III.B

# Memorandum
# Department of Public Services

**TO:** **Michael Herring, City Administrator**

**FROM:** **Michael Geisel, Director of Public Services**

**DATE:** **October 22, 2015**

**RE:** **Emerald Ash Borer**
**Preparedness Plan and Action Strategy**

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As you are aware, the Emerald Ash Borer's arrival has been confirmed in West County. As has been long anticipated, this devastating green jewel beetle is predicted to fully extirpate the Ash species. This is not your typical parasitic infestation that preys on sick, diseased, or stressed trees, but will destroy the entire Ash population within a relatively short time period. We have previously discussed this inevitable occurrence, the level of destruction as well as the financial impacts. Unfortunately, we are now faced with developing a response to the threat.

Accordingly, upon receipt of confirmation of local infestation, the Department of Public Services initiated development of an action plan for City Council to consider. As you also know, we've previously estimated the cost to remove the Ash trees from our rights-of-way to be in excess of $3.5 million. However, in recognition of this being a regional problem that will clearly stress the availability capacity of competent tree services, which will also likely increase costs significantly, the Department of Public Services has sought to mitigate this risk by addressing the threat in a creative and more cost effective manner.

Attached is a thorough and detailed preparedness plan that describes a seven year plan to systematically remove Ash trees from the City's rights-of-way. Rather than contract for the tree removal directly, we propose to shift our internal resources to create a dedicated full time crew for this program, while concurrently supplementing our contractual sidewalk maintenance with an annual appropriation from the General Fund – Fund Reserve amounts in excess of the 40% policy requirement. This is, in fact, a natural disaster for which our fund reserve policy was established.

I will refrain from restating the content of the detailed strategy provided in the attachment, but am pleased to report that **this strategy saves the City more than half of a million dollars and precludes exposure to carpetbaggers attempting to profit from communities lack of preparedness and over reliance on unscrupulous contractors.**

It should be evident that removal of the City's Ash trees will dramatically impact the aesthetics of our community. Accordingly, we have also provided a strategy for City Council to consider if they desire to develop or fund a reforestation program along with the Emerald Ash response. However, to be absolutely clear, the reforestation component of this strategy is an independent decision and if Council is so inclined, the Ash removals can proceed effectively with or without adoption of the reforestation recommendations.

Finally, these are substantive economic and community decisions. While the proposed strategy involves a seven (7) year time frame, funding decisions are required on an annual basis. Even if City Council fully implements the program strategy as proposed, City Council retains the ability to fund or discontinue the program each successive fiscal year.

For quick reference purposes, I've summarized the costs described within the report, for both the removal only, and with reforestation below.

| | **Ash Removals only** | | **Ash Removals with Reforestation** |
|---|---|---|---|
| **Year one** | $640,000 | | $780,000 |
| **Year two** | $400,000 | | $540,000 |
| **Year three** | $400,000 | | $540,000 |
| **Year four** | $400,000 | | $540,000 |
| **Year five** | $400,000 | | $540,000 |
| **Year six** | $400,000 | | $540,000 |
| **Year seven** | $400,000 | | $540,000 |
| | | | |
| **Program Totals** | $3,040,00 | | $4,020,000 |
| **Avg. Cost per Tree** | $453 | | $599 |

I request that this information be forwarded to the Planning and Public Works Committee of Council for information and direction.

If you have any questions or require additional information, please advise.

√MGH
10/22/15
——→ MAYOR/COUNCIL
GEISEL
WHITE

**City of Chesterfield, Missouri**

# Emerald Ash Borer Preparedness Plan

**Department of Public Services**

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# Introduction

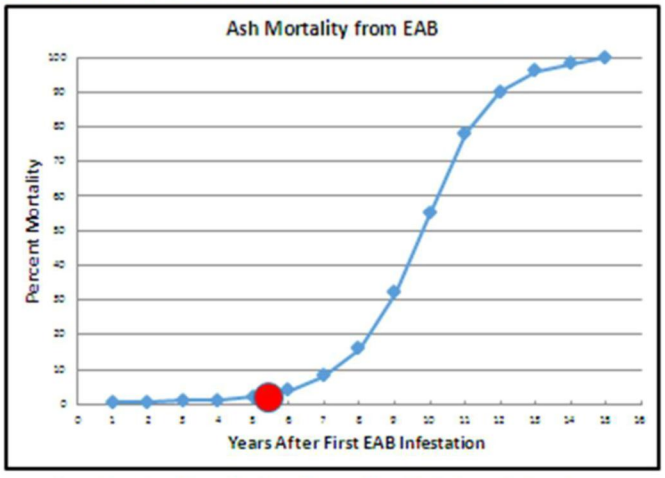
Emerald Ash borer (Agrilus planipennis), is an insect native to Asia. It was first discovered in North America in 2002 in the Detroit, Michigan greater metropolitan area. It is believed to have been accidentally introduced here in wooden shipping materials. Since its introduction the Emerald Ash Borer (EAB) has killed millions of Ash trees in North America. Areas near the epicenter have seen mortality up to 99% in Ash trees larger than 2.5 inches in diameter. All North American Ash species are susceptible without reservation, whether perfectly healthy, stressed or declining. This pest has the potential to functionally extirpate Ash (Fraxinus spp.) from North America. (See appendix A for a map of current infestations). **After initial infestation, all Ash trees are expected to die within 10 years without control measures.** Every North American Ash species shows susceptibility to EAB as North American species planted in China also show high mortality due to EAB infestation, but some Chinese ash species show resistance.

**The purpose of this document is to outline how the Chesterfield Department of Public Services proposes to address this epidemic.**

Fortunately for the St. Louis region extensive scientific studies have been, and still are being performed. So we are equipped with substantially more knowledge than communities who began dealing with EAB just a few years ago. The manner in which EAB moves through an area once it is established has been found to be extremely predictable. Typically, EAB is not detected until infestations have been present for 5-8 years, sometimes with symptoms not becoming evident until there is a high EAB population present and/or sometimes an entire-tree infestation.

The red dot on the graph below (courtesy of Davey Resource Group) is where most experts agree the St. Louis region is currently. As this graph demonstrates, the St. Louis area could potentially be within a few years of a rapid increase in ash mortality rates, which, again, is why it is so important to prepare now to avoid the possibility of being overwhelmed with large numbers of affected Ash trees.

A Predictable Pattern of Losses




Based on data from Dr. Dan Herms, The Ohio State University

# Current Inventory

The City of Chesterfield values its urban forest and is a recognized Tree City USA due to its public tree management practices. The Department of Public Services maintains a complete inventory of the urban forest, including information related to species, location, size and condition. This inventory is linked with our Geographic Informational Database and information can be queried and presented graphically or in report form. This information is available on the public website.

The City's current forestry practices were developed in response to a regional ice storm event that resulted in a disaster declaration. City maintenance crews worked 11,370 man-hours clearing fallen trees and debris during that emergency response. Even after the City's disaster response terminated, there was clearly an unknown level of damage remaining on an unknown number of trees. In the ensuing months, trees continued to die and limbs continued to fall as a direct result of the damage sustained during the original storm. It was impossible to account for the amount of loss and how these losses affected the street tree population City wide. At the time, the City lacked accurate estimates regarding the total number of public street trees, their species, their size, or condition. Similarly, the City had no ability to gauge the magnitude of the City's liability and certainly no way to develop an effective forestry management program. It was obvious that the City needed to develop an accurate inventory and condition assessment in order to effectively manage the risk, liabilities, and health of the City's street trees. As a result, and partially funded by grant funds, the City hired Davey Resource Group in 2009 – 2010 to perform a complete tree inventory which would be linked with the City's Geographic Information System to provide an accurate account of the street tree population and to provide information about each tree including species, size, and condition. The City received two T.R.I.M Grants from the Missouri Department of Conservation in the amount of $10,000.00 each to help fund this effort. The information obtained from the inventory enabled us to make accurate budgeting decisions and schedule pro-active maintenance actions, such as addressing the disproportionately large (36%) population of Ash trees that require removal now that Emerald Ash Borer is in the area. Since the original development of the City's tree inventory, it has been continuously maintained and updated in conjunction with the City's actual forestry management activities. Subsequently, City Council approved a forestry management strategy as proposed by the Department of Public Services, for systematic care, maintenance, removals, and species diversification of the City's tree assets.

The City's inventory has been critical in our efforts to effectively manage street trees. As was directed by City Council, concentrated efforts were directed to initially remove all dead, dying, and\or hazardous trees. Secondarily, in anticipation of the EAB infestation and to enhance the diversity of our urban forest, a conscious and directed effort was made to reduce the disproportionate population of Ash trees within our rights-of-way. Upon the initial completion of the inventory in 2010, Ash species totaled 8,167 trees or 36% of the total 22,523 total street tree population. The Department of Public Services has reduced the Ash population by 1,458 trees,

bringing the proportion of Ash trees from 36% to 28% to date. Yet there remains 6,709 Ash trees within the City's rights-of-way. While clearly this has been an effective program, the numbers are dwarfed by the magnitude of the needs resulting from the EAB presence.

**As has been previously reported, the estimated cost to remove the City's Ash trees is in excess of $3.5 million, at current contractual price levels. This amount does not include any tree replacements.**

# Assessment / Short & Long Term Plan

The Emerald Ash Borer is present in West County. The Emerald Ash Borer's impact is devastating to the Ash population. Experts agree, that the Ash population will be effectively eliminated due to the infestation. The EAB is not selective and there is no realistic expectation of Ash survival.

It should be readily evident that the EAB infestation will affect the entire region. The available capacity of the competent contractual tree services will be exceeded. I anticipate that service, response, and quality will be negatively affected. Equally as important, contractual pricing for tree removals will likely begin to accelerate due to the regional demand. Accordingly, we believe it will be undesirable to attempt to address the City of Chesterfield's EAB impacts with contractual tree services over and above the regular annual contractual tree services. We should not be forced into undesirable contracts due to an emergent crisis.

Although Department staff has previously estimated and advised City Council that the costs associated with removal of the 6,709 City maintained Ash trees in the right-of-way to be in excess of $3.5 million based upon current contractual pricing; it is simply not viable to initiate a contract to remove more than 6,700 Ash trees. There is simply insufficient contractual capacity and such an effort would be impossible to effectively manage. Accordingly, Department of Public Services staff has developed an alternative strategy to minimize costs and maximize efficiency by re-allocating existing staff and contractual services during this seven (7) year planned schedule.

## Phase 1:

**Phase 1 of the plan consists of information and assistance to residents and businesses.**

Private Property Consultation

Unfortunately the Emerald Ash Borer does not limit its activities to public rights-of-way. Ash trees will be impacted, without regard to who owns them. Not only will the Ash trees along public rights-of-way be infested, but so will those Ash trees which are

within private property. The Department of Public Services anticipates a substantial number of inquiries from the residential population ranging from: Do I have ash trees on my property? Have my trees been infested and what should I do? City staff will be prepared to inform and assist with private concerns. Department staff will create and share existing information relative to the EAB infestation through various newsletters and available social media outlets.

Ash Tree Treatment - (Emamectin Benzoate injections)
Current research suggests that the most effective treatment option is *emamectin benzoate* (brand name TREE-AGË). This is a comparatively safe chemical to use in an urban environment because it is a direct trunk injection, rather than a foliar spray. *Emamectin benzoate* treatments have been proven to be not only effective at staging trees for removal, but also as a long term protective solution for high value trees. This work should be performed by a private and licensed contractor. Estimated cost averages $15 per diameter inch. This treatment typically provides protection from EAB for up to two (2) years, and of course the treatment application cost will most surely increase as a result of the infestation.

While there are chemical treatments available to temporarily fend off EAB damage to trees, such treatments can only be applied to a select subset of Ash trees and must be re-applied biennially. While such treatments may be desirable for private owners of Ash trees, it is not a realistic option for City maintained street trees. Assuming an application cost of $200 per City maintained tree, it would require an expenditure of $650,000 per year in perpetuity, and of course it is not fully effective. Experts agree, while chemical treatments can be temporarily effective, the treatment process itself will ultimately mortally damage the tree itself.

**In an effort to assist and support Chesterfield residents, the Department of Public Services has prepared bid documents for preventive chemical treatment of Ash trees, for the convenience and benefit of Chesterfield residents and\or businesses.** The Department will receive, tabulate, and create a list of available vendors that owners of private Ash trees can use if they desire to treat their trees. Clearly the Department of Public Services has knowledge and expertise in this area that will benefit residents. While the City does not intend to apply preventive chemical treatments for street trees, having a list of approved vendors and clearly identifying effective treatments will serve to reduce opportunistic contractors from taking advantage of Chesterfield residents, trustees and\or businesses.

Costs to the City for this phase are nominal and be managed by existing staff. There is no additional funding or staffing associated with this phase of work.

## Phase 2:

**Phase 2 of the plan consists of inspections and preventive removal.**
Strategy for Public Trees within the right-of-way

Ash trees killed by the Emerald Ash Borer (EAB) quickly become brittle and fall apart, creating potential hazards to public safety. Therefore, the Department of Public Services has developed a strategy to prioritize and remove City maintained Ash trees throughout the City. Ash Tree removals will be prioritized and scheduled based upon condition, size, and threat. While the ultimate result is complete removal of the City owned Ash trees, it is undesirable and ineffective to simply start at one end of the City and globally remove Ash trees in each neighborhood. Accordingly, we propose to accomplish the Ash tree removals through a strategic scheduling in order to lessen the immediate impacts in individual neighborhoods. Sequencing the removals as we have proposed will spread out the drastic impact of removing 6,709 trees at the same time as we effectively distribute the work effort during the planned seven year schedule by ensuring that a diverse group of tree sizes are removed each year. Please refer to Appendix C – Schedule of Removals, attached hereto. Finally, the proposed schedule provides for a reasonable expectation of productivity acceleration over the program's life. It should be clearly stated, that the seven year program is aggressive and daunting. To successfully complete the program within the prescribed schedule, the Department of Public Services will be required to remove an average of four trees per day, each work day regardless of weather and other duties during the next seven years.

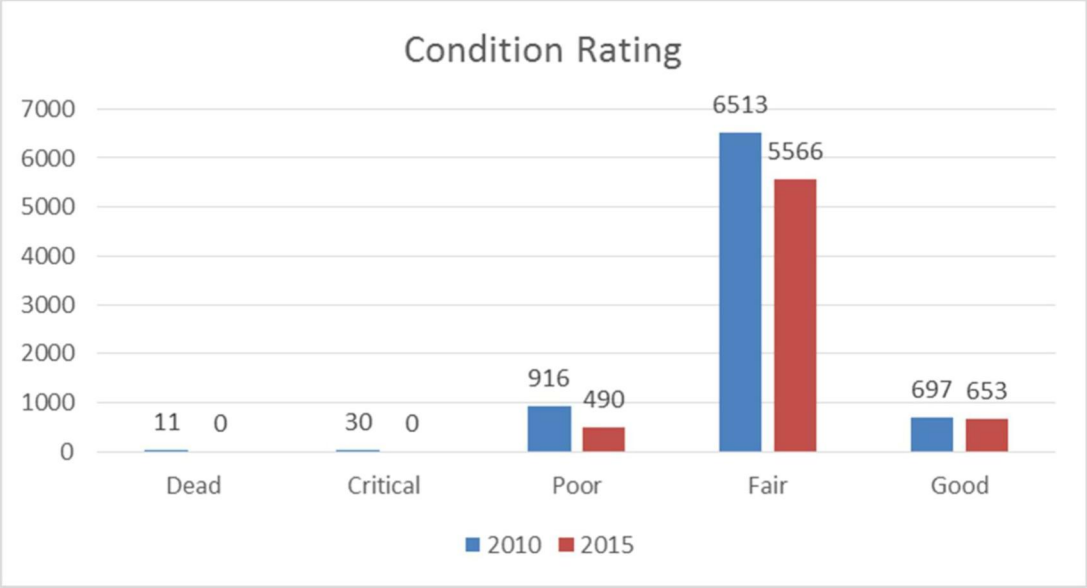
It is important to describe the tree removal process utilizing in-house staff. The City does not, for a multitude of reasons, employ "tree climbers". Rarely, if ever, do City maintenance crews fell a full tree. Typically, in order to protect surrounding structures, maintain traffic ways, and to maximize worker safety, trees are sectioned out from the top down using a bucket truck and the cut sections are lowered in a controlled fashion rather than letting them fall. You will not see a City maintenance worker free climbing a tree for pruning or removals. High work is done from the confines of a bucket truck, and as the work progresses downward, it can be completed with pole pruners and saws. Once a tree is removed, the City typically contracts with an independent contractor for grinding of the stump a few inches below surface grade.

We have reviewed our entire work program and determined that we would have the ability to initiate the Ash tree removals in-house if we can concurrently suspend our in-house sidewalk operations and initiate a contractual sidewalk maintenance\repair program funded by an annual $300,000 supplemental appropriation from the General Fund – Fund Reserves in excess of the 40% reserve policy, temporarily for the duration of the Ash tree removal program. In this way, the City can address the Emerald Ash Borer at a cost substantially less than we could by contracting for tree removals

directly. Accordingly, **I recommend that we suspend our in-house sidewalk repair and reconstruction efforts, and re-direct those assets to solely address the removal of Ash trees.** This will, of course, create a significant void and need to supplement our sidewalk repair\reconstruction budgets by annual transfers from the General Fund – Fund Reserve in excess of the 40% reserve requirement. The Department of Public Services has separately analyzed the City's sidewalk needs and developed the estimated contractual values required to keep up while the maintenance staff is otherwise occupied with tree removals (APPENDIX A- Staff Memoranda). While re-orienting the resources for tree removal, we will be faced with the additional annual contract cost of stump grinding 960 trees. This cost is expected to be approximately $75,000 annually and would necessarily have to be funded in conjunction with the transfer from General Fund – Fund Reserves. Finally, the administrative burden of resident contacts, assessments, work order generation, work tracking, contract management, and updates necessary to maintain our tree inventory will fall on the City Arborist. Understanding that this program is wholly in addition to the current and ongoing urban forestry functions, we will need to temporarily provide some basic support and assistance in the form of temporary arboricultural labor, interns, or seasonal employees. The annual cost of this effort for the duration of this program, would be $25,000. Accordingly, **I further recommend that Council approve an annual transfer of $400,000 from the General Fund – Fund Reserves. This fund transfer is required for the funding of the supplemental sidewalk contracts, increased stump removal costs, and temporary arboricultural assistance during the EAB response program**. No full time or permanent employees are proposed for this program. As reported by Finance Director Craig White, the end of year General Fund – Fund Balance is projected to be $12,359,054, which represents reserves of $3,521,576 in excess of the 40% fund reserve policy.

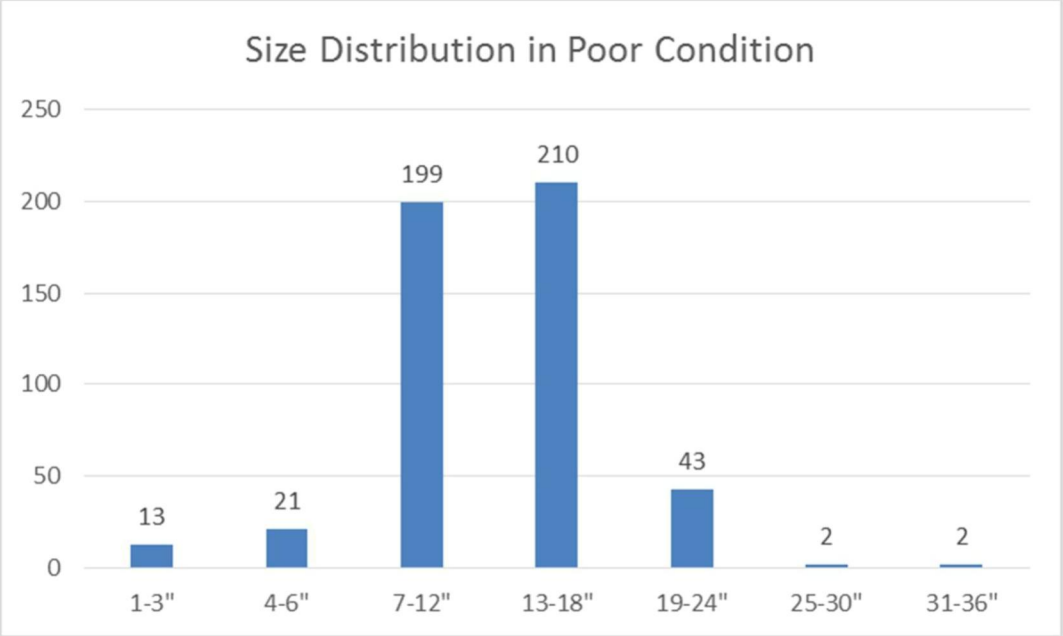
For the most part, the existing Public Works crews are skilled and equipped to perform this work. We believe that we have sufficient vehicles and small tools to effect this program. However, in order to manage the volume of tree removals, we would need to fund the one-time purchase of a second bucket truck, and one additional chipper. Inasmuch as the program is scheduled to last seven years, the equipment is expected to roughly coincide with program duration. After cessation of the program, the equipment will be sold or salvaged. The cost for a bucket truck is $180,000 and the cost of an additional chipper is $60,000, for a total cumulative one time cost of $240,000. **Accordingly, if City Council approves and implements this EAB Strategy, it must be accompanied in year one, by a transfer of $640,000 from the General Fund -Fund Reserves in excess of the 40% reserve policy. In each of the subsequent years, years two through seven, City Council will be asked to transfer $400,000 annually for continuance of the program.** While this is clearly a large sum of money, it should be stated that proceeding in this fashion results in a clear

and direct savings to the City of almost $1 million as compared to contracting directly for the tree removals, at current pricing. In fact, it is clear that pricing would increase due to regional demand and limited capacity, but the City would be recognizing a savings of at least $1 million based upon current tree removal pricing as reported several times previously.

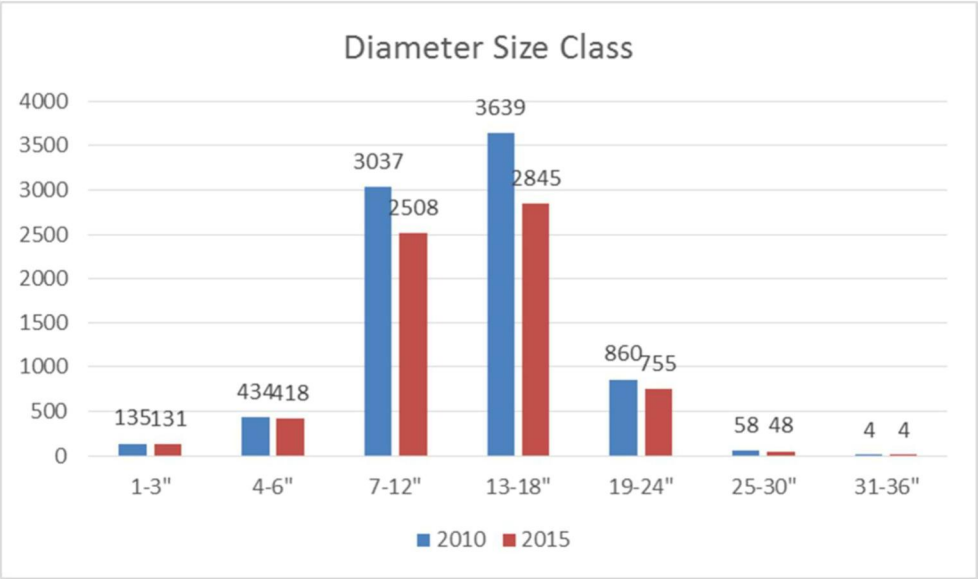



Projected phasing schedule

Removal efforts will begin in **year one** by removing all 490 of the Ash trees with a condition rating of poor as these trees currently represent the greatest risk to public safety.



After the trees with a poor condition rating have been removed, we will begin to remove the largest trees, regardless of condition, as these trees pose the next greatest risk to public safety.




Removal of the larger trees greater than 13" in diameter will continue into **year two**. As these largest trees are being removed, crews will also begin removal of the 1"-3" diameter Ash trees. Removal of the largest trees which create the highest risk for the City along with removal of the smallest trees which have limited visual impact is clearly the early priority. However, after this phase, it is necessary to incrementally remove Ash trees from neighborhoods in a controlled and measured practice. Accordingly, we propose to initiate removal of the remaining Ash trees by a proportional size based schedule over the duration of the remaining program. The detailed tree removal schedule is attached hereto and labeled as APPENDIX C – SCHEDULE OF REMOVALS. It should be noted that the schedule represents a planned strategy for the purpose of describing the overall intent and impact. Clearly, as time passes and the effects of the EAB become evident, the physical condition of specific trees will change and require modification of our priorities.

Ash Tree Removal

The Department of Public Services recognizes and acknowledges that this program creates multiple difficulties and concerns:

> First and foremost, it should be clear that removal of 6,709 Ash trees represents approximately 30% of the total number of street trees and it will have a dramatic visual impact within all neighborhoods. Some neighborhoods will be severely, but unavoidably impacted due to the preponderance of Ash trees in specific neighborhoods.

Second, unlike our prior practices, we will be removing trees, without regard for their current condition.

Third, and perhaps the single largest concern is the reality that the vast majority of residents who live along these streets, may know nothing of the Emerald Ash Borer and very likely will not desire, consent, or otherwise support removal of what they consider "their" Ash trees. While these Ash trees are within public right-of-way and a potential liability to the City, I have every expectation that we will encounter passionate and aggressive resistance in some instances.

## Reforestation Considerations

As described, the scope and impacts of this project will be immense. Up to this point, this strategy has discussed the logistics and process of removing the Ash trees within the right of way. We have not discussed or proposed any reforestation program. Given the significant expense in dealing with the EAB infestation, as well as a burgeoning problem with Horned Oak Gall, and the regular normal annual expenditures associated with maintenance of public trees, we suggest that City Council consider alternative locations for reforestation, if any.

Without discussing the policy consideration, if the City were to consider funding tree replacements at the current contractual unit cost of $300 per tree, the estimated cost would exceed $2 million. While doing so would certainly maintain the desirable tree lined streetscapes, it also creates the potential for the next future infestation or disease. Replacing City maintained trees within the right-of-way also perpetuates a significant and growing maintenance obligation.

The City has no obligation to fund replacements of street trees removed. The City has, in recent history, established a successful street tree replacement program which requires $100 participation by the property owner**. IF THE CITY ELECTS TO FUND ANY STREET TREE REPLACEMENT PROGRAM, THE DEPARTMENT OF PUBLIC SERVICES SUGGESTS AND RECOMMENDS THAT SAID REPLACEMENT TREES NOT BE PLACED WITHIN THE PUBLIC RIGHTS-OF-WAY. It would be preferable to require that no trees be planted within the right-of-way, but instead be located along the street frontage, located within the adjacent property, visible from the street and placed within 20 feet of the back of curb.** Under normal circumstances, this would result in tree placement being within the front eight (8) feet of a private property, within nine (9) feet of the sidewalk. All provisions of the street tree species, placement, sight distance, and other criteria should still apply. Further, rather than attempting to manage a City contract for planting of such trees, we recommend that the City designate a specific stipend value, perhaps 50% of the value to procure and contractually install a tree acceptable to the City, but not to exceed $200 per tree, to partially reimburse a property owner who elects to replace a street tree removed by the City. Of course, Department of Public Services staff would have to verify tree installation prior to authorizing any payments. **If City Council elects to initiate a reforestation program in association with the Emerald Ash Borer strategy as provided in this paragraph, the cumulative cost (at $200 per tree),**

**assuming 700 trees annually (roughly 70% participation), would be an additional $140,000 annually, or cumulatively $1 million throughout the seven year program.**

Finally, after experiencing the EAB infestation, potential Horned Oak Gall concerns, the magnitude of maintenance expenses resulting from trees within the public parkway, including sidewalk heaving and the associated liabilities, and finally the recognition of lost opportunities for street repairs; **City Council could consider modifying the City Code to require tree replacements in developments to be placed within the front yard as described in the preceding paragraph, in lieu of planting new trees within the rights-of-way.**

## Summary

**The total monetary cost to the City for the above outlined seven (7) year plan is $3,040,000, representing a SAVINGS of more than half a million dollars from the alternative strategy.** If, City Council elects to proceed, and elects to include the reforestation program with the program modifications as described herein, it increases the costs by $1 million or $4,020,000 cumulatively. It should also be clear that this program is based upon an aggressive schedule. While we are comfortable that we can achieve the schedule milestones, it should be equally clear that the program requires annual budgetary transfers and annual funding. City Council would be able to authorize or discontinue funding of the program in any given year.

The Department of Public Services is well aware of the unfavorable and substantial aesthetic impact and financial cost resulting from the Emerald Ash Borer infestation. It has not come without substantial forewarning. The reality is, however, that the City and every other community will face this severe problem with or without a plan. The Department of Public Services has been proactive in early mitigation and staying abreast of current State and Federal EAB research. We remain active in professional trade organizations to ensure we are developing sound recommendations and acting responsibly. The risk of doing nothing, equates to the risk of the EAB infestation devastating the City's Ash trees ahead of our removals, leaving dead, dying, and hazardous street trees within our rights-of-way and an inability for the City to respond in a timely and cost effective way.

There remains one unknown for which we continue to further develop our plans. The unknown variable deals with disposal of the chipped up trees. At present, we are able to dispose of our "chips" through local landscape companies that process this material further into consumer mulch and\or topsoil. We expect to be able to continue that process in the near future, but we also expect as the region addresses the EAB infestation, the demand for our "chips" would be reduced and we would seek alternative disposal options. We are actively seeking solutions in anticipation of this occurrence. Clearly, this is yet another motivation to address the EAB infestation and Ash tree removals on a pro-active, as opposed to reactionary basis.

Finally, if the City Council desires to pursue reforestation as described herein, as well as the recommendations for relocation of any new trees and as required by our City's Unified Development Code, Public Services staff will immediately begin development of a program and

action strategy to accomplish same, which would necessarily include code modifications for tree placement.

Further questions, comments or concerns involving this plan may be directed to:

Mike Geisel, P.E. Director of Public Services mgeisel@chesterfield.mo.us

Jim Eckrich, P.E. Public Works Director\City Engineer jeckrich@chesterfield.mo.us

Melinda Mohrman, Urban Forestor\City Arborist mmorhman@chesterfield.mo.us

# APPENDIX A

# MEMORANDUM

**DATE:** October 7, 2015

**TO:** Michael O. Geisel, P.E.
Director of Public Services

**FROM:** James A. Eckrich, P.E.
Public Works Director / City Engineer

**RE:** Allocation of Resources – Street Trees and Sidewalks

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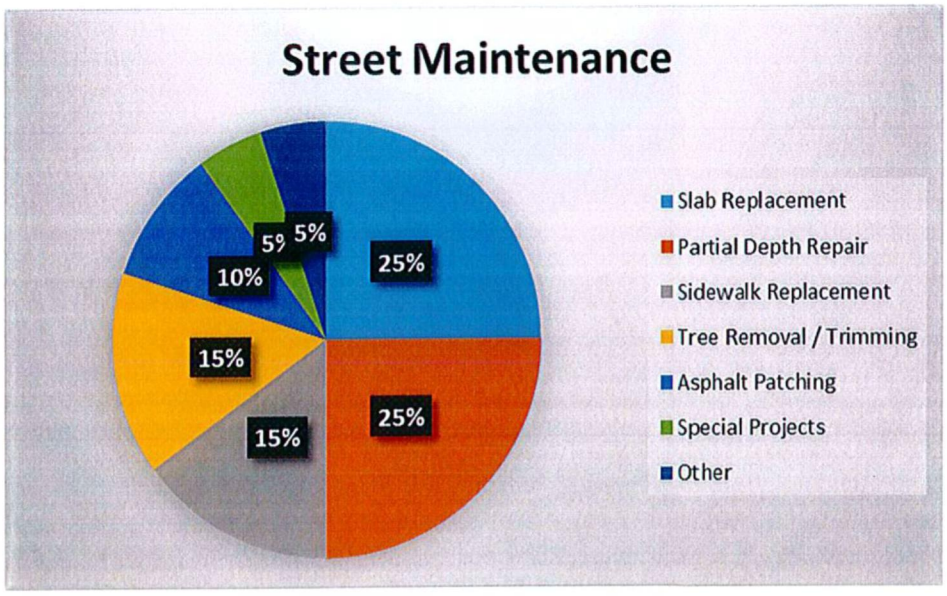
As you know, the Street Maintenance Division of the Department of Public Services contains 24 Maintenance Workers. These employees comprise three crews of eight, each under one of three Street Maintenance Supervisors. The Street Maintenance Division performs a variety of functions in order to maintain the City's 175 miles of public streets and 300 miles of public sidewalk. Not including snow removal and preparation, which accounts for 100% of our workforce during mobilization of that operation, the breakdown of our street maintenance activities are essentially as follows:




The function of each crew varies throughout the year, but during the main work season (non-snow events) it is typical that one crew is designated for slab replacement, one crew for partial depth repair and asphalt patching, and the other crew for sidewalk repair and tree trimming / removal. Recently we have begun to struggle with this third crew, as we are experiencing increased needs for both sidewalk repair and tree removal. This problem will be exacerbated now that Emerald Ash Borer (EAB) has reached the City of Chesterfield.

I will not repeat all of the details contained within City Arborist Mindy Mohrman's memorandum regarding EAB dated September 22, 2015. The important thing to note is that we can expect all

6,500 of the Ash Trees within City rights-of-way to die within five to seven years. As previously predicted, and conservatively assuming a seven year period, that is a financial exposure of $3.5 million dollars or $500,000 per year, only for Ash Trees. This does not include other dead / dying / hazardous tree removals or the removals of Sweet Gum Trees and trees infested with Horned Oak Gall, currently being accomplished with an annual allocation of approximately $150,000.

Accordingly, we have developed a strategy to address the Emerald Ash Borer in the most effective and financially viable way. In essence, rather than attempt to rely on additional outside contractual support to remove the Ash trees, we propose to temporarily (estimated 7 years) reallocate our current street maintenance staffing to focus on street tree removals. Concurrently, we propose to suspend in-house sidewalk repair / reconstruction and request supplemental General Fund appropriations to increase contractual efforts for sidewalks.

We will have to designate, at a minimum, one full Street Maintenance crew for tree removals. It should be recognized that the City's financial exposure and this alternative strategy is only possible due to the City's extensive efforts over the last several years to purposefully reduce the Ash population by almost 1/3$^{rd}$. Removal of the 6,500 remaining Ash trees within the 7 year period is truly a monumental effort. In addition to our routine and ongoing tree maintenance activities, the City will have to remove 930 Ash trees annually. This means that we will have to remove an average of four Ash trees per day, without consideration for weather, including emergency snow removal operations. In addition to the actual tree removals, we will have to manage a substantial additional contractual effort to grind and remove stumps.

One crew will obviously not be able to address both sidewalk deficiencies and tree trimming / removals, if that crew is dedicated to tree removals full time. Accordingly, sidewalks will need to be addressed in another manner. As you know, the City of Chesterfield has approximately 300 miles of public sidewalk. Through our annual inspections, we know there are approximately 5,200 trip hazards of one inch or more throughout the City. We are currently addressing these through an annual sidewalk contract of approximately $200,000 per year, and utilizing street maintenance personnel to address deficiencies reported through the Work Order System. If Street Maintenance personnel are no longer available to address sidewalk deficiencies, the contract work will have to be expanded dramatically and modified in order to provide a reasonable response time regarding sidewalk deficiencies. Rather than funding tree removals directly at a cost of $500,000 annually, we believe that if City Council provides an annual supplemental appropriation in the amount of $300,000 to supplement our contractual sidewalk efforts (from the General Fund – Fund Reserves above the 40% reserve policy) that during this EAB response, we can effectively manage the sidewalk program.

The extent of work required to address sidewalk deficiencies varies based upon the characteristics of each problem. However, we can estimate that a $200,000 sidewalk contract allows us to address 240 sidewalk deficiencies. By increasing that contract to $500,000, we can increase that to 600 deficiencies. Additionally, a contract in the magnitude of $500,000 will ensure that a contractor is working in the City of Chesterfield for the majority of the work season. This will yield a secondary benefit of a contractor being in the area to address emergency Work Orders, allowing the Street Maintenance personnel to remain dedicated to tree removals.

An increase in the allocation of funding for sidewalks from $200,000 to $500,000 will not immediately eradicate the City's sidewalk deficiencies and trip hazards. However, it will put us on a course to effectively reduce the deficiencies and trip hazards. If we were to proceed in this

manner, we would likely create three sidewalk contracts. Two of these contracts (each approximately $200,000) would commence at the start of a Snow Map and progress as far through the map as funding allows. This will ensure the contractor is not "jumping around" and should result in us obtaining a good price; even better than the prices were are currently receiving for sidewalk removal. The third contract would be a $100,000 contract used to address emergencies and Work Orders. This contract will involve multiple mobilizations and will likely receive higher bids. However, this work needs to be accomplished and contracting for this service will ensure our Street Maintenance personnel are dedicated to tree removals.

The Street Maintenance crew removing trees should be able to remove four to five trees per day, depending upon the size. This will result in the removal of approximately 900 trees per year, accounting for times the crew cannot work due to snow or other weather conditions. It will still be necessary to contract for dead, hazardous, and nuisance tree removals within the context of our regular departmental operational budget as we do currently. However, using our in-house forces, we should be able to eradicate the City's Ash Trees in approximately seven years.

Because the City of Chesterfield already performs tree removal, new equipment will not be necessary. However, dedicating a crew to tree removal full time will necessitate that a bucket truck and chipper are always available. This cannot be accomplished with the current bucket truck and chippers as that equipment is used for tree trimming, banner placement, banner takedown, streetlights, and other activities. Accordingly, the City will need to purchase one additional chipper and one additional bucket truck. These will only be used for the duration of the Ash Tree removal, and both will not be replaced once the Ash Trees have been removed. The estimated cost for the Bucket Truck ($180,000) and Chipper ($60,000) is $240,000.

I cannot overstate the impact that EAB is expected to have on the City's streetscape. Ash Trees comprise approximately 28% of the City's street trees. Many residents will not understand why these trees must be removed and will be opposed to the removal of what they consider to be "their" trees. The removal of the Ash Trees will need to be precipitated and accompanied by detailed information regarding the EAB. I would anticipate the use of the City's newsletter and website for generic information, as well as letters / flyers to all residents (and trustees) affected by the Ash Tree removals. I would recommend that in conjunction with the tree removals we provide options to residents who may qualify for a replacement tree(s) of any kind.

**Mike Geisel**

| | |
|---|---|
| **From:** | Mike Geisel |
| **Sent:** | Friday, October 02, 2015 4:39 PM |
| **To:** | Michael Herring |
| **Subject:** | 9 23 2015 EAB memo Treatment Final (002).pdf |
| **Attachments:** | 9 23 2015 EAB memo Treatment Final (002).pdf |

Mike:

The long anticipated arrival of the Emerald Ash Borer is upon us. In response, the Department of Public Services will be developing recommendations and developing a strategy for Council's consideration.

However, **in the interim, we have decided to develop a bid package for preventive "treatment" of Ash trees in the City. It is our intent to identify contractors that individuals or subdivisions can contract with for privately owned or subdivision owned trees. While we do not believe it is viable for the City to treat the Ash street trees, it may be viable for individual property owners or subdivisions.**

Melinda Mohrmann, the City's Urban Forester and Arborist, has prepared the attached memo describing the infestation and various financial liabilities. At the present time, I am unconvinced that the strategies described are the only means of addressing the City's Ash trees, and we will be developing an overall strategy in the near future.

Again, I wanted to share two critical issues at this time:

1) The Emerald Ash Borer is here; and
2) The Department of Public Services is preparing bid packages for private tree owners and organizations to access preventive treatments if they so desire.

More later.

# MEMORANDUM

**DATE:** September 22, 2015

**TO:** Jim Eckrich; Public Works Director/City Engineer

**FROM:** Mindy Mohrman, City Arborist/Urban Forester

**RE:** Emerald Ash Borer Management Strategy

---

They have arrived! As you are aware, the City of Chesterfield has been preparing for the possibility of an Emerald Ash Borer (EAB) infestation since 2010. Staff has provided multiple status updates and various presentations addressing the effort, status, and potential impacts for the long anticipated Emerald Ash Borer's arrival. Each year, through a combination of responding to resident requests and proactive surveying, the City removes between 200 and 300 dead or declining Ash trees. There remains approximately 6,500 Ash trees along City of Chesterfield maintained streets. The removal costs are estimated to be more than $3.5 million. Once the Ash trees in a city become infested, complete elimination of the entire Ash population is typical within five to seven years.

The Emerald Ash Borer infestation has recently been confirmed in several communities surrounding Chesterfield, including Lake St. Louis, North St. Louis City, and most recently, Creve Coeur. The insect population continues to expand. Although Chesterfield has been working to systematically reduce the Ash population, if/when an EAB infestation occurs the city should be prepared to address a large increase in the number of dead/dying Ash street trees which will create a hazardous condition and require their removal. Ash species still make up the highest population of the City's street trees (28%) and they are widely planted as private trees as well. That said, the City's options appear to be as follows:

1) Continue the systematic removal of Ash Trees at the current rate of approximately 200 annually. At that rate, it would take approximately 33 years to remove the existing population of Ash street trees. The estimated annual cost of removal is $109,000, not adjusted for inflation. This is obviously not a viable strategy if the City experiences the EAB infestation which would "kill off" the Ash population in an estimated five to seven year period.
2) Wait until the Ash trees actually become infected and react with a large scale removal program. As stated above, there are 6,500 Ash street trees, with an estimated removal cost of 3.5 million dollars. Not only is that reactionary, but it likely would exceed the capabilities and resources of the local tree care community.
3) Treatment of Ash Trees which are in good condition. Preventive treatments for Emerald Ash Borer are available and have proven to have a high rate of success. However, treatment can be costly and needs to be applied every other year for the life of the tree in order for the treatment to remain effective. EAB treatments are administered as injections or soil drench, with injections showing the highest rate of success. Cost is

determined based on the size of the tree, with larger trees obviously being more expensive. Treatment is only recommended for trees that are currently in good condition and show no signs of infestation. The treatment protects the tree from infestation for two years, and then needs to be re-applied. This biennial application would be necessary for the life of the tree. There is no reliable prediction for when the infestation will be eliminated. Assuming that 20% percent of the current Ash Trees are worthy of treatment, that would result in a total estimated application cost of $234,000 per treatment cycle, and would need to continue biennially. Further, there is no guarantee this treatment will work, and many treated trees may still need to be removed. As noted earlier, we estimate that only 20% of the Ash trees are in a suitable condition to be treated, which would result in a loss of 80% of the Ash street trees if this option is pursued.

In addition to the street tree problem, there are many residents which have planted Ash trees on their private property. Many of these residents may not know what to do when / if their tree(s) become infected by EAB. Accordingly, I believe that I have a solution which could work for everyone. It would be as follows:

a) The City of Chesterfield continue the systematic removal of all Ash street trees. We should expect to remove 6,500 Ash trees in a relatively short time frame. The actual strategy for this tree removal effort will have to be developed as a separate coordinated effort involving multiple divisions and associated financial considerations. It is probable that none of the three action alternatives described above are individually viable and some combination of these strategies and additional actions will be required.

b) In my opinion, the City of Chesterfield should NOT treat any of its Ash street trees. It is simply too costly, ineffective, and impractical. This would be a large, ongoing expense with no guarantee of effectiveness and only impact 20% of the Ash street trees. However, the City of Chesterfield could publicly bid a treatment price for any Ash tree within the City of Chesterfield, including public and private trees. Based upon the bids received, the City would select the lowest and best bid / preferred contractor and advertise that treatment option / price to area residents. These residents, and subdivision associations, could determine whether they want to treat any of the private or public trees on their property / subdivision. This would avoid an on-going cost to the City, but would allow residents / subdivisions to save Ash trees which they believe are worth saving. Those desiring to save trees would have the opportunity to utilize a treatment vetted by the City at what should be a low price obtained through value of scale.

Please let me know if you agree with this course of action. If so, I will begin the process of creating a bid package for the treatment of Ash Trees infested with EAB. Once the lowest and best bid is determined, a contract could be approved and the program advertised to the City's residents and subdivision associations.

If you have questions or need additional information, please let me know.

# APPENDIX B - SUMMARY OF PROGRAM COSTS

## SUMMARY OF COSTS

| | |
|---|---|
| **YEAR ONE** | |
| One Time purchase cost for BUCKET TRUCK | $170,000 |
| One Time purchase cost for CHIPPER | $70,000 |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| **YEAR TWO** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| **YEAR THREE** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| **YEAR FOUR** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| **YEAR FIVE** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| **YEAR SIX** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| **YEAR SEVEN** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| **TOTAL PROGRAM COST** | **$3,040,000** |
| **AVG. COST PER TREE** | **$453.12** |

## SUMMARY OF COSTS - WITH REFORESTATION ON PRIVATE PROPERTY

**Assume 700 trees annually at $200 stipend**

| | |
|---|---|
| **YEAR ONE** | |
| BUCKET TRUCK | $170,000 |
| CHIPPER | $70,000 |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| REFORESTATION | $140,000 |
| **YEAR TWO** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| REFORESTATION | $140,000 |
| **YEAR THREE** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| REFORESTATION | $140,000 |
| **YEAR FOUR** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| REFORESTATION | $140,000 |
| **YEAR FIVE** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| REFORESTATION | $140,000 |
| **YEAR SIX** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| REFORESTATION | $140,000 |
| **YEAR SEVEN** | |
| GF-FR TRANSFER for contract | $300,000 |
| GF - FR TRANSFER for Aboricultural Services | $25,000 |
| GF- FR TRANSFER for stump grinding | $75,000 |
| REFORESTATION | $140,000 |
| **TOTAL PROGRAM COST** | **$4,020,000** |
| **AVG. COST PER TREE** | **$599.20** |

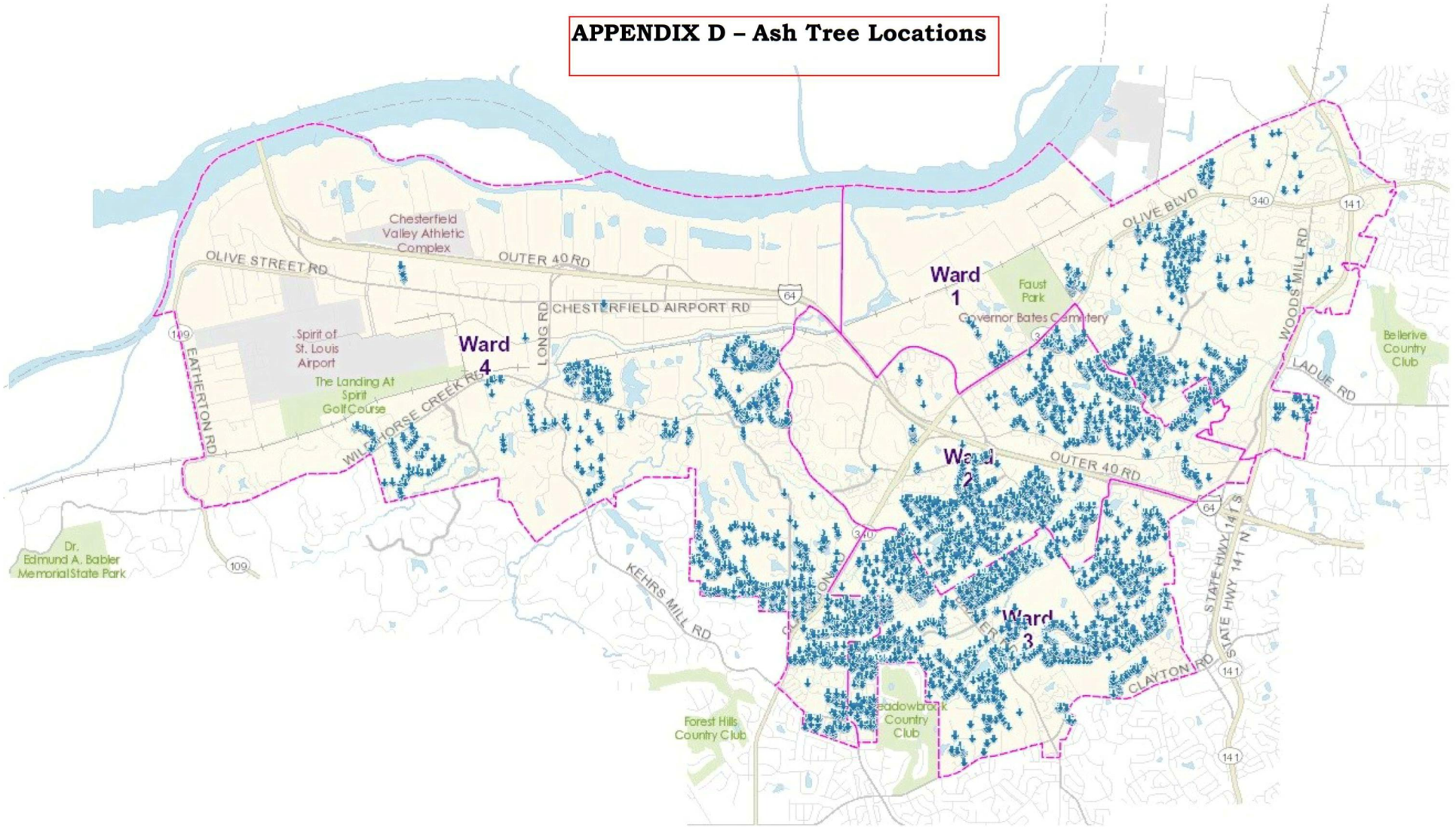
# APPENDIX C - SCHEDULE OF REMOVALS

| Tree Diameter Classification | 1" - 3" | | 4" - 6" | | 7" - 12" | | 13" - 18" | | 19" - 24" | | 25" - 30" | | 31" & greater | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **# of Ash Trees of this size** | **131** | | **418** | | **2,508** | | **2,845** | | **755** | | **48** | | **4** | **6,709** |
| **Year One** | | | | | | | | | | | | | | |
| **Total number of trees removed in this phase** | **926** | | | | | | | | | | | | | |
| Trees in poor condition | **10%** | **13** | **5%** | **21** | **8%** | **199** | **7%** | **210** | **6%** | **43** | **4%** | **2** | **50%** | **2** | **490** |
| Trees 1" - 3" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 4" - 6" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 7" - 12" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 13" - 18" | 0% | - | 0% | - | 0% | - | **2%** | **56** | 0% | - | 0% | - | 0% | - | **56** |
| Trees > 18" | 0% | - | 0% | - | 0% | - | 0% | - | **44%** | **332** | **96%** | **46** | **50%** | **2** | **380** |
| **# of Ash trees remaining** | | **118** | | **397** | | **2,309** | | **2,579** | | **380** | | **-** | | **-** | **5,783** |
| **Year Two** | | | | | | | | | | | | | | |
| **Total number of trees removed in this phase** | **934** | | | | | | | | | | | | | |
| Trees in poor condition | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 1" - 3" | **90%** | **118** | **20%** | **83** | **10%** | **250** | **17%** | **483** | 0% | - | 0% | - | 0% | - | **934** |
| Trees 4" - 6" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 7" - 12" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 13" - 18" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees > 18" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| **# of Ash trees remaining** | | **-** | | **314** | | **2,059** | | **2,096** | | **380** | | **-** | | **-** | **4,849** |
| **Year Three** | | | | | | | | | | | | | | |
| **Total number of trees removed in this phase** | **948** | | | | | | | | | | | | | |
| Trees in poor condition | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 1" - 3" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 4" - 6" | 0% | - | **35%** | **146** | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | **146** |
| Trees 7" - 12" | 0% | - | 0% | - | **15%** | **376** | 0% | - | 0% | - | 0% | - | 0% | - | **376** |
| Trees 13" - 18" | 0% | - | 0% | - | 0% | - | **15%** | **426** | 0% | - | 0% | - | 0% | - | **426** |
| Trees > 18" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| **# of Ash trees remaining** | | **-** | | **168** | | **1,683** | | **1,670** | | **380** | | **-** | | **-** | **3,901** |
| **Year Four** | | | | | | | | | | | | | | |
| **Total number of trees removed in this phase** | **958** | | | | | | | | | | | | | |
| Trees in poor condition | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 1" - 3" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 4" - 6" | 0% | - | **20%** | **83** | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | **83** |
| Trees 7" - 12" | 0% | - | 0% | - | **11%** | **275** | 0% | - | 0% | - | 0% | - | 0% | - | **275** |
| Trees 13" - 18" | 0% | - | 0% | - | 0% | - | **11%** | **298** | 0% | - | 0% | - | 0% | - | **298** |
| Trees > 18" | 0% | - | 0% | - | 0% | - | 0% | - | **40%** | **302** | 0% | - | 0% | - | **302** |
| **# of Ash trees remaining** | | **-** | | **85** | | **1,408** | | **1,372** | | **78** | | **-** | | **-** | **2,943** |
| **Year Five** | | | | | | | | | | | | | | |
| **Total number of trees removed in this phase** | **965** | | | | | | | | | | | | | |
| Trees in poor condition | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 1" - 3" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 4" - 6" | 0% | - | **20%** | **85** | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | **85** |
| Trees 7" - 12" | 0% | - | 0% | - | **15%** | **376** | 0% | - | 0% | - | 0% | - | 0% | - | **376** |
| Trees 13" - 18" | 0% | - | 0% | - | 0% | - | **15%** | **426** | 0% | - | 0% | - | 0% | - | **426** |
| Trees > 18" | 0% | - | 0% | - | 0% | - | 0% | - | **10%** | **78** | 0% | - | 0% | - | **78** |
| **# of Ash trees remaining** | | **-** | | **-** | | **1,032** | | **946** | | **-** | | **-** | | **-** | **1,978** |
| **Year Six** | | | | | | | | | | | | | | |
| **Total number of trees removed in this phase** | **977** | | | | | | | | | | | | | |
| Trees in poor condition | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 1" - 3" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 4" - 6" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 7" - 12" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 13" - 18" | 0% | - | 0% | - | **18%** | **451** | **19%** | **526** | 0% | - | 0% | - | 0% | - | **977** |
| Trees > 18" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| **# of Ash trees remaining** | | **-** | | **-** | | **581** | | **420** | | **-** | | **-** | | **-** | **1,001** |
| **Year Seven** | | | | | | | | | | | | | | |
| **Total number of trees removed in this phase** | **1,001** | | | | | | | | | | | | | |
| Trees in poor condition | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 1" - 3" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 4" - 6" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 7" - 12" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| Trees 13" - 18" | 0% | - | 0% | - | **23%** | **581** | **15%** | **420** | 0% | - | 0% | - | 0% | - | **1,001** |
| Trees > 18" | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | 0% | - | - |
| **# of Ash trees remaining** | | **-** | | **-** | | **-** | | **-** | | **-** | | **-** | | **-** | **-** |

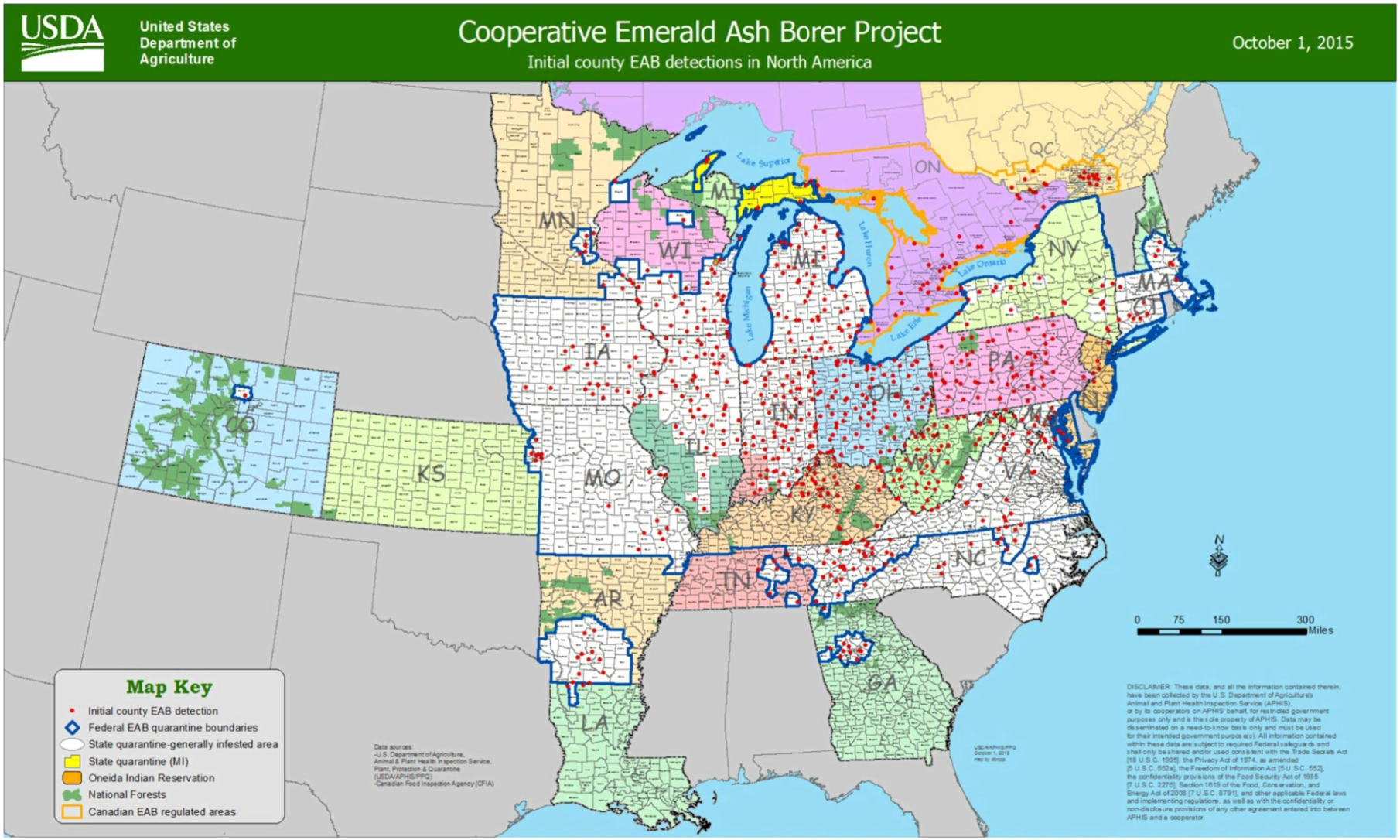
# APPENDIX C - SUMMARY SCHEDULE OF REMOVALS

| Tree Diameter Classification | | | 1" - 3" | | 4" - 6" | | 7" - 12" | | 13" - 18" | | 19" - 24" | | 25" - 30" | | 31" & greater | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # of Ash Trees of this size | | | 131 | | 418 | | 2,508 | | 2,845 | | 755 | | 48 | | 4 | 6,709 |
| **Year One** | | | | | | | | | | | | | | | | |
| Total number of trees removed in this phase | 926 | 10% | 13 | 5% | 21 | 8% | 199 | 9% | 266 | 50% | 375 | 100% | 48 | 100% | 4 | |
| # of Ash trees remaining | | | 118 | | 397 | | 2,309 | | 2,579 | | 380 | | - | | - | 5,783 |
| **Year Two** | | | | | | | | | | | | | | | | |
| Total number of trees removed in this phase | 934 | 90% | 118 | 20% | 83 | 10% | 250 | 17% | 483 | 0% | - | 0% | - | 0% | - | |
| # of Ash trees remaining | | | - | | 314 | | 2,059 | | 2,096 | | 380 | | - | | - | 4,849 |
| **Year Three** | | | | | | | | | | | | | | | | |
| Total number of trees removed in this phase | 948 | 0% | - | 35% | 146 | 15% | 376 | 15% | 426 | 0% | - | 0% | - | 0% | - | |
| # of Ash trees remaining | | | - | | 168 | | 1,683 | | 1,670 | | 380 | | - | | - | 3,901 |
| **Year Four** | | | | | | | | | | | | | | | | |
| Total number of trees removed in this phase | 958 | 0% | - | 20% | 83 | 11% | 275 | 10% | 298 | 40% | 302 | 0% | - | 0% | - | |
| # of Ash trees remaining | | | - | | 85 | | 1,408 | | 1,372 | | 78 | | - | | - | 2,943 |
| **Year Five** | | | | | | | | | | | | | | | | |
| Total number of trees removed in this phase | 965 | 0% | - | 20% | 85 | 15% | 376 | 15% | 426 | 10% | 78 | 0% | - | 0% | - | |
| # of Ash trees remaining | | | - | | - | | 1,032 | | 946 | | - | | - | | - | 1,978 |
| **Year Six** | | | | | | | | | | | | | | | | |
| Total number of trees removed in this phase | 977 | 0% | - | 0% | - | 18% | 451 | 18% | 526 | 0% | - | 0% | - | 0% | - | |
| # of Ash trees remaining | | | - | | - | | 581 | | 420 | | - | | - | | - | 1,001 |
| **Year Seven** | | | | | | | | | | | | | | | | |
| Total number of trees removed in this phase | 1,001 | 0% | - | 0% | - | 23% | 581 | 15% | 420 | 0% | - | 0% | - | 0% | - | |
| # of Ash trees remaining | | | - | | - | | - | | - | | - | | - | | - | - |

**APPENDIX D – Ash Tree Locations**



# Appendix E – Confirmed EAB Locations



APPENDIX F – EAB FACT SHEET

# Emerald ash borer

Credit Wikipedia

| Scientific classification | |
|---|---|
| Kingdom: | Animalia |
| Phylum: | Arthropoda |
| Class: | Insecta |
| Order: | Coleoptera |
| Family: | Buprestidae |
| Genus: | *Agrilus* |
| Species: | ***A. planipennis*** |

**Binomial name**

***Agrilus planipennis***
Fairmaire, 1888

**Synonyms[1]**

- *Agrilus feretrius* Obenberger
- *Agrilus marcopoli* Obenberger

***Agrilus planipennis***, commonly known as the **emerald ash borer** (EAB) is a green jewel beetle native to eastern Asia that feeds on ash species. In its native range, it is typically found at low densities and is not considered a significant pest. Outside its native range, it is an invasive species and is highly destructive to ash trees native to North America. Prior to EAB being found in North America, very little was known about EAB in its native range; this has resulted in much of the research on its biology being focused in North America. Local governments in North America are attempting to control it by monitoring its spread, diversifying tree species, insecticides, and biological control.

## Contents


- 1 Range
- 2 Identification
- 3 Host plants
- 4 Life cycle
- 5 Monitoring and management
    - 6.1 Tree removal and replacement
    - 6.2 Insecticides
    - 6.3 Biological control

# Range

The natural range of the emerald ash borer is eastern Russia, northern China, Japan, and Korea.[2] It is invasive in North America where it has a core population in Michigan and surrounding states and provinces. Populations are more scattered outside the core area, and the edges of its known distribution range north to the upper peninsula of Michigan, south to northern Louisiana, west to Colorado, and east to Massachusetts [3]

# Identification

The French priest and naturalist Armand David collected a specimen of the emerald ash borer during one of the trips he took through imperial China in the 1860s and 1870s. He found the beetle in Beijing and sent it back to France, where a brief description by the entomologist Léon Fairmaire was published in the *Revue d'Entomologie* in 1888.[4] Adults are a bright metallic green. Elytra are typically a darker green, but can also have copper hues. EAB is the only North American species of *Agrilus* with a bright red upper abdomen when viewed with the wings and elytra spread. The species also has a small spine found at the tip of the abdomen and serrate antennae that begin at the fourth antennal segment.[5]

Dorsal view of emerald ash borer adult with elytra and wings spread.

# Host plants

EAB primarily infest and can cause significant damage to ash species including green ash, black ash, white ash, and blue ash.[6] In its native range, emerald ash borer is only a nuisance pest on native trees as population densities typically do not reach levels lethal to healthy trees.[7] Ash susceptibility can vary due to the attractiveness of chemical volatiles to adults, or the ability of larvae to detoxify phenolic compounds.[8] EAB has also been found infesting white fringe tree in North America, which is a non-ash host.[8]

Adults prefer to lay eggs on open grown or stressed ash, but readily lay eggs on healthy trees amongst other tree species.[8] Both males and females use leaf volatiles and sesquiterpenes in the bark to locate hosts.[8] Damage occurs in infested trees due to larval feeding. The serpentine feeding galleries of the larvae disrupt the flow of nutrients and water effectively girdling the tree. On susceptible species or in the absence of organisms that suppress emerald ash borer populations, the tree will eventually no longer be able to transport sufficient nutrients to the leaves to survive.[9] EAB has also been found infesting white fringetree, but it was not apparent whether the trees were healthy when first infested, or were already in decline due to drought.[10]

# Life cycle

The emerald ash borer life cycle can occur over one or two years depending on the time of year of oviposition, the health of the tree, and temperature.[11]

Adult beetles are typically bright metallic green and about 8.5 millimeters (0.33 in) long and 1.6 millimeters (0.063 in) wide. After 400–500 accumulated growing degree days (GDD) at base 10 °C (50 °F), adults begin to emerge from trees, and peak emergence occurs around 1000 GDD. After emergence, adults feed for one week on ash leaves in the canopy before mating, but cause little defoliation in the process.[9] Males hover around trees, locate females by visual cues, and drop directly onto the female to mate; mating can last 50 minutes, and females may mate with multiple males over their lifespan. [8] A typical female can live around six weeks and lay approximately 40–70 eggs, but females that live longer can lay up to 200 eggs.[9]

Eggs are deposited between bark crevices, flakes, or cracks and hatch about two weeks later. Eggs are approximately 0.6 to 1.0 millimeter (0.02 to 0.04 in) in diameter, and are initially white, but later turn reddish-brown if fertile.[9][11] After hatching, larvae chew through the bark to the inner phloem, cambium, and outer xylem where they feed and develop.[8] Emerald ash borer has four larval instars. By feeding, larvae create long serpentine galleries. Fully mature fourth-instar larvae are 26 to 32 millimeters (1.0 to 1.3 in) long.[11] In fall, mature fourth-instars excavate chambers about 1.25 centimeters (0.49 in) into the sapwood or outer bark where they fold into a J-shape.[8] These J-shaped larvae shorten into prepupae and develop into pupae and adults the following spring. To exit the tree, adults chew holes from their chamber through the bark, which leaves a characteristic D-shaped exit hole. Immature larvae can overwinter in their larval gallery, but can require an additional summer of feeding before overwintering again and emerging as adults the following spring.[11]

Outside its native range, emerald ash borer is an invasive species, that is highly destructive to ash trees in its introduced range.[12] Prior to EAB being found in North America, very little was known about EAB in its native range aside from a short description of life-history traits and taxonomic descriptions, which resulted in focused research on its biology in North America.[9] Since its accidental introduction into the United States and Canada in the 1990s and its subsequent detection in 2002 in Canton, Michigan, it has since spread other parts of the North America.[13] It is suspected that it was introduced from overseas in shipping materials such as packing crates.[14]

## Invasiveness and spread

Without factors that would normally suppress EAB populations in its native range (e.g., resistant trees, predators, and parasitoid wasps), EAB populations can quickly rise to damaging levels.[9] **After initial infestation, all ash trees are expected to die in an area within 10 years without control measures.**[9] Every North American ash species shows susceptibility to EAB as North American species planted in China also show high mortality due to EAB infestation, but some Chinese ash species show resistance.[15][16]

Green ash and the black ash trees are preferred by EAB. White ash is also killed rapidly, but usually only after all green and black ash trees are eliminated. Blue ash displays some resistance to the emerald ash borer by forming callous tissue around EAB galleries, but are eventually killed.[17] Many of the specialized predators and parasitoids that suppressed EAB populations in Asia were not present in North America. Predators and parasitoids native to North America do not sufficiently suppress EAB, so populations continue to grow.[9][18] EAB populations can spread 20 km (12 mi) a year.[9] However, it primarily spreads longer distances by transport of firewood and other wood products that contain ash bark, which allows EAB to reach new areas and create satellite populations outside of the main infestation.[9]

Other factors can limit its spread. Climate research suggests that EAB growth may be stemmed in areas too cold for the beetle to survive.[19][20] North American predators and parasitoids can occasionally cause high EAB mortality, but generally offer only limited control. Mortality due to native woodpeckers is variable. Parasitism by parasitoids such as *Atanycolus cappaerti* can be high, but overall such control is generally low.[9]

### Environmental and economic impacts

EAB threatens the entire North American *Fraxinus* genus. It has killed at least tens of millions of ash trees so far and threatens to kill most of the 8.7 billion ash trees throughout North America.[3] Emerald ash borer kills young trees several years before reaching their seeding age of 10 years.[21] The loss of ash from an ecosystem can result in increased numbers of invasive plants, changes in soil nutrients, and effects on species that feed on ash.[9]

Damage and efforts to control the spread of EAB have affected businesses that sell ash trees or wood products, property owners, and local or state governments.[9] Quarantines can limit the transport of ash trees and products, but economic impacts are especially high for urban and residential areas due to treatment or removal costs and decreased land value from dying trees.[22] Costs for managing these trees can fall upon homeowners or local municipalities. For municipalities, removing large numbers of dead or infested trees at once is costly, so slowing down the rate at which trees die through removing known infested trees and treating trees with insecticides can allow local governments more time to plan, remove, and replace trees that would eventually die. This strategy saves money as it would cost $10.7 billion in urban areas of 25 states between 2009–2019, while removing and replacing all ash trees in these same areas at once would cost $25 billion.[23][22] Some urban areas such as Minneapolis, Minnesota, have large amounts of ash with slightly more than 20% of their urban forest as ash.[24]

## Monitoring and management

In areas where EAB has not yet been detected, surveys are used to monitor for new infestations. Visual surveys are used to find ash trees displaying symptoms of EAB damage and traps with colors attractive to EAB, such as purple or green, are hung in trees as part of a monitoring program.[9] These traps can also have volatile pheromones (3Z)-lactone and (3Z)-hexenol applied to them that both produce a response in EAB antennae of both sexes, but this only attracts a higher number of males.[8] This increased attractiveness to males is also highly variable depending on location.[8]

Sometimes trees are also girdled to act as a trap tree by attracting egg-laying female EAB in the spring and debarking the trees in the fall to search for larvae.[9] If detected, the area is typically placed under a quarantine to prevent infested wood material from causing new infestations.[25] Further control measures are then taken within the area to slow population growth by reducing EAB numbers, preventing them from reaching reproductive maturity and dispersing, and reducing the abundance of ash trees.[9]


A purple trap used for determining the extent of the invasion

Government agencies in both the USA and Canada have utilized a native species of wasp, *Cerceris fumipennis*, as a means of detecting areas to which EAB has spread. The females of these wasps hunt beetles in the same family as EAB and will hunt EAB if it is present. The wasps stun the beetles and carry them back to their burrows in the ground where they are stored until the wasps' eggs hatch and the wasp larvae feed on the beetles. Volunteers catch the wasps as they return to their burrows carrying the beetles to determine whether any of the catch consists of EAB. If it does, the agencies running the program may institute quarantine measures. This methodology is known as biological surveillance, as opposed to biological control, because it does not appear that the wasps have a significant negative impact on EAB populations.[26]

## Tree removal and replacement

In urban areas, trees are often removed once an infestation is found to reduce EAB population densities and the likelihood of further spread. Urban ash are typically replaced with non-ash species such as maple, oak, or linden to limit food sources for EAB.[27] In rural areas, trees can be harvested for lumber or firewood to reduce ash stand density, but quarantines may apply, especially in areas where the material could be infested.[28]

## Insecticides

Insecticides with active ingredients such as imidacloprid, emamectin benzoate, and dinotefuran are currently used since they are systemic (i.e., incorporated into the tree) and remain effective for one to three years depending on the product.[9][29][30] Insecticides are typically only considered a viable option in urban areas with high value trees near an infestation.[29] Ash trees are primarily treated by direct injection into the tree or soil drench. Some insecticides cannot be applied by homeowners and must be applied by licensed applicators. Initially, tree injections will not compromise tree health, but over many years drilling and chemical wounds will compromise the tree's health.[31] Damage from EAB can continue to increase over time even with insecticide

applications.[9] Insecticide treatments are not feasible for large forested areas outside of urban areas.[9]

## Biological control

The native range of EAB in Asia was surveyed for parasitoid species that parasitize EAB and do not attack other insect species in the hope they would suppress EAB populations when released in North America.[32] Three species imported from China were approved for release by the USDA in 2007 and in Canada in 2013: *Spathius agrili*, *Tetrastichus planipennisi*, and *Oobius agrili*, while *Spathius galinae* was approved for release in 2015.[33][34] Excluding *Spathius galinae*, which has only recently been released, the other three species have been documented parasitizing EAB larvae one year after release, indicating that they survived the winter, but establishment varied among species and locations.[34] *Tetrastichus planipennisi* and *Oobius agrili* established and have had increasing populations in Michigan since 2008; *Spathius agrili* has had lower establishment success in North America, which could be due to a lack of available EAB larvae at the time of adult emergence in spring, limited cold tolerance, and better suitability to regions of North America below the 40th parallel.[34]

The USDA is also assessing the application of *Beauveria bassiana*, an insect fungal pathogen, for controlling EAB in conjunction with parasitoid wasps.[35]

APPENDIX G

# Ash (Fraxinus spp.) Identification

## *Fraxinus* spp. Characteristics

Hosts Ash trees (*Fraxinus* spp.) are the only known North American hosts of EAB. Ashes have pinnately compound leaves arranged opposite one another on the branch. Each leaf bears 5-9 leaflets. The fruit is a winged seed (samara). Some ash species have bark with interlacing ridges that form a diamond-like pattern when mature.