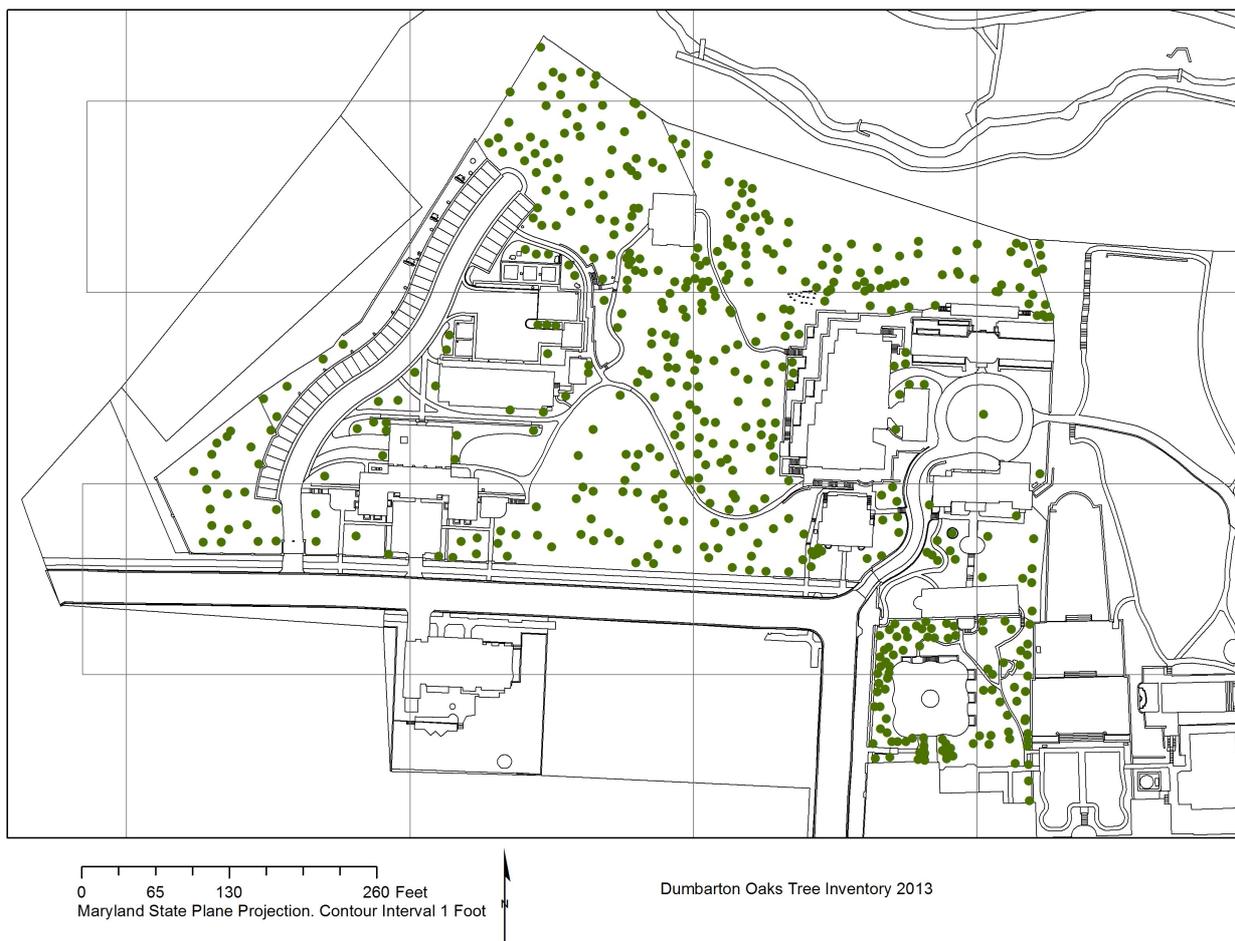Please see previous summer internship reports from Justin Scherma, David Wooden, and Charles Howe for details on the DO GIS model and other details about the Alliance of Public Gardens GIS.

<u>Tree inventory</u>

Dumbarton Oaks Tree Inventory 2013

0   65   130   260 Feet
Maryland State Plane Projection. Contour Interval 1 Foot

My main priority from the start of my internship was the completion of the Dumbarton Oaks tree inventory. Started in 2010 by David Wooden, this map and database records not only the position of all trees on the garden property but also data about each tree including species, size, diseases, any maintenance work performed on the tree, and even digital images. David inventoried the trees in the public garden; it was my job to do the same for the trees in the non-public areas. My tasks included printing out field maps, taking these maps into the field, and locating trees on the map. I recorded which trees were plotted in the correct location, which were plotted in the wrong location, and which were no longer present on the property. For the trees still present, I measured their diameter at breast height (DBH), a standard arborist measure.

After conferring with David about his protocol, I measured DBH for all trees six inches or greater at breast height (~1.4 meters above the ground or ~4.6 feet. For smaller trees, I measured the diameter at a height of one foot above the ground. This protocol was also followed by the arborist James Urban in 2000 for his tree inventory around the site of the libary construction. Somewhere along the

way, I either heard or read that multi-trunked trees should be measured only on the widest trunk. I later learned this may not be correct: all trunks should be measured and the total sum of diameters reported. Fixing this possible mistake of mine will not take long.

I checked a total of 746 tree points during the summer. 85 of these were double points, where the database had two points refering to the same tree feature (whether that tree still existed or not). 128 of these points refered to missing trees, a surprisingly large number. 533 points were existing trees for which I measured diameters and replotted when necessary.

Overall, finding the trees in the field was slightly overwhelming at first. In many areas of the non-public garden, there are swaths of trees with few reference points. I was first worried too much about pinpointing each tree points, but as the summer went on and afer talking with others about the project, it became clear that the relative positions of the trees to each other and to ground features was more important. The main quesiton to ask is: can someone use my maps and data to go into the field and tell which tree they are looking at? Using ground features, other trees, and topography, getting my best estimate of each tree's location on the map became an easier task. Someone could take one week with a Total Station to get the most accurate tree locations, but that is not necessary.

As part of documenting my work for the summer, I made scans of my field notes and field maps. These field maps were georeferenced and included as part of the the doaks_gis archive.

Trimble and ArcPad

From the beginning of the summer, the plan was to either borrow, or more likely, purchase a hand-held device capable of bringing GIS data into the field. This device would allow the garden staff to make edits to the tree database as they need to happen. While walking around checking for tree

disease or insect damage, the user could enter these observations directly into a version of the tree database. At the end of the day, she could then merge the observations made with the current copy of the database which is stored on the desktop GIS computer. The data entry process would be faster and more streamlined.

Paul brought one of Harvard's ArcPad enabled Trimble devices with him on his second visit. Despite its short battery life, we took it into the garden and found that its GPS capability wasn't too bad: you could generally tell on the map which tree you were standing by, open up the observation table, and make edits. I got a brief introduction to ArcPad, but it wasn't until I visited with Paul in Cambridge until I began to get more familiar with the software.

ArcPad is similar to ArcMap, but there were some subtle differences I needed to learn and master. The menus are slightly different, but the main issues lie in getting data to and from the device. See my ArcPad user guide for more information.

I wrote a summary guide for users of the Trimble and ArcPad based on both my experience using the software and help files online. Most of these help files have extranous information, so I thought it best to distill the basics into one reference document.

We got the Trimble device on 7/29. In Cambridge, Paul and I loaded the ArcPad software

Some of the challenges I solved in the last three weeks of my iternship were:
- Learning the basics of the Windows Embedded Mobile OS
- Figuring out why the camera application didn't work well with ArcPad. Digital images would not save and the orientation of the camera did not display correctly on the screen. It turns out that the ArcPad camera extension does not work correctly on Trimble Juno devices. Turning on only the Windows camera extension and restarting both ArcPad and the device fixed that problem. However, using the photo capture abilities in ArcPad wasn't playing well with the way the tree photo related table was set up.
- Fixing the width of data columns in the feature properties. By default, all the columns are very narrow making it hard to read tree data in the field. The user can enlarge each column using the stylus, but this is cumbersome and often just switches you between data screens if you don't tap the exact locations. Fixing this involved learning a little about ArcPad's customizable application, ArcPad Studio. I barely scratched the surface of this software, but learned what I needed to know through a combination of trial-and-error and online help fiels. See my ArcPad studio user guide for more information.
- Developing a workflow of getting data onto the Trimble into ArcPad and then back off the Trimble and into ArcMap. With Paul's help, online help files, and some dumb luck on my part, I was able to figure out the correct steps to make sure that not only could edits be made on the Trimble, but also that these edits could be merged with the official tree GIS database. See my ArcPad user guide for more information.

Updated map for facilites and others

During the first week, Gail, John, and I talked about making an updated map for facilities management. The main thing to include would be the new fellows' building being renovated/constructed at 1700 Wisconsin Avenue. I fugured that facilities would want more on their map and that I would extract layers from the groundplan edges and simplify and reassign their types. For example, some walkways had a different type. Facilities might also want stairs better delineated, building entrances and exits, and drivable areas on the property. This whole map would

then be saved as an Illustrator file for easier viewing and printing. Each layer in ArcMap would be a layer in the Illustrator file.

I worked on simplifying the groundplan edges and got street and building layers from DC GIS database. For all buildings besides 1700 Wisconsin, I decided to use the CAD building outlines. These were more accurate. DC GIS buildings were traced from aeiral photographs and had some innacuracies: for example, the library and reading room were not connected. I took the DC GIS streets layer and extracted the city streets and driveways around 1700 Wisconsin. On campus roads were taken from the CAD drawings. During my work on this and work on the tree inventory, I noticed that the north fence line of the property was inaccurate. The line type was "invisible boundary" and did not follow the actual fence lines. Paul and I traced the actual fence line from an older CAD drawing and merged the new fence line into the groundplan edges.

During week 9, Gail and I met with Alan, the new facilities director, about what he would like to see on a detailed map. His main wish was to have a map with all physical assests. The breakdown of our discussion:

- Things I planned to complete by the end of my internship:
    - In addition to 1700 Wisconsin, Alan would like a map to show La Quercha and a walking route for students living there next fall before the new building is completed
    - clear outlines of walkways on the property
    - drivable areas on the property
    - fountains
    - stairs
    - property line around director's house
    - cooling towers, generators, other permanent machinery
    - integration of some utility features like light poles, utility hole covers

- Things that I would not be able to finish by the end of my internship
    - vegetation around La Quercha
    - details of all roofs, like material, break lines, gutters, etc
    - getting all utility features on the map
    - all physical assets
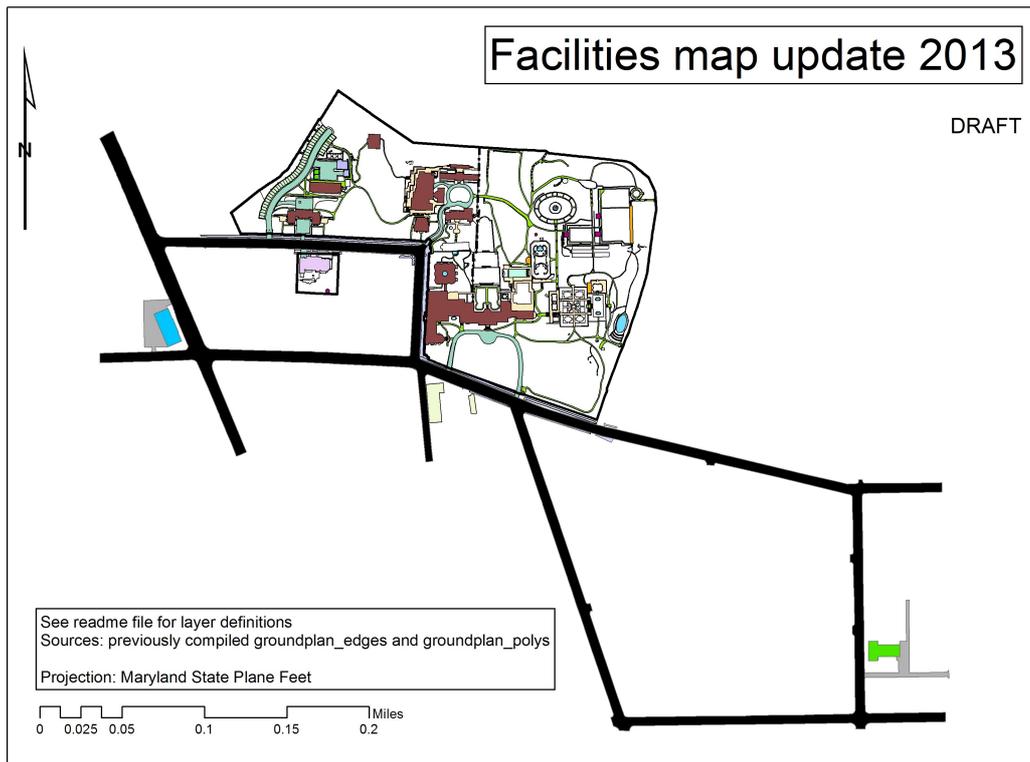
The map that I completed drew on the groundplan edges and polygon layers completed in a previous summer. I also took data from the DC GIS site for city streets and for buildings not included in the previous CAD drawings (i.e. 1700 Wisconsin and La Quercha).

I was able to include
- groundplan edges
- an outline of the DO property including the Director's House property line
- a line showing the division between the public and private garden areas
- CAD drawing 1-foot topographic lines
- city streets (from DC GIS data)
- parking areas and alleys connected to 1700 Wisconsin and La Quercha (from DC GIS)
- stairways (outlines and steps)
- the swimming pool
- walkways
- paved terrace areas (including walkways)
- arbors
- drivable areas
- dumpster alcoves
- fountains
- garden sheds
- monuments
- parking spaces
- fountain pump structure
- city sidewalks

- R street guest buildings
- Director's house
- 1700 Wisconsin
- La Quercha
- On-campus DO buildings

This map document is saved. I exported it to an Adobe Illustrator file where more edits can be made. Making labels is probably easiest in the Illustrator file.

Garden zones were included in a separate map document and Illustrator file.

While doing this map, I noticed discrepancies between the current garden and the groundplan files (some new or redone walkways and paved patios here and there). Also some of the groundplan polygon material attributes are not correct (asphalt where there is none, etc.)

File documentation

During the first two weeks of my internship, I realized that I didn't know what data were included in the GIS archive. So I spent a few days exploring the contents of the dc_sources, do_editable, and do_sources folders. See the document recording my notes. As I devoted more of my time to other projects, I didn't complete this, and my notes are mainly just lists of the files with some information about their sources. This is incomplete.

I should have started with the most recent files and the most relevant files, such as those made and compiled by David Wooden in 2010. Because I began working systematically through the folders alphabetically, I did not reach these more important files.

I did discover some duplicate files and folders which, when erased, freed up some space on the shared H drive.

Bee study

During the spring of 2013, I became interested in native bees through a volunteer project with Virginia Working Landscapes. I wanted to study how bees used the garden landscape at Dumbarton Oaks. To determine which kinds of bees were moving in and out of the garden, I set up transects of bee bowl traps along the edges of the public gardens: along Cherry Hill, Melissande's Allee, the East/South Lawn, and the North Vista. See http://online.sfsu.edu/beeplot/ for details on the sampling protocol.

These bowls are small white Solo brand 3.25 oz plastic bowls. 1/3 are left white, 1/3 are painted a specific flourescent yellow, and 1/3 are painted a specific flourescent blue. These colors yield the best numbers of bees captures. The bowls are filled with soapy water and 20 are placed about 5 meters apart in 100 meter transects (distances paced out). I left the bowls out for about 5.5 hours on three occasions: July 9th, July 18th, July 29th. I filtered the water with insects through paint filters, froze the specimens overnight, and then dried the insects for about a week. Due to the time constraints of drying the insects and the tree and Trimble/ArcPad projects, I did not have time this summer to analyze the bee data.

Bee bowls do not work as well for collecting bees when placed near flowers, so I planned to capture bees in a net in various areas of the garden. This proved very time intensve and difficult to do without damaging flower blossoms. I eventually scrapped this sampling method, although it does work well for certain bee species that are not as readily attracted by the bee bowls.

My overall plan would have been to document and map out where bees were using the garden and which areas supporte which kinds of bees. Obviously, these data are hard to collect, especially during a few weeks in a summer and especially for a very amateur entomologist with very little prior training. Most bee species are also extremely hard to identify and my source for ID help at the Patuxent lab became busy over the summer. I regret not making more progress on this project because most everyone at Dumbarton Oaks was very excited about it. I will work up the data during the fall and communicate what I did find to Dumbarton Oaks.

Plant diseases and GIS

My other idea for an extention of GIS for the garden was to construct a database of plant disease records. This database would preserve valuable historical and seasonal information about plant pathology and make it easy to produce disease maps of the garden. Although conditions for the development and propigation of plant diseases is well know to those who spend their time caring for plants, I thought that some new patterns might be seen when mapped across the garden landscape.

On July 2nd, I walked the garden with Marc and Jack on the latter's perioidcal check of the garden for Bartlett's tree company. I learned a lot about plant pathology and disease symptoms, especially how prevalent root rot can be and the mysterious "decline" which affects many tree species. I picked Jack's brain for a bit about how GIS methods could be use to visualize and analyze plant disease data. His main suggestion was to make a map of soil water retention over the property. This would require turning the irrigation systems off for a few days, during which time it would rain heavily. After the rain, measure the soil water content and make a gradient map of the results. Another idea was to use a hygromter to measure humidity levels at different elevations and heights above the ground. These projects never got started due to the intense nature of data collection. We would have needed an accurate grid across the property to sample soil moisture evenly plus the right conditions under which to make the measurements. I still think that such a map would be cruicial for the garden to have.

Making a database for plant diseases might require extending the garden tree inventory into an inventory of all plant resources including grass and hedge polygons and many points for herbaceous plants (or would these be polygons for planting beds?). I think Paul dreams of such a database and will someday get there.

Storm water/runoff analysis

During the first week, I tried to model the watersheds and runoff on the Dumbarton Oaks property by doing some 3D surface modeling of the garden. I had no prior experience with 3D GIS methods. Using some DC GIS data (2 foot contours, breaklines, and elevation mass points) and the help of Paul, I made a 3D TIN as well as a DEM of the garden topography. I tried to run a watershed analysis in the hopes of making a cool 3D map of the garden showing where water would drain over the surface. The whole process of watershed analysis ended up being a bit beyond my abilities.
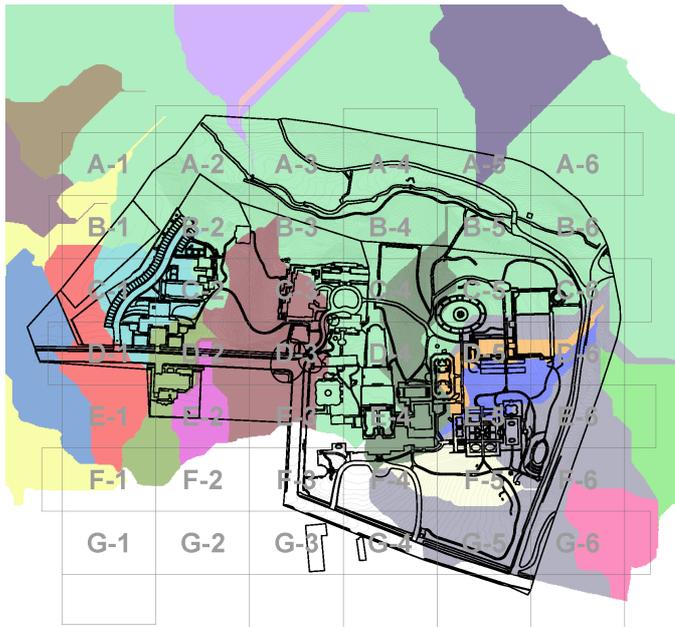
GIS sources for Wild DC study

Kate Hayes, the 2013 lanscape architechture intern, worked on a project titled "Wild DC", exploring the different types of wild spaces found in the city, from deep in Rock Creek Park to weeds in abandoned lots. She and I discussed ways to quantify wilderness in the city. I downloaded some data from the DC GIS online database and from LANDSAT land cover databases with the hopes of using some metrics to put a number to how wild some areas were as compared to others. I never got beyond inspecting the data, but I think this line of work has some promise.

Georeferencing Framehouse CAD drawing

Rosabella Alvarez-Calderon, the 2103 Garden Conservation intern, measured and made a CAD drawing of the frameyard pit house excavation begun in 2012. I helped her measure some reference points in the field and then georeference her CAD drawing in GIS.