

City of Prairie du Chien Emerald Ash Borer Readiness Plan



UGA9000019

Source: David Cappaert, Michigan State University, Bugwood.org

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EAB HOTLINE 1-800-462-2803

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INTRODUCTION & EXECUTIVE SUMMARY

In the summer of 2011, Bluestem Forestry Consulting Inc. conducted a street & park tree inventory throughout the City of Prairie du Chien for the purpose of preparing a plan to minimize the economic and social impacts of an emerald ash borer (EAB) infestation. Wooded areas were not inventoried.

While nobody can predict when the emerald ash borer will arrive in Prairie du Chien, it is assumed that the insect *will* arrive in Prairie du Chien in the near future. Currently, the insect has been confirmed in multiple locations throughout Wisconsin. The nearest confirmed EAB infestation is approximately 30 miles to the north in Crawford County along the Vernon/Crawford County line. Crawford County is quarantined. Since the emerald ash borer (EAB) was first detected nine years ago, it has spread to over a dozen additional states and Canada. By all appearances it is unstoppable and is spreading quickly. Prairie du Chien could lose 1 in every 8 publicly owned street trees if no preservation measures are enacted.

New infestations are popping up quickly. An up-to-date map of current infestations can be found at: <http://www.emeraldashborer.info/surveyinfo.cfm>.

Some findings/recommendations of this plan include:

- ❖ 393 (13.1%) publicly owned street & park trees are ash. Levels recommended by the WI DNR are not more than 5% of any one species and not more than 10% of any one genus per community. Prairie du Chien is over these recommended limits.
- ❖ 135 of ash are located in parks (34.4%).
- ❖ 345 street tree/park ash are green ash (87.8%), 36 are white ash (9.2%) and 12 are black ash (3.0%).
- ❖ Bluestem recommends chemically treating a total of 215 ash for preservation. These trees are in excellent or good condition. The estimated cost to treat these trees is \$21,133 every three years.
- ❖ Ash in fair, dead, poor or very poor condition, under utility lines or 1-6 inch in diameter are recommended for removal. These trees total 178. The cost to complete this activity is estimated to be \$65,359 over the course of four years.
- ❖ The total cost to implement this plan is approximately \$70,704 (over an approximate 5 year span). Staff hours to complete activities is estimated to be 694 hours.
- ❖ It is not necessary to perform routine or training prunes on any ash tree that will not be receiving chemical treatment for preservation. It is not necessary to spend the time or money to complete this activity when these trees will likely be removed in the near future.
- ❖ Recommended removal/replanting activities begin in 2012 and continue for approximately five years.
- ❖ The 'City of Prairie du Chien Urban Forestry Plan and Inventory Summary' is a companion guide discussing all inventory findings.
- ❖ The recommended contractual budget for 2012 – 2016 varies from \$23,310 to \$91,939 (including EAB expenses). The forestry budget for 2010 was \$0. Staffing requirements average 100 days annually. Recommendations include staffing and budgetary increases.

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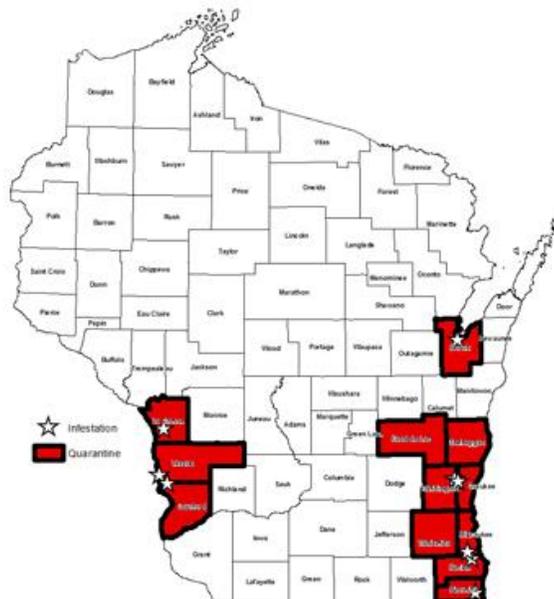
Purpose of Readiness Plan

The purpose of this Emerald Ash Borer readiness plan is to identify the essential personnel, resources, procedures and fiscal resources to manage the Emerald Ash Borer in Prairie du Chien. The City of Prairie du Chien anticipates taking proactive measures before an infestation occurs to spread costs over a longer period of time and minimize the impacts of EAB.

General Discussion of Emerald Ash Borer

The Emerald Ash Borer (*Agilus planipennis*) is an exotic pest native to Asia that was identified in southeastern Michigan near Detroit in the summer of 2002. The adult beetles munch on ash foliage but cause little damage. The real damage is caused by the EAB larvae that feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. It is suspected that the insect was initially introduced to the United States via solid wood packing material carried in cargo ships or airplanes originating in its native Asia. Thousands of dead and dying ash trees were infested indicating the EAB had been introduced several years prior to 2002. Before it was detected, EAB spread to several other states unchecked by regulation or control. Efforts to eradicate EAB have been unsuccessful in part because infestations are usually well established before they are detected.

No North American ash species have been found to be resistant to EAB. Nearly all untreated, infested ash trees die within a few years of infestation. Infested areas in Wisconsin are indicated by a star on the map below. Adult beetles have also been caught in Green Bay and Kenosha, but infested trees have not yet been found at these sites. Twelve counties are under a quarantine that restricts the movement of certain items such as hardwood firewood that could transport the pest. Also of importance to Prairie du Chien are infestations in Northeast Iowa and Southeast Minnesota.



Current state infestation map as of October 2011. Map updates can be found at: <http://datcpservices.wisconsin.gov/eab/article.jsp?topicid=25>

Tree Inventory Findings

Bluestem conducted an individual tree inventory of all trees within maintained areas of streets rights-of-ways and parks (excluding La Riviere Farm Park) during the summer of 2011. Particular attention was paid to ash trees in anticipation of the emerald ash borer.

A total of 393 ash trees were individually inventoried in Prairie du Chien. La Riviere Farm Park did not receive an individual tree inventory. One hundred thirty-five of these are located in parks and the remaining 258 are located on street rights-of-way. The total street tree population in Prairie du Chien is 2,994 trees. Ash accounts for 13.1% of the public urban forest in Prairie du Chien. Species diversity guidelines developed by the Wisconsin Department of Natural Resources recommends not more than 5% of any one species and not more than 10% of any one family. For example, green ash is an individual species and these can be found within the ash family. As with nearly all communities in Wisconsin, the ash population in Prairie du Chien is beyond recommended limits, however, it is not grossly over the recommended limits and is manageable.

There are 12 black ash, 36 white ash and 345 green ash trees. The average condition of the ash tree population is good. A total of 48 ash trees are in poor or very poor condition. As explained on page 10, all trees, regardless of species, in these conditions should be eliminated from the City population for safety reasons. Overall, the ash population in Prairie du Chien is quite healthy.

The average diameter is 14.0". Sizes range from 1" dbh (diameter at breast height) on St. Feriole Island to 34" dbh green ash in fair condition on South Waucota Avenue. It is advantageous that Prairie du Chien has a mid-sized population rather than high numbers of large trees, simply because it is easier and less costly to remove or treat smaller diameter trees.

Some additional findings of ash in Prairie du Chien include:

Condition	Count of Ash Trees
Good	211 (53.7%)
Fair	96 (24.4%)
Excellent	37 (9.4%)
Very Poor	26 (6.6%)
Poor	22 (5.6%)
Dead	1 (0.3%)
Total	393

DBH	Count of Ash Trees
1-8"	73 (18.6%)
9-16"	203 (51.6%)
17-24"	95 (24.2%)
25+"	22 (5.6%)
Total	393

A definition of terms and an in-depth discussion of all inventory data can be found in the 'City of Prairie du Chien Urban Forestry Plan and Inventory Summary'. A database listing each individual tree and its attributes has been provided to the City. A map of ash locations within the City can be found as attachment 1.

PRE-EMERALD ASH BORER ACTIVITIES

Prairie du Chien believes in preemptively responding to EAB and is in an elite group of communities in Wisconsin to do so. However, the option of 'doing nothing' is always present. The pros and cons of doing nothing vs. a preemptive response are:

Do nothing until EAB arrives in Prairie du Chien:

Pro: No cost incurred at present	Con: Large cost outlay at a single time
Pro: Allows additional time for planning	Con: Prices for trees/contractor may increase with demand; disreputable contractors take advantage of emergency
	Con: Saving trees becomes less of an option
	Con: Other City services suffer because funds diverted to tree removal
	Con: Public safety & fiscal crisis to dead and dying trees becoming hazards

Preparing in advance of EAB:

Pro: Cost spread over longer time frame	Con: Cost/time outlay begins immediately
Pro: Impacts of tree loss are slowed	
Pro: Tree preservation thru chemical treatment Is viable option	

As is nearly always the case, advance planning and preparation is always the better option. Pre-planning and readiness can be broken down into tasks to make the job more manageable. These tasks are: establish a chain of command, conduct detection surveys, decide to chemically treat ash for preservation, outline a schedule for reducing the number of ash trees, evaluate staffing and begin community education. These topics are discussed below.

Establish Chain of Command

A successful action plan always has a designee who is charged with directing the response. This individual will essentially function as a lead for the entire City. They will coordinate all EAB related activities. This EAB project leader will have many responsibilities and duties. Some of these duties will include:

- Prioritizing and budgeting for tree removals, treatments and replanting
- Updating City administration and council members
- Public and media outreach
- Education of public
- Enforcement of ordinances
- Coordination with state and local officials
- Set up of marshalling yard
- Coordinate staff training
- Purchase equipment as needed

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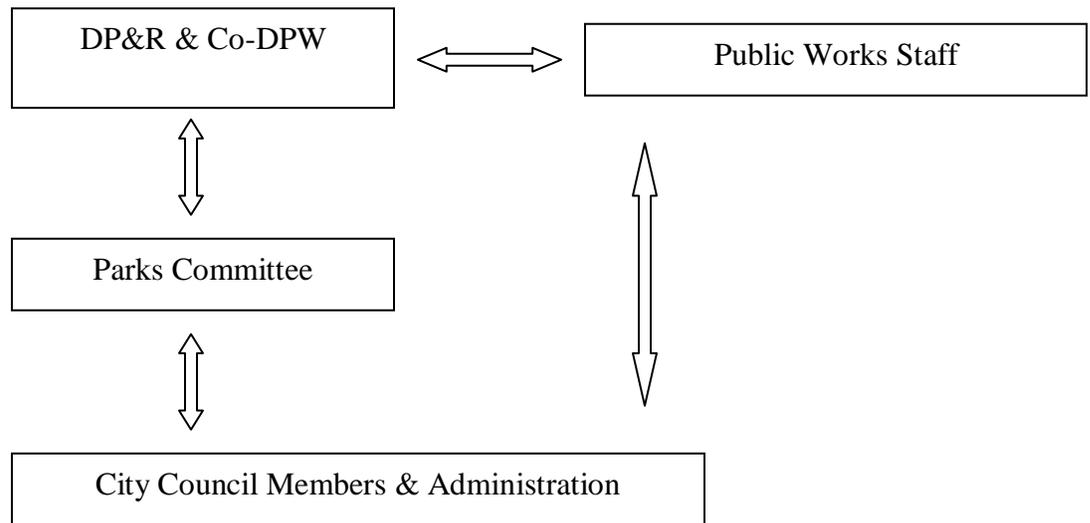
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- Produce templates and investigate contracting/mutual aid agreements with other communities and local utilities
- Investigate and arrange for wood utilization options

The Director of Parks & Recreation is the clear choice for the EAB designee. The Director of Parks & Recreation (DP&R) and the Director of Public Works manage all trees, both street and park.

For EAB related activities within Prairie du Chien, the following flowchart will apply:

City of Prairie du Chien EAB Chain of Communications:



Conducting Detection Surveys

DATCP monitors for EAB statewide thru the use of the ‘purple traps,’ but because funding for future trapping is uncertain, it is important that City monitoring be completed also. EAB monitoring by municipalities has proven very effective and City crews in Franklin identified their own infestation. There are several survey methods that can be utilized, but one method in particular seems well suited to Prairie du Chien.

Branch Sampling as a method of EAB detection is a protocol developed by Dr. Krista Ryall of the Canadian Forest Service. This type of EAB detection will work well in Prairie du Chien. This method of sampling is suitable for open grown-ash in any landscape, but is of particular value in urban areas with high-value ash trees. Ideal sampling would be completed between November and May when galleries are easiest to see. Grid sampling is established by the municipality on approximate ½ mile plots throughout the City. Based on ash density in Prairie du Chien, sampling 5-6 trees at each plot center will suffice. Generally, two 2-3” limbs are removed on each tree and a section of the branch is peeled through the cambial layer looking for EAB larvae or galleries. The methodology has proven to be 80% effective. (Ryall et al; Canadian Forest Service; Detection of emerald ash borer in urban environments using branch sampling). This activity can be completed by City staff. This survey

method should begin in the fall of 2011 and continue annually thereafter. The tree inventory database can be used for recordkeeping.



If crew members find multiple possible symptoms of EAB on a tree they should call DATCP at 1-800-462-2803 and DATCP will determine/coordinate any follow-up.

Larvae in small diameter branch. Photo courtesy of Ping Tree Service/IN DNR

Decide to Remove or Chemically Treat Trees

One of the first questions that arise when a community is making decisions regarding EAB is whether to maintain an ash component within their public urban forest. Any untreated tree can be expected to die. The options that exist are:

- ✓ *Remove all ash from the public urban forest*
- ✓ *Save all ash thru the use of chemical treatments*
- ✓ *Treat a portion of trees deemed significant and remove the remaining ash trees*

Similar to the decision of whether to be proactive or wait for an infestation, there are pros and cons to each choice:

Removing all ash from the public forest (and replanting):

- | | |
|--------------------------------------|---|
| Pro: Costs are definitive and finite | Con: High initial cost |
| Pro: No long term costs | Con: A unique species is lost to the forest |
| Pro: Diverse # of species replanted | Con: Mature trees are replaced with small trees |
| | Con: Public sentiment against removal |

Save all ash thru the use of chemical treatments:

- | | |
|--|--|
| Pro: Ash remains a component of forest | Con: Long term treatment costs are incurred |
| Pro: Public is generally supportive | Con: Potential environmental effects unknown |
| Pro: Large trees continue contributing to forest | |

Remove a portion of trees and treat a portion of trees:

- Pro: Ash remains a native component of forest
- Con: Long term treatment costs are incurred
- Pro: Reduces high initial removal costs
- Con: Public disapproval of decision criteria
- Pro: Only trees in good condition retained

To strike a balance between costs and benefits and for these reasons and the ones described above Bluestem recommends that some ash trees are retained for two chemical treatment cycles (6-8 years). At that time, reevaluation of the ash resource and accompanying costs needs to be considered.

Identify Significant Ash Trees Suitable for Chemical Treatment

It is unrealistic to expect a community to chemically treat large numbers of ash trees indefinitely. A very rough, current (2011), estimate for a contractor to treat using Tree-äge™ (Emamectin benzoate) via Arborjet is \$7/inch of tree diameter on an every two to three year basis. This pesticide is a restricted use pesticide and application will need to be completed by a DATCP certified and licensed applicator. Other pesticides and methods of application are available, but Tree-äge™ results in less time commitment from City staff. While City staff will not be completing the application, they will need to coordinate and bid out the treatment, resulting in a time investment. Other treatment options are available as well. Insecticide treatment options are discussed in Attachment 5 and additional information can be found at:

http://www.emeraldashborer.info/files/multistate_eab_insecticide_fact_sheet.pdf

Based on health, growing site and size, some ash trees are recommended for removal. Bluestem recommends that Prairie du Chien does not retain any ash in poor or very poor condition. Additionally, no tree under 6” in diameter need be treated nor any ash growing under utility lines. Small diameter trees are easily and economically replaced with little impact to the overall tree canopy and there are many more suitable species than ash for growing under utility lines.

Excluding trees in poor or very poor condition, trees 6” in diameter and under and trees under utility lines, the following chemical treatment cost options are projected **every-third year**:

Projected budget to chemically treat ash trees:

tree condition	# of trees	cost*	treatment type**	year/timeline
Excellent	27	\$2,387	Tree-äge™ (Emamectin benzoate) via Arborjet	Spring 2012
Excellent, Good	215	\$21,133		
Excellent, Good, Fair	292	\$29,939		

*based on estimate of \$7/diameter ash
 **current recommendations are to treat once every 2-3 years.

As a comparison, the cost to remove these same trees is:

Cost of Removal:				
tree condition	# of trees	contractor cost*	in-house hours	total cost (including in-house labor)
Excellent	27	\$6,247	154	\$9,750
Excellent, Good	215	\$51,093	1193	\$84,480
Excellent, Good, Fair	292	\$71,626	1583	\$105,013

*includes cost of replacement trees

Comparing the cost of chemical treatment and the cost of removal indicates that it is approximately 4 times more expensive to remove and replant trees than to provide treatment. It is a reasonable investment to treat the 215 ash in excellent and good condition. It is likely that the public will support this amount to preserve part of history and continue enjoying the many benefits of trees. Additionally, any boulevard/street tree that is in fair condition that a homeowner would like to treat should be allowed. This may save additional trees at homeowner expense.

Reduce Ash Tree Volume

Once infested with EAB, ash trees typically decline and die over a period of 4-5 years depending upon insect volume. The burden of dealing with volumes of dead and dying trees within a short period of time can place an enormous strain on community budgets, personnel and resources. Prairie du Chien stands to lose 13.1% of its public trees. EAB could appear in Prairie du Chien at any time and it may already be present, just not yet detected. The City of Prairie du Chien can take small steps now to prepare for and manage for the arrival of this pest.

Prairie du Chien should take the pro-active approach of removing some of its presumably non-infested ash over the next 3-5 years as a way to minimize the impacts when EAB arrives. The order and timeline of removal should be:

Remove trees in poor or very poor condition or dead trees. The most logical method to reduce ash volume initially is to remove ash trees identified through the inventory as in poor or very poor condition. A tree in very poor or poor condition is most likely considered a high risk tree regardless of EAB and therefore has an associated liability. Any tree, which has the potential to entirely or partially fail and impact a target can be considered a higher risk. A target can be a person, vehicle, building or any place where people gather (Source: Urban Tree Risk Management Guide, USDA Forest Service: www.na.fs.fed/us/spfo/pubs/uf/utrm). Dead or dying ash trees, whether weakened/killed by EAB or not, pose a risk to public safety and therefore a potential liability for communities if left standing. There are 39 ash trees in poor or very poor condition. A handful of these trees are of especially high priority and will be removed as a first step during the removal of high risk trees (discussed in companion 'City of Prairie du Chien Urban Forestry Plan and Inventory Summary') The remaining ash in poor or very poor condition should be removed immediately following the high risk trees, likely in 2013. Based on staffing and equipment and equipment limitations, a portion of these removals can be

completed in-house (trees 1-20" dbh) and a portion will need to be removed by a contractor (≥ 23 " dbh). Replanting can be completed in-house. The City has an agreement with Alliant Energy. Alliant will remove trees to below the power lines leaving only the bole/stump. They will complete this activity for ash on all other municipal trees. The City is then responsible for removal of the bole and stump. Bole/stump removal has been factored into budget projections.

Remove and replace small diameter ash trees. After removal of poor/very poor trees, communities anticipating EAB infestation within a few years have begun removing and replanting small diameter (1-6") ash trees prior to infestation. Replanting in these locations is occurring simultaneously with the removals so that the impact of the removal on residents is lessened. The removal of small diameter ash trees is relatively easy and less expensive than large trees and it is a good opportunity to spread the expense of replanting over a longer time period. EAB infestation has been confirmed in multiple locations throughout Wisconsin, in Allamakee County, Iowa and in Winona and Houston Counties in southeast Minnesota. Again, the nearest find is approximately 30 miles from Prairie du Chien in Crawford County. However, due to the size of and proximity to the current infestations in Northern Crawford County and the high likelihood that additional, but as-yet-undetected, infested trees exist closer to Prairie du Chien, the City should begin removing and replacing the 40 small-diameter ash in 2013, immediately following the removal of poor/very poor/dead trees.

Remove ash trees growing under utility lines. Ash is a poor species choice on sites where overhead utility lines are present. They are too tall, growing into the lines and interfering with transmission. This results in utilities pruning trees in ways that are harmful or aesthetically displeasing. Some trees growing under utility lines in Prairie du Chien have been topped resulting in weakened and disfigured trees. For this reason, the working with Alliant Energy to remove ash under utility lines is another logical step to reduce ash population prior to infestation. After removing the aforementioned trees, there will be 22 ash growing under utility lines. The DP&R/DPW should coordinate these removals with Alliant in 2014. Some utility companies provide low-growing replacement trees. Prairie du Chien should investigate this possibility with Alliant.

Chemically treat ash in excellent & good condition trees. As discussed earlier, it is recommended that the 215 ash in excellent and good condition receive chemical treatment for preservation. Current guidelines for treatment with emamectin benzoate specify application once every two to three years. State guidelines recommend treatment of ash when EAB has been confirmed 12-15 miles away and/or when a county quarantine is enacted. EAB has been confirmed in Crawford County and is very near to 15 miles from the City. For these reasons, and Bluestem recommends the trees be protected beginning in 2012. However, continuation of treatment should be reevaluated in two cycles. At that point all other ash should have been removed from the public tree population and replanted where appropriate. Hopefully, this additional time will grant a better understanding of the impacts of EAB at the community level and perhaps additional chemicals or some other means of control will be available.

Remove remaining ash in fair condition. After removal/replanting of trees in poor and very poor condition, the removal/replanting of small diameter ash, removal of ash under power lines and chemically treating the ash in good/excellent condition, 77 ash trees will remain. These are trees that were given a condition rating of fair. They aren't particularly nice, but aren't particularly poor either.

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These trees will also need to be re-evaluated and likely removed/replanted. This activity should occur after the removal of small diameter trees, likely in 2015.

A breakdown of ash trees and the recommended actions are:

1. Remove and replant 39 ash in poor or very poor condition (2012).
2. Chemically treat 215 ash in excellent/good condition (2012).
3. Remove and replant 40 ash that are small diameter (1-6") (2013).
4. Remove and replant 22 ash growing under utility lines (2014).
5. Remove remaining 77 ash in fair/good condition (2015).

Following the above recommendations will halve the City's ash population to 215 trees within 4-5 years. These remaining trees should be reevaluated for preservation in two treatment cycles (6-8 years).

An annual review should be completed as new information about the borer is learned and new EAB finds are detected. These recommendations are subject to change as research-based guidelines are developed. The DP&R/DPW should complete this activity.

Budget Projections for Identified Activities

Cost estimates for recommended ash management activities are shown in the following tables. Based on current equipment and staffing, all ash tree removals sized 1-20" dbh and replantings can be completed in-house. Tree removals over this size need to be completed by a reputable tree maintenance firm. Each tree will need to be individually evaluated by the DP&R or public works department to determine if the tree can be safely removed in-house or if the removal should be contracted.

Projected budget to remove 39 ash in poor or very poor condition:						
Timeline: 2012						
	# of removals	Man hr/ contract cost*	# trees to be replaced	man hr for planting**	cost to purchase replacement trees***	TOTAL HOURS/ CONTRACT COST
In-house cost/time	21	96/\$880 (stump grinding)	21	44	\$3,850	140/\$4,730
contract removal cost	18	\$4,698	18	36	\$3,150	36/\$7,848
TOTAL COST OF IN-HOUSE LABOR						\$4,004
TOTAL COST OF CONTRACT WORK/TREES						<u>\$12,578</u>
GRAND TOTAL						\$16,582
*based on estimate of 4 removals daily per 2 person crew @\$22.75/hour each (no benefits) or \$261/tree contract removal cost. Stump grinding =\$40/tree. Average contract removal cost based on average dbh of 25". Average stump grinding dbh of 14".						
**based on estimate of 8 tree plantings per day per 2 person crew @\$22.75/hour each (no benefits)						
***based on 1.75" caliper b&b tree @ \$175/ea planted in-house						
Removal & stump grinding costs obtained from Riverland Tree Service.						

Projected budget to remove and replant 40 ash 1-6" dbh:

Timeline: 2013

	# of removals	Man hr/ contract cost*	# trees to be replaced	man hr for planting**	cost to purchase replacement trees***	TOTAL HOURS/ CONTRACT COST
In-house cost/time	40	80	40	n/a	\$7,000	40/\$7,000

TOTAL COST OF IN-HOUSE LABOR

\$910

TOTAL COST OF TREES

\$7,000

GRAND TOTAL

\$7,910

*based on estimate of 8 removals/replantings daily per 2 person crew @\$22.75/hour each (no benefits)

**removals and replanting will occur simultaneously.

***based on 1.75" caliper b&b tree @ \$175/ea.

Projected budget to remove and replant 22 trees under utility lines:

Timeline: 2014

	# of removals	Man hr/ contract cost*	# trees to be replaced	man hr. for planting**	cost to purchase replacement trees***	TOTAL HOURS/ CONTRACT COST
In-house cost/time	22	44/\$1,760 (stump grinding)	22	44	\$7,700	88/\$9,460

TOTAL COST OF IN-HOUSE LABOR

\$2,002

TOTAL COST OF CONTRACT WORK/TREES

\$9,460

GRAND TOTAL

\$11,462

*utility co. will remove tree to below utility lines leaving bole & stump; stump removal contracted, bole removal in-house at rate 8 per day per 2 person crew @\$22.75/hour each (no benefits)
Stump grinding =\$40/tree. Average stump grinding dbh of 14".

**based on estimate of 8 tree plantings per day per 2 person crew @\$22.75/hour each (no benefits)

***based on 1.75" caliper b&b tree @ \$175/ea.

Projected budget to treat downtown & excellent ash:

Timeline: Spring 2012

tree condition	# of trees to be treated	cost	treatment type
excellent & good	215	\$21,133	Tree-äge™ (Emamectin benzoate) via Arborjet
Treatment occurring once 2-3 years			

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Projected budget to remove remaining 77 ash in fair condition:

Timeline: 2015

	# of removals	Man hr./ contract cost*	# trees to be replaced	man hr. for planting**	cost to purchase replacement trees***	TOTAL HOURS/ CONTRACT COST
In-house cost/time	59	236/\$2,360 (stump grinding)	59	118	\$10,325	354/\$12,685
contract removal cost	18	\$4,698	18	36	\$3,150	36/\$7,848
TOTAL COST OF IN-HOUSE LABOR						\$8,872
TOTAL COST OF CONTRACT WORK/TREES						\$20,533
GRAND TOTAL						\$29,405

*based on estimate of 4 removals daily per 2 person crew @\$22.75/hour each (no benefits) or \$261/tree contract removal cost.

Stump grinding =\$40/tree. Average contract removal cost based on average dbh of 25". Average stump grinding dbh of 14".

**based on estimate of 8 tree plantings per day per 2 person crew @\$22.75/hour each (no benefits)

***based on 1.75" caliper b&b tree @ \$175/ea. planted in-house

A summary of the budget projections is:

TOTAL REMOVAL/REPLANTING/TREATMENT COSTS:

Cost of in-house labor (694 hours):	\$15,788
Cost of replacement trees (178 trees)	\$35,175
Cost of treatment (215 trees)*	\$21,133
Cost of contract removal (35 trees):	\$14,396
	\$86,492

*recurring every third year

Staffing

The Public Works Department is responsible for all tree maintenance activities. The DP&R with assistance from the co-Public Works Director (PWD) are responsible for all tree decisions. These two entities work together to manage the urban forest. Staffing for public works includes seven full-time and two seasonal employees. The City also accesses inmates at the penitentiary to assist when needed. Equipment includes an aerial lift truck, chipper truck, end loader, skid steers, dump trucks, chainsaws, pole pruner, safety equipment and hand tools. The biggest limiting equipment factor is the reach on the aerial lift truck. To safely complete very large removals a 50' or 60' reach is required. Because Prairie du Chien's lift truck is not this length, tree removals (and prunings) ≥21 inches dbh should be contracted to a qualified tree maintenance firm. The public works crew, prison laborers and DP&R have been successfully planting trees in-house and as noted in the budgets above, this activity can continue as is.

It will require an estimated 964 staff hours to complete EAB related work alone, excluding risk tree work (discussed in companion document). The staff is currently completing work on an emergency

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basis only and do not have sufficient time to complete routine maintenance such as pruning. The city is understaffed to manage EAB. It is highly recommended that the City hire an additional staff member to assist with these activities. This new hire should have forestry related experience in addition to large equipment experience. Taking no action to prepare for EAB has proven to be an expensive option. To best manage and limit future EAB costs it is imperative that the recommendations in this plan be started immediately. Though known to be no more than 30 miles away, it is possible EAB already exists in Prairie du Chien and simply hasn't been detected yet. One of the primary recommendations of communities that are managing current infestations is to begin work prior to confirmation. A dead standing dry ash is likely to take 2-3 times the amount of time to removal than a live, green ash.

The Wisconsin Department of Natural Resources has an excellent opportunity designed for tree managers with limited forestry background. The Community Tree Management Institute (CTMI) course encompasses 6 days of training (over 3 sessions) from forestry experts and experienced city foresters in a wide variety of fields. This course provides a solid knowledge of forestry basics. It is highly recommended that the DP&R and/or the co-DPW attend this course. As always, the DP&R should be allowed the liberty to consult with a credentialed urban forester if he feels necessary as complex or issues beyond his scope of knowledge arise.

As with most communities, Prairie du Chien is underfunded to manage EAB. The forestry budget in 2011 was \$0. Work has largely been performed on an as-needed emergency basis. The figures above are EAB only costs. The overall recommended contractual annual budget for 2012 – 2016 varies from \$23,310 to \$91,939 (including EAB expenses). Staffing requirement recommendations average 100 days annually. A separate document has been prepared ('City of Prairie du Chien Urban Forestry Plan and Inventory Summary') that details additional work unrelated to EAB such as risk-tree removals. It is critical that Prairie du Chien budget adequate funds to properly and safely manage their urban forest.

Community Education

It would be beneficial to distribute the findings of this action plan and general EAB information to residents. This is most likely to be effective through a direct mailing and through posting on the City website. Information to be discussed includes:

- Numbers of public ash trees found in Prairie du Chien
- Ash tree and EAB identification tips, lookalike insects, signs/symptoms of EAB
- Reporting hotline
- Assistance to landowners locating ash trees on their properties
- Disposal site location
- Removal of unhealthy and other ash trees in anticipation of the EAB's arrival
- Chemical treatment options and the City treatment plan
- Replanting efforts
- FAQs and link to WI EAB website (<http://www.emeraldashborer.wi.gov/>)
- Homeowner's Guide to EAB Treatment (Attachment 5)

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It would also be beneficial to develop a FAQ sheet for callers and interested individuals. Additionally, preparing a press release for print and live media would be beneficial. Because EAB has been confirmed only 30 miles to the north and Crawford County is quarantined, these educational items should be prepared in 2012.

The Park Board is comprised of resident's interested in trees and these types of activities are perfectly designed for the assistance from that organization.

Chemical Treatment of Trees

Current protocols recommend treatment when EAB is known to exist within a county or no more than 12-15 miles away. Since an infestation exists in Crawford County, EAB treatment should begin next spring in 2012. An estimated cost for treatment of significant trees was obtained using Tree-äge™ (Emamectin benzoate) via the Arborjet delivery system. This treatment option has proven to be very effective, reasonably priced and necessary only every other to every third year. However, different treatment options are available and others are being developed at fast rates. Because of the speed of ongoing research and development, it is best to utilize a source of information that is updated quickly. The national emerald ash borer website: www.emeraldashborer.info contains up-to-date information about EAB pesticides.

Additional sources of information and websites can be found as Attachment 4.



PRE-EAB ACTION CHECKLIST

Activities to be completed prior to arrival of EAB

1. _____ Establish chain-of-command with Director of Parks & Recreation and co-Director of Public Works at top
2. _____ Begin visual survey for EAB.
3. _____ Begin hiring process for additional employee and increase funding for contract tree work. 964 staff hours required to complete EAB related activities. Contract cost is estimated at \$70,704.
4. _____ Remove and replant ash in poor or very poor condition
5. _____ Remove and replant ash 1-6" in diameter
6. _____ Remove and replant ash with overhead utility lines
7. _____ Chemically treat ash in good and excellent condition
8. _____ Prepare and distribute EAB education items
9. _____ Remove remaining ash in fair condition
10. _____ Review ordinances for effectiveness (revisions completed in 2011)
11. _____ Evaluate existing brush site for suitability as an ash marshaling yard and identify alternative sites.
12. _____ Investigate wood utilization options (see page 18 for additional information)
13. _____ Contact regional DNR urban forester for updates and new information

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EAB CONFIRMED INFESTATION ACTIVITIES

EAB has been confirmed a mere 30 miles north of Prairie du Chien. Activities should begin immediately with chemical treatment of selected ash trees (see page 9). Once EAB has been confirmed in Prairie du Chien the following activities will be happening in quick succession.

Removal of Ash Trees



Source: Steven Katovich, USDA Forest Service, Bugwood.org



Source: Pennsylvania Dept. of Conservation and Natural Resources – Forestry Archive, Bugwood.org

Once EAB has been confirmed in Prairie du Chien, activities will be proceeding very rapidly. Depending upon circumstances, Prairie du Chien may need to coordinate activities with DATCP to allow for delimitation and aging before any wholesale removal begins. The object of the EAB removal operation will be to remove dying and infested ash as quickly as possible in the most economical fashion before they become hazards. One of the primary lessons learned by other communities that have faced EAB infestation is that the trees need to be removed while they are green and not brittle. Removing dead, brittle trees increases the expense and time of removals due to the associated clean up costs and wear and tear on equipment. Assuming a fairly heavy infestation, research has shown that from the time of infestation with EAB it takes an average tree 4-5 years to completely die. The first 2-3 years of infestation are typically symptom free. Once the tree exhibits symptoms it will die in 1-2 additional years.

Private Ash Trees

The majority of a community's trees are typically located on private property. In most cases, the responsibility for tree removal on private property will be that of the property owner. In situations

where a hazardous condition exists on a private tree with the potential to impact a public right-of-way or park property, Prairie du Chien should promptly address the issue. Inspection will need to be completed on private property as safety issues arise. Prairie du Chien should evaluate its tree ordinances now so they encompass EAB. While the City will not be removing trees on private property, the City marshaling yards will most likely be accepting wood from private owners who remove their own trees.

Marshaling Yard Location



Source: David Cappaert, Michigan State University, Bugwood.org

A marshaling yard is a disposal site whose purpose is to help prevent ash wood which could house the EAB from being transported out of a quarantined area. They can be used as staging sites for wood processing, such as chipping, debarking and sawing. The yard will also serve as a temporary or emergency storage site as trees are removed.

Marshaling yards allow municipalities and perhaps private individuals to drop off ash material for disposal and processing to slow human-assisted spread of EAB. Most utilities and private contractors dispose of their own wood. A marshaling site needs to be several acres in size and big enough to accommodate large volumes of wood debris. It should also be fenced to prevent other dumping and to protect the public from accessing potential dangerous equipment.

The City currently uses a large site on Vineyard Road. This site appear to be adequate for EAB at this time.

Wood Utilization

If the City of Prairie du Chien considers receiving private ash waste, they will be looking at a large amount of debris including boles, branches and grindings. Something will need to be done with this debris. Utilization and marketing of the ash debris has proven to be difficult and complicated. Prairie du Chien currently uses wood waste products (chips, boles suitable for firewood) for city related

projects. It may be possible to continue this practice, but likely, more wood waste will be produced than needed.

Crawford, LaCrosse and Vernon County are under quarantine. This means that ash wood waste or products can be moved freely within these counties, but cannot be taken outside this area without meeting specific guidelines developed by DATCP to assure that no borers will be transported to an uninfected area. DATCP has a process to certify transportation of firewood, mulch and logs outside the quarantined area. This information can be found at www.emeraldashborer.wi.gov Considering Prairie du Chien's proximity to Iowa it is important to note that APHIS (United States Department of Agriculture Animal and Plant Health Inspection Service) also enacts quarantines and regulates compliance agreements of regulated wood out of state.

Prairie du Chien will need to spend a significant amount of time researching uses for the wood debris prior to EAB. Some choices for utilization include:

Firewood: The wood can be made available to individuals within the quarantined area for firewood purposes. This option does present some disadvantages. Staff must be available to monitor public access to the site and assure safety and the supply of wood will greatly exceed demand. Decisions to be made prior to release of firewood include: hours of operation, length of logs to be provided for firewood (12", entire bole), assistance loading wood and how to protect the public from harm.

Mulching: Landscape quality mulch can be generated to be used for mulching new plantings, flower beds and playground. The mulch could possibly be sold to residents for a small fee which would help offset the cost of the chipping. The best way to create this mulch is to periodically contract for tub or horizontal grinder that can accommodate entire trees. It may be possible to coordinate this work with neighboring communities to reduce cost.

Portable Sawmilling: A portable sawmill operator may be interested in milling the wood. The City of Monroe, MI created a partnership with a portable sawmill operator that benefits both the operator and the City. The sawmill operator mills the wood once per week to custom sizes specified by the City and for the operators own use. Monroe uses the wood to make tables, benches and other items needed by the City. No money changes hands and the only paperwork required is a liability waver for the sawmill operator.

Traditional Sawmilling: Traditional sawmilling is also an option, particularly considering the local Amish community and artisans. These operations mill wood for different purposes and utilize a variety of woods. Each sawmill differs with their wood requirements and it is advisable to contact these or other mills as soon as possible prior to EAB.

The Wisconsin Primary Wood Using Directory is a listing of companies who use or process wood products in Wisconsin. It includes sawmills, veneer plants, particle board plants, log cabin manufacturers, pulp mills and chip plants. This directory can be found at www.woodindustry.forest.wisc.edu/apps/search.asp

Replanting Strategies

If no trees are chemically treated, the City of Prairie du Chien will lose 393 ash trees due to EAB. While it is not always appropriate or feasible to replant all trees that are removed, replanting the majority of these trees is important to Prairie du Chien's urban forest.

Replanting is one of the most often delayed or eliminated forestry operations. It takes quite a sum of money and staff-hours to replant large numbers of trees. However, the ultimate cost savings that trees generate is enormous. An in-depth discussion of the benefits of trees can be found in the 'City of Prairie du Chien Urban Forestry Plan and Inventory Summary'.

A comprehensive list of tree species (by size) recommended for Prairie du Chien can be found as Attachment 3.



CONFIRMED INFESTATION CHECKLIST

Activities to be completed upon confirmation of EAB in Prairie du Chien.

1. _____ Continue chemical treatment of ash trees in good/excellent condition
2. _____ Mobilize plans and agreements for wood disposal and utilization
3. _____ Prepare for a diverse replanting
4. _____ Continue ongoing public information/education campaign
5. _____ Contact regional DNR urban forester for updates and new information

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SUMMARY

This plan has several goals. These include preparation, increased safety and cost reduction. Experience has shown that communities who develop a readiness plan and begin preparing for EAB will have a much easier time managing their infestation. This plan gives Prairie du Chien a head start on EAB activities. Prairie du Chien is now armed with the knowledge of:

- The location of their ash trees
- An estimate of the time and money required to manage EAB
- Equipment and staffing resources
- Public education strategies
- Resources available for information and assistance

By beginning activities immediately and using the most current information, the impacts of EAB can be lessened and the costs can be distributed over a more manageable period of time.

Attachment 1:
Map highlighting ash locations in Prairie du Chien

Attachment 2:

Additional EAB/Ash Tree Information Including:

Description and Lifecycle of EAB

Ash Tree Identification

Host Tree Signs and Symptoms

Description and Lifecycle of EAB

The Emerald Ash Borer adults are dark metallic green in color and belong to a group of wood boring beetles known as Buprestidae. Adults are approximately 1/2" long and 1/8" wide with very short antennae. The larvae are white in color with flattened segmented bodies and may grow to a length of one inch.

Adults emerge through the bark of ash trees in early summer, creating a D-shaped exit hole in the process. Adult emergence is thought to be staggered, beginning in May and peaking in late June. Adults live approximately 3 weeks and have been observed into August. Adults are most active during the daytime under warm, sunny conditions and have been seen feeding on the ash tree leaves. Mating occurs soon after emergence and females will begin to lay eggs about 2 weeks after emergence. A single female will lay between 60 and 90 eggs in her lifetime.

Eggs hatch in 1-2 weeks, and the tiny larvae bore through the bark and into the cambium - the area between the bark and wood where nutrient levels are high. As the larvae feed they wind back and forth, creating characteristic S-shaped or serpentine galleries in phloem and outer sapwood. The larvae feed under the bark for several weeks, usually from late July or early August through October. As mature larvae complete feeding they create a pre-pupal chamber in the outer bark or in the outer inch of wood and overwinter in this small chamber. Pupation occurs in spring and the new generation of adults will emerge in May or early June, to begin the cycle again. At low levels of infestation, the insect can take two years to complete development and females will continue to lay eggs on the same tree they emerged from until that tree's food source is depleted.

Unaided, the beetle is thought to move slowly through the landscape, approximately one mile annually, though the rate of spread varies by insect and host tree abundance. However, humans greatly accelerate the spread of the insect by moving infested nursery stock, firewood and logs to uninfested areas. Emerald ash borer movement into parts of Michigan outside of the Detroit area, Ohio, and Indiana has been the direct result of moving these ash products.

Ash Tree Identification

In North America, the emerald ash borer feeds exclusively on ash trees. Green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*) and black ash (*Fraxinus nigra*) are all found within Prairie du Chien's public urban forest. An ash tree is most easily identified by its opposite branching

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pattern (the leaves grow opposite one another at the same spot on the branch/twig) and compound leaves with 5-11 leaflets each. The leaflets will have minor serration (teeth) along their margins. The following photographs are representative of white ash bark and green ash leaves.



Source: Paul Wray, Iowa State University, Bugwood.org



Source: Paul Wray, Iowa State University, Bugwood.org

Signs and Symptoms

The symptoms associated with EAB infestations are very similar to those of other common ash pests or diseases including other wood boring insects that attack ash trees. It is important to look for a combination of at least 2 or more symptoms before concluding that the borer may be present. EAB is extremely difficult to detect at low populations and by the time severe symptoms are evident the trees are generally heavily infested. Tree death is not instantaneous; it generally takes 4 to 5 years for a tree to die.

Local governments and residents are not expected to be able to diagnose EAB. They should call the Department of Agriculture and Consumer Trade Protection (DATCP) and DATCP will determine whether follow-up is necessary. The DATCP hotline number is 1-800-462-2803. This number can also be found on the cover of this plan and at the bottom of each page.

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Crown dieback: Trees begin to show dead branches throughout the canopy beginning at the top. Foliage at top of tree is thin and sickly. This photo represents severe, late-stage infestation most likely 4-5 years after infestation.

UGA5171036

Source: Daniel Herms, The Ohio State University, Bugwood.org



Epicormic sprouting: Sprouting at the base or along the trunk of the tree. This is often referred to as suckering. This photo represents severe, late-stage infestation most likely 4-5 years after infestation.

UGA1241004

Source: Michigan Department of Agriculture, Bugwood.org

D-shaped exit holes: As adults emerge from within the tree they create an exit hole approximately 1/8" in diameter that looks distinctly like a capital 'D.'

Increased woodpecker damage: Some older infestations have increased woodpecker activity as the birds try to feed on the EAB larvae. This usually occurs in the upper portions of the tree and may be accompanied by branch dieback.

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Serpentine larval galleries: The larvae feed just underneath the bark of the ash tree. As the insect larvae feed they wind back and forth creating serpentine or s-shaped larval galleries. Various other insects form larval feeding galleries beneath ash tree bark; the distinctive s-shaped pattern is unique to EAB.

Photo of serpentine larval galleries. Source: Toby Petrice, USDA Forest Service, Bugwood.org

Bark splitting: Vertical splits in the bark appear and are caused by callus tissue that forms around larval galleries. Larval galleries can often be seen beneath the splits.

Presence of larvae or adults: The actual presence of the adult insect or of EAB larvae is confirmation of an infestation. Again, there are similar-looking wood boring insects and DATCP will need to confirm an infestation.

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Attachment 3:

Recommended species for planting

Prairie du Chien will be replanting large numbers of trees in a short time frame. It is important to diversify the forest as much as possible to help mitigate the effects of disease and insects. The general population guidelines are to plant not more than 10% of any one genus and not more than 5% of any one species. One illustration is to plant not more than 10% oak and not more than 5% of bur oak. This will help assure that if there is a population crash, large portions of the tree canopy will not be lost.

Native species are a good choice in certain circumstances and should be encouraged. However, not all native species are hardy to urban settings and may be better suited to park situations than street settings. Many of our urban street soils are not native and native species can be difficult to establish and grow in these situations. Consider all available species for the site and choose the one that will thrive and provide the most benefit to Prairie du Chien.

Prairie du Chien has a USDA hardiness zone rating of 4.

The following are some species recommended for planting in the City of Prairie du Chien (partially compiled from: Alternative to Ash Trees: Commercially Available Species and Cultivars by Dr. Laura G. Jull, Department of Horticulture, University of Wisconsin-Madison).

****Maple trees should be planted very sparingly as they are beyond the WI DNR recommended limit of not more than 10% of any one genera. No ash of any kind should be planted.****

Some of these trees are suitable for street/boulevard planting sites and some are better suited to park sites. Each site should be evaluated for tree suitability.

Large to medium-sized Trees

Acer x freemanii: Freeman maple, Zone 3b-4 (depends on cultivar), native hybrid of red and silver maple, oval to rounded form, ascending branches, 40-60' tall, 35-40' wide, moderate to fast growth rate, yellow, orange to red fall color, smooth, light gray bark when young, red samaras in spring, not fall, adaptable to most soils and pH, some cultivars can get chlorotic at very high pH, tolerant to wet soils, drought and urban conditions, moderate salt tolerance, can get verticillium wilt and leaf hoppers, some cultivars prone to included bark formation and narrow branch crotch angles, dioecious (separate male and female flowers produced on separate plants)

'Armstrong': narrow, fastigate form, 45' tall, 15' wide, yellow fall color, female, produces seeds

'Celzam' (Celebration[®]): upright to oval form, 45' tall, 25-30' wide, better branch angles and straight central leader, yellow fall color, fast grower, male, seedless, drought tolerant

'DTR 102' (Autumn Fantasy[®]): broadly oval form, upright branches, 50' tall, 40' wide, bright to dark red fall color, female, produces seeds

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'Indian Summer' or 'Morgan': broadly oval to rounded form, 45' tall, 40' wide, early, bright rosy-red fall color, vigorous, female, produces seeds, very sensitive to flooded soils
 'Jeffersred' (Autumn Blaze®): broadly oval form with upright branches, 50' tall, 40' wide, bright orange-red to red fall color that is longer lasting, male, seedless, drought tolerant, tends to develop narrow crotch angles, included bark, and multiple leaders
 'Marmo': upright, oval form, 55' tall, 45' wide, early, fair, mottled blend of deep red and green fall color starts at leaf tips and gradually works its way down leaf, good branching with straight central leader, male, seedless, slower grower
 'Scarsen' (Scarlet Sentinel®): upright form becoming oval, 40' tall, 20' wide, yellow-orange to orange-red fall color, fast grower, male, seedless
 'Sienna' (Sienna Glen®): pyramidal form, 50' tall, 35' wide, rusty orange to burgundy fall color, male, seedless, wider branch angles, from northern seed source, less susceptible to frost crack, hardy to zone 3

Acer rubrum: red maple (in acidic soils (pH below 7) only or else very chlorotic), hardy to zone 3b-5b (depends on cultivar), native to eastern and central U.S., Canada, and Wisconsin, oval to rounded to irregular form, 40-60' tall, 25-35' wide, moderate to fast grower, yellow, orange to bright red fall color, smooth, light gray bark when young, reddish flowers in early spring, red samaras in spring, not fall, dioecious (separate male and female flowers produced on separate plants), adaptable to most soils, requires acid pH or else develops serious chlorosis due to lack of manganese, not iron, easy to transplant, tolerant to wet soils (some cultivars), sensitive to salt and air pollution, susceptible to verticillium wilt, leaf hoppers, frost crack, girdling roots, prone to included bark formation and narrow, branch crotch angles, shallow roots

Autumn Flame®: dense, rounded with spreading branches, 40' tall, 35' wide, early, bright red fall color, male, seedless, slower grower
Autumn Radiance®: rounded, open, symmetrical form, 60' tall, 40' wide, early red-orange fall color
 'Autumn Spire': narrow to oval form, 40-50' tall, 30' wide, bright red fall color, male, seedless, from a northern seed source, newer cultivar, Zone 3
 'Bailcraig' (Scarlet Jewell™): upright form, 60' tall, 30' wide, early, deep crimson-red fall color, from a northern seed source, Zone 3, new cultivar
 'Bowhall': upright, very narrow form, 40-50' tall, 15' wide, yellowish-orange to reddish fall color, female, produces seed, prone to included bark formation
 'Brandywine': oval form 40' tall, 30' wide, deep red fall color for a longer period, male, seedless, newer cultivar
Fairview Flame™: good branching, 45' tall, fast growing, later, orange-red fall color
 'Frank Jr.' (Redpointe™): broadly pyramidal form, 45' tall, 30' wide, bright red fall color, faster growing, straight central leader, better branch crotch angles, new cultivar
 'Franksred' (Red Sunset®): upright, dense, oval form, symmetrical form, bright red to orange fall color, fast grower, 45-50' tall, 35' wide, female, produces seeds, dark green, glossy leaves, older cultivar
Karpick®: narrow, oval, dense form, 40' tall, 20' wide, yellow to orange fall color, male, seedless, prone to included bark formation
 'Magnificent Magenta' (Burgundy Belle®): oval to rounded form, 45' tall, 40' wide, bright red fall color that changes to burgundy, symmetrical form, heat tolerant, prone to leafhoppers and witches' broom
 'New World': upright, narrow-oval form, 40' tall, 20' wide, orange-yellow to orange-red fall color, male, seedless
 'Northwood': symmetrical, broadly oval to rounded form, ascending branches, 40' tall, 35' wide, early orange to reddish fall color, male, seedless, from a northern seed source, Zone 3
 'Olson' (Northfire®): oval form, 50' tall, 35' wide, early, bright red fall color, northern seed source, Zone 3

'PNI 0268' (October Glory[®]): not hardy, zone 5b-6a, broadly oval to rounded form, 40' tall, 35' wide, red fall color for a longer period, female, produces seeds, old cultivar

'Polara' (Ruby Frost[™]): upright, dense, broad oval form, 45' tall, 40' wide, ruby-red fall color, selected in NW Wisconsin, Zone 3

'Red Rocket': narrow, columnar form, 35' tall, 8' wide, red fall color, northern seed source, tolerant to leaf hopper

'Schlesinger': broadly vase-shaped to rounded, 45' tall, 35' wide, very early orange to purplish-red fall color, female, produced seed

'Somerset': broadly oval to rounded form, 45' tall, 35' wide, red fall color, leaf hopper resistant newer cultivar

'Summer Red[®]': dense, broad oval form, 20' tall, 10' wide, burgundy red new leaves that turn purplish-green, yellow to orange to purple fall color, leaf hopper resistant, Zone 5

'Sun Valley': oval, symmetrical form, densely branched, 40' tall, 35' wide, bright red fall color

Acer saccharum: sugar maple, hardy to zone 3a-5 (depends on cultivar), native to eastern U.S., Canada, and Wisconsin (our state tree), upright, oval to rounded form, 60-75' tall, 35-50' wide, showy, bright yellow to orange-red fall color, prefers a fertile, moist, well-drained soil, will not tolerate heavy clay, poorly drained, or dry soils, sensitive to drought, salt and air pollution, susceptible to leaf tatter and leaf scorch, verticillium wilt, basal rot, girdling roots, leaf hoppers

'Astis' (Steeple[®]): narrow oval form, 45' tall, 20' wide, yellow-orange fall color

'Autumn Splendor': broadly oval to rounded form, 45' tall, 40' wide, glossy leaves, orange-red fall color, resistant to heat drought and leaf tatter, Zone 5, newer cultivar

'Bailsta' (Fall Fiesta[®]): broadly ovate to rounded form, 50' tall, 40' wide, glossy, leathery leaves, yellow-orange to red fall color, leaf tatter and leaf hopper resistant, faster grower, newer cultivar

'Barrett Cole' (Apollo[®]): symmetrical, narrow, columnar form, 35' tall, 10' wide, yellow-orange to red fall color

'Bonfire[™]': broadly oval form, 50' tall, 40' wide, orange to red fall color, more heat tolerant, fast grower

'Commemoration[®]': oval to rounded, dense form, 50' tall, 35' wide, thick, glossy, dark green leaves, yellow-orange to red fall color, vigorous, faster grower, resistant to leaf tatter

'Endowment': broad columnar form, 50' tall, 20' wide, bright yellow fall color, no leaf scorch

'Heartland' (Autumn Faith[™]): oval to vase-shape, dense form, 35' tall, 20' wide, new leaves are bronze opening to dark green, bronze fall color, slow grower

'Flax Mill' (Majesty[®]): broadly oval, symmetrical form, 50' tall, 40' wide, thicker leaves, orange to reddish fall color

'Jefcan' (Unity[®]): upright, oval form, 50' tall, 30' wide, yellow to orange-red fall color, selected for harsh prairie climate, from Canada, slower grower, resistant to frost crack, newer cultivar, zone 3

'Legacy[®]': oval to rounded, dense form, 50' tall, 35' wide, glossy, thick, dark green leaves, later reddish-orange to red fall color or none, leaf scorch and leaf tatter resistant, faster grower, heat tolerant,

'Morton' (Cresendo[™]): broadly oval form, 45' tall, 40' wide, orange-red to red fall color, heat tolerant

'PNI 0285' (Green Mountain[®]): broadly oval form, 45-50' tall, 35' wide, reddish-orange to red fall color, leathery leaves less subject to leaf scorch, faster growing, more heat tolerant

'Wright Brothers': oval form, 50' tall, 35' wide, yellow-orange to red fall color, resistant to leaf scorch and frost crack, faster growing

Celtis occidentalis: common hackberry, zone 3b, native to eastern and central U.S., Canada, and Wisconsin, vase-shaped when young becoming rounded with drooping branches, moderate to fast growth rate, 50-70' tall, 40-60' wide, corky, warty looking bark, small, pea-sized, purplish-

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black fruit in fall, adaptable to most soils and pH, tolerates dry, sandy, rocky, and compact, heavy clay soils, slow to establish, plant in spring, drought, urban, wind, and wet soils tolerant, but sensitive to salt, susceptible to hackberry nipple gall on leaves, witches' brooming of twigs, resistant to DED, sensitive to Dicamba herbicides used near tree, branches tend to break in storms, prone to included bark formation, need to train to develop good branch structure

'Chicagoland': broad pyramidal form with upright branches, 55' tall, 40' wide, forms a straight central leader, rich green leaves, yellow fall color, warty bark

'Windy City': upright, spreading form, straight, central leader, fast grower

Corylus colurna: Turkish filbert, hardy to zone 4b, native to southeastern Europe and western Asia, broad, pyramidal form, formal looking even with age, dense, coarse texture, 40-50' tall, 20-25' wide, no fall color, scaly to corky, gray-brown bark, long, pendulous catkins in early spring are showy, may produce nuts, difficult to transplant, heat, urban, and drought tolerant, once established, sensitive to salt

Ginkgo biloba: ginkgo, maidenhair tree, hardy to zone 4b, native to eastern China, living fossil, found in fossil records dating back 150 million years ago, deciduous gymnosperm, pyramidal when young, becoming wide-spreading with age to upright, slow grower, 50-80' tall, 30-60' wide, very interesting, fan-shaped leaves, golden-yellow fall color, dioecious (separate male and female flowers produced on separate plants), female trees produce smelly, messy fruit, but not until 20 years old, so plant male cultivars only, tolerant to most soils and pH, prefers a sandy, deep soil, difficult to transplant, plant in spring, heat, salt, urban, and drought tolerant, no pests

'Autumn Gold': broadly pyramidal, symmetrical form, 45' tall, 35' wide, golden yellow fall color, male, no fruit, good, uniform branching

'Fairmount': dense, upright, pyramidal form, straight central leader, male, no fruit

'Halka': broadly pyramidal becoming oval, 45' tall, 40' wide, bright yellow fall color, male, no fruit

'Golden Globe[™]: broad, rounded form, 60' tall, 40' wide, slightly faster growth rate, male, no fruit, dense form, golden yellow fall color, Zone 5

'Magyar': upright form, 50' tall, 30' wide, bright yellow fall color, male, no fruit

'PNI 22720' (Prairie du Chien Sentry[®]): narrow pyramidal, upright form, 50' tall, 20-30' wide, bright yellow fall color, male, no fruit

'Saratoga': compact, dense, rounded form, with straight central leader, 20-30' tall, 15-20' wide, pendulous leaves, soft yellow fall color, slower and smaller than other ginkgos, male, no fruit

'Shangri-La[®]: moderately pyramidal form, 45' tall, 25' wide, slightly faster growth rate, bright yellow fall color, male, no fruit

'Windover Gold[®]: upright, oval form, 40-60' tall, 30-40' wide, golden yellow fall color, strong grower, male, no fruit

'Woodstock' (Emperor[™]): uniform, oval form, strong, central leader[™], good branching, male, no fruit

Gleditsia triacanthos var. inermis: thornless honeylocust, hardy to zone 4a, native to central U.S. and southern Wisconsin (thorny type native, not *var. inermis*), fine texture, fast growing, vase-shaped form becoming flat-topped, spreading branches, open, 50-70' tall, 40-50' wide, early, bright golden-yellow fall color, no thorns, dioecious (separate male and female flowers produced on separate plants), female plants produce long, twisted, black pods that make a slippery, litter mess, tolerant to most soils and pH, tolerant to compacted, heavy clay soil, drought, salt, and urban tolerant, tolerant to periodic flooding, susceptible to leaf hoppers, plant bug, cankers, sunscald on trunk, high maintenance pruning, tends to develop co-dominate branches, can break in storms

'Christie' (Halka[™]): broad, oval to rounded form, 40' tall, 40' wide, horizontal branches, some pods, fast growing, yellowish fall color

'Emerald Cascade': irregular, weeping form with pendulous branches, grafted, 16' tall, male, no pods

'Harve' (Northern Acclaim[®]): symmetrical, upright, spreading form, 45' tall, 35' wide, yellow fall color, male, no pods, developed in North Dakota, hardy to zone 3b

'Impcole' (Imperial[®]): rounded form, symmetrical, wide-spreading, with good branching, 35' tall, 35' wide, seedless but can throw a few pods, susceptible to leaf hoppers and plant bug

'Moraine': uniform, rounded crown with vase-shaped branching, male, no pods, older cultivar

'PNI 2835' (Shademaster[®]): vase-shaped to rounded, irregular form, 45' tall, 35' wide, uniform, ascending branches, occasionally, some trees may produce pods

'Skycole' (Skyline[®]): broadly pyramidal form, ascending branches with wider crotch angles, 45' tall, 35' wide, develops a strong, central leader better than any other cultivar, male, no pods, bright golden yellow fall color

'Suncole' (Sunburst[®]): irregular, oval form, 40' tall, 35' wide, 8" of new leaves are bright yellow then fades to green, yellowish fall color, susceptible to leaf hoppers, plant bug, and canker, male, no pods

True Shade[®]: broadly oval form, 40' tall, 35' wide, wider branch angles, yellow fall color, faster grower, male, no pods

'Wandell' (Perfection[™]): develops a good crown at a younger age, 35' tall, 30' wide, dark green leaves, male, no pods

Gymnocladus dioica: Kentucky coffeetree, hardy to zone 4a, native to central U.S., southern Ontario, and Wisconsin (scattered distribution), vase-shaped form with upright branches becoming irregular and open, 50-75' tall, 40-50' wide, slow to moderate grower, coarse texture in winter with sparse branching when young, lacy texture when in leaf, yellow fall color, large, bluish-green leaves, ashy-gray, deeply furrowed bark with exfoliating plates, dioecious (separate male and female flowers produced on separate plants), females produce thick, sausage-like, pendulous pods, that can be a litter problem along with the leaf rachis in fall, adaptable to most soils and pH, slow to establish, tolerates compacted, heavy clay soil, salt, drought, periodic flooding, and urban conditions, no pests, can look a bit "gauntly" when young due to sparse branching

'Espresso': oval to vase-shaped form with arching branches, 50' tall, 35' wide, large, blue-green leaves, yellowish fall color, male, no pods, newer cultivar

'J.C. McDaniel' (Prairie Titan[™]): oval to vase-shaped form, 50' tall, 35' wide, large, blue-green leaves, yellowish fall color, male, no pods, newer cultivar

Phellodendron amurense '**Macho**': Macho Amur corktree, hardy to zone 3b, native to northern China and Japan, broadly vase-shape, upright form, 40' tall, 30' wide, ascending branches, thick, dark green leaves, yellowish-green fall color, male, no fruit, corky bark when older, adaptable to most soils and pH, slow to establish, urban tolerant, moderate salt tolerance, no pests, shallow roots, low branching, avoid female trees as they produce invasive seeds

Quercus bicolor: swamp white oak, hardy to zone 4a, native to eastern U.S. and Wisconsin, pyramidal when young, becoming broad, rounded, wide-spreading with age, 50-60' tall, 50-60' wide, slow to moderate growth rate, easier to transplant than bur oak, prefers acidic to neutral pH, but will tolerate a bit higher, but at very high pH, it will get chlorotic, adaptable to most soils including heavy clay, tolerant to wet soil, drought, and urban conditions

Quercus macrocarpa: bur oak, hardy to zone 3a, native to eastern and midwestern U.S. and Wisconsin, pyramidal when young, becoming very wide-spreading, rounded, 70-80' tall, 60-80'

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wide, slow growing, coarse texture, deeply furrowed bark, no fall color, adaptable to most soils and pH, drought and urban tolerant, difficult to transplant

***Quercus* × *macdenielli* ‘Clemon’s’:** Heritage[®] oak, hardy to zone 4, hybrid of *Q. robur* × *Q. macrocarpa*, broadly pyramidal becoming oval form, 60-80’ tall, 40-50’ wide, dark green, glossy leaves, no fall color, mildew resistant, vigorous, zone 4

***Quercus* × *schuettei*:** swamp bur oak, hybrid of *Q. bicolor* × *Q. macrocarpa*, broad, rounded form, 75’ tall, 70’ wide, faster growing, better tolerance to high pH and easier to transplant, may be susceptible to leaf/twig galls, zone 3b

***Tilia americana*:** American linden, basswood, hardy to zone 3a, native to northeast and central U.S., Canada, and Wisconsin, pyramidal when young becoming upright-oval with age, 60-80’ tall, 40-50’ wide, fragrant, pale yellow flowers in early summer, small nutlet fruit attached to bract, large, heart-shaped leaves, prefers a deep, fertile soil, pH adaptable, easy to transplant, tolerant to wetter soils, sensitive to salt and air pollution, susceptible to Japanese beetle, linden borer, gypsy moth, basal and stem rots, sunscald on bark, tends to sucker at base, can break in storms, prone to included bark formation and narrow, branch crotch angles, girdling roots

‘Bailyard’ (Front Yard[®]): broadly pyramidal when young becoming rounded and dense, symmetrical form, 60-75’ tall, 40’ wide

‘Boulevard’: narrowly pyramidal form, 50’ tall, 25’ wide, ascending branches, yellow fall color

‘DTR 123’ (Legend[®]): broadly pyramidal form, 40’ tall, 30’ wide, well-spaced branches, thicker leaves, single leader, yellow fall color

‘Lincoln’: pyramidal, compact, dense form, 40’ tall, 25’ wide, upright branches, dark green leaves, yellow fall color

‘Mcksentry’ (American Sentry[™]): symmetrical, pyramidal form with straight central leader, 45’ tall, 30’ wide, better branch angles, lighter gray bark, yellow fall color

***Tilia* ‘Redmond’:** Redmond linden, hardy to zone 4, hybrid of *T. americana* × *T. × euchlora*, pyramidal to oval form, upright branches with terminal leader above the foliage, reddish stems and buds, can sucker at base, 50-70’ tall, 30-40’ wide, fragrant, pale yellow flowers in early summer, small nutlet fruit attached to bract, large, heart-shaped leaves

***Tilia tomentosa*:** silver linden, hardy to zone 4b, native to southeastern Europe and western Asia, broad-pyramidal form becoming upright-oval, formal looking, dark green leaves with silvery-white undersides, pale yellow flowers in summer, small nutlet fruit attached to a bract, no fall color, prefers a deep, fertile soil, but is adaptable, pH adaptable, easy to transplant, more heat, drought, and urban tolerant than other lindens, does not tolerate poorly-drained, compacted soils, same pests as American linden

‘PNI 6051’ (Green Mountain[®]): broadly pyramidal to oval form, 50’ tall, 35’ wide, dark green leaves with silvery undersides, yellowish fall color, prone to included bark formation

‘Wandell’ (Sterling[®]): broadly pyramidal form, 45’ tall, 35’ wide, green leaves with silvery undersides, yellowish fall color, prone to included bark formation

***Ulmus americana*:** American elm (DED resistant cultivars), hardy to zone 3a, native to eastern and central U.S., Canada and Wisconsin, all have vase-shaped form with pendulous branches, 70-80’ tall, 60-70’ wide, yellow fall color, adaptable to most soils and pH, tolerant to compacted, heavy clay soils, easy to transplant, tolerant to periodic flooding, salt, urban, air pollution, and drought tolerant, pest prone

‘New Harmony’ (from U.S. National Arboretum): broad, vase-shaped form, arching branches, good form, easier to grow

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'Valley Forge' (from U.S. National Arboretum): broad, vase-shaped form with arching branches, 70' tall, 70' wide, wild looking form and branching, vigorous, needs training

***Ulmus* hybrids:** hybrid elms, most are hardy to zone 4-5, all Dutch elm disease resistant, needs pruning in nursery to develop good form, adaptable to most soils and pH, tolerant to compacted, heavy clay soils, moderate salt tolerance, drought, urban, and air pollution tolerant

'Cathedral' (UW-Madison intro): hybrid of *U. japonica* × *U. pumila*, broadly vase-shaped, spreading form, 40-50' tall, 40-60' wide, prone to elm leaf beetle, zone 4

'Frontier' (from U.S. National Arboretum): hybrid of *U. carpinifolia* × *U. parvifolia*, broadly oval form, 35' tall, 25' wide, ascending branches, glossy, small, dark green, glossy leaves, late, burgundy fall color, can get elm leaf beetle, Zone 5

'Homestead' (from U.S. National Arboretum): hybrid of *U. pumila* × (*U.* × *hollandica* × *U. carpinifolia*), upright, narrow to oval form, 55' tall, 35' wide, upright, arching branches, prone to elm leaf beetle, fast growing, Zone 4b

'Morton' (Accolade[®]) (from Morton Arboretum): hybrid of *U. japonica* × *U. wilsoniana*, vase-shaped form with arching branches, 70' tall, 60' wide, resistant to elm leaf beetle, vigorous, resistant to elm leaf beetle, dark green, glossy leaves, zone 4

'Morton Glossy' (Triumph[™]) (from Morton Arboretum): hybrid of *U.* 'Morton Plainsman' × *U.* 'Morton', upright oval to vase-shape, 55' tall, 45' wide, very glossy, dark green leaves, good form, some elm leaf beetle, excellent drought tolerance, zone 4

'Morton Plainsman' (Vanguard[™]) (from Morton Arboretum): hybrid of *U. japonica* × *U. pumila*, rounded, vase-shaped form, 45' tall, 40' wide, glossy, dark green leaves, prone to elm leaf beetle, zone 4

'Morton Red Tip' (Danada Charm[™]) (from Morton Arboretum): complex hybrid of (*U. japonica* × *U. wilsoniana*) × *U. pumila* vase-shape form with arching branches, 70' tall, 60' wide, reddish new leaves, new leaves, prone to elm leaf beetle, zone 4

'Morton Stalwart' (Commendation[™]) (from Morton Arboretum): complex hybrid of *U.* 'Morton' × (*U. pumila* × *U. carpinifolia*), upright, oval form, 60' tall, 50' wide, zone 5

'New Horizon' (UW-Madison intro): hybrid of *U. japonica* × *U. pumila*, upright, compact form, 50' tall, 25' wide, dark green leaves, wide crotch angles, susceptible to verticillium wilt, zone 3b

'Patriot' (from U.S. National Arboretum): complex hybrid of *U. wilsoniana* × *U. pumila* × *U. carpinifolia* × *U. glabra*, stiffly upright branches, narrow, vase-shape form, 50' tall, 40' wide, dark green leaves, straight central leader, zone 5

'Pioneer' (from U.S. National Arboretum): hybrid of *U. glabra* × *U. carpinifolia*, rounded form, 50' tall, 50' wide, dark green, glossy leaves, prone to elm leaf beetle, zone 5

'Regal' (UW-Madison intro): complex hybrid of *U. carpinifolia* × (*U. pumila* × *U.* × *hollandica*), upright, pyramidal form, 50-60' tall, 30' wide, prone to double leaders and narrow crotches, stiff branches, zone 4

***Ulmus japonica* 'Discovery':** Discovery Japanese elm, hardy to zone 3, native to Japan and Asia, upright, vase-shape, compact form, 35-40' tall, 35-40' wide, resistant to DED and elm leaf beetle, yellow fall color

Small Sized Trees

***Acer tataricum* subsp. *ginnala*:** Amur maple, Zone 3a, native to China, Manchuria, and Japan, very invasive, do not plant near any natural areas, multi-stemmed, rounded form, low branches, 15-18' tall and wide (smaller cultivars are available), dagger-shaped leaves, orange to bright red fall color, red samaras in summer turn brown in fall, adaptable to most soils and pH, easy to transplant, drought, salt, and urban tolerant, very susceptible to verticillium wilt

'Compactum' or 'Bailey Compact': dense, compact, rounded, shrubby form, 6-8' tall, 6-8' wide, slower grower, orange to scarlet fall color

'Embers': rounded form, 15-20' tall, 15' wide, bright red samaras, scarlet fall color

'Emerald Elf': compact, rounded, dense, shrubby form, 5-6' tall and wide, scarlet to purple fall color

'Flame': multi-stemmed, spreading, irregular form, 15-20' tall, 20-25' wide, bright orange-red to deep red fall color

'JFS-UGA' (Red November[™]): multi-stemmed, low, rounded form, 18' tall, 24' wide, later, bright red fall color, heat tolerant, Zone 5

Amelanchier* × *grandiflora: apple serviceberry, hardy to zone 3a, native hybrid of downy and Allegheny serviceberry, multi or single-stemmed tree to large shrub, upright to irregular form, no suckers, 15-30' tall, 15-25' wide, produces bronze to purplish-red, fuzzy leaves in spring that turn smooth and green, white flowers in early spring, edible fruit in June, smooth, gray bark, yellowish-orange to red fall color, can develop chlorosis at high pH, prefers loamy soil, does poorly in poorly drained soils, difficult to transplant, plant in spring

'Autumn Brilliance': upright, spreading form, 20-25' tall, 15' wide, orange-red fall color, leaf spot resistant, multi-stemmed

'Cole's Select': upright, spreading form, 15-20' tall, 15' wide, multi-stemmed, orange-red fall color, leaf spot resistant, thicker, glossier leaf

'Forest Prince': oval form, 20' tall, 15' wide, red-orange fall color

'Princess Diana': wide spreading form, 15-20' tall, 15' wide, multi-stemmed, red-orange fall color, leaf spot resistant

'Robin Hill': upright, open form, 20-30' tall, 15-20' wide, flowers pink in bud open to pale pink fading to white, red fall color, single-stemmed

Amelanchier laevis: Allegheny serviceberry, hardy to zone 4a, native to eastern and central U.S., Canada, and Wisconsin, upright form, single or multi-stemmed tree, 15-25' tall, 15-20' wide, can sucker, produces white flowers in early spring, bronze to purplish-red new leaves in spring that turn green, edible fruit in June, orange to reddish-bronze fall color, prefers moist, loamy soils, does poorly in poorly drained soils, difficult to transplant, plant in spring

Cumulus[®]: upright, open form, 20-30' tall, 15' wide, orange-red fall color, minimal suckering, single-stemmed

'JFS-Arb' (Spring Flurry[®]): upright, oval form, 30-35' tall, 20' wide, orange fall color, single-stemmed, straight central leader, newer cultivar

'Rogers' (Lustre[®]): upright, open form, 20-30' tall, 15-20' wide, orange-red fall color, minimal suckering, single-stemmed

'Snowcloud': upright, oval form, 25' tall, 15' wide, scarlet fall color, single-stemmed

Cornus mas: Corneliancherry dogwood (more of a boulevard tree), hardy to zone 4b, native to Europe and western Asia, bright yellow flowers in early spring, long lasting, fruit is in summer and is bright red changing to dark purple and becoming edible, but tart, adaptable to most soils, but prefers rich soils, pH adaptable, easy to transplant, tolerates partial shade, straight species is sensitive to drought, but cultivars are more tolerant, sensitive to salt, no pest problems, hardy to zone 4b

'Golden Glory': narrow, upright form, 20-25' tall, 10' wide, much better form and darker green, glossy, thicker leaves, more flowers and fruit, good substitute to invasive tallhedge buckthorn!

'Pyramidalis': upright, pyramidal to upright form, 20' tall, 10-15' wide, dark green leaves

Crataegus crus-galli* var. *inermis: thornless cockspur hawthorn, hardy to zone 4a, native to eastern and central U.S., Canada, and Wisconsin, multi-stemmed tree, broad, spreading,

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horizontal, low branches, flat-topped crown, 20-30' tall, 20-35' wide, adaptable to most soils and pH, difficult to transplant, plant in spring, drought, salt, and urban tolerant, susceptible to cedar quince rust (on fruit) or cedar hawthorn rust (leaves), this variety has no thorns, white flowers in late spring, deep red fruit in early to mid fall that drops creating a litter problem, bronzish-orange to reddish fall color, dark green, leathery, spoon-shaped leaves

'Cruzam' (Crusader[®]): rounded form, 15' tall, 15' wide, thornless, bright red fruit, orange fall color

Crataegus phaenopyrum: Washington hawthorn, hardy to zone 4b, native to eastern U.S. and Canada, multi-stemmed tree, vase-shaped to broadly oval form, horizontal, low branches, 20-30' tall, 20-25' wide, adaptable to most soils and pH, difficult to transplant, plant in spring, tolerant to poor, sandy soils, drought and urban tolerant, moderate salt tolerance, susceptible to cedar quince rust (on fruit) or cedar hawthorn rust (leaves), has long, sharp thorns, white flowers in late spring to early summer, showy, persistent, glossy, bright-orange-red fruit fall to winter

'Westwood I' (Washington Lustre[®]): rounded, upright form, 20-25' tall, 20-25' wide, has fewer thorns than species, vigorous

***Crataegus viridis* 'Winter King'**: Winter King hawthorn, hardy to 4b, native to eastern U.S., vase-shaped to rounded, wide-spreading form, horizontal, low branches, adaptable to most soils and pH, difficult to transplant, plant in spring, drought and urban tolerant, moderate salt tolerance, less susceptible to cedar hawthorn rust but can get cedar quince rust on fruit, white flowers in late spring, very showy, bright orange-red, persistent fruit from mid fall to winter, silvery-gray bark that exfoliates on the trunk revealing orange inner bark, has few if any thorns, yellowish-purple fall color

Maackia amurensis: Amur maackia, hardy to zone 4a, native to Manchuria, vase-shaped to rounded form, upright, arching branches, 20-30' tall, 20-30' wide, slow grower, silvery and fuzzy leaves in spring turn olive-green and smooth, coppery-green to bronzish-brown, slightly exfoliating bark, off-white flowers in summer, small pods in fall, tolerant to most soils and pH, roots fix atmospheric N, tolerant to poor, infertile soils, urban and salt tolerant, prone to included bark formation, needs pruning when young, no pests, not invasive

'Starburst': upright, vase-shaped form with rounded crown, 25-30' tall, 20' wide, dark green leaves

'Summertime[®]': upright, rounded form, 18-20' tall, 12-15' wide, white flowers in summer

***Malus* spp.**: flowering crabapple, most are hardy to zone 4a and are hybrids with parents originating from Asia, Europe and U.S., size and form are quite variable, adaptable to most soils and pH, prefers low nitrogen to decrease disease susceptibility, drought and urban tolerant, apple scab resistant species and cultivars listed below and have smaller fruit, some cultivars prone to suckering and watersprouts on branches

White Flowers/Red Fruit

'Adirondack': narrow, upright form, 18' tall, 10' wide, persistent fruit

'Guinzam' (Guinevere[®]): rounded form, 8-10' tall, 10' wide, persistent fruit

'Jewelcole' (Red Jewel[®]): upright, pyramidal form, 15' tall, 12' wide, persistent fruit, can get fireblight

'Kinarzam' (King Arthur[®]): upright, rounded form, 12' tall, 10' wide, can sucker from base

'Sutyzam' (Sugar Tyme[®]): upright, spreading, oval form, 18' tall, 15' wide, persistent fruit

Malus baccata 'Jackii': Jackii crabapple, hardy to zone 3, rounded form, 20' tall, 20' wide, glossy leaves, zone 3

Malus sargentii: Sargent crabapple, low, spreading form, 8' tall, 12' wide, alternate bearing, persistent fruit

'Select A' (Firebird[®]): rounded, spreading form, 7' tall, 9' wide, persistent fruit, bears annually, persistent fruit

'Tina': small, rounded, dwarf form, 5' tall, 6' wide, slow growing

Malus × zumi var. calocarpa: redbud crabapple, rounded, spreading form, 20' tall, 24' wide, persistent fruit

White Flowers/Yellow Fruit

'Bob White': dense, rounded form, 20' tall, 20' wide, persistent fruit, but is a watersprouter

'Cinzam' (Cinderella[®]): dwarf, rounded to upright form, 8' tall, 5' wide, persistent fruit

'Excizam' (Excalibur[™]): upright form, 10' tall, 8-10' wide, good form

'Hargozam' (Harvest Gold[®]): upright, oval form, 22' tall, 18' wide, persistent fruit, may get some scab

'Lanzam' (Lancelot[®]): compact, upright, dense form, 8-10' tall, 8' wide, persistent fruit

'Ormiston Roy': broad, rounded form, 20-25' tall, 25' wide, furrowed, orangish bark, yellow fruit with a rosy blush turn orange-brown after a hard frost

Pink or Reddish Flowers/Red to Purplish-Red Fruit

'Camzam' (Camelot[™]): rounded form, 10' tall, 8' wide, pinkish-white flowers, burgundy-green leaves, persistent fruit

Malus sargentii 'Candy mint': low, spreading, horizontal form, 10' tall, 15' wide, purple tinted foliage becoming bronze-green

'Canterzam' (Canterbury[™]): rounded, compact form 10' tall, 8-10' wide, light, pinkish-white flowers

'Cardinal': irregular, spreading form, 16' tall, 22' wide, dark purplish-red, glossy leaves

'JFS-KW5' (Royal Raindrops[®]): upright, spreading form, 20' tall, 15' wide, cutleaf, purple leaves, orange-red fall color, persistent fruit

'Orange Crush': spreading form, 12-15' tall, 12-15' wide, bronze to purplish-green leaves

'Parsi' (Pink Princess[®]): low, spreading form, 8' tall, 12' wide, purple leaves become bronze-green

'Prairifire': upright, spreading to rounded form, 20' tall, 20' wide, slower growing, purple leaves become reddish-green

'Prairie Maid': rounded to spreading form, 20' tall, 25' wide, burgundy tinged leaves in spring, but is a watersprouter

'Purple Prince': rounded form, 20' tall, 20' wide, purple leaves become bronzish-green,

'Coral Cascade': semi-weeping form, 15' tall, 20' wide, white flowers, coral fruit,

'Louisa': graceful weeper, 15' tall, 15' wide, pink flowers, fruit are yellow turning orange-brown, not showy or persistent

'Luwick': graceful, low weeper, 7' tall, 14' wide, deep pink buds open to light pink to whitish flowers, bright red fruit

'Manbeck Weeper' (Anne E.[®]): wide spreading, horizontal weeper, 10-12' tall, 10-12' wide, white flowers, cherry-red fruit, persistent fruit, is difficult to find, but is one of the nicest crabs

'Molazam' (Molten Lava[®]): broadly weeping form, 14' tall, 20' wide, white flowers, bright red fruit

Pyrus calleryana: callery pear, hardy to zone 4b, native to China and Korea, upright, pyramidal to oval form, 25-35' tall, 20-30' wide, adaptable to most soils and pH, drought, urban, and salt tolerant, can get fireblight, fast grower, dark green, glossy, leathery leaves, late, reddish-orange to purple fall color, white flowers in mid spring, small, brown, rounded fruit

Aristocrat[®]: pyramidal form with open branching, 35' tall, 25' wide, yellow to red fall color but is inconsistent for fall color, wider branch crotch angles

- 'Autumn Blaze': rounded form, 30' tall, 25' wide, earlier, bright red to purplish fall color, wide crotch angles, less prone to included bark formation
- 'Cambridge': upright, narrowly pyramidal form, 35' tall, 15' wide, bright orange fall color
- 'Capital': narrow, columnar form, 30' tall, 12' wide, reddish-purple fall color, susceptible to limb breakage in storms, susceptible to fireblight, zone 5
- 'Cleveland Select' or 'Glenn's Form' (Chanticleer[®]): formal, upright, narrowly pyramidal form, 25-30' tall, 15' wide, late orangish to reddish fall color, not as good as other cultivars for fall color, rarely produces fruit
- 'Redspire': pyramidal, dense, symmetrical form, 35' tall, 25' wide, yellow to reddish fall color or none at all, susceptible to fireblight, slower grower
- 'XP-005' (Trinity[®]): broadly oval to rounded form, 30' tall, 25' wide, glossy, lighter green leaves, orange-red fall color

Syringa reticulata: Japanese tree lilac, hardy to zone 3a, native to Japan and Manchuria, upright with a rounded to oval form, 20-25' tall, 15-20' wide, no fall color to yellowish, reddish-brown, shiny bark, creamy-white, large flowers in early summer that do not smell like lilacs but rather like a privet, tends to flower heavily every other year, adaptable to most soils and pH, easy to transplant, salt and urban tolerant, susceptible to bacterial blight and verticillium wilt, resistant to mildew

- 'Elliott' (Snowcap[™]): upright, more compact form, 15-20' tall 10-12' wide, uniform branching, thick, dark green leaves, good form
- 'Golden Eclipse': upright, compact form, 18-24' tall, 8-14' wide, new leaves in spring emerge green with a darker center, the edge of the leaf gradually turns bright gold with the dark green center remaining
- 'Ivory Silk': over used, upright, spreading becoming oval to rounded, 20' tall, 15' wide, susceptible to bacterial blight
- 'Summer Snow': broad, rounded, compact form, 20' tall, 15' wide, good form, glossy, dark green leaves
- 'Williamette' (Ivory Pillar[™]): upright, pyramidal, narrower form, 20-25' tall, 10-15' wide

Attachment 4: Sources of Information

Additional sources of information include:

www.emeraldashborer.wi.gov/ - EAB portal for the state of Wisconsin

www.emeraldashborer.info/ - EAB web page administered by Michigan State University

www.dnr.state.wi.us/org/land/Forestry/Ash/index.htm - WI-DNR EAB web site

www.entomology.wisc.edu/emeraldashborer/ - UW-Extension, Dept of Entomology EAB website

www.datcp.state.wi.us/arm/environment/insects/emerald-ash-borer/index.isp - WI DATCP EAB website

<http://dnr.wi.gov/forestry/uf/eab/> - EAB toolkit developed by the WI DNR

<http://dnr.wi.gov/forestry/fh/pdf/WIEABResponsePlan.pdf> - State of Wisconsin EAB response plan

www.entomology.wisc.edu/emeraldashborer/ - University of Wisconsin Cooperative Extension Entomology website describing pesticide treatments for EAB

<http://dnr.wi.gov/forestry/UF/index.htm> - WI DNR tree planting guidelines

www.woodindustry.forest.wisc.edu/apps/search.asp - Wisconsin Primary Wood Using Facilities

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Prepared by Bluestem Forestry Consulting Inc.

November 9, 2011

Attachment 5: Homeowner's Guide to EAB Treatment

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Emerald Ash Borer: Homeowner Guide to Insecticide Selection, Use, and Environmental Protection



Before Using an Insecticide Consider the Following

- ✓ **Identify if EAB is Near**
Start insecticide treatments only when your property is within 15 miles of an EAB infestation, or if you are within a county that is quarantined for EAB. Check [MDA's Interactive EAB Survey Map](#) for current infestations in Minnesota.
- ✓ **Remove and Replace Ash Trees on Your Property**
It may be more cost effective to replace a small or struggling ash tree than to pay the cost of ongoing treatments. In addition, trees in poor health are not likely to respond well to treatments. Do not treat trees showing more than 50 percent canopy decline; these ash trees are unlikely to recover even if treated.
- ✓ **Treatment Requires a Long-Term Commitment**
Once EAB arrives in an area, it will remain a constant threat to ash trees. It is likely that protective insecticide treatments will be needed for the rest of the tree's life at a potentially significant cost.
- ✓ **Check Your Calendar – Timing is Everything**
To ensure the insecticide is in the leaves by the time adults emerge to feed in early June, products are most effective when applied mid-April until the end of June.

RECOMMENDED TREATMENT DATES ARE SHADED

APRIL							MAY							JUNE						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3						1			1	2	3	4	5	
4	5	6	7	8	9	10	2	3	4	5	6	7	8	6	7	8	9	10	11	12
11	12	13	14	15	16	17	9	10	11	12	13	14	15	13	14	15	16	17	18	19
18	19	20	21	22	23	24	16	17	18	19	20	21	22	20	21	22	23	24	25	26
25	26	27	28	29	30		23	24	25	26	27	28	29	27	28	29	30			
							30	21												

- ✓ **Contact a Certified Arborist or City Forester to Evaluate Treatment Options**
When contacting a professional, consider the following:
 - Your city or township may have requirements or prohibitions related to the treatment of EAB, especially for ash trees located on city property, which may include trees planted on or near boulevards or sidewalks. Check with your city's park and recreation or forestry departments.
 - Many effective products are best administered by professionals. If hiring a professional, check to make sure that they are licensed in Minnesota as a Commercial Pesticide Applicator for category "E: Turf and Ornamentals."
- ✓ **Have a Professional Treat Large Ash Trees**
There are homeowner treatment options for small ash trees, though these require careful application to avoid unintended environmental impacts. Homeowners wishing to protect trees larger than 48 inches in circumference (as measured 4½ feet above ground level) should have their trees professionally treated.





Insecticide Treatment Options

Professionals have access to some products that are not available to homeowners.
This document does not endorse the listed insecticide products over other options.

Products Marketed to Professionals and Arborists				
Insecticide Active Ingredient	Examples of Products	Treatment Frequency	Application Methods	Environmental Profile
Emamectin benzoate	<ul style="list-style-type: none"> • TREE-age <p><i>Restricted Use Pesticide</i> <i>Any person using this product is required to be a licensed or certified pesticide applicator.</i></p>	Every 2 years	Trunk injection	<ul style="list-style-type: none"> • Persistent in tree tissue, relatively immobile in the environment.
Azadirachtin, (neem tree seed oil)	<ul style="list-style-type: none"> • TreeAzin 	Once per year	Trunk injection	<ul style="list-style-type: none"> • Classified as a biopesticide, minimal or no exposure or risk to non-target organisms, habitats or water.
Dinotefuran	<ul style="list-style-type: none"> • Safari • Transtect 	Once per year (bark spray) 1 – 2 times per year (other methods)	Bark spray, soil injection, soil-applied drench	<ul style="list-style-type: none"> • Strong potential to leach to shallow groundwater. • Potential exposure to adjacent water bodies through spray drift and runoff events.
Imidacloprid	<ul style="list-style-type: none"> • Merit products • Xytect 2F • Ima-jet 	1 - 2 times per year	Trunk injection, soil injection, soil-applied drench	<ul style="list-style-type: none"> • Highly toxic to aquatic life. • Potential to leach to shallow groundwater or be transported in runoff when using soil injection or drench.

Products Marketed to Homeowners				
Insecticide Active Ingredient	Examples of Products	Treatment Frequency	Application Methods	Environmental Profile
Dinotefuran	<ul style="list-style-type: none"> • Green Light Tree and Shrub Insect Control with Safari 	Once per year	Granular soil-applied product	<ul style="list-style-type: none"> • Strong potential to leach to shallow groundwater. • Potential exposure to adjacent water bodies through runoff events.
Imidacloprid	<ul style="list-style-type: none"> • Bayer Advanced Tree and Shrub Insect Control • Bonide Tree and Shrub Insect Control • Ferti-lome Systemic Insect Drench • Ortho Max Tree and Shrub Insect Control 	Once per year ¹	Soil-applied drench	<ul style="list-style-type: none"> • Highly toxic to aquatic life. • Potential to leach to shallow groundwater or be transported in runoff.
Imidacloprid	<ul style="list-style-type: none"> • Bonide Systemic Insect Spray 	Check with an arborist, may not be practical for trees > 20-25 ft. in height ²	Insecticide spray to tree canopy or bark	<ul style="list-style-type: none"> • Highly toxic to aquatic life. • Tree canopy (foliar) sprays can lead to drift, posing risks to surface water, children, pets and nearby flowering plants (with potentially toxic affects to bees and other pollinators).

1. Recommended only for trees less than 48 inches in circumference (as measured 4% feet above ground level)
2. Due to the chances of insecticide drift to other areas during a canopy or bark spray, they are best applied by professionals. Additionally, there is little research to support the efficacy of canopy spray products.

Follow These Recommendations to Protect Water Quality

Generally, professionally applied tree injections have significantly fewer concerns for water quality.

For soil-applied products, bark sprays or sprays applied to tree canopies, the following considerations are important:

- Do not use within 25 feet of water bodies; such as, streams, lakes, ponds, wetlands or conduits to surface water or groundwater such as street curbs, storm drains, sumps, or well heads.
- Do not apply when heavy rainfall is expected within 24 hours of the planned treatment.
- Do not allow sprays to drift. Avoid spraying trees when there is wind. These sprays pose exposure risks to surface water, children, pets and nearby flowering plants (with potentially toxic affects to bees and other pollinators).

Avoid situations that could cause insecticides to wash away or leach, potentially contaminating water resources

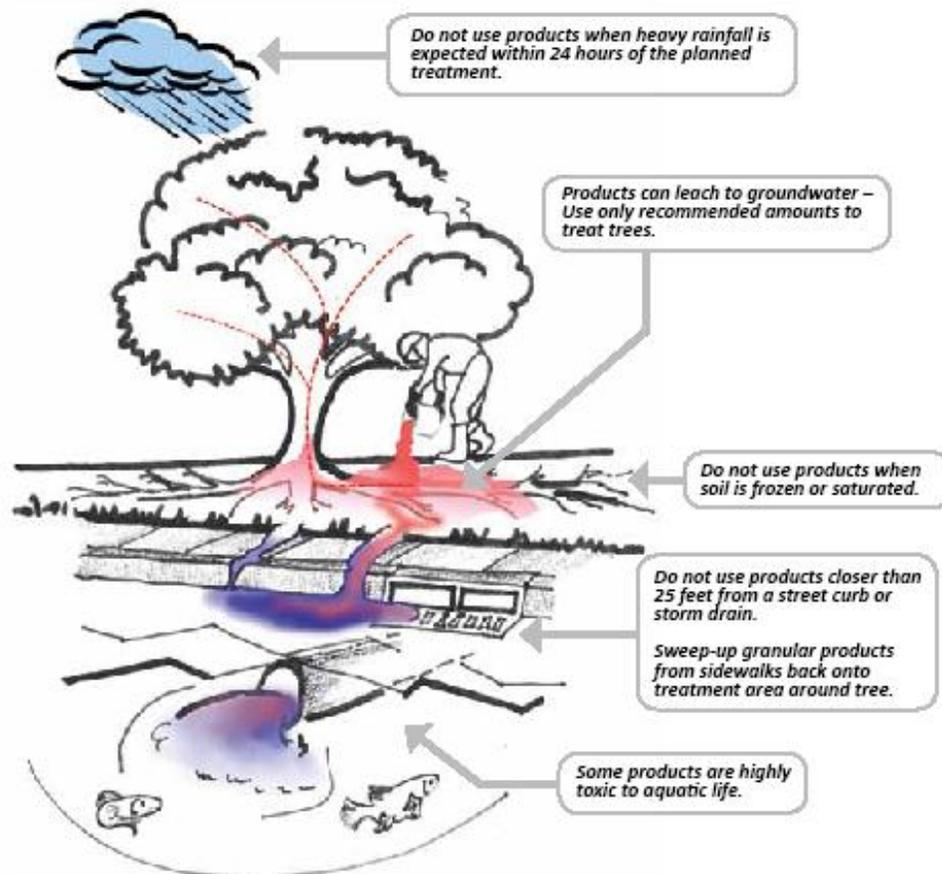


Illustration adapted from Dreistadt, S.H., J.K. Clark, M.L. Flint. 2004. Pests of Landscape Trees and Shrubs, An Integrated Pest Management Guide. Publ. 3359. Page 13.; and, Flint, M.L. 2009. Lawn and Residential Landscape Pest Control, A Guide for Maintenance Gardeners- Workbook. Publ. 3510. Page 44.

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Making Sense of EAB Insecticide Labels

Read the Label! It is your legal responsibility to read, clearly understand, and follow all current label directions for the specific insecticide product being used.

Selecting an Insecticide:

- Look for products marketed to control emerald ash borer (see table in this guide).
- Read the *Environmental Hazard Statements* on the insecticide label. Products applied as a canopy spray are likely to result in a considerable amount of insecticide drift, even when conditions are ideal.

Using an Insecticide:

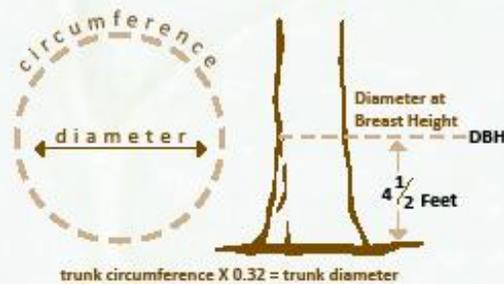
- To facilitate uptake, soil-applied insecticides should be applied when the soil is moist but not saturated or excessively dry.
- For soil drenches remove or rake any mulch or dead leaves, then pour the insecticide solution directly onto soil.
- Do not allow children and pets to re-enter treatment area until sprays or drenches have dried.
- Store insecticides where children cannot reach them.
- Many homeowner products only allow one soil drench application per year.

Disposing an Insecticide:

- When using the last of a liquid insecticide container, triple-rinse before disposal, then apply the rinse water as you would apply the insecticide.
- Unusable and unwanted insecticides must be disposed of according to the label directions, or at a county household hazardous waste disposal event.
- It is illegal to bury or burn a insecticide.

Measure your Ash Trees

Soil-applied insecticide treatments available to the general public are most effective on smaller trees, less than 48 inches in circumference.



CONVERSION TABLE	
Tree Measurements at 4 1/2 Feet Above Ground Level	
Circumference – Inches	Diameter at Breast Height (DBH) – Inches
15	5
20	6
25	8
30	9.5
35	11
40	13
45	14
> 48 inches	> 15 inches

Large trees should be treated by a professional

Additional Resources

For more information on this publication, contact the “Arrest the Pest” Hotline at 651-201-6684 or 888-545-6684.

Pesticide Disposal

For more information about disposing of unusable or unwanted pesticides, visit MDA online at www.mda.state.mn.us/chemicals/spills/wastepesticides/schedule.aspx or 651-201-6562.

Reporting and Investigating Pesticide Spills and Misuse

Complaints can be reported to the Minnesota Duty Officer at 800-422-0798. MDA staff will evaluate the information provided and if a pesticide misuse is suspected, an MDA inspector will be assigned. More information is available online at www.mda.state.mn.us/chemicals/pesticides/complaints.aspx

Emerald Ash Borer Online Resources

- Minnesota Department of Agriculture – <http://www.mda.state.mn.us/eab>
- University of Minnesota Extension – www.extension.umn.edu/issues/eab
- USDA-APHIS – www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b
- Minnesota Department of Natural Resources – www.dnr.state.mn.us/invasives/terrestrialanimals/eab
- City of St. Paul – www.stpaul.gov/index.aspx?NID=2495
- Minneapolis Park and Recreation Board – www.minneapolis.org/default.asp?PageID=1059
- EAB Multi-State Site – www.emeraldashborer.info

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