Kansas State University Emerald Ash Borer Readiness and Response Plan

Executive Summary

The goal of this Emerald Ash Borer Readiness and Response Plan is to acknowledge, manage, and minimize the ecological, economic, and aesthetic effects that the emerald ash borer (EAB) will have on the Kansas State campus in Manhattan, K-State Polytechnic, and other K-State properties with ash trees. A July 2017 inventory found 251 trees on the Manhattan campus and at the Kansas Forest Service, of which half were rated in fair condition, 32% in good condition, 18% in poor condition, and two trees (1%) were dead. No ash trees are present at K-State Olathe. There are 9 ash trees at K-State Polytechnic in Salina. Six trees there are in poor condition, 2 fair condition, and 1 in good condition.

The emerald ash borer is an exotic invasive insect in the United States that prefers native and cultivated ash trees of the *Fraxinus* genus as its host. The larval stage of the insect causes significant damage to the vascular system of the tree by disrupting the trees ability to transport water and nutrients. The damage usually starts in the canopy of the tree and as the population of the insect builds within the tree, the damage becomes more severe and more noticeable when canopy dieback, bark cracking, and epicormic sprouts occur. Chemical treatment is the only option to protect ash trees from being infested but it must be utilized as a preventative measure before 30% of the canopy is lost due to the insect's damage.

The objectives of this plan are to minimize the impact and potential for loss of ash trees on K-State properties utilizing the best-known science of the time at the lowest cost to the University; limit the exposure to liability imposed by an infestation of the EAB; protect students, faculty and staff, and visitors from hazardous trees and conditions; and maintain the beauty and efficacy of University properties.

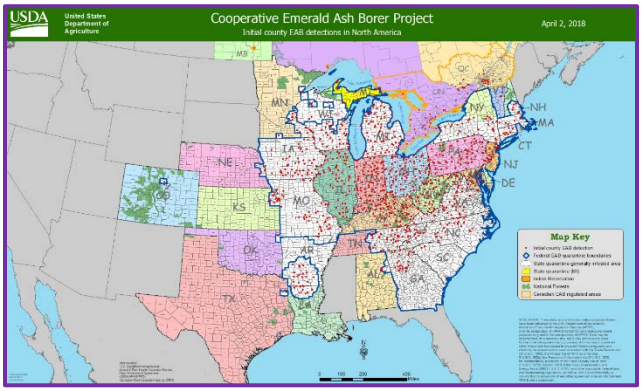
A five-year ash management strategy is proposed, with an annual review. Management strategies recommended are the removal of dead, poor, and fair condition trees and trees in poor locations. Chemical treatment will be reserved for notable and historic trees and other good condition trees that contribute to a healthy campus landscape. Tree planting will occur in advance of or in tandem with the removal of trees. Solid ash logs and those of other species will be kept for campus construction or renovation and instructional opportunities. A communication strategy to inform students, faculty and staff, alumni, and visitors to Kansas State will be developed, implemented, and reviewed annually.

Ash trees on the Manhattan campus are relatively young, with 69% less than 18" in diameter. At the Polytechnic campus in Salina, all trees are less than 20" in diameter. The Manhattan Campus Facilities Grounds Maintenance Department includes arborists, equipment, and staff that are capable of removing, treating, and planting trees. At K-State Polytechnic, these services will need to be contracted. Inventory data and cost estimates for management at the Manhattan campus follow on pages 3-7.

This readiness and response plan is intended to proactively guide the University in advance of and during an infestation of the EAB. The insect could be present now on K-State properties but undetected because the population of the insect is low. The EAB will only continue to spread in Kansas so now is the time to plan and implement management practices that will minimize its devastating effect to the University.

Introduction and Background

The EAB is an invasive pest that is native to eastern Russia, northern China, Japan, and Korea. The beetle was first discovered in North America in 2002 in the Detroit, Michigan area. Since that time, the insect has killed and caused the removal of hundreds of millions of ash trees in an attempt to reduce liability of dying trees and to slow its spread. Since its initial discovery, the core area affected by the beetle has expanded to 31 states and two providences in Canada. Ash is the primary species killed by the insect but with the EAB found in a white fringetree in Ohio, it is not possible to rule out the insect moving to other tree species if its preferred host is not available.



Initial county detections in North America and Canada, as of April 2, 2018.

On August 29, 2012, the first-ever presence of emerald ash borer in Kansas was confirmed at Wyandotte County Lake. The discovery was made by Kansas Department of Agriculture's Plant Protection (KDAPP) and USDA's Animal and Plant Health Inspection Service's Plant Protection & Quarantine (USDA-APHIS-PPQ) staff conducting a survey due to the July 2012 confirmation in Platte County, Missouri. Since that first detection in Wyandotte County, seven other counties in Kansas have confirmed the presence of the EAB: Johnson, Leavenworth, Douglas, Jefferson, Atchison, Doniphan, and Shawnee counties. Upon a detection of the EAB, a temporary quarantine is enacted and after a public hearing and signature by the Kansas Secretary of Agriculture, the quarantine order becomes permanent 90 days later. A quarantine order applies to any corporation, company, society, association, partnership, governmental agency, and any individual or combination of individuals, as stated at the Kansas Department of Agriculture emerald ash borer website - http://agriculture.ks.gov/divisions-programs/plant-protect-weed-control/emerald-ash-borer. It prohibits movement of regulated items from the quarantined area, except under specific conditions established in the permanent quarantine for the affected counties.

Regulated items under a quarantine include the following items:

- The emerald ash borer, (*Agrilus planipennis* [Coleoptera: Buprestidae]), in any living stage of development;
- Firewood of all hardwood (non-coniferous) species;
- Nursery stock of the genus *Fraxinus* (ash);
- Green lumber of the genus *Fraxinus* (ash);
- Other material living, dead, cut, or fallen, including logs, stumps, roots, branches, and composted and uncomposted chips of the genus *Fraxinus* (ash);
- Any other article, product, or means of conveyance that an inspector determines presents a risk of spreading emerald ash borer and notifies the person in possession of the article, product, or means of conveyance that it is subject to the restrictions of the regulations.

Understanding the life cycle of the emerald ash borer is necessary when considering chemical and other management decisions. *It should be noted that the below is a guide and that actual temperatures (specifically the number of degree days) will influence when adults emerge and how the life cycle progresses each year.*

A general emerald ash borer lifecycle:

- In mid to late May, adults emerge from overwintering sites under bark to mate, with peak emergency mid to late June. Some sources indicate an emergence corresponding with the bloom of the black locust tree.
- Adults live 3 to 6 weeks.
- Yellowish eggs are laid in bark crevices 2 weeks after emergence. Eggs hatch in about 10 days.
- Eggs transform to larvae. First instar larvae chew through bark and into cambial region.
- Larvae tunnel under bark to feed on phloem and outer sapwood for several weeks. The extensive galleries created by the larvae under the bark disrupt translocation of water and nutrients in the infested tree.
- Feeding continues through autumn and pre-pupal larvae overwinter in shallow chambers excavated in the outer sapwood or in the bark of thick-barked trees.
- Pupation begins late April to May. Newly-enclosed adults often remain in pupal chamber for 1 to 2 weeks before emerging head-first through a 1/8th inch D-shaped exit hole (at right).

Other Images of Emerald Ash Borer Damage

Faculty and staff of Campus Planning and Facilities Management, members of the Landscape Advisory Committee, and the Kansas Forest Service are equipped to serve as an interdepartmental EAB Readiness Team. This team led the effort to collect the ash data that influences the following recommendations. Outlined are measures intended to reduce the risk and negative impacts associated with the EAB on Kansas State University properties. The implementation and annual review of this plan rests with this group.

While the EAB has not been detected in Riley or Saline counties, it has been found in Johnson County. Currently, there are eight counties in Kansas under an EAB quarantine; Wyandotte, Johnson, Leavenworth, Douglas, Jefferson, Atchison, Doniphan, and Shawnee. A quarantine order requires that regulated items not be moved out of the quarantine area to prevent the spread of the insect. Additional information about the EAB in Kansas may be found at http://agriculture.ks.gov/divisions-programs/plant-protect-weed-control/emerald-ash-borer and http://www.kansasforests.org/forest_health/current_pests/emeraldashborer.html
University staff and contractors are encouraged to inspect all ash trees that are pruned and removed for the presence of the insect. These measures can include visual survey, following a branch sampling method, and the peeling of branches and trunks during removal. The Kansas Department of Agriculture's Plant Protection Program conducts annual surveys throughout the state that the Manhattan campus intends to participate in.

Inventory Results and Recommended Strategies

Trees on college campuses provide many tangible benefits. They shade buildings, sidewalks, and parking lots, mitigate heat islands, absorb carbon and other air pollutants, and provide spaces where faculty, students, and visitors can relax or study. These contributions help the University reduce energy costs, reduce negative health incidents due to improved air quality, reduce stormwater runoff from the campus, and bolster visual appeal to prospective and current students and faculty. Trees are the only infrastructure that appreciates in value and contributions as they mature but proper care and maintenance must occur for trees to mature in good health and yield the greatest benefits. The following results and recommendations are based on the data collected during the July 2017 inventory on the Manhattan campus and January 2018 inventory on the Polytechnic campus.

Summarized Ash Tree Data **Manhattan Campus** **Inventoried July 17, 2017**

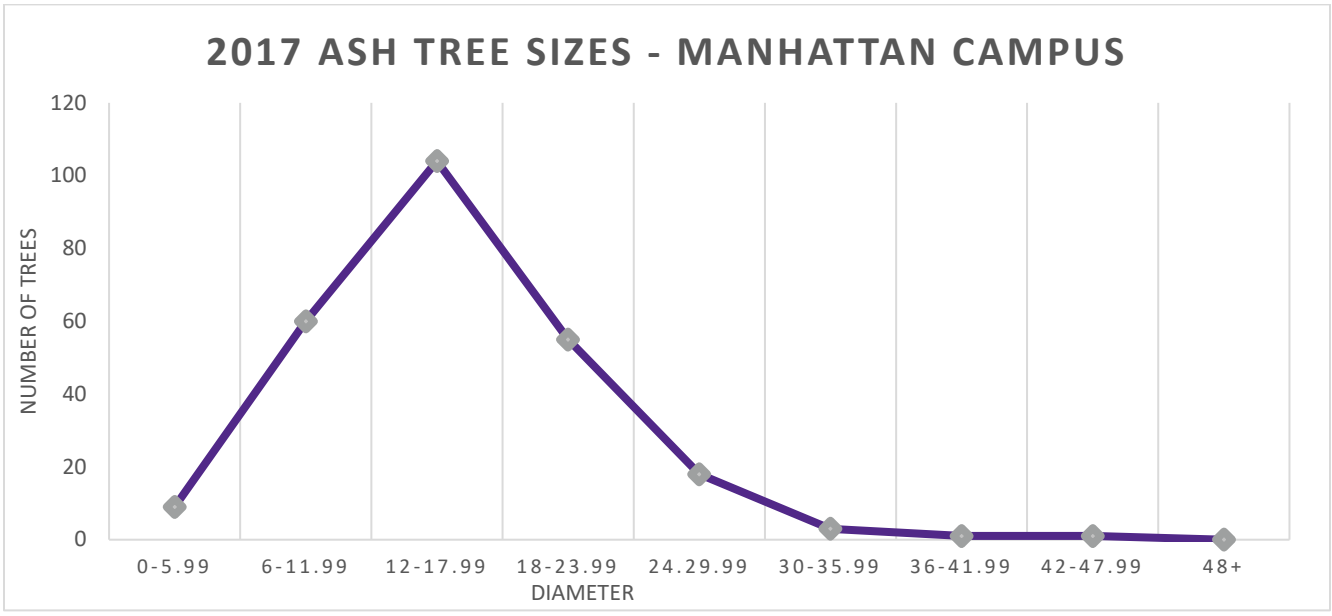
Diameter by Range

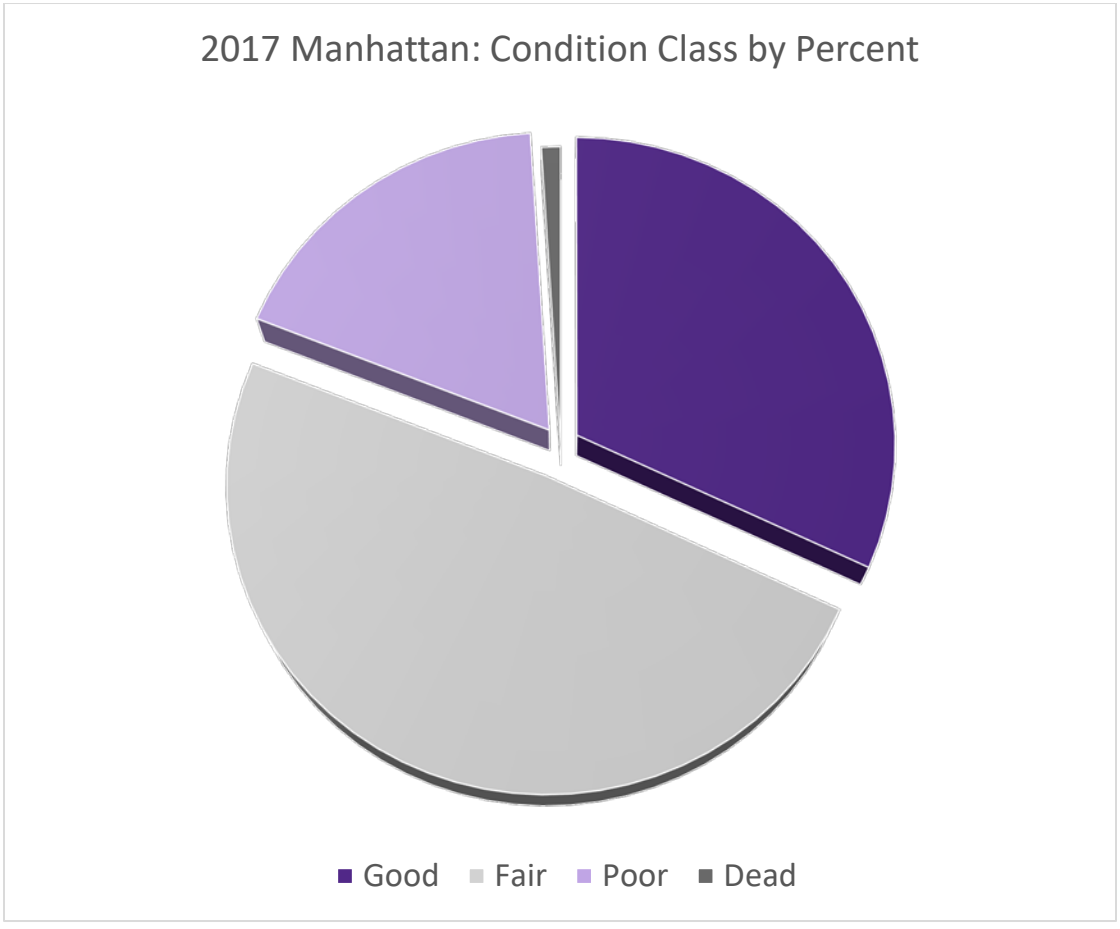
	0 to 5.99”	6” to 11.99”	12” to 17.99”	18” to 23.99”	24” to 29.99”	30” to 35.99”	36” to 41.99”	42” to 47.99”	48+”	Total Trees	Value
Good Condition											
All Ash	3	28	28	13	7		1	1		81	
Est. Value	$162	$13,692	$37,996	$34,580	$30,779		$9,174	$12,215			$138,598
Fair Condition											
All Ash	1	24	55	30	9	3				122	
Est. Value	$36	$7,824	$49,775	$53,190	$26,379	$13,137					$150,341
Poor Condition											
All Ash	5	7	20	12	2					46	
Est. Value	$90	$1,141	$9,040	$10,644	$2,932						$23,847
Dead Ash		1	1							2	$0
TOTAL	9	60	104	55	18	3	1	1	0	251	$312,786

Summarized Ash Tree Data **Polytechnic Campus** **Inventoried January 19, 2018**

Diameter by Range

	0 to 5.99”	6” to 11.99”	12” to 17.99”	18” to 23.99”	24” to 29.99”	30” to 35.99”	36” to 41.99”	42” to 47.99”	48+”	Total Trees	Value
Good Condition											
All Ash		1								1	
Est. Value		$489									$489
Fair Condition											
All Ash		1	1							2	
Est. Value		$326	$905								$1,231
Poor Condition											
All Ash		3	1	2						6	
Est. Value		$489	$452	$1,774							$2,715
TOTAL		5	2	2						9	$4,435


2017 ASH TREE SIZES - MANHATTAN CAMPUS
NUMBER OF TREES
120
100
80
60
40
20
0
0-5.99
6-11.99
12-17.99
18-23.99
24.29.99
30-35.99
36-41.99
42-47.99
48+
DIAMETER


2017 Manhattan: Condition Class by Percent
Good
Fair
Poor
Dead

Ash Tree Locations – Manhattan

Ash Tree Locations – Polytechnic

Management Strategies

In the July 2017 and January 2018 inventories, all ash trees on the Manhattan and Polytechnic campuses were classified into four condition categories, Good, Fair, Poor, and Dead. These categories are defined as:

Good	Fair	Poor	Dead
▪ Full canopy ▪ Minimal to no mechanical injury to trunk ▪ No dieback of branches over 2” diameter in the upper crown ▪ No epicormic sprouts	▪ Thinning canopy ▪ Significant damage to trunk caused by insects, disease, or mechanical injury ▪ Premature fall coloring on foliage	▪ Visible dead branches over 2” diameter in the canopy ▪ Significant dieback of living branches ▪ Severe mechanical damage to the trunk, including decay ▪ Bark is cracked or peeling	No live foliage is visible during the growing season

Approach

A proactive strategy that balances the removal and planting of trees is recommended. The strategy will be implemented in a 5-year time frame, with review after 5 years to evaluate management needed in the next 5-year cycle. Currently, there are 46 poor condition (18%), 122 fair condition (29%), and 81 good condition (32%) ash trees. The 2 dead ash trees have been removed. One hundred-four ash trees are in the diameter range 12" to 17.99" (41%), 60 trees between 6" and 11.99" (24%), 55 trees between 18" to 23.99" (22%), 18 between 24" and 29.99" (7%), and the other diameters less than 4% of the total. Ash trees on the Manhattan campus are relatively young, with 69% less than 18" in diameter. At the Polytechnic campus, the 8 trees are less than 20" in diameter, with 12% in good condition, 25% in fair, and 63% in poor condition.

Treatment

The recommended treatment for larger diameter trees is a systemic insecticide injected into the tree that is effective for two years. Other treatment products may be utilized, depending on the size of the tree and where the tree is growing. Chemical treatment will be used to prevent the EAB from killing ash trees for the long term or to prevent the infestation of trees waiting to be removed. Considerations for treatment are:

- Ash trees determined to be in good condition and in prime locations, where the loss of the trees will have an impact on the campus environment. Historic, iconic, or large healthy specimens are priorities for treatment when the EAB is detected within 15 miles of a campus.
- Good condition trees not in prime locations will not be treated initially, but will be monitored closely for any signs of decline or infestation. When the EAB is detected on campus, the condition of these trees will be evaluated to determine whether treatment is still a warranted course of action.
- The 122 fair condition trees will be monitored for infestation and decline in condition but will not be treated.
- Trees with 30% or more canopy loss will not be considered for treatment.

Removal

When a tree does not warrant treatment due to its condition or location, the best course of action is to remove the tree before the EAB establishes itself on University property. With drought and storm events also a factor to Kansas trees, ash trees rated in good and fair condition could decline to a poor or dead condition.

The Facilities Grounds Maintenance Department (FGM) will be responsible for removing any ash tree at the Manhattan campus. One hundred-seventy trees (170) were rated dead, poor, and fair. A five-year cycle for removals is recommended to allow FGM to comfortably incorporate the additional removals into its annual plan of work. Trees considered a priority for early removal include dead, dying, and poor condition trees. The next priority for removal will be fair condition ash trees. Felling 35 trees a year will remove the poor and 18% of fair condition trees in the first 2 years. The remaining fair condition trees would be removed in the last 3 years of the cycle. Services for tree management at the Polytechnic campus will be contracted.

Replacement

The Manhattan ash tree resource conservatively represents 3,951 inches of trunk diameter. It is not possible to replace the shade and ecosystem services provided by mature and maturing trees with small caliper trees, so two trees will be planted for each tree removed to more quickly fill the void of the larger trees lost and establish shade in hot locations. In this 5-year strategy, 70 trees will be planted each year for a total of 350 trees in five years. Ideally, new trees are planted in tandem with removals. When this is not possible, replacement trees will be planted in the next planting season.

Species selection and locations for planting will be determined by collaborative efforts of the EAB Readiness Team. Replacement trees will be a minimum of 1.5" caliper and will be planted and maintained by FGM staff. New trees will be selected that increase the diversity of the campus landscape, for suitability to the site where trees are removed, and where shade and protection is most needed. In this early stage of plan development, some time is still needed to better identify revenue sources.

Utilization

The utilization of campus trees is an important environmental and economic strategy and a valuable learning opportunity for multiple academic programs. While some ash logs may not be of a quality to be utilized for campus construction and student learning projects, that wood can be used as landscape mulch throughout the campus property. Logs that are of a quality to be milled or otherwise utilized will be stored in a marshalling yard on University property for future use. Cooperative agreements will be sought from area sawyers. Potential uses of campus trees are as flooring, wall covering, ceilings, furniture, and other interior use in new construction projects, renovations of University buildings, lab instruction, landscape structures, art, and mulch for campus landscapes.

Public Education and Communication

The Department of Communications and Marketing will assist with public education and the communication component of this plan. An outreach strategy will be developed and implemented to inform students, faculty and staff, alumni, and visitors about the EAB and the related management of the pest. Multiple media strategies will include print, electronic, and web platforms, and Arbor Day projects and outreach.

Operational and Cost Implications

An annual budget for the care, treatment, removal, and replacement of ash trees should be established and based on the following factors. Cost estimates in the table below are based on Manhattan FGM arborists and staff performing the tasks on that campus. These services at Polytechnic will be contracted and are not reflected below.

- The cost to treat a 16” ash (average size of the inventoried Manhattan population) with a systemic trunk-injected chemical ranges from approximately $30 to $100, depending on the strength of dosage. Additional costs to treat include the purchase of the injection equipment. The level of infestation will determine the strength of chemical dose needed.
- Treatment will be needed every year or two for the life of the tree or until the tree is removed. It should be expected that the cost to treat will increase as the tree grows and if product costs increase.
- The average cost to plant a 1.5 to 2” caliper tree is $500.
- The expected cost to remove a tree is $600.

Proposed Budget: Manhattan Campus

Activity	Details	Cost per Tree	Total Cost
Treatment	Chemical for 40 trees	$30 - $100	$1,200 - $4,000
Removal	Remove 35 trees per year	$600	$21,000
Replacement	Plant 70 trees per year	$500	$35,000
Annual Budget			$57,200 - $60,000

Summary

With the emerald ash borer now found in eight Kansas counties, now is the time to act. This readiness and response plan is intended to proactively guide the University in advance of and during an infestation. By doing so, the impact and potential loss from an infestation will be minimized by utilizing the best-known science of the time at the lowest cost to the University. Exposure to liability from dying and dead trees will be limited, and the beauty and natural features of University properties will be maintained and enhanced.

This Emerald Ash Borer Readiness and Response Plan was written by Kim Bomberger, Kansas Forest Service, with input from K-State Campus Planning and Facilities Management and the Landscape Advisory Committee. The plan is subject to periodic review and revision as necessary. EAB Readiness Team Members include:

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Chad Miller	Associate Professor, Horticulture and Natural Resources
Ray Cloyd	Professor, Entomology
Chip Winslow	Professor, Landscape Architecture/Regional and Community Planning
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Judy O'Mara	Instructor and Diagnostician, Plant Pathology
Chandler Day	Graduate Student, Plant Pathology
Kim Bomberger	Community District Forester, Kansas Forest Service
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For more information about the emerald ash borer, please visit:

Kansas Forest Service: http://www.kansasforests.org/forest_health/current_pests/emeraldashborer.html
Riley County Research and Extension: http://www.riley.k-state.edu
Central Kansas Extension District: http://www.centralkansas.k-state.edu
K-State Research and Extension publication: https://www.bookstore.ksre.ksu.edu/pubs/MF3168.pdf
Kansas Department of Agriculture Plant Protection Program: http://agriculture.ks.gov/divisions-programs/plant-protect-weed-control/emerald-ash-borer