

Campus Arboretum at Washington & Jefferson College

Tree Care Plan (2014)

W&J Campus Arboretum Mission

The Mission of the Campus Arboretum at Washington & Jefferson College is to preserve, manage, and enhance a vital and diverse living collection of woody plants; to provide a landscape aesthetic; to promote the conservation of trees and shrubs; and to educate the College and surrounding communities through horticultural display, curriculum, scientific research, and outreach.

Arboretum Boundaries

The Campus Arboretum comprises all space on which the College has developed facilities, including: the main campus bordered by Maiden Street, Wade Avenue, Walnut Street, and College Street; Brooks Field; Cameron Stadium; and Alexandre Stadium and Ross Park. As the main campus expands, the new properties will be inventoried and contained within the Campus Arboretum. All woody plants, whether planted or naturally occurring, within these spaces are considered part of the Campus Arboretum. While comprehensive, this delineation may be revisited to better focus on the landscape of the main campus.

Purpose of the Tree Care Plan

The purpose of the Tree Care Plan is to identify the policies, procedures, and practices that are used in establishing, protecting, maintaining, and removing trees from the campus. The overall goal of the plan is to ensure a safe, attractive, sustainable, and educational campus urban forest.

The specific objectives of the plan are to:

- Ensure proper species selection, high-quality nursery stock acquisition, and industry-consensus planting procedures
- Promote species diversity in the tree population
- Protect high-value campus trees during construction and renovation projects
- Promote tree health and safety by utilizing best management practices when maintaining campus trees
- Ensure that trees are reasonably replaced when there is mortality due to weather, pest infestations, disease, injury, or construction displacement

- Encourage campus and surrounding community members to respect and value the campus landscape

Note: This plan has been promulgated in partial fulfillment of Arbor Day Foundation's standards for Tree Campus USA certification and does not reflect official college policy on all matters. However, many of these policies, procedures, and practices are currently in place and administered. The Arboretum Advisory Committee is seeking to have the plan officially adopted by the College.

Responsible Department

The Campus Tree Care Plan is jointly enforced by the Curator (Botanist, Biology Department) and Manager (Grounds Supervisor, Facilities Services), whose department is overseen by the Vice President for Business and Finance.

Campus Tree Advisory Committee

The campus tree advisory committee is formally known as the Arboretum Advisory Committee (AAC) and is composed of faculty members (3-yr term), administrative staff (3-yr term), at least one student (2-yr term), and at least one community member (2-yr term). The AAC meets biannually, is chaired by the Curator and Manager, and assists with long-range planning, helps identify funding sources, reviews the annual budget, and supports ongoing Arboretum efforts in light of the Mission.

The current members of the AAC include:

- Dr. Jason Kilgore (Co-Chair), Curator and Botanist, Biology Department, W&J College
- Jim Mirage (Co-Chair), Manager and Grounds Supervisor, Facilities Services, GCA
- Dr. Robert East, Environmental Studies Program, W&J College (Fall 13 – Fall 16)
- Dean Michael Shaughnessy, Graduate and Continuing Studies, W&J College (Fall 13 – Fall 16)
- Dr. Patrick Caffrey, History Department, W&J College (Fall 14 – Fall 17)
- Julie Throckmorton, Foundation and Corporate Relations Officer, W&J College (Fall 13 – Fall 16)
- Lindsey Dove, Biology student ('16), W&J College (Fall 13 – Fall 15)
- David Kraueter, community member (Fall 13 – Fall 15)

Tree Care Policies – Species Selection

As part of the Mission to increase the diversity and promote the conservation of trees and shrubs, plans for new plantings should consider the existing diversity and location of campus trees and attempt to increase the species diversity and display of new trees, with the consideration of creating habitat for native birds and other desired wildlife in the urban

environment. While native tree species are important to include in the Arboretum, especially for demonstrating species that are more acclimated to the regional environment, the Arboretum should also include demonstration of the diversity of trees on Earth. Since some species (e.g., rainbow eucalyptus (*Eucalyptus deglupta*)) will not survive the climate of southwestern Pennsylvania, species selection should consider the likelihood for survival and growth.

However, some species can become invasive, i.e., produce propagules that spread outside of the original planting and have a negative effect on the native community or ecosystem. Consequently, species identified as highly invasive should be prohibited from the Arboretum, including the planned removal of existing trees and shrubs and lack of use for new plantings. For example, the [Pennsylvania Department of Conservation and Natural Resources](#) lists the following tree and shrub species as highly invasive and thus will be prohibited from new plantings in the Arboretum:

Invasive Tree Species:

- Amur maple (*Acer ginnala*)
- Norway maple (*Acer platanoides*)
- sycamore maple (*Acer pseudoplatanus*)
- tree-of-heaven (*Ailanthus altissima*)
- European black alder (*Alnus glutinosa*)
- mimosa (*Albizia julibrissin*)
- Japanese angelica tree (*Aralia elata*)
- paper mulberry (*Broussonetia papyfera*)
- white mulberry (*Morus alba*)
- empress-tree (*Paulownia tomentosa*)
- corktree (*Phellodendron amurense*, *P. japonicum*, *P. lavallei*)
- common buckthorn (*Rhamnus cathartica*)
- glossy buckthorn (*R. frangula*)
- bee-bee tree (*Tetradium daniellii*)
- Siberian elm (*Ulmus pumila*)

Invasive Shrub Species:

- Russian olive (*Elaeagnus angustifolia*)
- autumn olive (*E. umbellata*)
- privet (*Ligustrum* spp.)
- shrub honeysuckles (*Lonicera* spp.)
- jetbead (*Rhodotypos scandens*)
- multiflora rose (*Rosa multiflora*)
- linden viburnum (*Viburnum dilatatum*)
- guelder rose (*V. opulus*)
- doublefile viburnum (*V. plicatum*)
- Siebold viburnum (*V. sieboldii*)

Tree Care Policies – Planting

Trees shall be planted to enhance the campus landscape, increase species diversity, replace removed trees, and dedicate a special donor. Planting may be performed by landscape contractors, GCA staff, and W&J employees and students. Members of the public can participate in tree planting only as part of a ceremony or other event. New campus trees must be added to the Campus Arboretum database by the Curator; tree information includes scientific name, variety, common name, nursery source, size, and cost, as well as location in the GIS. Trees must be installed according to the below guidelines (Figure 1).

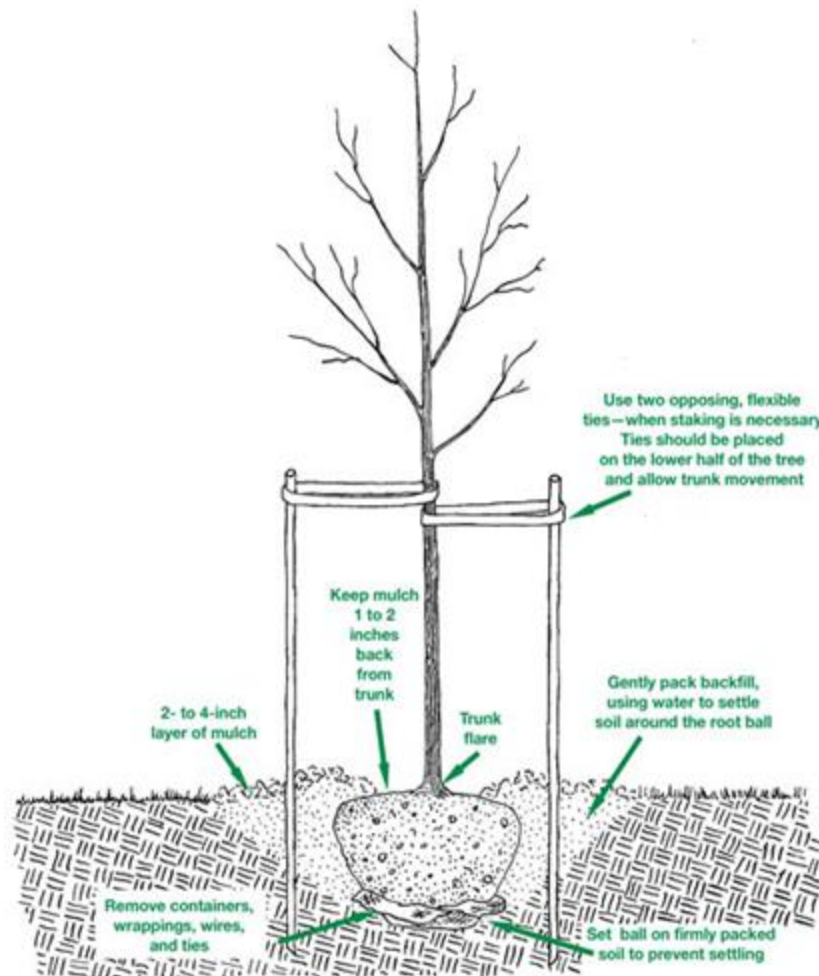


Figure 1. Tree installation guidelines. From www.treesaregood.com/treecare/tree_planting.aspx

1. Dig the planting hole just as deep as, and 2-3 times as wide as, the root ball, with the root flare remaining above the surface of the soil. If you are planting a containerized tree, then remove the container, and measure the root ball with the handle of your shovel to estimate the depth to dig. If you are planting a ball-and-burlap tree, estimate the digging depth with your shovel. To prevent air pockets below the tree, create a small mound of soil in the base of the hole and tamp down the soil by firmly pressing but not over-compacting the soil to prevent the tree from settling.

2. If the tree was containerized, loosen the tree roots at the edges of the pot soil by massaging the soil and trimming the roots. Roots should ideally radiate out straight from the center of the root ball. Lay the tree on its side with the root ball on a tarp, and work gloved fingers deeply into the root ball to loosen and free the roots. Cut off any circling roots to prevent girdling; when circling roots get bigger, they grow around the base of the tree and cut off the flow of water and nutrients to other parts of the tree. This is a good time to cut the green ties and remove the nursery stake.

3. Place the tree in the center of the hole. The tree has only one chance to be properly planted so make sure the depth and position are correct before filling in the soil. The root flare should lie above the plane of the surrounding soil surface. If it is too low or too high, lift the tree out, and add or remove soil as needed. Rotate the tree until you find the best placement to keep major branches away from walkways or buildings. If the tree is ball-and-burlap, fully remove the wire cage and cut all but the very bottom of the burlap away from the root ball; check for compacted or girdling roots, as for a containerized tree. Hold the tree upright, and fill in soil around the root ball. Gently tamp down soil around the root ball with a shovel or the toe of your shoe to eliminate large air pockets. Do not step directly on the root ball as this will damage and compact the roots.
4. Build a soil berm, or mound, 10-12 inches from the trunk encircling the tree to create a basin or bowl that will hold about 10 gal water. The inside of the berm should be at the outer edge of the root ball. Keeping the root ball moist is essential until the tree is established.
5. Stake the tree to help the young tree grow up straight until the roots are established. Larger trees and trees planted in mowed areas may need 3 stakes to protect the tree from lawn mowers. Set the point of the wooden stake just outside the root ball, and use a stake driver to pound the stake straight into the ground; be sure to wear protective eye, ear, and hand protection while using the stake driver. Install the other stakes equally spaced around the tree.
6. Connect the tree to the stakes using flexible guying material (e.g., ArborTie). Ties should be placed at the lowest point on the trunk where the tree can be held straight, or about 4 ft from the ground. Hold the trunk at the level you plan to tie it; the tree should stand straight without leaning. Create a figure-8 pattern with the tie, with one loop around the trunk and the other around the tree. Nail the ends of the tie together into the stake. The ties should allow the tree to move 2-3 in with the wind but no more. Remove support staking and ties after the first year of growth.
7. Mulch the soil around the base of the tree with 3-5 in of wood chips, shredded bark, or leaves to retain moisture, suppress weeds, and improve soil composition. Keep the mulch 2-3 in from the trunk and root flare of the tree to keep insects and burrowing rodents away from the bark.
8. Thoroughly water the soil in the basin surrounding the tree! Fill the basin with water, and reinforce the berm if needed. Continue watering at least once a week when there has not been a soaking rain, or install a tree water bag (e.g., Treegator), for at least the first full growing season.

Tree Care Policies – Maintenance

Regular tree maintenance is needed to maintain safe, strong, and healthy trees. Maintenance may be performed by certified arborists, GCA staff, and W&J employees and students, with

permission of the Curator and/or Manager. Managed trees are documented by the Manager in a spreadsheet, forwarded to the Curator on a regular basis, and updated to the Campus Arboretum database by the Curator or student volunteers.

Pruning

The maintenance pruning schedule shall be dictated by tree species, age, function, and placement:

- Trees less than 7 yr old should receive structural pruning every 1-2 yr.
- Trees 7-20 yr old should receive structural pruning every 2-5 yr.
- Trees older than 20 yr should receive maintenance pruning every 5-7 yr to clean dead, diseased, dying, and defective branches from the crown.
- Trees adjacent to roadways, walkways, signs, and street lights are annually inspected for safety and clearance issues and maintenance pruned as necessary.

To encourage the development of a strong, healthy tree, the following guidelines shall be followed when pruning:

- Pruning shall not be conducted without a clear objective or outcome.
- Prune first for safety, next for health, and finally for aesthetics.
- When removing branches, the pruning cut shall not damage the branch bark ridge and branch collar.
- Internode (heading) cuts should not be used except in storm response and crown restoration procedures.
- Branch reduction or thinning should be used to achieve pruning objectives rather than making large (>8" diameter) branch removal cuts.
- Thinning shall be performed to remove dead, diseased, dying, and defective branches, which reduces hazards, promotes health, and improves appearance.
- Large branches should be removed with the aid of ropes and rigging equipment to minimize the risk of tree injury from falling debris.

When thinning is required to reduce the density of branches, thereby increasing light penetration, improving visibility, and decreasing wind load, the following guidelines shall be followed:

- Assess how a tree will be pruned from the top down.
- Favor branches with strong, U-shaped angles of attachment.
- Remove branches with weak, V-shaped angles of attachment and/or included bark.
- Ideally, lateral branches should be evenly spaced on the main stem of young trees.
- Remove any branches that rub or cross another branch.
- Make sure that lateral branches are no more than one-half to three-quarters of the diameter of the main stem to discourage the development of co-dominant stems.
- Do not remove more than one-quarter of the living crown of a tree at one time. If it is necessary to remove more, do it over successive years.

When raising is necessary to provide vertical clearance from thoroughfares, signs, street lights, and structures, the following guidelines shall be followed:

- Always maintain live branches on at least two-thirds of a tree's total height. Removing too many lower branches will hinder the development of a strong main stem.
- Remove basal sprouts and vigorous epicormic sprouts.

When reduction is absolutely necessary to decrease the overall height of a tree or to decrease the length of an individual branch, the following guidelines shall be followed:

- Make the pruning cut at a lateral branch that is at least one-third the diameter of the stem to be removed.
- If it is necessary to remove more than half of the foliage from a branch, remove the entire branch.

Fertilization

Trees in poor condition should receive deep root fertilization of 5-35-10 plus micro-nutrients, with repeat application if necessary. Also, when necessary, use 10-20-10 for evergreen trees and 25-10-10 for general application. Routine tree fertilization is not recommended; however, campus trees receive adequate nutrients from routine application of fertilizers to turf, shrubs, and groundcover.

Pest Management

Insects and disease organisms weaken trees by defoliation or by causing stem and root damage that impedes absorption and translocation of water and nutrients. Pests of campus trees are managed using integrated pest management (IPM) principles. IPM is a technique of periodically inspecting plants for pests and other health problems. When detected, pests are maintained at threshold levels through the most safe, effective means possible.

Tree Care Policies – Tree Protection

Tree protection fencing must be installed around all existing trees noted to remain on construction plans within the fenced staging area, thus creating a Tree Protection Zone. Compaction of soil and tree roots leads to decreased water absorption, decreased soil oxygen, and decreased root and therefore tree survival. These tree protection guidelines will be provided with all RFP's and contracts for any construction activities occurring on campus.

Fencing shall extend a distance from the stem at 1.25 ft per inch of stem diameter or 6 ft, whichever is greater. For example, a tree with a 12 in stem diameter shall be fenced 15 ft from the stem. Fencing must be installed prior to any equipment arrival on the site and must be a minimum of 4' height. Work may not begin until fencing is installed. The fence shall be maintained for the duration of the project and shall not be removed without the permission of the Grounds Supervisor.

No vehicular or commercial traffic or parking shall take place within the protection zone other than on an existing paved surface.

No paving with asphalt, concrete or other impervious materials shall be placed within the protection zone. However, paving may encroach up to within 6 ft from the stem upon approval of the College.

No material storage, vehicles or any other activity shall occur at any time within tree protection fencing.

No equipment shall be cleaned or other foreign materials deposited or allowed to flow over land within the tree protection zone. This includes, without limitation, paint, oil, fuels, solvents, asphalt, concrete, mortar, or similar materials.

No signs, wires or other objects, other than those of a protective nature shall be attached to any protected tree. Furthermore, no person shall prune, remove, or effectively destroy through damaging any tree at Washington & Jefferson College unless otherwise permitted by College officials.

Enforcement of protection measures is performed by project managers and on-site engineers.

The Contractor may be required to pay tree replacement and/or soil compaction remediation costs if there is any incursion in to tree protection zones. Assessment on low profile trees is performed by the Grounds Supervisor, while higher profile trees are assessed by an outside consultant (e.g., Bartlett Tree Experts).

Tree Care Policies – Removal

Live trees are generally removed only when required to protect the public safety or are detracting from the quality of the landscape, while dead trees should be removed as soon as possible. Live trees may only be removed after consultation with the AAC where the committee reaches a consensus. Where the committee cannot reach a consensus, an independent assessment by a qualified arborist may be required and submitted to the committee for review.

Removed trees are documented in the Campus Arboretum database as “removed” by the Curator, with the following reasons for removal: Dead, Blowdown, Disease, and Construction.

Removed trees should be replaced, not necessarily with the same species, toward the goal of maintaining a vital and diverse Campus Arboretum.

Managing for Catastrophic Events – Storm Response and Recovery

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 the tree planting budget permits, lost trees are strategically replaced to restore the structure and function of the campus landscape in a reasonable time frame. During storm response and recovery, trees requiring specialized equipment not available in-house are addressed by an outside contractor.

Goals and Targets

Campus Tree Inventory and Arboretum Database

The initial campus tree inventory, database design, and tree evaluation were completed in the Summers of 2012 and 2013 by Dr. Kilgore (Curator, Biology Department) and student interns and was funded by the Dean's Fund for Innovation and Development and supported in part by the Biology Department. In Summer 2012, Kyle Karwatski (CIS, '14) worked with Drs. Kilgore (BIO) and North (CIS) to design and develop a geospatial database (i.e., GIS) to map every tree on every W&J-owned property from high-resolution aerial photographs and ground-truthing. Dr. Kilgore and Kyle located and mapped 1,241 trees on W&J properties by August 2012. The trees were also identified to species in all but a few instances and entered into another custom-designed database (Campus Arboretum database) that is linked to the GIS. These databases are stored on the LEM server. In Summer 2013, Lindsey Dove (BIO, '16) worked with Dr. Kilgore to evaluate the condition of >1,000 trees associated with the main campus and Alexandre Stadium. These data are entered into a spreadsheet, proofed, and uploaded into the Campus Arboretum database.

As trees are removed and added to the Arboretum, the Grounds Supervisor tracks relevant data which are entered into spreadsheets, emailed to the Curator, who then proofs and uploads the file to the database, thus generating an information trail for every campus tree.

In Spring 2014, Kyle mentored Nathan Pisciotano (CIS, '15) in the management of the Arboretum database. Dr. Kilgore and Nathan will work together to update the database by April 2015. Before Nathan graduates in May 2015, he will help identify and recruit one or more students with similar potential skills to take over the role of database administration.

Campus Arboretum Website

In October 2013, Kyle launched the inaugural Campus Arboretum website, which was hosted by the LEM server. The purpose of the website is to provide a public interface to the Campus

Arboretum showcasing recent and future events and planting projects, an interactive tree map, a downloadable brochure, and resources related to tree planting and other arboreta.

To improve website flexibility and management, Nathan identified an external hosting server (ASmallOrange.com, ASO), established our own domain name – washjeff-arboretum.com – and migrated the [website](#) from the LEM to ASO server, which he completed in October 2014. Domain registration and hosting services cost \$50 per annum; these funds were provided through a donation from AAC member David Kraueter in May 2014.

Nathan will be developing an interactive tree map for the website in January-May 2015. Before Nathan graduates in May 2015, he will help identify and recruit one or more students with similar potential skills to take over the role of website and interactive map management.

Arbor Day Observance Events

The Curator and Manager have cooperatively planned and led three years (2012-2014) of successful Arbor Day Observance Events featuring W&J students planting trees on campus. The 2012 event was featured in the *Observer-Reporter* (5/5/12) and W&J website, the 2013 event was not featured in the media, and the 2014 event was again featured in the *Observer-Reporter* (4/26/14). Trees were provided by the tree planting budget provided to the Manager by the Vice President for Business and Finance.

Each April, Arbor Day will be continue to be celebrated by a tree planting event for W&J students. Local media (*Observer-Reporter*), the student newspaper (*Red & Black*), and the Office of Communications will be contacted at least one week prior to the event. Planting tools, watering, and safety equipment will continue to be provided by Facility Services. Each event will be added to the Arboretum website.

Species Diversity and Conservation

As part of the Mission for the Arboretum to increase the species diversity and conservation value of new plantings, proposed plantings should take into consideration the creation of “habitat islands” or “pockets” with specific conservation values, such as increasing bird habitat (e.g., cover, food), decreasing water flow problems (e.g., phreatophytic plants, water gardens), and decreasing erosion and sedimentation in the urban environment. Rather than considering each planting as an individual tree, the Curator and Manager should intentionally design habitat components in the campus landscape, when possible, to enhance the campus “living classroom.” To increase woody plant species diversity, for each Arbor Day Observance event, a tree species not already found in the current Arboretum will be selected for planting.

Part of the conservation component of the Mission is understanding the ecological role of the Arboretum in the campus landscape. For example, quantifying and finding sustainable uses for tree litter would enhance the value of the Arboretum and could reduce mulch costs. Quantifying carbon sequestration by campus trees could justify future plantings, offset campus carbon

costs, and attract new funding sources. In June 2014, Dr. Kilgore presented a proposal at the All-Members Meeting for the Ecological Research as Education Network (EREN) to generate interest in developing standards for quantifying the ecological values of campus arboreta, with some interest by the audience. In both examples, students would be involved in the research and development, thus broadening their education with real-world experiences.

Memorial/Dedication Trees

As part of the Mission to enhance the diversity of woody plants on campus, a policy was drafted in Fall 2014 in collaboration with the Office of Development to attract donors to sponsor new or existing trees on campus. This policy covers several options from new trees to sponsoring existing (e.g., Heritage) trees on campus, recognition by a standardized plaque, management plan including loss and replacement of the tree, and costs. The AAC approved the determination of criteria for and selection of Heritage Trees from the Campus Arboretum, with a separate account for funds used to maintain these trees. The draft policy is under review by the AAC and should be sent to the College Administration for approval in Spring 2015.

W&J Campus Arboretum Account

In May 2014, the first donation (\$100) was made to establish the W&J Campus Arboretum Account by AAC member David Kraueter. The account is managed by the Curator in compliance with the Arboretum Mission with approval for all budgeted expenditures by the AAC. One-half of these funds were used to establish an internet domain name (washjeff-arboretum.com) through ASmallOrange.com, with the annual \$50 registration and hosting service fees expected in May 2015. Now that this account has been initiated, additional funds are needed to keep the account open, retain the website hosting services, and fund future endeavors. The Curator met with Michael Grzesiak, VP for Development and Alumni Relations, in April 2014 to develop initiatives to seek external funding to support the Arboretum, such as Campus Tree Tours during Homecoming 2015.

EAB in Campus Ash Trees

Emerald ash borer (EAB) is an invasive and highly lethal insect to all species of ash (*Fraxinus* spp.) trees in North America and was first detected in Washington County in 2010. The Campus Arboretum hosts a number of ash trees in prominent locations (e.g., along Wheeling Street between Lincoln and College Streets; along Beau Street, and in the Library parking lot). The Curator and Manager assessed these ash trees in Summer 2014, noting dieback, branch loss, and even mortality, and made strong recommendations to the Administration in July and October 2014 to remove all of the ash as soon as possible to prevent injuries and property damage.

One W&J student, Josiah Ritchey, has capitalized on the EAB infestation on campus. In September 2014, with approval from the AAC, he obtained phloem samples from several ash trees to compare microbial diversity in trees with varying levels of EAB infestation and found a

positive correlation with relative abundance of Proteobacteria. In addition, he co-developed, with the Curator, an informational sign on the natural history, signs, and impacts of EAB in ash trees. They installed three coroplast signs, funded by the W&J Sustainability Committee, near ash trees on campus in October 2014.

Arboretum Accreditations

The W&J Campus Arboretum earned [Tree Campus USA](#) certification for the year 2013 and will apply for recertification every year. Campus arboreta must meet five standards: Campus Tree Advisory Committee; Campus Tree Care Plan; Campus Tree Program with Dedicated Annual Expenditures; Arbor Day Observance; and Service Learning Project. This certification is free and can be renewed each year with an application due December 31.

In September 2014, the Curator applied for the Tree Campus USA Contest, becoming a Finalist in early October 2014 and one of the ten campuses across the United States to win in late October 2014. The award includes \$500 toward the purchase of trees or tree-related materials, 2 Tree Campus USA banners, 5 Tree Campus USA yard signs, and 30 Tree Campus USA T-shirts and hats to give away for hosting an Arbor Day celebration in spring 2015. The Curator will be working with teachers from Washington High School to develop an outreach program pairing college and high school students to explore the natural history and impacts of EAB on ash trees

The W&J Campus Arboretum became registered through the [Morton Register of Arboreta](#) in May 2014 and will be applying for Level I Accreditation (Arboretum plan, Arboretum organizational group; Arboretum collection with at least 25 species of woody plants with documentation (history) and labeling; Arboretum staff or volunteer support; Arboretum public dimension; and participation in ArbNet) once trees are labeled in Summer 2015.

Campus Arboretum Logo

In Summer 2012, Kyle Karwatski (CIS, '14) generated a logo for the Campus Arboretum for use in the database interface. However, this logo does not best represent the integration of the Arboretum with W&J, and a more professional and appropriate logo needs to be designed. Ideally, a W&J student with artistic skills and digital media interests would design this logo, but no student has yet been identified.

Definitions

arboretum -- a place where trees and shrubs are cultivated for scientific, educational, and/or aesthetic purposes, including the conservation of trees

integrated pest management (IPM) -- an approach to pest control that focuses on pest prevention by eliminating the root causes of pest problems. When infestations are present and

require immediate intervention, the safest, most effective methods available for the situation are chosen. See [Penn State Extension](#) for more information.

root ball -- the mass of soil and roots that comes out of the container

root flare -- the point where the trunk widens and becomes roots

Communication Strategy

With approval from the AAC, the Tree Care Plan is shared with the President, Vice President for Business and Finance, Facilities Services, and public through posting to the Arboretum website. The Office of Communications is notified of upcoming events, certifications, and changes in the composition and function of the AAC, all of which will also be reflected in the Arboretum website. Tree Campus USA certification by Arbor Day Foundation is announced through the College website, Arboretum website, faculty/staff newsletter (*Greensheet*), and press releases to the local media through the Office of Communications.

Dedicated Annual Expenditures

The Campus Arboretum is managed by GCA Services, which is contracted by W&J College for facilities management. Their staff includes the Grounds Supervisor (Manager, Arboretum) and seven full-time Grounds employees, with responsibilities for managing the campus landscape, sidewalks, outdoor athletic facilities, and College vehicle fleet, as well as event set-ups. Consequently, GCA has available staff but is not dedicated to the Arboretum. The W&J Office of Business and Finance has oversight of GCA and provides their budget for Arboretum plantings, maintenance, and removals.

New trees are largely planted in the Campus Arboretum by GCA staff, with occasional plantings of large trees by contractors. Trees are also maintained on a regular basis by GCA staff; this maintenance includes ground-based pruning, fertilizing, pest management, and watering. Larger trees that require specialty equipment are pruned by contractors (e.g., Newman's Landscaping, Bartlett Tree Experts). Tree removals are generally performed by GCA staff except for large trees, whose removals are contracted. The costs for in-house maintenance and removals are borne by GCA, while costs for contracted work are provided directly by the Office of Business and Finance.

The Campus Arboretum also benefits from a suite of volunteers. The Curator, Dr. Jason Kilgore, Department of Biology, is not assigned duties relative to campus trees or the Arboretum, but rather initiated the development of the Arboretum of his own accord, beginning in Spring 2011. Consequently, this work is voluntary. Through W&J College grants from the Dean of Academic Affairs, Dr. Kilgore has provided two Summers of internships to W&J students to participate in the development of the Arboretum. In 2012, Kyle Karwatski (CIS, '14) designed and populated

two databases to collect and manage data from campus trees and then developed the Arboretum website in November 2013, and he continued *pro bono* management of these information resources through graduation in May 2014. The second internship from Summer 2013 was awarded to Lindsey Dove (BIO, '16), who assisted Dr. Kilgore in the evaluation of size and health of >1,000 trees in the Arboretum; she continues her involvement with the Arboretum as the student representative to the AAC. Emily Kauffman (CIS, '14) joined the Arboretum team for the 2013-14 academic year to develop an online brochure containing a static tree map, while Nathan Pisciottano (CIS, '15) transitioned as the information resource manager in Spring 2014.

Other W&J students have contributed to the Campus Arboretum mission in other ways. For example, students in Dr. Kilgore's General Botany course have planted trees in the Campus Arboretum as part of the annual Arbor Day Observance event and contribute phenological data on two maple species on campus to the National Phenology Network. Another student, Josiah Ritchey (BIO, '15) turned on his Fall 2014 Microbiology class to his research on early detection methods for emerald ash borer (EAB) based on differences in bacterial diversity and used campus ash trees as a class project. In October 2014, he and a W&J graduate, Jourdan Gottlieb (ITL, '14), helped Dr. Kilgore develop campus signs on the natural history, signs, and impacts of EAB infestation in campus ash trees.