

Emerald Ash Borer Management Plan
West Chester, Pennsylvania



Completed April 16, 2015
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[modified from model plan prepared by PADCNR, Bureau of Forestry]

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Larva feeding gallery under bark



Adult (Actual size)

Administration

West Chester University (WCU) Emerald Ash Borer Management Plan is administrated by the President, Grounds Management, and overseen by the WCU Tree Campus USA Committee and Executive Director Facilities Management. The Emerald Ash Borer (EAB) Manager reports to WCU Tree Campus USA Committee and Executive Director Facilities Management on this plan. Campus residents are encouraged to contact the EAB Manager for any questions or concerns related to this plan.

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Executive Summary

The purpose of this document is to provide suggestions on how to deal with emerald ash borer, *Agrilus planipennis* (EAB), and the impact it will have on the street ash trees of north and south campus. Unfortunately, EAB threatens the future of all ash trees on campus. EAB is now located in 55 Pennsylvania counties, the closest being Montgomery County (Appendix 1).

West Chester University recognizes the benefits of urban trees to the quality of life, air pollution reduction, energy conservation, storm water mitigation, carbon uptake and storage and property value for its nearby residents. Twenty-five (25) ash trees, *Fraxinus species*, are found on north and south campus. These ash trees are appraised at \$10,118.00 and provide a value of \$65,896.00 in ecosystem services. Purdue Cooperative Extension Service provided the landscape tree appraisal (Dana 2006). The value analysis for ecosystem services was derived from i-Tree software from the USDA Forest Service (i-Tree Tools n.d.)

To manage the ash tree population and to mitigate potential damages, we have adopted a selective management approach toward the management of this invasive pest over the next 10 years (2015-2025). A total of ten (10) ash street trees on campus will be protected using a systemic insecticide called Tree-äge. The main active ingredient is *Emamectin benzoate*. The remaining 15 trees will be removed and replanted with a non-host tree species suitable for each site. The total cost for this program is estimated over 10 years is \$30,896.

The program will be administrated by the EAB Program Manager, along with WCU Grounds Department. Annual auditing of the program will be conducted by WCU Tree Campus USA Committee and Executive Director Facilities Management. Necessary adjustments will be recommended each year based on progress reports on the status of tree conditions and EAB infestations within the campus. Technical assistance will be provided by WCU's Tree Campus USA and Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry.

All data for this report were collected by Kendra McMillin and Dr. Gerard Hertel. All the decisions as to treatments were made by the EAB Manager. The report format was provided by the Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, Division of Forest Pest Management (Appendix 2).

West Chester University's Tree Care and Policies:

The following pages are from West Chester University's web page: https://www.wcupa.edu/_INFORMATION/AFA/Facilities/Grounds/Policies/policyTreeCare.asp

CAMPUS TREE CARE POLICIES

A. PLANTING:

Tree planting has been and will continue to be a priority. Tree planting will stay at a rate higher than tree removal. The University aims at a 2:1 ratio for trees planted to trees removed. Our policy is to choose healthy nursery stock of diverse species composition that is site compatible and preferably native to the Northeast United States. A list of preferred tree species for planting is available.

B. LANDSCAPING:

1. Tree mulching is accomplished every year for trees up to approximately 6" in diameter. Periodically, drip lines of larger trees and tree groupings are mulched to keep lawn maintenance equipment away. Mulching is accomplished with material that has been properly aged.
2. Fertilization and Pest Management: Trees are treated for pest problems as needed and as funding allows. There is no regular tree fertilization beyond treatment received as a result of lawn fertilization.

C. MAINTENANCE AND REMOVAL:

1. Despite the best efforts of the University, individual trees will decline and die. It is important to identify problems as they occur and take appropriate action. Trees that are unsafe whether due to structural defects or located near a target are considered hazards. A target is defined as a structure, roadway, sidewalk, or any area where people congregate.
2. The University has a moral and legal obligation to regularly inspect for hazardous conditions and correct them in a timely manner. Failures to report and correct a problem may be considered negligent. Hazardous conditions will be continuously monitored throughout the year. Hazardous conditions are documented on an annual basis and trees are identified by the following terms: Need to be Removed, Need to be Pruned, and Trees to watch.
3. Hazardous conditions should be identified by a thorough visual inspection. Problems to identify are dead and hanging branches, cavities and rotten wood in the trunk, major seams and splits, v-crotches, leans, fungal fruiting bodies at the base, and broken or rotten roots. Insects and diseases should also be investigated. Hazards such as but not limited to these will be used to determine if a tree will need to be removed or pruned.

D. MANAGING FOR CATASTROPHIC EVENTS:

Storm response and recovery are generally accomplished in-house. In a crisis, the first priority is to remove tree debris that blocks campus thoroughfares, disrupts campus operations, or poses hazards to the campus community. Once these critical needs are addressed, a prioritized recovery plan is implemented during which unsalvageable trees are systematically removed and salvageable trees are pruned to restore their health and structure. As funding permits, lost trees are strategically replaced to restore the structure and function of the campus urban forest in a reasonable time frame. During storm response and recovery, trees requiring specialized equipment not available in-house are addressed by outside contractor.

West Chester University's Tree Care and Policies Continued:

PROTECTION AND PRESERVATION

A. CONSTRUCTION : PROTECTION ZONE AND DRIP LINE

1. Protective fencing shall be erected prior to construction and remaining to project completion.
2. Tree fencing shall be a minimum of 4 foot high orange polyethylene laminar safety netting.
3. Posts shall be set 2 feet in ground made of durable metal "T" or approved equivalent.
4. Aeration before and after construction shall be done to area within the fencing and extending out 10 feet from exterior of fencing.
5. Storage of fuels, materials, or equipment within fenced area is PROHIBITED.

B. PROTECTION FROM DAILY MAINTENANCE

1. Trees up to 6 inches in diameter will have a tree rings edged to outside the current drip line and mulched. This is to keep mowers and small equipment from coming in contact with the tree's base or root system.

GOALS and TARGETS

1. It is a goal of West Chester University to follow the preceding guidelines as general policy. The benefits will be numerous and the aesthetics of the campus will be enhanced for generations to come.
2. Potential hazards will quickly be identified and removed.
3. There will always be a constant influx of young trees of varied species.
4. Good record keeping will provide an excellent picture of the overall process.
5. A tree inventory covering the core campus has been developed within the last 5 years. The ultimate goal being worked towards is to utilize this data for campus planning, tree inventory purposes, tree management, and academic exercises (read only access). Notify the Grounds Manager with needed updates.

TREE DAMAGE ASSESSMENT

- A. Assessment on low profile trees is performed via the Grounds Manager, Facilities Landscape Designer/ Drafter, and a Faculty member (typically Biology/Forestry). Higher profile trees are assessed by an outside consultant (such as Shreiner Tree Care or Arader Tree Care). Enforcement of protection measures are performed by project managers and on-site engineers.

PROHIBITED PRACTICES

- A. Bicycles may be parked only at bicycle racks, except when permission has been granted to keep a bicycle inside a campus building. No person is allowed to park a bicycle as follows: on a sidewalk, at a tree or post, on a lawn, next to a building, in a roadway, at a utility pole, light post, banister, parking meter, or other available structure. Bicycles in violation of this are removed by the Heavy Equipment Department in presence of a WCU Police Officer, confiscated, and stored by The Department of Public Safety.
- B. Vehicles are to be parked on paved surfaces only and not on lawn surfaces under the canopy of trees so as to not damage root zones.

COMMUNICATIONS STRATEGY

The University's Tree Care and Policies is viewable on the West Chester University website within The Facilities Division page. The tree protection guidelines listed in the attachment are to be communicated to project managers for inclusion into project specifications.

Introduction

West Chester University is not just known for its educational accomplishments in the Pennsylvania State System of Higher Education, but also known for its breath-taking landscape and exceptional natural beauty on campus. As part of the piedmont plateau, the trees were here first and our campus was built among the trees and many were planted. West Chester University participates in the Tree Campus USA program and was recognized by the Interactive Community of Arboreta as an Accredited Arboretum Level II. Trees are an integral part of the campus infrastructure and identity, and their foliage (crowns) covers 20% of north campus (Dr. Joan Welch, personal communication).

Emerald ash borer (EAB), *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae), is an invasive, non-native insect that feeds on and ultimately causes the demise of ash trees. This wood-borer is metallic green in color and approximately one half (1/2) inches in length. EAB is from northeast Asia and was first discovered attacking ash trees in Michigan in 2002. In 2011, West Chester University began a visual survey looking for signs of activity or symptoms of the EAB, because it has been found in 22 additional states and two Canadian provinces (Appendix 3). It is found in 55 counties in PA and was found in Montgomery County in 2013 and in Berks County 2014 (Appendix 1).

Adult females lay their eggs under the bark where they hatch. Larvae feeding in the cambial region disrupt water and nutrient transport inside the tree, resulting in 99% tree mortality within 3-5 years after initial attack. An estimated 20 to 55 million ash trees have been killed by this pest in North America. The potential economic damage may exceed \$10 billion in the 25 states expected to be affected within in the next 10 years (Kovacs et al. 2010).

West Chester University is committed to preserving its urban forest resources as a designated "Tree Campus USA". The *Emerald Ash Borer Management Plan* is to serve as the master plan to manage urban ash street trees on campus over the next 10 years.

There are three goals for this plan:

- △ Protect high value ash trees
- △ Replace canopy cover that will be lost to EAB infestation
- △ Minimize public safety and liability risk from EAB infestation on the university's campus

The following actions will be carried out in the next 10 years:

- Maintain an updated ash inventory within campus and monitor EAB infestation on the trees yearly
- Remove dead or dying ash trees from roadways, sidewalks, and any area where people congregate
- Utilize ash wood from tree removal activities and dispose of ash-related material properly
- Treat valuable ash trees with an insecticide
- Replant non-host tree species at locations where ash trees were removed

The Ash Resource: Campus Street Trees

An ash street tree assessment was conducted by West Chester University, Department of Biology in June 2012. A total of forty-six (46) ash trees are recorded from the roadways, sidewalks, and any area where people congregate, and they ranged in diameter from 3 to 60 inches at breast height (4.5 feet) (Table 1). Another ash assessment was conducted in June 2014 to revisit areas on campus where, new geo-thermal wells were installed below ground. After the installation of the geo-thermal wells, twenty-five (25) street ash trees were left (Table 2).

Table 1. Diameter and condition of the street ash trees on campus in 2012

Tree Conditions	Diameter class (inches)					<i>Total</i>
	<10	10-25	26-35	36-50	>50	
Excellent	3	3	0	0	0	6
Good	6	7	6	1	0	20
Fair	0	4	4	0	1	9
Poor	1	5	2	2	1	11
Dead	0	0	0	0	0	0
Total	10	19	12	3	2	46

Table 2. Diameter and condition of the street ash trees on campus in 2014

Tree Conditions	Diameter class (inches)					<i>Total</i>
	<10	10-25	26-35	36-50	>50	
Excellent	3	2	0	0	0	5
Good	4	6	3	1	0	14
Fair	0	0	0	0	1	1
Poor	1	0	2	1	1	5
Dead	0	0	0	0	0	0
Total	8	8	5	2	2	25

Management Options

Trees in general provide canopy cover, aesthetic value, erosion control, and valuable renewable resources. With the imminent arrival of EAB, all communities or campuses will be forced to properly manage their ash resources to some degree. Whether it is removal and replanting trees of a non-host species, or chemically treating the high value ash trees, some form of management strategy and approach must be used. A good management plan requires conscientiousness to make sure each step is carried out to minimize the long lasting effects of a reduction in canopy and the loss of high value trees.

The following are management options or types of actions a university could choose from:

Option A. No Special Actions. Taking no action, a university must realize that the end result will be a loss of all of their ash resources, regardless of size and location, after the EAB infestation.

Option B. Semi-Action. In this option, ash trees on campus will be removed preemptively and replaced with non-host species. No future EAB survey will be conducted. As a result, the university will have a high cost of removal and their canopies will have gaps for several years until natural or planted replacement trees fill the space.

Option C. Aggressive Action. All ash resources on campus will be managed actively with all available management tools. Chemical treatments will be administered to all ash trees, with only the dead or dying trees removed and replaced regardless of the location or size. Surveys will be performed in the future and used to determine appropriate management actions across campus. This option would accumulate the highest costs because of the cost of treatments, removals and replacements. The result of this option would be no reduction in canopy, and the ability to save most of the ash resources on campus.

West Chester University has selected an Selective Action, option D:

Option D. Selected Action. In this option, all the high-value ash street trees within campus will be managed actively, whereas those in preserved areas, such as in or near the Robert B. Gordon Natural Area for Environmental Studies, will be left alone. All the ash trees will be monitored in the future for EAB activity, and chemical treatments will be put in place for the high value trees. Removal and tree replacement (2:1) will be done. The preserved areas could be used as biological control release site. As a result, the university will have a minimal reduction in canopy cover, while annual cost is moderate.

EAB Infestation

As of the summer of 2014, EAB had not been found on West Chester University's campus. Trapping was used during the spring of 2011 and ended late summer of 2014, and will not continue in the future. All the ash trees on campus will be intensively surveyed by looking for pest signs and symptoms annually. A pest status component will be added to routine maintenance and sanitation operations for the Departments of Biology and Ground Management.

Management Approaches

Chemical treatment, tree removal, and replacement of ash trees will begin in 2015.

Chemical Treatment

High-value ash trees on campus will be treated with Emamectin benzoate or better known as Tree-äge. A human health and ecological risk assessment with Emamectin benzoate was done by Syracuse Environmental Research Associates, Inc. (Appendix 4). This pesticide provides excellent protection against EAB larval development for 2-3 years with a single application. Trees in either excellent or good conditions are considered for Tree-äge, since they are in a better health condition to survive the attack from EAB. Other factors were considered during the determining treatment process such as cost, location, logistics, and local support. A total of 10 trees were selected to receive four treatments for the next 10 years (year 1, 4, 7, and 10) (Table 3).

Table 3. Proposed ash trees for chemical treatment on campus.

Tree Conditions	No. of treated trees by diameter class (inches)					Total
	<10	11-20	21-30	31-40	>41	
Excellent	3	2	0	0	0	5
Good	4	0	0	1	0	5
Fair	0	0	0	0	0	0
Poor	0	0	0	0	0	0
Dead	0	0	0	0	0	0
Total	7	2	0	1	0	10

Tree Removal

EAB will kill all the University's ash resources within 3 to 5 years after the infestation. The detrimental effects of the EAB infestation will be illustrated in the near future by the dead and dying trees all across WCU's campus. A total of fifteen (15) remaining street trees on campus will need to be removed to protect public safety and reduce liability (Map 1). To accomplish this goal, the university plans to remove the remaining fifteen ash street trees within one year. Street trees that are listed as dead, poor, or fair conditions will be selected for removal based on their hazardous situations and budget. Removal of the trees that are listed in good or excellent condition in the future years will be determined by WCU's Department of Grounds based on the development of the infestation annually.

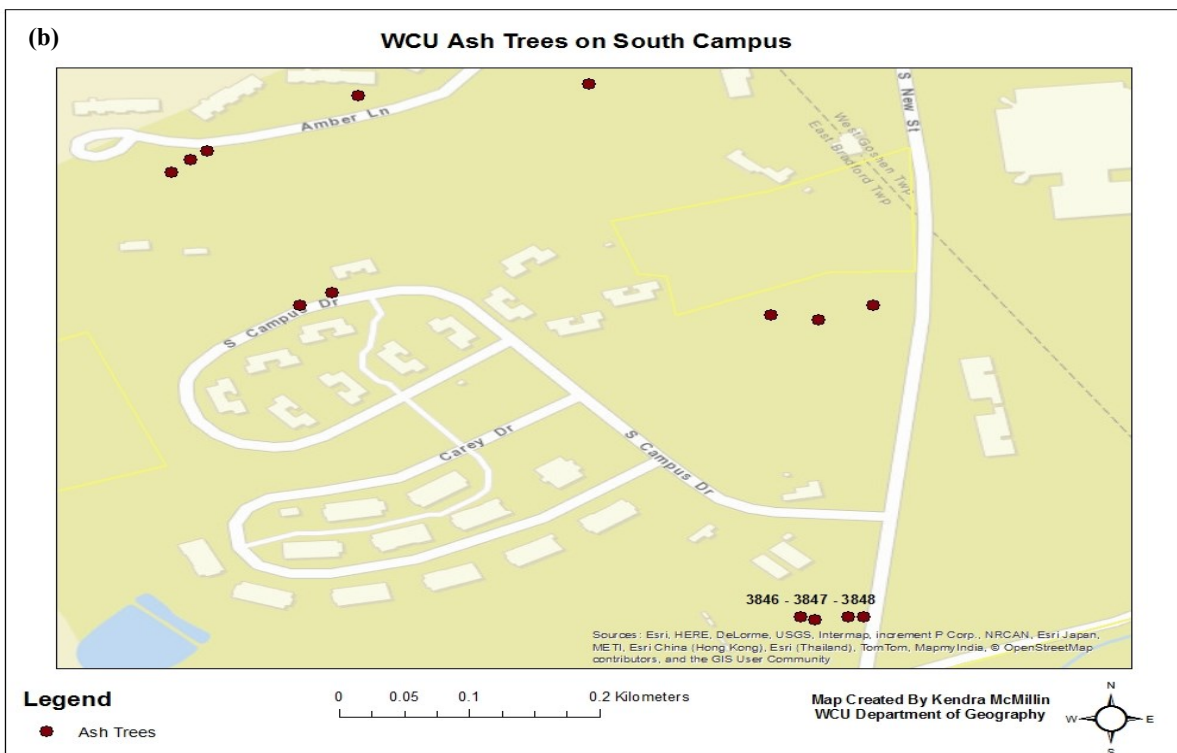
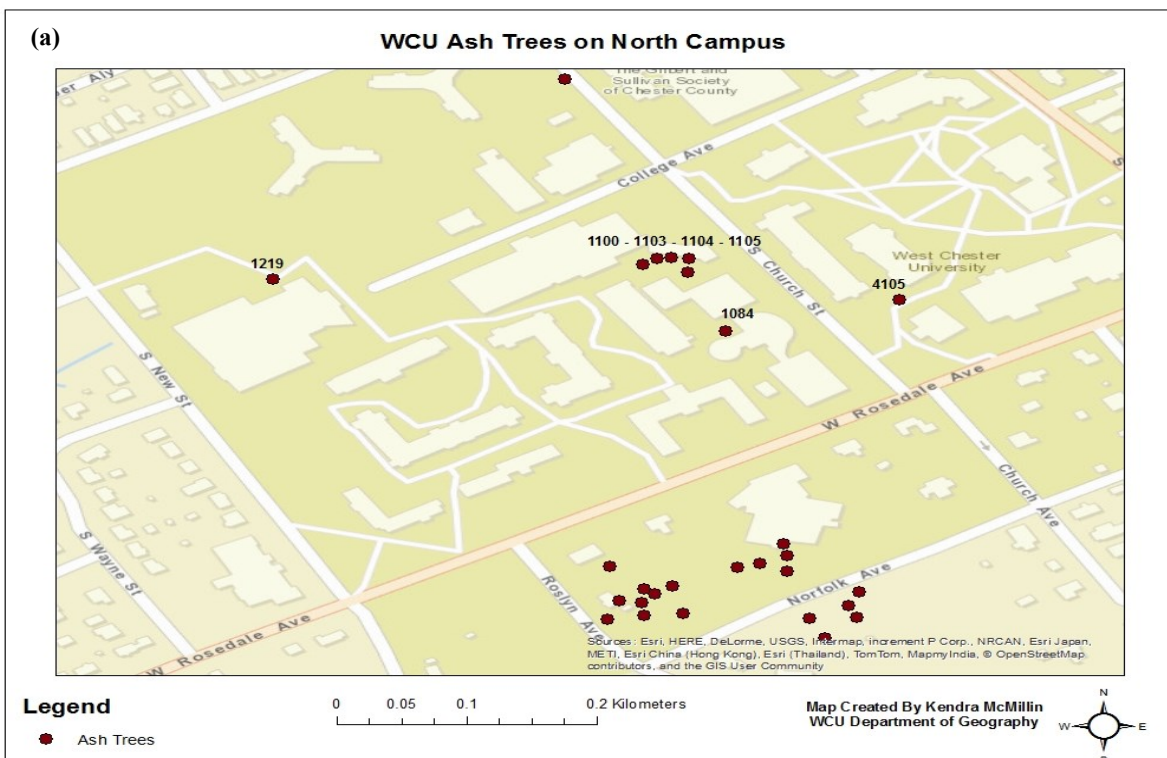
Replanting

All removed ash street trees will be replaced on campus. A 2:1 replacement ratio will be used by the protocol adapted by West Chester University's Tree Policy.



Photo: West Chester University Arbor Day Tree Planting with actor John Bartram
March 2014

Map 1. Locations of ash street trees from survey conducted in 2012. Ash trees with numerical labels are selected for treatment and trees without label are selected for removal. (a) North Campus and (b) South Campus



Cost/Benefit Analysis

At the University's request only chemical treatment and replanting cost will be analyzed. Tree removal cost will be calculated by EAB Manager in 2015.

Chemical Treatment

A total of four treatments (year 1, 4, 7, and 10) are needed for the project period since Tree-äge is effective against EAB larvae for at least two years (up to three years). The total cost for chemical treatment is estimated at \$4,720 with \$1,128 (2015), \$1,162 (2018), \$1,197 (2021), and \$1,233 (2024), for each treatment, respectively (Table 4). A public bidding process will be conducted to select a tree care company with the lowest reasonable bid for this activity.

Table 4. Cost of chemical treatment of ash trees in West Chester University for 10 years

Year	No. trees	Total DBH (inch) *	Unit price (\$) *	Cost (\$)
2015	10	107	8	\$1,128
2016	0	0	0	0
2017	0	0	0	0
2018	10	108	8.2	\$1,162
2019	0	0	0	0
2020	0	0	0	0
2021	10	109	8.4	\$1,197
2022	0	0	0	0
2023	0	0	0	0
2024	10	110	8.6	\$1,233
Total	10			\$4,720

*1% annual increase is assumed to the total diameters of ash trees and 2% annual increase for cost of treatment.

Replanting

A total of 36 trees will be replanted with non-host species to replace the loss of the ash street trees, with a total cost of \$26,176 over 10 years, ranging from \$670.00 to \$1,340.00 per year (Table 6). Replanting cost includes cost of two (2) ball and burlled trees and labor (e.g. \$130 for 2 ball and burlled and \$540 for labor in 2014).

Table 6. Cost of Replanting in West Chester for 10 years (2015-2024)

Year	No. trees	Average DBH (inch)	Unit price (\$) *	Cost (\$)
2015	4	2-3	670	2,680
2016	4	2-3	683	2,732
2017	4	2-3	697	2,788
2018	4	2-3	711	2,844
2019	4	2-3	725	2,900
2020	4	2-3	740	2,960
2021	4	2-3	755	3,020
2022	4	2-3	770	3,080
2023	2	2-3	785	1,570
2024	2	2-3	801	1,602
Total	36			\$26,176

*2% annual increase for replanting cost

Fiscal Planning

To support the EAB management plan, West Chester University will create a new line item in its budget for this program, with an estimated annual cost of \$1,570 to \$4,399 (Table 7). The total estimated cost for chemical treatment and replanting is \$30,896. The University will explore potential cost saving measures such as public bidding and auction, in house service, corporate and private donations, volunteering, etc. to lower the fiscal burden.

Table 7. Annual cost of West Chester EAB management plan for 10 years 2015-2024)

Year	Chemical treatment (\$)	Replanting (\$)	<i>Total (\$)</i>
2015	1,128	2,680	3,808
2016	0	2,732	2,732
2017	0	2,788	2,788
2018	1,162	2,844	4,006
2019	0	2,900	2,900
2020	0	2,960	2,960
2021	1,197	3,202	4,217
2022	0	3,080	3,080
2023	0	1,570	1,570
2024	1,233	1,602	2,835
Total	\$4,720	\$26,176	\$30,896

Contacts and Information

Emerald Ash Borer (www.emeraldashborer.info)

Pennsylvania Department of Agriculture EAB hotline: 1-866-253-7189

Pennsylvania Department of Conservation and Natural Resources (www.dcnr.state.pa.us/forestry/fpm_invasives_EAB.aspx)

Pennsylvania State University Extension
(<http://ento.psu.edu/extension/trees-shrubs/emerald-ash-borer>)

USDA APHIS
(http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml)

USDA Forest Service (<http://na.fs.fed.us/fhp/eab/>)

i-Tree - Tools for Assessing and Managing Community Forests (<http://www.itreetools.org/>)

TreeVitalize - A partnership to restore tree cover in Pa. communities
(<http://treevitalize.net/TreeCare/SelectingTrees.aspx>)

Kendra McMillin (Email km731995@wcupa.edu)

References

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Kovacs, K.F., Height, R.G., McCullough, D.G., Mercader, R.J., Siegert, N.W., and Liebhold, A.M. 2010. Cost of potential emerald ash borer damage in U.S. communities, 2009-2019. *Ecological Economics* 69: 569-578.

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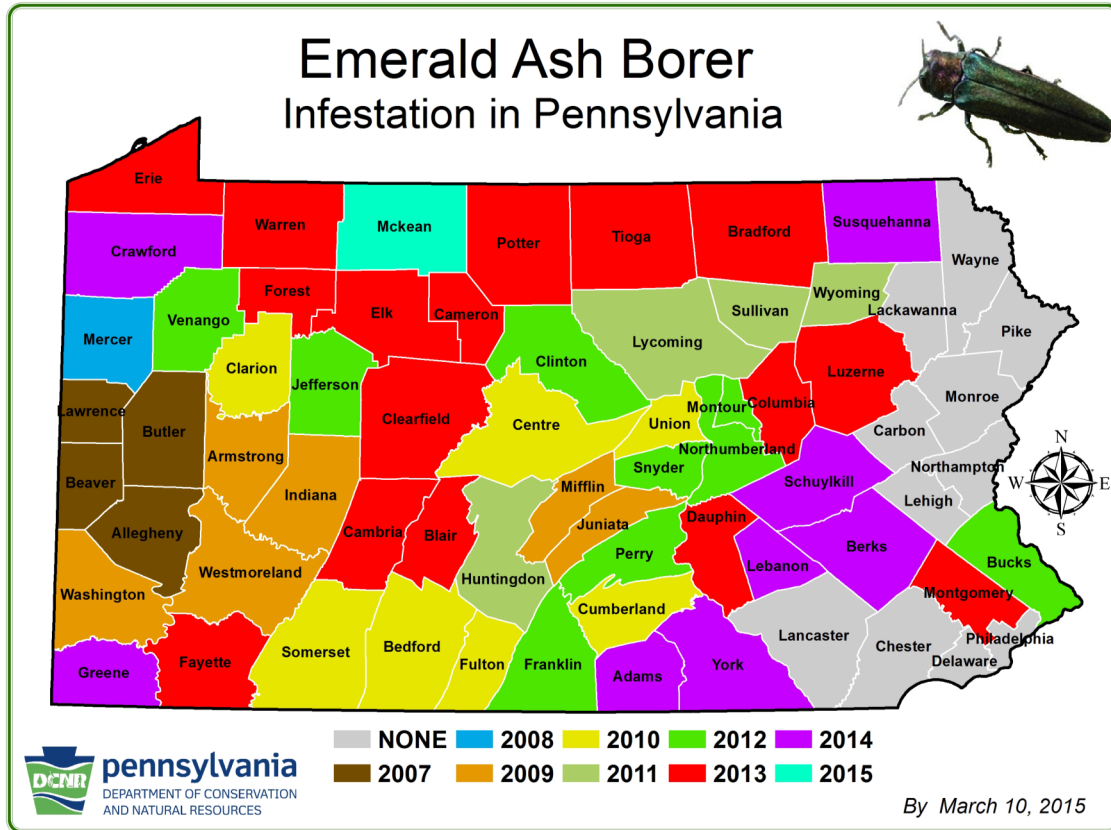
Donald Eggen and Houping Liu, Forest Health Pest Management Division, Department of Conservation and Natural Resources for their technical assistance.

We would like to thank the West Chester University Department of Geography and Planning for access to Environmental Systems Research Institute (ESRI) ArcGIS 10.1 software suite.

Appendix 1

Below is Pennsylvania Department of Conservation and Natural Resource’s web site last updated on March 2015 showing Emerald ash borer Infestation Map of Pennsylvania.

http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_20029653.pdf



Appendix 2

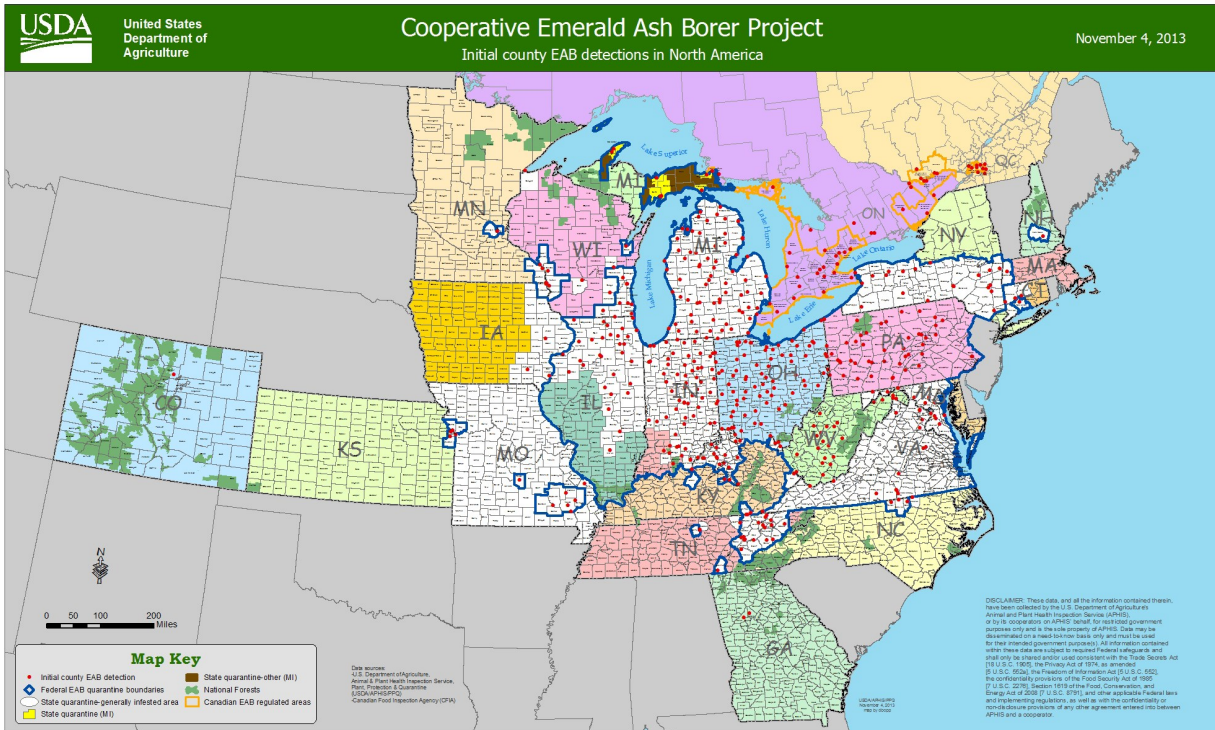
Pennsylvania Department of Conservation and Natural Resource’s web link last updated on July 2013 of the Emerald Ash Borer Management Plan for Pennsylvania Communities template prepared by Houping Liu, PhD, Forest Entomologist.

http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_20028831.pdf

Appendix 3

Below is Pennsylvania Department of Conservation and Natural Resource web site last updated on November 2013 showing the Cooperative Emerald Ash Borer Project Map of North America.

http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_20028475.pdf



Appendix 4

A human health and ecological risk assessment of Emamectin benzoate was done by Syracuse Environmental Research Associates, Inc.

http://www.fs.fed.us/foresthealth/pesticide/pdfs/052-23-03b_Emamectin-benzoate.pdf