The University of Wisconsin–Madison Arboretum Map

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INTRODUCTION

The combination of Web 2.0, social computing, and the Geoweb has given rise to an ever-increasing array of collaborative mapping technologies. The public's ability to participate in the creation and maintenance of an online map has never been easier. Sites like GeoCommons Maker*!* (http://maker.geocommons.com/) have turned a wide range of users into authors by giving them the ability to make compelling and cartographically-sound maps in a matter of a few clicks. By bringing once highly-technical map-making techniques to the public, sites like this effectively democratize cartography (Rød, Ormeling, and Elzakker 2001). Other, custom-built, small-scale mashups of disparate web services present another area in which non-cartographic professional authorship is growing (Zang, Rosson, and Nasser 2008). New map authors are not limited to mashing together data; they can also participate in the creation of base maps and geographic datasets through volunteered geographic information (VGI) initiatives such as OpenStreetMap (Goodchild 2007a). The purpose of this paper, using The University of Wisconsin—Madison Arboretum Map as a case study, is to highlight ways in which maps can be built to attract new map authors from the public and retain them as the maps' keepers.

THE UNIVERSITY OF WISCONSIN—MADISON ARBORETUM MAP

Located on 1,260 acres in a semi-urban neighborhood in southwest Madison, the UW Arboretum features restored prairies, forests, and wetlands. The Arboretum was established in the early 1930's on reclaimed farmlands and pastures. Its attractions, such as the world's oldest prairie restoration, Curtis Prairie, draw one million visitors annually.

In honor of its 75th anniversary, the Arboretum commissioned an online interactive map of its grounds, facilities and research initiatives. In the last year, the University of Wisconsin—Madison's Cartographic Laboratory, in partnership with Axis Maps, LLC, completed work on this map (**http://uwarboretum.org/map/**). The core project team consisted of staff from these two partners, as well as the Arboretum itself, but the map would not have been possible without the cooperation and input of the public. The map framework was built in Adobe Flash, while data was processed in ArcGIS and graphic design was done in Adobe Illustrator and Adobe Photoshop.

ENGAGING THE PUBLIC

A primary goal of the Arboretum map was to engage the public from planning to launch. The nature of the final product, a mapping platform that would rely on volunteered geographic information, made it essential to encourage input and feedback from community members who would be most likely to use it. This was a major challenge at the onset because of the diversity of Arboretum staff, volunteers, and visitors. Some Arboretum users see it as a scientific laboratory, some see it as place of recreation, and others as a place to join a community. Thus, in our needs assessment, it was clear that if the Arboretum Map could not be limited to one map interface. Similar to the market research conclusions of Howard Moskowitz in the 1980's (Gladwell 2004)—that there is no one perfect product, just perfect *products*—the Arboretum Map was to have a number of user-centered (Gabbard, Hix and Swan 2008) map interfaces, each geared toward specific user groups. The map would have three main scenario views: "Learn," "Go," and "Your Turn" (Figure 1).

A PRIMARY GOAL OF THE ARBORETUM MAP WAS TO ENGAGE THE PUBLIC FROM PLANNING TO LAUNCH

When toggling across scenarios, map users would filter map content based on the purpose of their visit. The "Learn" scenario would provide a spatial portal for learning more about the Arboretum soils, plants, and wildlife, as well as the results of recent research conducted in the Arboretum; the "Go" scenario would provide tools and information for planning a visit to the Arboretum, whether to run, bike, or ski; and the "Your Turn" scenario would allow users to contribute to the map in their own way, by posting photos and short narratives on experiences in the Arboretum to share with the community. While a user-centered design approach was used for each map scenario, we also aimed not to limit users to a certain role, but rather to dissolve the boundaries among roles, using certain data and functionalities of the map to bridge the different user groups.

Figure 1. The three main scenarios for the Arboretum map: "Learn", "Go", and "Your Turn".

The structure and layout of the map were set up for the community who would be primed to use it. But in order for the map to succeed, we needed to foster as much buy-in as possible up front. We wanted to encourage users to make the map theirs and return to it often to see and contribute to its evolution. To that end, the Arboretum hosted a community meeting while the map was still in development. People of all backgrounds and interests were invited through established Arboretum communication channels. Approximately thirty people were in attendance while the overarching mapping technology and an Arboretum map prototype were introduced. A lively discussion followed, concerning the design and focus of the map. Some suggested using the map to delineate where Arboretum volunteers would meet to do their work. Others impressed the importance of the time sensitivity of certain features that should be mapped—flowers in bloom, migrating birds, and fall foliage were all mentioned as ephemeral features.

THE COMMUNITY MEETING WAS A CRUCIAL STEP IN PROMOTING PUBLIC PARTICIPATION IN THE CREATION AND MAINTENANCE OF THE ARBORETUM MAP

The community meeting was a crucial step in promoting public participation in the creation and maintenance of the Arboretum map. Some attendees thought of the meeting as a demonstration of new technology and not an opportunity to share their vision of the Arboretum. But by the end of the meeting, many left with clear ideas on ways to contribute: some would contribute through the collection of additional spatial datasets, and others through the composition of narratives meant to accompany map layers. This played to a main strength of VGI, that those who are immersed in the environment being mapped can provide valuable geographic information that could not be acquired otherwise (Flanagin and Metzger 2008). In an effort to narrow the digital divide, channels were established to allow community members of all technical abilities to contribute. We encouraged those with less technical ability to communicate directly with Arboretum staff. For those more technologically inclined, a Wiki was set up as a data depot for community-generated content. With the feedback and continuous flow of data from the Arboretum community, the production of the map continued as a much larger effort.

CONTRIBUTIONS FROM THE COMMUNITY

The Arboretum community is extremely active. It is full of photographers, bird-watchers, and clubs for all kinds of naturalists. It was important during the development of this map to allow these sub-communities to contribute their own unique Arboretum data and experiences. Contributions from

experts in the community fostered buy-in and relinquished project cartographers from the need to become experts in subjects related to the Arboretum.

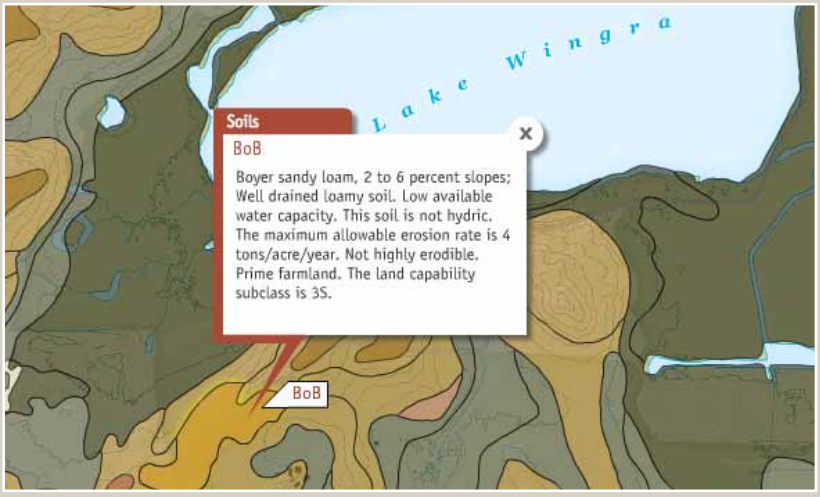
Many community members contributed information at the start of the project to seed the map; for example, a number of community members offered up photographs and datasets for the map. Others helped with descriptive text and the quality assurance/quality control (QA/QC) of data. Suddenly, thanks to a crowd of interested community members, certain data layers on early versions of the map that were assumed accurate were being corrected and updated.

Figure 2. A custom, hand-drawn map of effigy mounds incorporated in the Arboretum map.

Additional data that we would not have necessarily incorporated otherwise also was acquired through volunteered information from Arboretum community members. Wisconsin has a rich history of Native American burial and effigy mounds, eighteen of which are located in the Arboretum area. Traditionally on a project of this kind, if something of this nature were to be incorporated at all, a "team member" would be responsible for mapping these mounds. But by tapping into the knowledge and expertise of the public, our "team" was much bigger than those employed by the project. Instead of being limited to a stock shapefile or having to go out and survey the mound locations manually, we were able to add a community member's hand-drawn sketch of effigy mounds for the "History" section of the "Learn" scenario of the map (Figure 2). The inclusion of analog user-generated content opened potential authorship to an even larger group of people, and as a result, more content was generated. The buy-in that was so important from the map's inception had grown into something that gave user groups confidence in their contributions to the map.

Though cartographic or technological expertise was not a requirement of contributing community members, the map did benefit from the feedback of those who had domain-specific expertise. In one instance, a community member close to the project also happened to be a soil scientist. This community member generously volunteered to develop a generalized classification scheme for our soils layer based on information we had collected from the Natural Resources Conservation Service (Figure 3). In so doing, he provided us with scientific reasoning for the map's soil representation. An enormous benefit of how the map was built is that we are able to engage experts, through channels of communication established at the community meeting, on everything from history to biology.

Figure 3. A soil color scheme developed by an Arboretum community member.



CONTROLLED CONTRIBUTIONS

WHILE IT WAS IMPORTANT FOR THE CORE TEAM TO ASSERT CARTOGRAPHIC EXPERTISE, IT WAS EQUALLY IMPORTANT TO MAKE ROOM FOR PUBLIC CONTRIBUTIONS

Nearly everyone has the ability to make a map, whether cognitively, on a napkin, or with high-tech software (Wood 2003). While it was important for the core team to assert cartographic expertise, it was equally important to make room for public contributions. We accomplished this through controlled inclusion of user contributions through specific online services. The contributions were controlled in basic ways (e.g., geographic extent, color choices, appropriateness of topic) to keep the map from becoming cluttered or incoherent. One of the more novel approaches taken in the development of this project was to allow users to add their own experiences to the map via Flickr and Google My Maps. There were two main benefits of this approach. First, we tapped into non-expert services to which many people likely had been exposed. Second, we offloaded development of these tools, so we did not need to build in a tool for uploading photos or drawing features. This aspect of the Arboretum Map is a mashup designed specifically for VGI. These tools make it possible for interested members of the public to become geographic sensors (Goodchild 2007b) for the Arboretum Map, giving it breadth and depth that a professional survey could not achieve.

The "Your Turn" scenario of the Arboretum map was designed for this purpose; it is the key to maintaining community ownership of the map. It allows community members to refer to expert content as needed, and reflect on their personal Arboretum experiences in a public forum. Users are encouraged to go to their Flickr accounts and apply a unique tag to

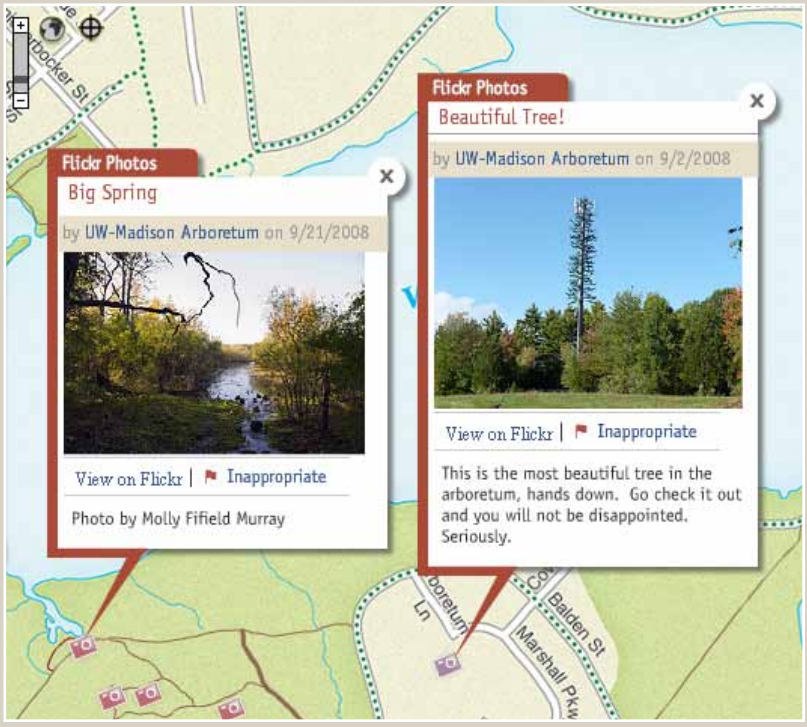


Figure 4. "Appropriate" (left) and "inappropriate" (right) user-generated photos. The "appropriate" photo shows a spring located on the Arboretum grounds; the "inappropriate" photo is labeled "beautiful tree!" but features a cellphone tower disguised as an evergreen located off of the Arboretum grounds.

geo-located photos taken within the Arboretum. Each time the Arboretum Map loads, it searches the Flickr server for photos with this tag and displays them in real time. Users are also given the ability to police content. In order to keep the map's photos from getting too off topic, we allow users to flag "inappropriate" volunteered content and alert the map's curators of its existence (Figure 4). This is similar to the "gate-keeping" model used by Craigslist, Wikipedia, and others for managing user-driven content.

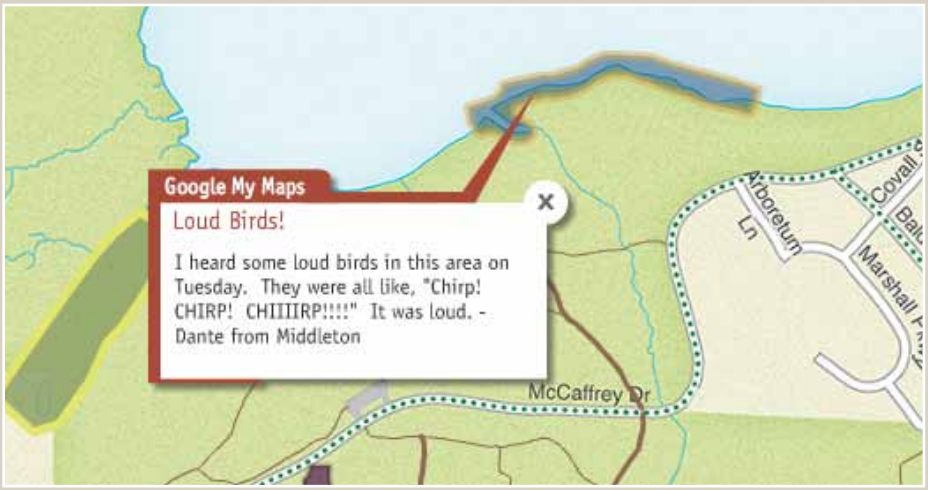


Figure 5. A user-generated experience on the Arboretum map via Google My Maps.

In addition to adding user-generated photos to the maps, we allow users to contribute other experiences in the form of spatial data. For many years, Arboretum naturalists have been recording their observations throughout the seasons, forming a valuable phenological record of Arboretum events. These notes contain a wealth of information on what visitors can expect to see and enjoy at the Arboretum at any particular time of the year. We wanted a way to tap into this knowledge base and view it on the map. The "Observations" section of the "Your Turn" scenario of the map allows users to make their observations available to the entire community in a few simple steps. If the user has an account with Google, the My Maps interface can be used to draw points, lines, or polygons to represent user experiences at the Arboretum. If a user has heard a particularly unique bird call in an area (Figure 5), decided on the best hiking route for beginners, or found a really great spot for fall foliage photos, they can follow directions for drawing them in Google My Maps. Then, as with the Flickr photos, these features will be added to the map.

WE PROVIDE THE CARTOGRAPHY

Not all authoring power can be relinquished to the public. Just as Google employs user-generated content and not user-developed search algorithms, we have allowed for user-generated experiences in the Arboretum Map, but not user-generated cartography. Though some studies have shown that active contributors in social computing are most often "well-meaning" (Goodchild 2007b), there is still considerable concern surrounding the credibility and veracity of volunteered geographic information (Flanagin and Metzger 2008). To extend digital map-making tools to the public may be a wholesale positive in a vacuum, but in application, it could prove problematic. Every member of the public cannot be expected to adhere to the same cartographic principles, nor can all "citizen sensors" be expected to agree on what is "appropriate" and what is "inappropriate" for the map. To that end, the Arboretum Map represents an attempt to democratize cartography, but only

in a specific way. We aimed to cultivate a major benefit of democratizing cartography: to increase the public's understanding of how maps, and the map-making processes they represent function as a means to communicate phenomena on the ground (Rød, Ormeling, and Elzakker 2001). While doing this, however, we limited the map-users' ability to drastically alter the map's mission.

WHILE FOSTERING PUBLIC PARTICIPATION IN THE CREATION AND MAINTENANCE OF THE ARBORETUM MAP, WE ALSO ASSERTED OUR EXPERTISE AS CARTOGRAPHERS

We were aware of these issues up front and aimed to keep all of our map content relevant and clear. While fostering public participation in the creation and maintenance of the Arboretum Map, we also asserted our expertise as cartographers. So while the style and appearance of base map tiles were discussed with the community, they were designed first and foremost based on cartographic principles. Similarly, layer combinations and organization were controlled by a team of cartographers. For example, scientific content about biodiversity was not made available to users under the "Go" scenario—the idea being that if someone is planning an afternoon jog, he or she may not want to be bothered with the locations of invasive species on the route.

Allowing users to draw in My Maps presented a unique cartographic dilemma, however, and this is where the assertion of cartographic expertise really came in to play. Should we allow users to submit their personal experiences in the form of a 70-color line drawing of their favorite paths? We thought not. Instead, we opted to develop a 21-color palette that was compatible with the pre-designed Arboretum map base tiles. This palette now acts as a filter, or on-the-fly 'map brewer' (Brewer 2003), forcing all color options from My Maps to the closest approximation that will suit the base tiles in the Arboretum map (Figure 6). So, if users draw their points, lines and polygons in bright red, hot pink, or a sickly yellow, the Arboretum map reads their RGB values and automatically converts them to more appropriate colors for the map. In essence, we give the users a general choice of color, but we guide that choice based on simple cartographic principles.

Figure 6. The Google My Maps Color Palette (left columns) and its Arboretum map color equivalents (right columns).

SETTING THE MAP FREE

The Arboretum map was built using technologies that are not familiar to all Geographic Information Scientists and Cartographers, let alone public users of online maps. Adobe Illustrator and Photoshop are relatively mainstream, but add Flash, KML, and XML to the mix and things tend to get complicated for most people. Because our aim was to retain users as contributors and hand off the map to Arboretum staff as curators, we recognized that it was imperative to build a flexible and approachable infrastructure for the map. This way, when the map was "complete" from our point of view, its life was really just beginning.

By marrying Flash with XML, we were able to eliminate the need for the map curator to be a programmer. Aside from major design changes, the map can be maintained and updated in a simple text editor. Layer visibility, order, and structure can be altered, narratives can be edited, and hyperlinks added all outside the Flash integrated development environment. One example of this could be the mapping of a "Hike of the Month." At the same time, additional layers can be developed and added through several methods: Google My Maps, manual KML production, or a KML conversion tool (from any kind of spatial database). Technically, the map curator does not even need to own (let alone employ) professional GIS or graphics software.

THE FLEXIBLE INFRASTRUCTURE WE CREATED ALLOWED US TO LITERALLY SET THE MAP FREE WHEN IT WAS COMPLETE

The flexible infrastructure we created allowed us to literally set the map free when it was complete. All future updates and maintenance to the map can be tackled easily by the Arboretum staff, pushing ownership and authorship of the map even further away from the experts and toward the community.

CONCLUSION

The University of Wisconsin—Madison Arboretum has a diverse and active community at the ready to help with the Arboretum's mission. When embarking on this project to make a map for the Arboretum's 75th anniversary, it was our goal as cartographers to tap into that community as much as possible. This would both relieve us of the expectation of expertise in multiple disciplines and give the public a sense of ownership and authorship of the Arboretum map.

Our efforts were just a small part of a growing trend in spatial technology to find a happy medium between professionally-generated content and crowd-sourced data. Google Maps has begun to allow users to edit locations, relying partially on local knowledge over remotely placed technicians. Google Goggles combines

professional image search technology with user-generated reviews, allowing users the ability to search for comments and reviews on products and places by simply taking a snapshot. Bing is also following this model, now merging their street-view level data with Creative Commons imagery via Flickr, creating a seamless three-dimensional environment from multiple sources. Many spatial tasks that had previously been reserved for highly motivated technicians have been opened up to a broader user base; editing OpenStreetMap, for example, once a highly complex task, has been simplified for the masses by developers at CloudMade. Edits can now be made via an uncomplicated graphical user interface called Mapzen.

The new University of Wisconsin—Madison Arboretum map strives to embrace this new trend. It is not loaded explicitly with expert content telling users how they "should" experience the Arboretum. By allowing users to post their own photos and experiences (and allowing a committee of user-gatekeepers to decide whether those photos are relevant), the map becomes a dynamic and rich environment for experiencing the Arboretum in ever-new and novel ways. Unless tapped into a live data feed, even animated and interactive maps become stagnant and outdated quickly after publication. But by giving the Arboretum community ownership of this map, it will continue to be as active and vibrant as the community that makes it.

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