



City of Madison Emerald Ash Borer Plan

June 2012

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EAB Taskforce Report

Executive Summary and Recommendations (June 2012)

Summary

Since 2008, the City of Madison has been working on how to mitigate the impact of the Emerald Ash Borer (EAB). With an estimated 21,700 terrace ash trees, an unknown number of ash trees in parks and the many thousands more found on private property, the EAB could have a devastating effect on our urban forest. A taskforce was created to coordinate assessing the EAB threat, planning various response strategies, reviewing the latest research and acting to mitigate impacts on our tree canopy, ensuring public safety, protecting our environment and containing costs.

The EAB Taskforce Report provides background on the EAB; the key issues and potential strategies that were researched for addressing the threat; and summarizes comments collected at three public listening sessions.

In late 2011, the Taskforce presented background information on the EAB and an overview of their report to the Common Council. The Taskforce was asked to continue meeting on the EAB threat and to report back to the Council in June 2012 with a list of final recommendations and costs. Based on that continuing review and discussion, the Taskforce makes the following recommendations.

Recommendations

1. Preemptively remove ash street trees in poor condition. Replace these trees with Forestry designated species within one year (or next appropriate planting season) to hasten renewal of urban tree canopy.

2. Remove ash street trees designated in poor condition or that are under power transmission lines, during infrastructure maintenance projects. Offer property owners the option of removing fair or good condition ash street trees during infrastructure maintenance projects. Replace these trees with Forestry designated species within one year (or next appropriate planting season) to hasten renewal of urban tree canopy.
3. Provide property owners with the option of chemically treating publically owned trees through use of a Certified Pesticide Applicator treatment program that would be facilitated by the Forestry Section and performed by a contractor. Chemical treatment programs would only be offered once EAB has been detected in Dane County.
4. Facilitate opportunities to connect licensed and certified Chemical Applicators with interested private property owners who wish to treat their private ash trees at their own expense that preserves the tree canopy for environmental, economic or social reasons.

If an EAB infestation is discovered in Madison or Dane County, State of Wisconsin response guidelines and regulations would have to be followed and all options for mitigating its impact would be reexamined and the best options that help us ensure public safety, preserve the tree canopy and mitigate environmental impacts would be pursued.

The Taskforce will provide a yearly update of the City of Madison EAB Plan which highlights actions taken to mitigate the EAB threat, latest research findings and other key issues impacting the urban tree canopy.

The City of Madison Parks Forestry Section has diversified their replacement tree selection to 29 different tree species and cultivars to diminish future impacts on the tree canopy by invasive species. Preemptive removal and replacement would follow Forestry planting policy to ensure a variation in tree age, canopy cover and species diversity.

The City of Madison Parks Forestry Section plans to utilize the EAB process—problem analysis, collaboration with researchers on latest findings and development of cost effective

and environmentally friendly solutions, as a frame work for dealing with other potential insect and urban forest threats.

Mission Statement

The Emerald Ash Borer Management Plan (hereafter called the Plan) will maintain and enhance the urban forest's maximum, long-term benefits to the community.

Goal Statement

The Plan goal is to minimize the impact of the Emerald Ash Borer (EAB) on the health of our urban forest and the potential loss of ash trees, by using the best scientific advice, while being as cost effective as possible.

Overview

The City of Madison EAB Plan is based upon the EAB Taskforce's professional assessment of both the impact on the city's tree canopy and the best utilization of resources to manage this invasive pest while ensuring public safety.

By implementing the provisions of the Plan, the City will attempt to mitigate the disruptive impact of EAB on its human population and its urban forest. The Plan takes a proactive approach to this invasive species and should enable the City to address public and private environmental, economic and social needs in an efficient and effective manner. The City will endeavor to distribute the costs associated with possible and massive tree death over a manageable time period, as well as lessen the social and economic impact that such an extensive tree loss will have on the quality of life in our community. The Plan provides for continuing public education and communication. The Madison Parks Forestry Section has already provided the following public education:

- EAB awareness week
- EAB identification cards
- Neighborhood presentations

- FAQs on City of Madison website
- Displays at public venues
- Public forums and meetings
- Neighborhood information packets.

This Plan applies throughout the City on all public properties where ash trees are currently growing, as well as on private properties where such trees may negatively impact public rights-of-ways or other public properties. The response plan is a dynamic document and, as such, changes over time in response to new information about EAB biology and management. (The original 2010 Plan recommendations and strategies assessed can be found at the web link <http://www.cityofmadison.com/parks/services/forestry/pests/documents/EABPotentialStrategiesandIssuesOverviewNovember2011.pdf>.)

The current ash tree population along City of Madison streets is estimated at 21,700 (inventory data collected in 2007-2011.) It is estimated that many thousands ash trees exist in the City of Madison park system. The number of privately owned ash trees is unknown, but a similar number probably exist. The average life span of an ash street tree, with all conditions being favorable, is approximately 30 to 40 years. In a private landscape or park situation ash trees can live up to 60 to 80 years.

In 2006 the City of Madison stopped planting ash trees upon the discovery of EAB in Kane County, Illinois.

Background on the Emerald Ash Borer

The Emerald Ash Borer (EAB) is an exotic pest from Asia that has already been responsible for the death of over 30 million ash trees in the United States and Canada (See Map 1). The State of Wisconsin Department of Agriculture, Trade and Consumer Protection Agency (DATCP) has been conducting statewide EAB surveys and placing EAB traps in one-mile increments within targeted areas searching for this insect. In February 2007, the City of Madison participated in the trapping and surveying by removing over 50 city owned ash trees

and peeled the bark of these trees to look for EAB larvae galleries. EAB was not found during this 2007 survey. On August 4, 2008, EAB was found in Wisconsin near the Village of Newburg in Ozaukee County and has been found in several other Wisconsin counties since then (See Map 2). In 2009 and 2010, the State of Wisconsin continued placing EAB traps throughout the state in an attempt to define the extent of the infestation. So far in 2012, two additional counties, Walworth and Rock, have confirmed EAB infestations. As of the date of this report, no EAB has been detected in Dane County. The nearest known EAB infestation is in Janesville, Wisconsin which is approximately 28 air miles from Madison, Wisconsin (See Map 3). Branch sampling, conducted by Madison Parks Forestry in the winter of 2012, did not find any EAB larvae or signs of infestation in Madison. (See Appendix E.) Limited trapping is being conducted by the State of Wisconsin in the summer of 2012.



Map 1. Emerald Ash Borer locations in North America as of May 2012. (Source US Department of Agriculture).



Map 2. Emerald Ash Borer locations in Wisconsin as of June 2012 (source DATCP).



Map 3. Nearest EAB infestation to Madison is approximately 28 miles in Janesville, Wisconsin.

The adult EAB is about $\frac{1}{2}$ inches long and metallic green in color (See photo 1). During the summer and fall the EAB larvae life stage feeds and develops in the cambium region (the layer within the bark where sap moves), thereby disrupting the tree's ability to transport water and nutrients (See Diagram 1). All native ash trees (*Fraxinus* spp.) are affected by EAB. (See www.emeraldashborer.info for further information).

Photo 1. EAB is smaller than a penny.



EAB adults can fly at least a $\frac{1}{2}$ mile radius per season from the tree where they emerge. Humans, however, started many infestations by moving infested ash tree nursery stock, logs and firewood into un-infested areas. Shipments of ash nursery trees and ash logs with bark are now regulated, but the transport of infested firewood remains a problem. EAB populations initially build very slowly, but later increase rapidly as more trees become

infested. As EAB populations reach their peak, many trees decline and die within one or two years. (Herms, D, et al. 2009). (See Appendix C: EAB Life Cycle.)

The Threat to Madison's Urban Forest

EAB management is coordinated at the federal level by the U.S. Department of Agriculture (USDA). Due to diminishing federal funds, Wisconsin's EAB management program has eliminated its eradication efforts, changing its strategy to slowing the spread and mitigating the

effects of EAB infestation through monitoring and regulation.

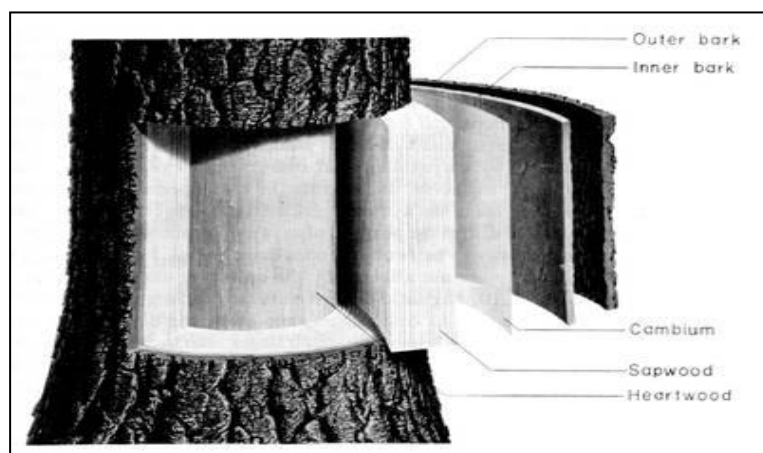


Diagram 1. Tree physiology.

It is possible that EAB will be discovered in the Madison area at any time. EAB infestation will have the most dramatic impact on budgets and tree canopy loss since Dutch elm disease decimated Madison's American Elm population during the 1960s and 1970s.

Plan Implementation Responsibilities

The City of Madison Parks Forestry Section, in collaboration with other city agencies, will be responsible for implementing this Plan and seeing that its provisions are carried out. The EAB Taskforce will monitor plan implementation, report back to various governing bodies and make recommendations for changes to the Plan as new research delivers different strategies for dealing with the pest.

EAB Management strategies assessed by Taskforce

The City of Madison EAB Taskforce assessed seven possible EAB Management Strategies. These responses were proactive approaches to addressing the need to contain the infestation, remove ash trees, replant with other species and mitigate possible financial and environmental impacts.

1. Remove infested trees as they become a public safety concern.
2. Chemically treat all ash trees in healthy condition.
3. Preemptive removal of 10-inches Diameter Breast Height (DBH) or less, ash in poor condition and during infrastructure improvements and replace, and chemically treat only legacy and high value trees.
4. Preemptive removal of 10-inches DBH or less, ash in poor condition and during infrastructure improvements and replace, and no chemical treatment.
5. Remove all terrace ash trees and replace removed trees systematically and preemptively, anticipating that EAB will eventually arrive in Madison.
6. Allow homeowners to voluntarily enter into a fee based agreement with the City of Madison to treat city owned trees.
7. A combination of any of the above.

Based on their assessment of the above options, the EAB Taskforce recommends the following actions.

EAB Taskforce Recommendations

1. Preemptively remove ash street trees in poor condition. Replace these trees with Forestry designated species within one year (or next appropriate planting season) to hasten renewal of urban tree canopy. (See Appendix D: Ash Condition Criteria.)
2. Remove ash street trees designated in poor condition or that are under power transmission lines, during infrastructure maintenance projects. Offer property owners the option of removing fair or good condition ash street trees during infrastructure maintenance projects. Replace these trees with Forestry designated species within one year (or next appropriate planting season) to hasten renewal of urban tree canopy.

3. Provide property owners with the option of chemically treating publically owned trees through use of a Certified Pesticide Applicator treatment program that would be facilitated by the Forestry Section and performed by a contractor. Chemical treatment programs would only be offered once EAB has been detected in Dane County.
4. Facilitate opportunities to connect licensed and certified Chemical Applicators with interested private property owners who wish to treat their private ash trees at their own expense that preserves the tree canopy for environmental, economic or social reasons.

If an EAB infestation is discovered in Madison or Dane County, State of Wisconsin response guidelines and regulations would have to be followed and all options for mitigating its impact would be reexamined and the best options that help us ensure public safety, preserve the tree canopy and mitigate environmental impacts would be pursued.

Additional Recommendations

The following are additional recommendations of the EAB Taskforce:

- Continue branch sampling at ½ mile intervals.
- Obtain Plan approval from the Common Council.
- Create Certified Pesticide Applicator treatment program listed in main recommendations and assess a licensing program for commercial tree care companies in order for them to perform tree work within the city limits. The annual license should include adequate amounts of liability and property damage insurance.
- Complete and maintain the street tree inventory.
- Add Forestry Specialist overtime to 2013 operating budget to aid implementation of Plan. Add another Forestry Specialist FTE in 2014.
- Provide for public education in the Forestry section's operational budget for the production of public service announcements, advertisement, and outreach regarding EAB and the city's response plan.
- Provide for street and park tree replacements within the Parks Capital Improvement Program.

- Provide for street tree replacement in infrastructure capital budgets.

As necessary:

- Increase the Forestry Section's Capital budget within the Parks Division by adding equipment to their fleet and increasing the street tree planting budget for EAB response.
- Increase the Forestry Section's operational budget by adding personnel, work supplies, training, safety supplies and contract services.
- Increase Streets Division equipment by adding to the fleet for EAB response in the Streets Division Capital budget.
- Increase Streets Division's operational budget by adding personnel, work supplies, training, safety supplies and contract services.

State of Wisconsin EAB Action Plan

An outbreak of EAB has local, state, national and international impact. Because of the threat to other states and Canada, if EAB is found in Madison there will be a joint response, using local, state and federal authorities and resources according to the 2008 Wisconsin Emerald Ash Borer Response Plan. State Agencies that will be involved are Department of Agriculture, Trade, Consumer and Protection (DATCP) and Department of Natural Resources (DNR). As of early 2010, the state uses a process that involves small Interagency Response Teams.

The Village of Oak Creek, Wisconsin is using the Interagency Response Teams process for the first time and will become a model for future EAB finds. The function of these teams is to:

- Survey
- Regulate
- Outreach
- Manage

Recently DATCP revised the rule (DATCP 21) regarding the transporting of EAB infested wood, allowing for restrictions on the movement of certain items (firewood, logs, mulch or nursery stock) coming from areas infested with emerald ash borer (EAB quarantined areas).

DNR revised rule NR 45.04 (1) (g) restricting firewood movement onto DNR managed properties in Wisconsin to prevent the spread of EAB to Wisconsin forests and recreational areas. Current regulations regarding wood waste management from EAB infested areas can be found here:

http://emeraldashborer.wi.gov/articleassets/Managing_Infested_Wood_1-15-09.pdf

With eradication eliminated as an option, management strategies by state and local governments and public and private property owners must focus on actions that may reduce the rate of spread and impact of EAB on rural and urban landowners and communities. Unfortunately, the current scientific knowledge on EAB does not yet provide a clear recommendation for a single best method to manage this infestation. However, the state EAB response plan outlines management activities in three categories:

- 1) Prevention,
- 2) Early detection and
- 3) Integrated control or containment – which may help reduce the spread and impact of EAB.

Current thinking on the City's response to a confirmed infestation can be found on page 21. It blends the State process with a proposed city process. The City's EAB Taskforce will continue to review approaches and address issues once EAB infestation is confirmed.

Protective Pesticide Treatment

Since preparation of City of Madison's Emerald Ash Borer (EAB) response plan in 2008, new EAB infestations have been found in Wisconsin. Also, an insecticide called Emamectin benzoate has been found to be effective against EAB for two years and recent research suggests it may be actually good for three years. Based upon current research and observations of other communities EAB response plans, once treatment begins it should

continue for the desired life of tree. However, there have been no complete conclusions on the long term impact of the pesticides on the environment.

Wisconsin has numerous counties that are quarantined by the state due to EAB infestations. At the time of this report, these counties are: Brown, Crawford, Fond du Lac, Kenosha, La Crosse, Milwaukee, Ozaukee, Rock, Sheboygan, Vernon, Walworth, Waukesha and Washington. Many of these are using pesticide treatments.

The EAB Taskforce has consulted with Dr. Chris Williamson to discuss chemical treatment options and their effects on the environment. Dr. Chris Williamson is an Assistant Professor of Entomology at the University of Wisconsin-Madison where he is an extension/research entomologist in urban landscape entomology including turf grass (golf courses, lawns, athletic fields, and sod farms), ornamentals (nursery and landscape), Christmas trees, and greenhouses. Dr. Williamson indicated that insecticides can effectively protect ash trees from EAB. However, insecticides are not effective in eradicating EAB infestations. Insecticide chemicals need to be in the leaves before the adult EAB becomes active and feeds, which is June through August. We have learned from other communities who have suffered from an EAB infestations that the size of EAB populations in a specific area will change over time, initially building very slowly, but later rapidly increasing as more trees become infested. Pesticide treatment used appropriately can slow EAB spread and preserve tree canopy.

Currently there are four insecticides that are found to protect healthy ash trees from EAB. They are Imidacloprid, Emamectin benzoate, Azadirachtin and Dinotefuran (see Table 1. Insecticides Used for Protecting Ash Trees). Extensive testing of insecticides for control of EAB has been conducted by researchers at Michigan State University and The Ohio State University. "Tests have shown that we can protect healthy trees from EAB with insecticides, but successful protection of compromised trees is less likely. By the time you see dead branches, thinning of the canopy, and woodpecker activity, the ash tree is severely damaged, and it may be too late to save it with insecticides." (Smitley, D. 2008). Trees exhibiting more than 40 percent canopy decline are highly unlikely to recover even if treated. Research and experience suggests that EAB control with insecticides becomes less consistent on larger

trees as tests have not been done on trees larger than 25-inch DBH. Results of some of the insecticide trials can be found at www.emeraldashborer.info.

Table 1. Insecticide Options Used for Protecting Ash Trees

Active Ingredient	Type of Application	Timing of Treatment	How often re-applied?	Average cost of treatment per 20-inch DBH ash tree	Environmental Impact
Imidacloprid	Trunk injection, Soil injection or drench	Mid-fall and/or mid-to late spring	Annually	\$20/year	Toxic to aquatic invertebrates-can leach to shallow groundwater. Trunk injections have fewer water quality issues
Dinotefuran	Systemic bark spray or soil injection	Early May through June	Annually	\$35/year	Strong leaching potential to shallow groundwater
Emamectin benzoate	Trunk injection	Early May through June	Every two years	\$62.40 every two years	Trunk injections have fewer water quality concerns.
Azadirachtin	Trunk injection	Early May to mid June	Annually	\$ /per year unknown	Classified as bio-pesticide. Minimal or no exposure

The EAB Taskforce has evaluated the overall costs of treating ash using the EAB Cost Calculator developed by Dr. Cliff Sadof from the Department of Entomology, Purdue University. The factors that are considered include the cost of the insecticide and expense of application, the size of the trees, the likelihood of success, and potential costs of removing and replacing the trees. (See Appendix B: EAB Cost Calculator Report.)

Imidacloprid and Dinotefuran are products that have been in use for over 20 years and are in the neonicotinoid chemical class of insecticides. Common pests controlled include Japanese beetle, aphids, adelgids, emerald ash borer, scales, sawflies, bronze birch borer, two-lined chestnut borer and birch leaf miner. Both have to be applied on an annual basis by soil drench or soil injection. Imidacloprid can also be applied by trunk injection through multiple injection holes on an annual basis. Soil applied insecticides are applied at the base of the tree. Soil-applied insecticides are used to manage numerous pests on trees and shrubs. Tree growth regulators, fertilizers and soil amendments are also applied using soil application techniques

Soil insecticide applications have the following advantages and disadvantages:

Advantages:

- Applications are quick (minutes/tree)
- Non-invasive and do not wound the tree
- Operationally predictable
- More flexible treatment period
- Equipment may be used to apply multiple products
- Minimal exposure to applicators

Disadvantages:

- Longer time to enter into and move throughout the tree before full protection is achieved
- Most soil applied insecticides require annual applications
- Soil injection requires specialized equipment
- Recommendation is not to use within 100 yards of water sources due to possible contamination of ground water and surface water if applied as a soil application

Emamectin benzoate has been studied the last three years by Michigan State University and Ohio State University by injecting ash trees in Toledo, Ohio and results have been positive. A single application of Emamectin benzoate in Mid-May through early June provided excellent control of EAB for at least two years, even under high pest pressure. To date this is the only product that controls EAB for more than one year with a single application made by multiple injection holes into the tree; however, this pesticide is not effective on ash trees that exhibit 40-

percent or greater dieback of the crown. Emamectin benzoate is now federally registered for distribution and use in Wisconsin. Because Emamectin benzoate will be labeled as a restricted use pesticide, any person using or directing the use of Emamectin benzoate must be a certified pesticide applicator. This requirement also applies to municipal employees using pesticides. This includes any person assisting with any activity which the pesticide label requires of the applicator, including drilling the treatment holes. It is unknown how many times an ash tree can be injected over time without causing extensive harm to the tree.

Research is ongoing and the Taskforce will continue to review and track results. Based on a city wide inventory of street ash trees, current municipal finances and the potential environmental impact of pesticide use, the city will determine which, if any, ash trees will be chemically treated. Because research in this field is currently evolving, the city will monitor all treatments for their effectiveness and future use.

Pesticide treatments may be applied to a publicly owned tree(s) at the residents' discretion and expense, with prior municipal approval (see Madison General Ordinance 23.21). Treated trees will be removed if the City of Madison determines the treatments have failed and EAB infests the tree.

The Purdue University EAB Cost calculator can be loaded with data reflecting different scenarios, and used to estimate the cost of several responses to an EAB infestation. As the City of Madison street tree inventory is nearly complete, it is now possible to load data for estimated current ash tree population statistics, by size of tree, and then proceed to develop the costs of different scenarios. Different assumptions can also be made for chemical treatment costs, tree replacement costs, the number of years allotted to any ash tree removal plan, and the cost of capital.

The City's current street tree inventory to date indicates the presence of 19,111 ash trees in terraces. To this number, an estimated 2,600 trees should be added to the smaller tree categories, to reflect the small trees in the City's peripheral areas not yet counted in the inventory. Using an estimated ash tree population of 21,711 trees, loaded to the appropriate

size classes, assuming a five year tree removal program, and using an estimated cost of replacement of \$250 per tree, the following cost estimates can be generated:

If all terrace ash trees are removed, and none of the trees are replaced, the total estimated cost of the program would be \$8,120,656 incurred over five years.

If all terrace ash trees are removed and replaced by trees of different species, a total estimated cost of \$13,105,280 would be anticipated over five years.

The chemical treatment option is very different. This plan has the lowest annual operating costs for the initial years, but the highest anticipated costs over time. If all of the trees are treated chemically, with no preemptive tree removal, total costs of \$437,134 could be expected in the first year. (This number is all inclusive, and contains provisions for both chemicals and labor.) Unlike the “removal without replacement” or the “removal and replacement” scenarios, however, the chemical treatment costs would continue over the natural lives of the trees, so that annual costs could exceed \$437,000 for many years. Although the total number of ash trees would fall slowly over time due to natural attrition, the smaller trees at the same time become larger and consequently more expensive to treat. As the current terrace ash inventory is estimated to contain over 12,800 trees of 15 inch DBH or less, treatment expenses resulting from growth of the current ash forest would therefore be expected to more than offset savings due to the attrition of older trees for many years to come.

Cumulative chemical treatment estimated costs of \$8,572,922 incurred by the end of year 19 would be expected to exceed the cost of a total removal of the entire ash forest (that is, \$8,120,656, as noted above). Within 30 years, cumulative chemical treatment costs could be expected to exceed the cost of removal and replacement of the entire ash forest (that is, \$13,105,280, as noted above). And as a terrace ash tree can be expected to live for 30 to 40 years, the chemical costs for the overall forest could be expected to continue at a declining level for up to ten more years. From a purely economic standpoint, chemical treatment of ash trees is therefore generally considered to be the least attractive option. However, this option

could be the most cost effective option in the event of a timely scientific breakthrough that leads to cheaper, more effective treatment. (For example, see the Bio-Control section below.)

It may also be noted that the EAB Cost Calculator does not take into account the ecological benefits of treating trees and maintaining canopy cover. The average life span of an ash street tree is 30 to 40 years. Landscape and street trees increase property values and contribute to the quality of life in a neighborhood. Trees create more pleasant walking and exercising environments, bringing about increased exercising, talking among residents, pride, care of place, association of residents in their neighborhoods. Trees help with energy savings. For example, the American Public Power Association (APPA) states that landscaping can reduce air conditioning costs by up to 50 percent, by shading the windows and walls of a home.

Once you begin insecticide treatments on ash trees you must continue the treatment every year or two depending on which insecticide is used for the desired life of the tree. Insecticides have both advantages and disadvantages. The overall environmental impact of the insecticides used for protecting ash trees from EAB is unknown, but research is ongoing.

Consumer Protection

A licensing system, ensuring that commercial tree companies performing arboricultural work within the City needs to be implemented. All commercial companies involved in providing private tree service for tree pruning, removal, stump removal, chemical treatment and wood disposal would require a license, proof of insurance and bonding for the protection of residents. A list of licensed firms would be maintained and updated on the City's EAB website. The licensing will ensure the proper disposal of wood debris as well as compliance with other elements of the Plan.

Potential Environmental Impact of Chemical Treatment

It is unknown at this time the long-term ecological impact that chemical treatments would have on our environment, but the creation of the Certified Pesticide Applicator treatment program will ensure that best practices for protecting the environment will be followed. On-going

research and testing will also be utilized to modify the chemical treatment program as appropriate.

Bio-control Research

The bio-control research on parasitoids (aka parasitic wasps) looks very promising and there is a good chance that in the next five years they could become a viable option to manage EAB infestations. Success in this field could be a tremendous boost for controlling EAB. This development makes protecting larger ash trees early on in an infestation even more important. Larger ash trees can be protected by the parasitoids at that time and chemical controls can be reduced or eliminated entirely. This would help the City of Madison maintain a high ratio of canopy cover while the urban forest recovers from the losses incurred during the early removal phase of the program.

Chemically treat ash trees when EAB is confirmed in Dane County

The following would be priorities for chemical treatment and would be developed designations would be developed as part of an Adopt-a-Tree Program.

Legacy Trees. These are ash trees that could not be easily replaced and have significant value to the community. These trees are often substantial in size (large than 15 inches in diameter at breast height) and provide historical value.

High Value Trees. These are ash trees that carry a high value to the community but may not be as large as a legacy tree. These trees are often in highly visible locations such as major thoroughfares, parks, city buildings, the Mall Concourse and municipal golf courses.

Infested Private trees

Current city ordinance language allows Forestry to act on trees that may be infested. See below language:

If the City Forester, or designee, shall determine within reasonable certainty that any public nuisance as defined by Madison General Ordinance 23.40 exists in or upon private premises, s/he shall report the existence of such nuisance to the Board of Park Commissioners; the Board shall, if it determines that such

nuisance exists, cause notice to be issued to the owner of the lot or parcel of land on which such tree(s) stand. The notice shall specify the general location and number of such tree(s) on the lot or parcel of land, and inform that a hearing will be held before said Board of Park Commissioners for the purpose of ordering the removal and destruction of such tree(s). The notice to the owner, agent or tenant of the property shall be issued at least two (2) weeks prior to the hearing and shall indicate the date, time, and location where the hearing will be held before the Board of Park Commissioners. The notice shall be mailed via first class mail to the property owner's last known address, and a copy shall be served upon the owner or occupant at the property location or may be posted by attaching to the entrance of any dwelling, building or other structure on the premises. After such hearing the City Forester, or designee, subject to the direction of the Board, shall abandon the work or proceed with it as s/he believes the best interests of the public require. Once the Board of Park Commissioners has ordered the removal and destruction of such tree(s) as nuisances under this ordinance, in lieu of such removal by the City Forester, or designee, the City Forester, or designee, shall issue a written notice to the owner, agent or tenant or operator of the property to abate such nuisance within a reasonable period of time as specified in the notice. The notice shall include the method(s) by which the property owner, agent, tenant or operator shall abate the nuisance and the proper method(s) of disposal of such trees, and that failure to abate the nuisance as so ordered will result in the City abating the nuisance at the property owner's expense. The notice shall be mailed via first class mail to the property owner's last known address, and a copy shall be served upon the owner or occupant at the property location or may be posted by attaching to the entrance of any dwelling, building or other structure on the premises.

Canopy Replacement and Care

As the budget permits, public ash trees removed will be replaced with non-host species as determined by the Forestry Section that will enhance the planting site, are appropriate for the planting site, and add to the diversity and general health of the urban forest. Trees will be

planted in accordance to Forestry Section standards and Department of Public Works specifications. Plantings will be budget based and prioritized by canopy cover. Those goals are being established in partnership with UW–Madison, Forestry and the City of Madison Parks Division.

Tree species that will be planted along the streets will be determined by City Forester as defined by City of Madison General Ordinances 10.10 Installation of Street Trees which states:

(1) It shall be the policy of the City of Madison to promote and enhance the beauty and general welfare of the City through the planting and maintenance of trees or shrubs within the public right-of-way of any street, alley or highway. The City Forester shall direct, regulate and control the planting, care and removal of all public trees and shrubs within the City subject to the direction of the Superintendent of Parks and the Board of Public Works and Board of Park Commissioners.

(2) Diseased and destroyed street trees shall be replaced by the City, provided that adequate space for tree growth is available and subject to availability of funds. The replacement of diseased or destroyed trees shall not be assessed to the abutting property owner.

Property owners who would like to plant trees themselves on the terrace must first obtain a written permit from the Forestry Section. The Forestry Section will determine the species, size and location of the planting site.

Replant trees as timely as possible to re-establish urban forest canopy

Replant all available planting sites as defined by city ordinances.

Note: Replanting of park and golf course trees will be budgeted independently of street trees budgeting.

Postponed Work

While financial, staffing, and equipment resources are focused on in the EAB Management Plan, normal Forestry Section services will either be delayed or put on hold indefinitely. If EAB is confirmed within the city limits, Forestry's service will focus only on removing city owned trees that are: infested with EAB, dead, diseased (oak wilt or Dutch Elm), storm damaged and found to be a risk to the public. Pruning of city trees will be limited to public safety concerns.

Communication Procedures

Internal Communication Procedure:

1. Educate and inform all municipal leaders and officials through presentations and written reports to Common Council, Parks Commission, Board of Estimates, and other committees as appropriate. Develop EAB frequently asked questions (FAQ) document.
2. If EAB is found within the City of Madison, information should be provided on exact location of infestation and plans on how it will be addressed. A meeting will be held with the Public Works team, the Mayor, City Forester, Parks Operations Manager, Forestry Operations Supervisor, and the Parks Outreach Coordinator.
3. If EAB has not been found, information should be provided on how the community is addressing EAB through the EAB Plan.
4. Identify person(s) who can answer EAB related questions and provide their contact information.

External Communication Procedure: These procedures would be utilized for disseminating information to the community's residents. The community's external communication protocol should work in tandem with the internal protocol.

1. Inform the community through local media outlets, direct or indirect mailings (i.e. tax/utility bills), newsletters, fliers, public meeting, neighborhood associations, and local garden clubs.
2. Public Service Announcements (PSAs) should be created and be distributed to local media to educate the public about EAB.
3. If EAB is found, information should be provided on exact location of infestation and plans on how it will be addressed.
4. If EAB has not been found, information should be provided on how the community is addressing EAB through the EAB Plan.

Response Process when Infestation is found

Following the receipt of complaint and confirmation of an EAB infestation the following steps will be taken:

- Remove ash street trees that are declining and in poor condition.
- Preemptive removal of ash street trees during infrastructure work.
- Chemically treat selected ash street and park trees when EAB is confirmed in Dane County.
- Remove ash street and park trees as they become infested with EAB.
- Remove ash street trees adjacent to EAB infested zones
- Replant trees as timely as possible to re-establish urban forest canopy.
- Research alternative wood waste utilization.
- Apply MGO 23.40 to infested private trees (*MGO 23.40: Elm Trees Infected With Dutch Elm Disease Or Oak Trees Infected With Oak Wilt Disease Or Ash Trees Infested With Emerald Ash Borer a Nuisance.*)

Following the receipt of complaint

Following receipt of a complaint, the City Forester, or designee, shall inspect or cause to be inspected all premises and places within the City to determine whether any public threat of Emerald Ash Borer exists.

Upon confirmation of an EAB infestation

If the City Forester, or designee, upon inspection or examination in person or by some qualified person acting for her/him, shall confirm that an Emerald Ash Borer is present within the City of Madison and if this is an initial discovery, DATCP and DNR officials will be contacted to officially confirm EAB's presence. Next, the City of Madison will work with DATCP and DNR officials using the Interagency Response Team process (as previously mentioned).

Ash Removal

City tree removal will be prioritized with hazardous trees being removed first, followed by those that are no longer assets to the community (stressed, dead, dying, or diseased). Utility contractors will be encouraged to remove EAB infested ash within their easements as part of their normal line clearance activities.

Remove ash trees that are declining and in poor condition

Ash street trees that are in a declining state of health are in low vigor and in fair or poor condition. They may have at least ten percent crown dieback or a major dead limb. They may also have native insects actively boring into the trunk of the tree which continues to weaken the tree. Ash trees with large trunk wounds will also be removed (See Appendix E - Ash Condition Criteria).

Preemptive removal of ash street trees during infrastructure work

After EAB infestation occurs, when ash trees are encountered during sidewalk repair or street reconstruction, the Forestry Section may decide to remove the ash trees rather than designing the project and constructing around them. This removal process may be substantial and may mean an entire block will lose all their ash street trees, although every effort to retain the tree canopy for as long as possible will be made.

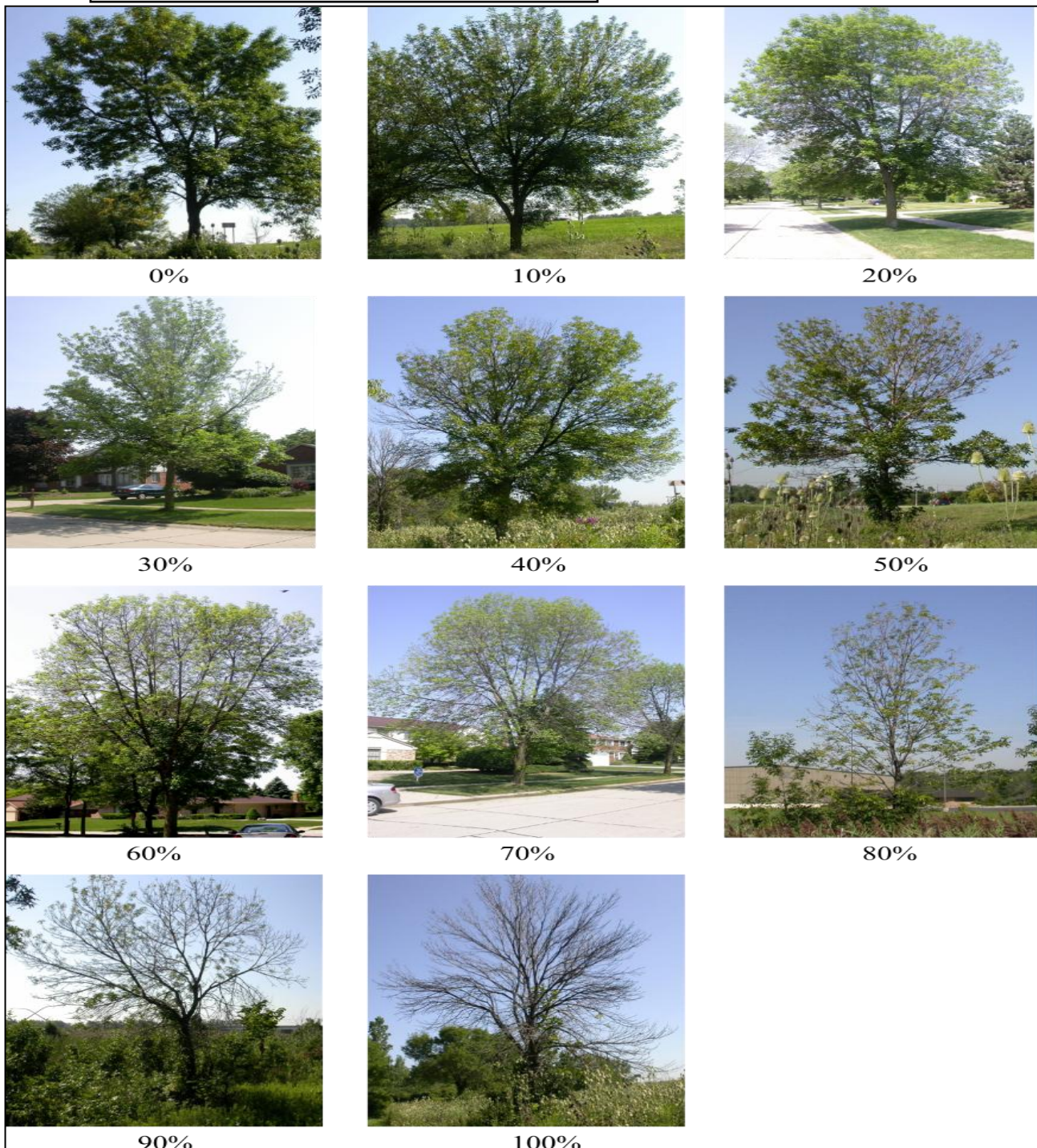
Considerations for removal:

- Ash trees that show ten percent or greater crown dieback should be removed.
- Ash trees located in four foot terraces or less.
- Ash trees that would not be considered a legacy tree or a high value trees (see page 28 for definition).
- Ash trees located underneath primary electrical lines.

Remove ash trees as they become infested with EAB

The removal of ash trees would begin in October and would continue throughout the winter months until March. EAB becomes a dormant insect during this time frame so there is no risk of spreading EAB to other parts of the city when transporting wood debris. Current research demonstrates that ash trees that show 40 percent or greater crown dieback are not treatable (see Photo 2).

Photo 2. The stages of ash canopy thinning and dieback.



Infested ash tree removal would be prioritized by:

High: trees located on major thoroughfares or in publically owned land near publically owned parking lots, shelters, playgrounds, benches, designated bike paths, city golf course tee boxes or fairways. Ash that is located on the border of adjacent communities.

Medium: trees located on minor thoroughfares.

Low: trees located in parks, conservation areas and greenways that are not located in high priority locations.

Remove ash street trees adjacent to EAB infested zones

Ash trees that will not be chemically treated and are adjacent to the EAB infested zone should be removed. Removal will be prioritized by:

High: tree measuring 10 inches DBH or greater.

Low: trees measuring 10 inches or less DBH.

Wood Utilization and Disposal

The City of Madison prohibits public access to wood at the Olin Avenue Brush Processing Site to eliminate the spread of invasive insect species, fungi and pathogens. The City of Madison will grind all wood debris from city and private sources into 1-inch by 1-inch or smaller (see photo 3). The wood chips after processing would be available to the public for a fee. Future markets may change this policy.

The City of Madison will make concerted efforts to find alternative ways to utilize wood waste. This may include partnering with other government agencies or non-profit organizations.



Photo 3. Peterson Pacific horizontal grinder at Streets Division Brush Processing Center.

Research alternative wood waste utilization

The city will research and support alternative wood waste utilization methods beyond the current wood mulching process used to dispose of wood waste. One such method is processing ash logs for utilization in:

- City wood projects:
 - park benches
 - park signs
 - cabinets
 - landscape timbers
 - flooring for shelters
 - book shelves
 - New City Facilities (flooring, shelves, etc.)
- High School education involving wood working
- College or technical school education involving wood working
- Biomass fuels for large industrial boilers.

Definitions

Cambium – Thin layer of generative tissue lying between the bark and the wood of a stem, cambium produces new layers of phloem on the outside and of xylem (wood) on the inside, thus increasing the diameter of the stem.

Canopy – The upper most layer in a forest, formed by the crowns of the trees.

Crown – The upper part of a tree, including the branches with their foliage.

DATCP – The State of Wisconsin Department of Agriculture, Trade, Consumer and Protection agency. This agency is responsible for the State of Wisconsin's emerald ash borer response plan. They have the authority to issue a quarantine to restrict the movement of EAB and infested host material.

Diameter at Breast Height (aka DBH)- Diameter of a tree at breast, or 4 ½ feet above the ground.

EAB – The Emerald Ash Borer insect.

EAB readiness team – The group of people, both government employees and private volunteers, responsible for all aspects of preparing for Emerald Ash Borer within City of Madison.

EAB readiness plan – A document delineating local EAB readiness activities and processes; includes scope and purpose, authority, responsibility, policies and procedures, actions/tasks, available resources, forms and contracts, technical references and support information (such as surveying and reporting protocols), and similar content.

High value trees - These are ash trees that carry a high value to the community but may not be as large as a legacy tree.

Legacy trees - These are ash trees that could not be easily replaced and have significant value to the community. These trees are often substantial in size (larger than 15 inches in diameter at breast height) and provide historical value

Quarantine area – A defined geographic area from which host goods may not be transported; quarantines will be established by federal or state agencies to restrict ash wood movement out of infested areas to avoid emerald ash borer infestation of new areas; quarantines can be applied to an individual property, county, or entire state.

Soil drench - Wetting the soil surface thoroughly with a systemic insecticide so that feeder roots absorb the pesticide and then the pesticide is translocated through the trees vascular system.

Soil injection - Utilizes a specialized tool to inject systemic insecticide under pressure into the soil under the drip line of the tree. The pesticide is taken up by feeder roots and then translocated through the tree's vascular system.

Trunk injection – The process involves the use of injectors to apply systemic pesticides directly into a trees vascular system by means of a small drill hole into the tree trunk. The pesticide is then translocated through the trees vascular system.

References

Smitley, D.. 2008. *Professional Guide to Emerald Ash Borer Treatment Products*. Michigan State University, Department of Entomology.

Herms, D., McCullough, D., Smitley, D., Sadof, C., Williamson, C., Nixon, P.. 2009. *Insecticide Options for Protecting Ash Trees From Emerald Ash Borer*. U.S. Dept. of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) and U.S. Forest Service. See www.emeraldashborer.info.

Appendix A: Cost Analysis For EAB Taskforce Recommendations

2013 Additional Forestry Specialist overtime to continue EAB prep and other tasks

2013-2018 Equipment and personnel in Madison Parks Forestry and Streets for EAB mitigation and infestation efforts.

Below is a chart highlighting costs associated with removing ash trees and replanting trees in increments of 200, 400, 800 and 1,000 trees. The chart outlines costs associated with either Forestry staff doing the work, contractors doing the work or a combination of Forestry staff and contractors doing various activities.

Cost Estimates for Pre-emptive Ash Street Tree Removals

Operational Year 1*							
200 Trees		400 Trees		800 Trees		1000 Trees	
Staff/Equip	Cost	Staff/Equip	Cost	Staff/Equip	Cost	Staff/Equip	Cost
Forestry Specialist OT	\$4,238	Forestry Specialist** For Spec Equipment	\$65,824 \$500	Forestry Specialist** For Spec Equipment	\$65,824 \$500	Forestry Specialist** For Spec Equipment	\$65,824 \$500
						Arborist 2**	\$60,917
						Eq. Operator 3**	\$60,917
						Arborist 1**	\$57,401
						Arborist 1**	\$57,401
						Arb. Equipment	\$6,000
		Deprec. for Pickup	\$2,500	Depreciation for Pickup	\$2,500	Depreciation for Pickup	\$2,500
		Pickup annual repair and Fuel	\$2,420	Pickup annual repair and Fuel	\$2,420	Depreciation for 45 ft tower	\$9,500
						Depreciation for clam	\$15,400
						Clam annual repair and Fuel	\$13,380
						Tower annual repair and Fuel	\$8,599
						Pickup annual repair and Fuel	\$2,420
Totals	\$4,238		\$71,244		\$71,244		\$360,759

Year #2 and beyond, or until EAB is discovered*							
200 Trees		400 Trees		800 Trees		1000 Trees	
Trees	Cost	Trees	Cost	Trees	Cost	Trees	Cost
Ash Replacement	\$15,000	Replacement Plantings	\$100,000	Replacement Plantings	\$284,000	Ash Replacements	\$250,000
		Ash Replacements	\$100,000	Ash Replacements	\$200,000	Contract Stump Removal	\$200,000
		Contract Stump Removal	\$30,000	Contract Stump Removal	\$90,000		
Totals	\$15,000	\$230,000		\$574,000		\$450,000	

The following applies to both operational and capital budgets for preemptive ash removals until a confirmed EAB infestation is found in Dane County:

200 Trees: estimated number of trees Forestry could remove without adding field staff or vehicles to our East or West crews. Planting site and species is determined by the Forestry Section.

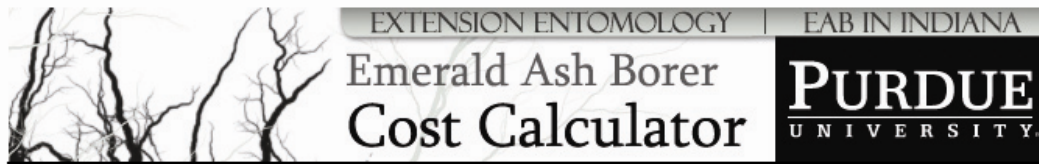
400 Trees - estimated number of trees Forestry could remove if 500 general tree replacement sites (B&B) were planted by contractors instead of by Forestry staff in addition to current contract planting. Forestry would continue to plant trees in new developments (Assessable Plats) and for Street Reconstruction projects. Planting site and species is determined by the Forestry Section.

800 Trees - estimated number of trees Forestry could remove if all tree planting was contracted out. Costs for labor to plant trees in new subdivisions would be assessed directly to property owners instead of using city labor (reimbursed to Operation Budget). Costs would also increase for Engineering to plant trees along non-assessable street reconstruction projects. Planting site and species is determined by the Forestry Section.

1,000 Trees - estimated number of removals if additional forestry staff added to specifically remove ash street trees. Replacement of ash removals would need to be contracted out - Forestry crews could continue to plant normal street tree replacements, new street trees on assessable plats, and street trees for street reconstruction projects. Planting site and species is determined by the Forestry Section.

Appendix B: EAB Cost Calculator for All Ash Street Trees

This assessment of Emerald Ash Borer management options is for all ash street trees that are 1-inch in DBH to over 30 –inches DBH.



Assessment of Emerald Ash Borer Management Options for **Madison**

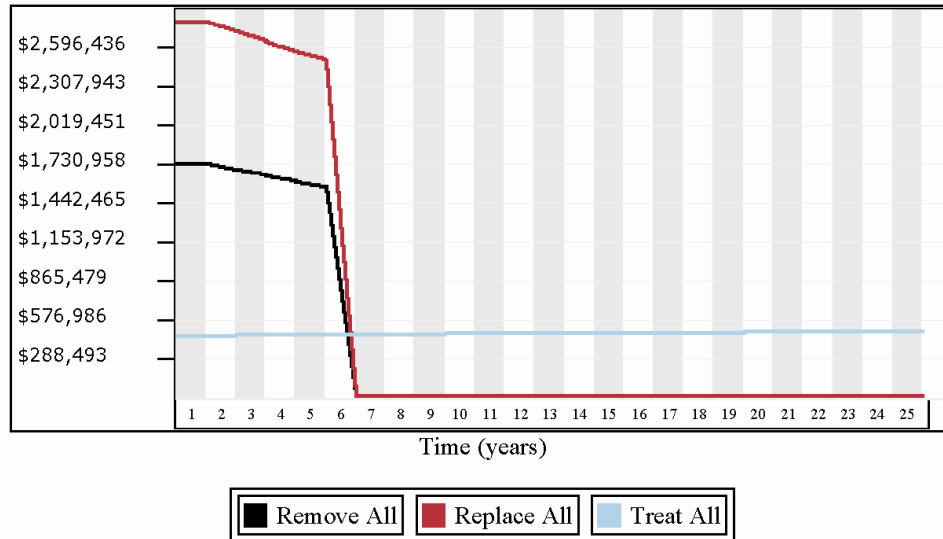
*This report was prepared using the Emerald Ash Borer Cost Calculator developed at Purdue University,
<http://extension.entm.purdue.edu/treecomputer/index.php>

Tree Size Class Distribution	
Size Span (inches)	Number of Trees
1 - 5	2709
5 - 10	5135
10 - 15	4965
15 - 20	5225
20 - 25	2887
25 - 30	663
30 -	127

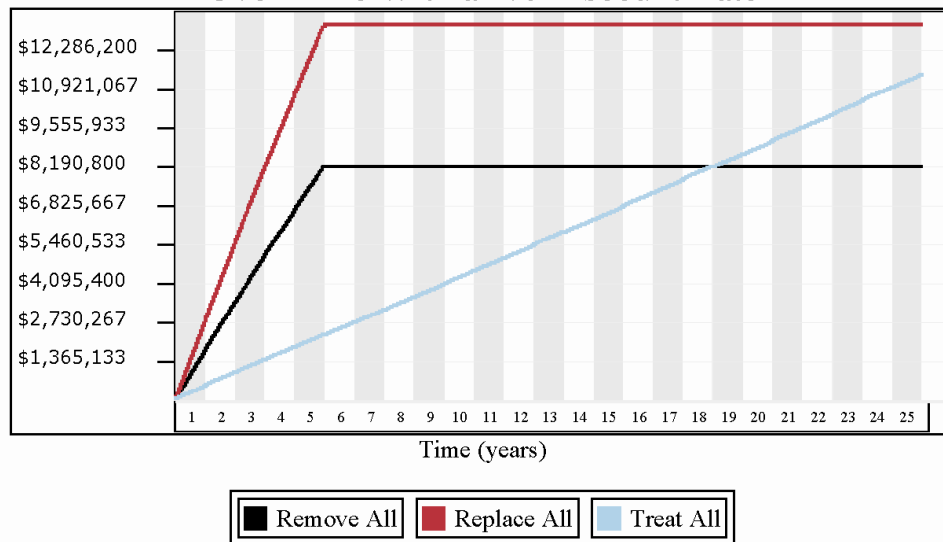
Treatment and Removal Costs	
Treatment Cost:	
DBH	Cost / DBH
1 - 5	\$1.75
5 - 10	\$1.56
10 - 15	\$1.56
15 - 20	\$1.56
20 - 25	\$1.56
25 - 30	\$1.56
30 -	\$1.56
Treat Every: 1 year(s)	
Replacement Cost: \$250 /tree	
Removal Cost:	
DBH	Cost / DBH
0 - 10	\$20.00
10 - 24	\$30.00
24 - 40	\$30.00
40 -	\$30.00
Years to Remove: 5	
Discount Rate: 3%	
Ash Mortality Rate: 0%	
Replacement Mortality Rate: 0%	

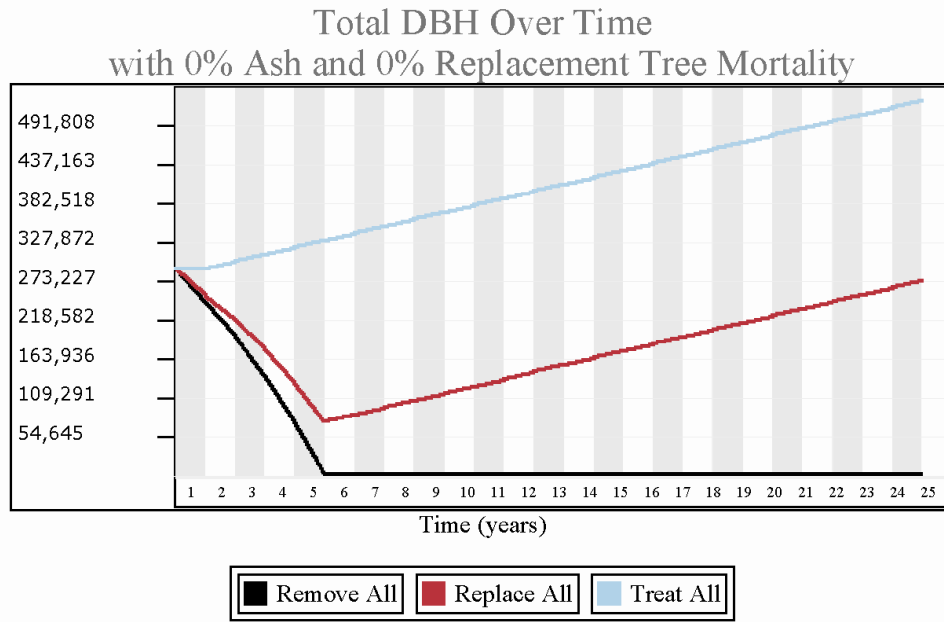
Management Plans		
Plan	Description	Why Important
Remove All	All ash trees will be removed. No trees will be replanted.	After the EAB comes to your city you will have to remove the ash trees in order to prevent dead trees from falling on people or property and causing harm. This plan has the lowest out of pocket expense. In the long term from this plan causes the greatest losses to the aesthetic, ecological value that ash trees provide your city. Use the graph of forest size (Total DBH Over time) to compare its effect with other options.
Replace All	All ash trees will be removed and replaced with a new tree.	This option replaces every ash tree with a new tree that won't get emerald ash borer. No pesticides are applied. In time the ash forest will be replaced with a different forest. This plan is the least costly way to manage your forest and allow it to regain its former size. Use the graph of forest size (Total DBH over Time) to determine how long it will take the forest to get back to its original size.
Treat All	All ash trees will be treated with insecticides.	This plan has the lowest annual out of pocket cost, but the greatest costs over time. It also produces the largest remaining forest over time. Research demonstrates that insecticides can easily protect small trees (<12" DBH) until they reach a 15" DBH. Protection of larger trees with a DBH of up to 25" is possible, but may require higher doses depending on the product used. For details please see this link http://extension.entm.purdue.edu/EAB/index.php?page=industries/master_gardeners/pesticides/how_long

Annual Cost Comparison in Today's Dollars
Over Time With a 3% Discount Rate



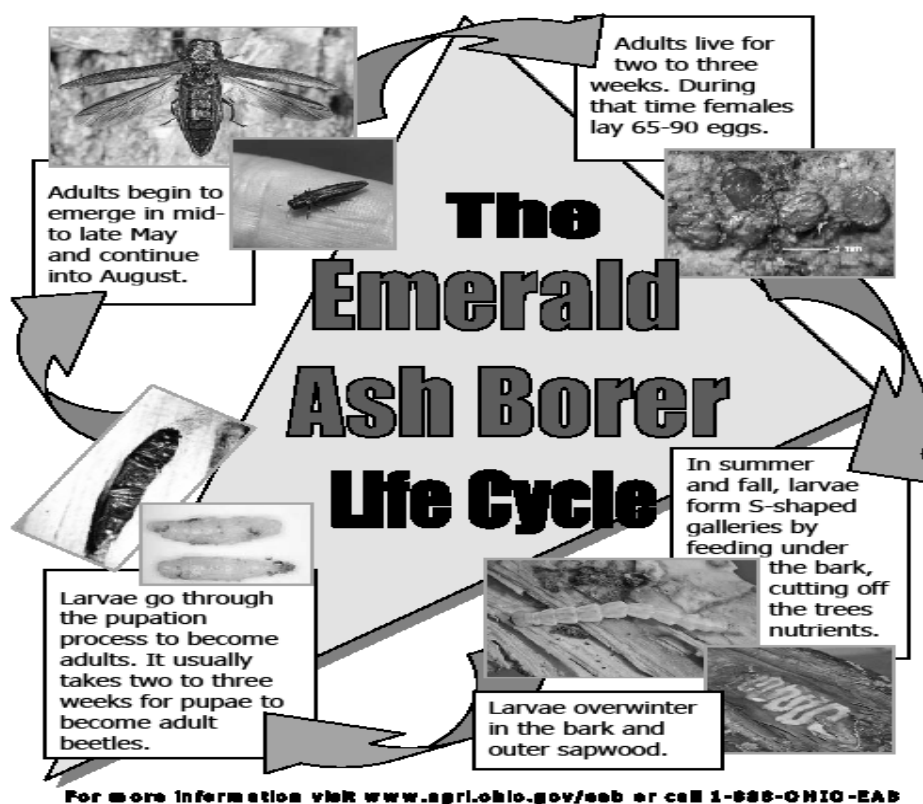
Cumulative Cost Comparison in Today's Dollars
Over Time With a 3% Discount Rate





	Remove All		Replace All		Treat All	
Year	Cost This Year	Total Cost	Cost This Year	Total Cost	Cost This Year	Total Cost
1	\$1,716,134	\$1,716,134	\$2,769,532	\$2,769,532	\$437,134	\$437,134
2	\$1,667,564	\$3,383,698	\$2,691,149	\$5,460,681	\$439,228	\$876,361
3	\$1,621,668	\$5,005,366	\$2,617,081	\$8,077,762	\$441,178	\$1,317,539
4	\$1,578,230	\$6,583,597	\$2,546,980	\$10,624,743	\$442,999	\$1,760,538
5	\$1,537,059	\$8,120,656	\$2,480,537	\$13,105,280	\$444,707	\$2,205,245
6	\$0	\$8,120,656	\$0	\$13,105,280	\$446,301	\$2,651,545
7	\$0	\$8,120,656	\$0	\$13,105,280	\$447,798	\$3,099,343
8	\$0	\$8,120,656	\$0	\$13,105,280	\$449,197	\$3,548,540
9	\$0	\$8,120,656	\$0	\$13,105,280	\$450,509	\$3,999,049
10	\$0	\$8,120,656	\$0	\$13,105,280	\$451,792	\$4,450,841
11	\$0	\$8,120,656	\$0	\$13,105,280	\$453,182	\$4,904,023
12	\$0	\$8,120,656	\$0	\$13,105,280	\$454,511	\$5,358,534
13	\$0	\$8,120,656	\$0	\$13,105,280	\$455,782	\$5,814,316
14	\$0	\$8,120,656	\$0	\$13,105,280	\$457,000	\$6,271,316
15	\$0	\$8,120,656	\$0	\$13,105,280	\$458,167	\$6,729,484
16	\$0	\$8,120,656	\$0	\$13,105,280	\$459,287	\$7,188,771
17	\$0	\$8,120,656	\$0	\$13,105,280	\$460,363	\$7,649,134
18	\$0	\$8,120,656	\$0	\$13,105,280	\$461,397	\$8,110,531
19	\$0	\$8,120,656	\$0	\$13,105,280	\$462,391	\$8,572,922
20	\$0	\$8,120,656	\$0	\$13,105,280	\$463,348	\$9,036,269
21	\$0	\$8,120,656	\$0	\$13,105,280	\$464,269	\$9,500,538
22	\$0	\$8,120,656	\$0	\$13,105,280	\$465,157	\$9,965,696
23	\$0	\$8,120,656	\$0	\$13,105,280	\$466,014	\$10,431,710
24	\$0	\$8,120,656	\$0	\$13,105,280	\$466,841	\$10,898,551
25	\$0	\$8,120,656	\$0	\$13,105,280	\$467,640	\$11,366,191

Appendix C: EAB Life Cycle



Appendix D: Ash Condition Criteria

GOOD

- Healthy, full canopy
- No structural defects
- Adequate grow space

FAIR

- 10%- 30% decline
- Structural defects
- Growing under high voltage power lines

POOR

- 30%-50% decline
- Multiple structural defects
- Heavily pruned for power line clearance – probably would be removed during next City Forestry or MGE pruning cycle (5 yrs)
- Poor crown structure – e.g. storm damage, heading cuts, lions tailing. Prior pruning that results in poor branch taper, poor wind load distribution, and a higher risk of branch failure.
- Poor grow space – narrow terraces, vision obstructions at corners, stop signs

REMOVE NOW – trees that Forestry will schedule removal and replacement during inspection

- >50% decline
- Structural defects that warrant removal

Appendix E: EAB Detection Methods

One of the many requirements for effective management of EAB is early detection of infestations, when densities are still low and before signs and symptoms are obvious. *Visual surveys* rely on external signs and symptoms (e.g., exit holes, larval tunnels seen through cracks in the bark, feeding by woodpeckers or squirrels) that may not be noticeable for 2 to 3 or more years after the arrival of the population, particularly if the infestation begins in the upper part of the tree (Ryall, K. L., et al. 2010).

Currently the Emerald Ash Borer can be detected by two methodologies. They are by purple traps or by branch sampling. In 2003, researchers began investigating EAB to develop an effective detection tool. For many insects, color frequently plays an important role, and EAB is no exception. Scientists found that buprestids (the insect family to which EAB belongs) in general are more attracted to red and purple hues compared to other colors. Therefore, researchers initiated a study using a variety of red and purple traps to determine which trap attracted the most beetles; the purple trap achieved the best results. To improve the purple traps' attractiveness to EAB adults, they are baited with oil from the Manuka tree. Researchers found that there are four active compounds in Manuka oil that are also produced when an ash tree is stressed.

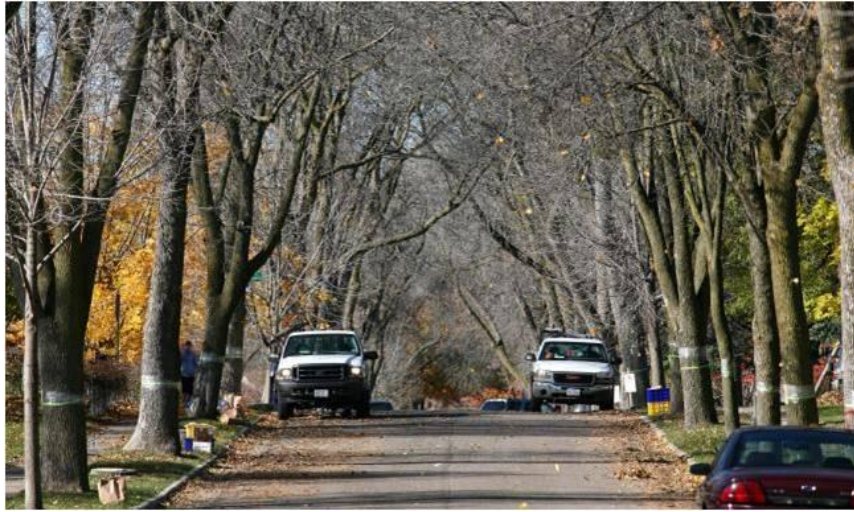
The purple trapping process was implemented in 2009 by the U.S. Department of Agriculture. Wisconsin was one of 47 States that participated in the purple trap program. There is a 44% success rate that EAB will be discovered by the purple trapping program. The trap is a three-dimensional triangle or prism. It's made out of thin, corrugated, purple plastic that has been coated with non-toxic blue on all three sides. The purple prisms are about 24 inches long and hang vertically in an ash tree or are secured to the trunk of a tree or on a pole. The purple traps are placed in spring before EAB adults emerge. The trap is monitored and remains in place throughout the summer during the beetle's flight season and is removed in the fall. The purple trap process may not be wholly funded in 2012. Also, there is a question if purple traps will be available for purchase by local governments.

The branch sampling method was developed by the Canadian Forest Service in 2009. This technique was developed using open-grown ash trees in an urban setting. In this method, a maximum of five ash trees (measuring at least 10 inches in diameter at breast height) are sampled on plot grid basis. Two live branches (measuring two inches minimum diameter at the base to six inches at the top) from the south side of tree at mid-crown are removed and labeled. The branches are then stored in a cool dry place until they can be whittled (peeled) to find the EAB larvae life stage and gallery. If the objective is only to detect EAB, then sampling can stop when the first gallery is found. If the objective is to assess densities, then it is important to count all EAB galleries and living larvae on the sample branch.

Branch sampling has an 88% success rate as a highly effective tool for detection of low level EAB populations, before outwardly signs or symptoms become apparent. The optimum time for branch sampling is January through May because the larvae galleries are easiest to see.

The City of Madison EAB Task Force recommends branch sampling be the primary EAB detection tool used by city staff. It is further recommended that branch sampling should continue in 2013 if funding is secured.

Appendix F: Before and After Effects of EAB



Dead ash trees in St. Paul, MN before and after removal.
CREDIT: Minnesota Public Radio

