to reduce public risk due to hazardous tree conditions.

Infested trees on edges of unmaintained natural City outlots, conservation areas, and open space will be removed at the discretion of City Staff to follow best-management practices (BMPs) within budget and time constraints.

- In general, infested trees found in deep wooded City out lots or conservation areas that will not impact public safety or an adjacent private property will not be removed. The reason for this is twofold: damage to adjacent natural resources often exceeds the overall environmental benefits of removal, and the costs and staff time associated with the volume of removals will likely exceed budget constraints.
- USDA Forest Service research has indicated “thinning” woodlands of ash does not “slow the spread” of EAB and instead kills any remaining ash trees in woodlands faster due to less ash material being present.
- If an ash tree becomes infested within a City owned natural area, City staff will evaluate if removal is necessary for safety.
 - This practice does not provide optimum sanitation to reduce EAB but acknowledges the reality of staff and budget constraints and places a realistic focus on those trees will most impact public safety.
- Ash tree mature heights range from 65-80 feet tall. Field Staff will determine if an infested ash tree would qualify for removal.

8.3.3 EAB Infested Ash Removal for Hazard Prevention – Private Property

Currently, the City of Savage does not have an estimate of the number of ash trees growing on private property and does not plan to proactively inspect or identify infested trees unless they are on public property. A private-property code



enforcement program takes an enormous amount of staff time and resources. City Staff will continue to provide education and outreach to the community, as well as answer calls and emails from individual residents.

In some instances, however, dying private property ash trees may impact public streets, trails, parking lots, and parks due to their proximity. In those instances, the City may declare the ash tree a “nuisance” requiring abatement. Abatement measures would include tree removal and appropriate disposal of wood. Stump grinding is not required to abate the safety risk.

Although the City of Savage will not require residents to remove infested ash trees unless they are an immediate risk to public spaces, it will still be a sizable burden for residents to handle EAB on their property. When ash start dying in large cohorts, City staff will get a greater number of email and phone call complaints. In some cities, there is a formal process to assist fixed-income or in-need residents in removing trees that are a risk to their home or public property.

- A program to consider implementing is a nuisance abatement program or other agreement which would authorize the City to send their designated contractor to remove an infested tree (or any dead/high risk tree) if the property owner communicated an inability to remove the tree that is creating a public safety risk. This type of program would be useful in situations where an individual loses a job, experiences a death in the family, or for an individual on a fixed-income due to retirement status or disability. Occasionally, the sheer number of ash trees planted on a single-family lot creates an enormous financial burden – where treatment or removal are both out of reach for the property owner.
 - The ability to require removal of a tree that is posing a risk to a public space as noted in City Code Title IX: General Regulations: Chapter 102 Urban Forest and Shade Tree Management (102.12).
 - The City’s EAB Treatment Discount Program is one solution to this issue since treatment of the average ash is \$50-150 per tree depending on size (DBH), which is often many times less than a tree removal. Costs per-diameter inch are solicited from contractors on a regular basis to provide a discount to residents on this service.

9.0 Ash Wood Disposal

The strategies used to dispose of ash wood must meet the current Minnesota Department of Agriculture (MDA) quarantines, which are established by county. Scott County is under a quarantine. The quarantine allows movement of wood within other quarantined counties, but prohibits removing any of the following from a quarantined county into a non-quarantined county:

- The emerald ash borer (*Agrilus planipennis*),
- Ash trees (*Fraxinus* spp.), ash limbs and branches, ash stumps and roots, ash logs, ash lumber, ash chips, ash bark chips, and
- Firewood of any hardwood (deciduous) species.



Wood and wood chips from tree removals and pruning by City Staff is being deposited at Shakopee Mdewakanton Sioux Community (SMSC) Organics Recycling Facility . They create compost and mulch. Savage residents are also encouraged to dispose of wood at the site or the Mulch Store in Burnsville to ensure they are processing infested trees properly. If wood is being chipped, it must be chipped into 1-inch by 1-inch sections to kill larvae and prevent them from maturing. When hauled to a wood tipping site, it is often double ground and heat-treated for mulch, or burned for energy. Currently, the State of Minnesota does not have a uniform and organized wood disposal strategy and there are significant concerns about the volume of wood that EAB will produce in the next ten years. There are also concerns about the increase in wood tipping fees that are paid by tree contractors, and the few locations that are equipped to accept and utilize ash wood. Keeping ash wood out of the waste stream is another benefit to preserving ash by injection.

10.0 Reforestation and Canopy Replacement

According to the Growing Shade Tool, produced by the Metropolitan Council in 2021, the City of Savage's tree canopy cover is 40 percent. The remaining 60 percent of Savage includes cover types such as water, grass/forb, and impervious surfaces such as homes, parking lots and streets.

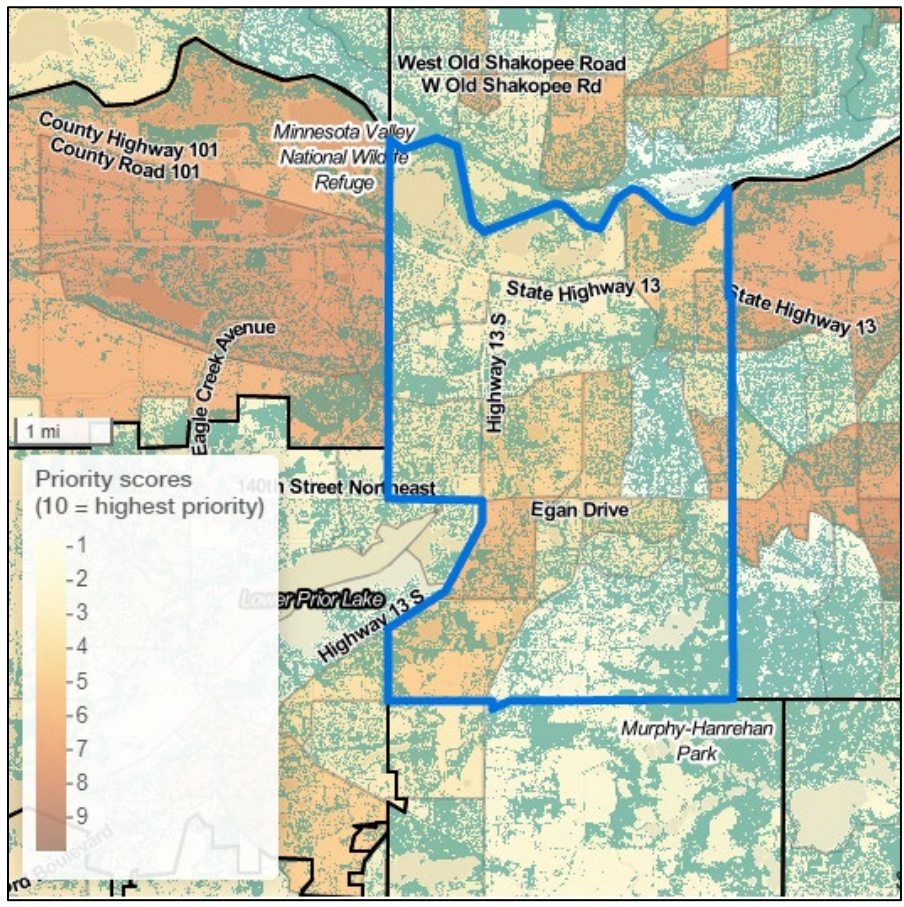
- Other cities and townships across the Twin Cities region average 27.8 percent tree canopy cover. While Savage is well above average in canopy coverage, the goal for most cities is to have an average of 45 percent tree canopy coverage so increasing that percentage over time should be a priority that could tie in with Green Steps Cities or other sustainability goals (Growing Shade Tool, Metropolitan Council).

Additionally, the 40 percent canopy cover is an average; there are some areas of the City that are lower, and others that are higher. Using the data provided by the Growing Shade tool could serve as a start for prioritizing replanting efforts to improve the heat-island effects of too much pavement and not enough shade, and ensure trees are being planted equitably.

- Nationally, tree canopies tend to be higher in areas of wealth. Trees provide dynamic benefits to the community, and planting with an environmental justice lens can help ensure those benefits are experienced by all.



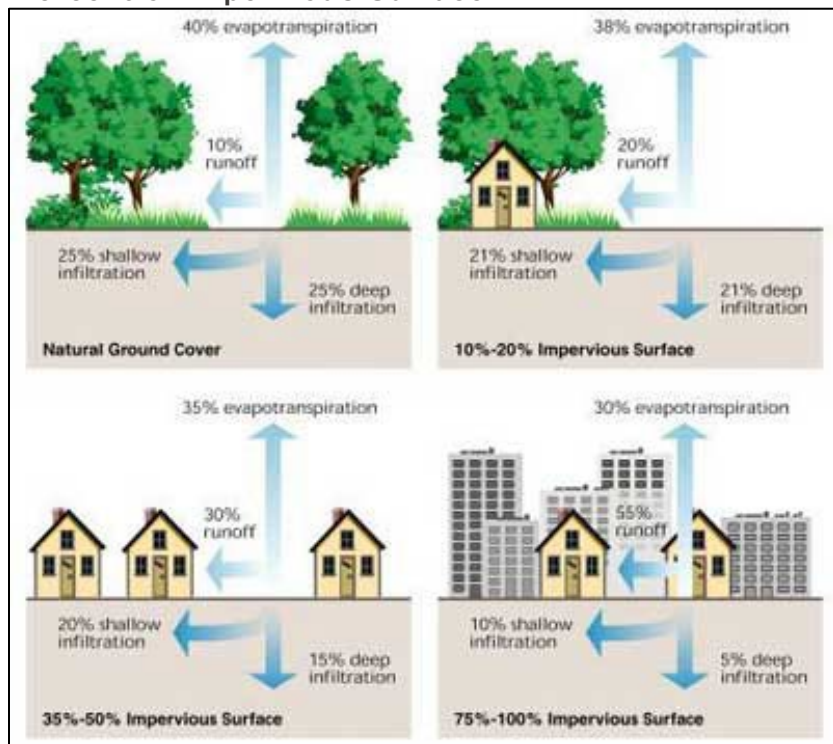
Figure 7. Growing Shade Tool, indicating the highest priority areas for planting based on climate change variables (Amount of green space, surface temperature on a hot summer day, and existing tree canopy)



As a community develops, natural ground cover and forest land is often lost. With the loss of trees and canopy cover, the tree benefits are lost as well. In particular, a community loses the valuable natural stormwater interception services of trees to the impervious surfaces of buildings and streets which increases runoff, negatively affecting the water quality of surface water in the area. Canopy cover can be maintained or increased by proper tree planting and care across the community.



Figure 8: Runoff Volumes will Increase Based on the Percent of Impervious Surface



Higher volumes of runoff result in flooding, water pollution, and erosion. Photo courtesy of LEARN NC, www.learnnc.org

10.1 Reforestation

To replace canopy cover, ash trees lost to EAB on maintained City properties will be replaced at a one-for-one replacement when space permits. Each tree lost in high value public spaces will be replaced with a tree that would improve the species diversity of that property and the entire system. Ash trees that are removed from boulevards will not be replaced with a new tree.

- Some of the ash trees slated for preservation on City boulevards and property in the first ten years may be removed and replaced due to changes in physical condition.
- Once a full inventory is obtained, the “10 percent rule” by Dr. Frank Santamour, US National Arboretum geneticist should be followed.
 - The rule proposes no more than 10 percent of any one species should make up the tree population, no more than 20 percent of any genus, and no more than 30 percent of any one family.
 - An application of this rule would be that no more than 10 percent of public trees should be bur oaks, no more than 20 percent should be in the Quercus (oak) genus, and no more than 30 percent should be in the Fagaceae family (oaks, beech, chestnut).



- It is regarded as a rule that has some limitations, and many urban foresters believe each percentage should be even smaller, but it is a good starting point to work from. Percentages for City property can be viewed in the computer-based inventory which is updated as trees are removed and planted.

Although boulevard tree planting is prohibited in most areas, there are select street corridors that have ash trees. Some of the ash trees will be preserved with stem injections, but those that are too small or in poor condition will be removed and only replaced on a case-by-case basis using a diverse group of trees. In general, boulevard ash will not be replanted.

Although symmetry and repetition are planting concepts often implemented with traditional landscape designs, they run in opposition with promoting species diversity.

- Monoculture-type plantings where one to two species are utilized increase the chance an entire space is clear cut when a non-native disease or insect like EAB is introduced.
- Instead, there will be a less formal appearance in the boulevard planting areas, shifting to more of a specimen-based arboretum style planting. Repetition can be used, but the patterns could be more complex with a longer stretch of space before species are repeated in the planting design.
- In neighborhoods where boulevard trees are not eligible for preservation by injection and are lost in front of homes, residents could be encouraged to purchase a tree through the Arbor Day Tree Sale. Trees could then be planted in front or back yards, outside of the boulevard (rights-of-way).
- Infested ash trees lost in unmaintained/naturalized outlots, conservation areas or other natural spaces would only be replanted if needed for significant screening needs, or as part of a larger natural resource plan which would also minimize non-native invasive species like European buckthorn and garlic mustard. This program would not be the main reforestation focus during the peak of EAB infestation unless significant resources were diverted.

In general, the best way to maximize the number and diversity of trees planted is to use all available planting stock types: bare root, container, and balled-and-burlap (B&B).

- Currently most of the trees planted on City property are handled by contractors, but there are additional creative ways to plant trees without driving up a planting budget.
- As part of the replanting plan, the City should implement a three-year aftercare program. Stressed trees are more susceptible to diseases and insect pests. Each tree must be watered and checked weekly during the growing season of May through October for a minimum of two years (and ideally three) to ensure the City's investment is retained and the tree continues to mature and provide ecosystem services and benefits.



- At a minimum, one additional seasonal employee working forty hours a week, should be charged with this task when tree planting on City property commences on a larger scale.
- The most expensive option for an after-care program is hiring a contractor to monitor and water newly planted trees. This option is sometimes used on busy street corridors or roundabouts that are more dangerous for an inexperienced person to access with a watering truck.
- New trees should not be planted at an increased rate unless new seasonal staff or resources are committed to ensure each tree is watered once weekly during the growing season.

In addition, the City could consider these options to foster reforestation and tree establishment in the community:

- Utilizing existing staff to assist with replanting, watering, and care from May through October of each year.
- Host a planting event in a park or collaborating with a local non-profit such as Tree Trust to host a volunteer planting so residents can learn proper planting and engage in improving a local park.
- Utilize Sentence to Serve (STS) and/or Institutional Community Work Crews (ICW crews) to assist in ensuring trees stay mulched and have tree guards and watering bags on at the appropriate time of year. They can also be supervised by trained staff to assist with planting trees.
- Continue to fund the Arbor Day Tree Sale or other tree replacement incentive program to encourage property owners to replant trees on their property (out of the boulevard) after an ash tree is removed.
- An outreach program targeted at Commercial, Industrial and Multiple-Family parcel-owners to replant after EAB infested trees are removed to improve and preserve the aesthetics of these areas in Savage, and to try to recapture the tree benefits over time.
 - The current ordinances related to trees may need to be amended to ensure the “conditions of approval” that the developments were approved with are fulfilled to ensure entire parking lots or parcels are not clear cut when ash (that are not injected) die from EAB. In some cases, ash trees will be preserved and would not need to be replaced.



11.0 Estimated Cost and Budget

Emerald ash borer management is a significant cost for cities. The costs that need to be budgeted include injection/protection of ash trees, tree removal and stump grinding, and tree replacements. There are also costs related to staff time including increased phone calls and emails from the public regarding private trees, inspection requests for public ash trees, and deferred maintenance work like pruning by City Staff to remove dead and dying ash trees. Keeping replacement trees watered, staked, and mulched during the 2–3-year establishment period takes a big resource commitment from a staffing and equipment basis.

The costs to begin a comprehensive EAB program in Savage have been estimated applying all public 2022 tree inventory data to 2023 tree contractor estimates. The data includes all boulevard and park/open space tree data. Inherent in the estimates are some factors that can change including:

- As long as ash trees remain untreated, their condition can change as EAB infestation advances in the tree, changing a “fair” condition tree to more of a “poor” condition tree. This can make a tree less likely to do well with injections, moving it to the removal list.
- Tree contractor workloads change from season to season and year-to-year. Higher demand can increase the cost of tree and stump removals.
- The presence of obstacles or targets adjacent to dead/dying trees and the degree to which a tree has died and become brittle can influence actual removal cost, which is often based on amount of time to remove the tree and the risk to the tree worker.
- The tree removal costs are based on per-diameter-inch estimates from a desk review. Each tree was not examined in the field which may increase or slightly decrease cost-per-tree when put out for bid/exact estimates.
- The ash injection estimate is based on a cost per-diameter-inch.
- The tree replacement per-tree cost includes a 2” balled and burlap (B&B) tree planted by a contractor with a 1-year warranty. Costs for purchasing bare root or container stock and planting in-house can be significantly less if there is enough staff time and resources.



Figure 9: Estimated Cost for Boulevard Ash Tree Removal and Stump Grinding

Condition/Size	Tree Removal Cost	Stump Removal Cost
Ash Less than 10" DBH (too small for injection)	\$54,475	\$42,000
Poor	\$61,925	\$18,800
Dead	\$725	\$400
Subtotal	\$117,125	\$61,200
Total		\$178,325¹

¹ Costs will vary based on annual condition assessment.

Figure 10: Estimated Cost for Park/Open Space Ash Tree Removal and Stump Grinding

Condition/Size	Tree Removal Cost	Stump Removal Cost
Ash Less than 10" DBH (too small for injection)	\$8,175	\$6,200
Poor	\$12,662	\$3,000
Dead	\$1,525	\$800
Subtotal	\$22,362	\$10,000
Total		\$33,362¹

¹ Costs will vary based on annual condition assessment.

Figure 11: Estimated Cost for Injection on City Property – All Fair and Good Condition Ash Trees >10" diameter

Condition	Cost ¹
Good	\$15,721
Fair	\$4,046
TOTAL	\$19,767

¹ Treatments are required biennially.



Figure 12: Estimated Cost for Ash Replacement (Replanting) on Park/Open Space (No Boulevard Replacement)

Condition	Cost (Assumes \$600 per tree)
Dead	\$2,400
Poor	\$7,800
Fair	\$9,600
Good (under 10")	\$9,000
TOTAL	\$28,800

12.0 Conclusion

Emerald ash borer is a significant “predicable” natural disaster facing the City of Savage but following a systematic, proactive plan and leveraging appropriate resources to respond will minimize the fiscal and environmental impacts of the pest. The EAB Management Plan is consistent with the City’s guiding principle that “Savage will preserve and enhance our natural amenities and maximize recreational opportunities for our community.” The plan should be implemented immediately to manage the beetle population and preserve the benefits that ash trees provide to the community.