Cartographic Perspectives

Journal of the

North American Cartographic Information Society

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From the Editor

As I look out over the synclinal valley unfolding below Big Savage Mountain I can already see spots of crimson, amber, and brown dotting the forested landscape. Autumn comes early to the mountains in Western Maryland and winter is not too far behind. There is a saying by those who live in Garrett County Maryland, which is located immediately west of Frostburg State University and is on the Appalachian Plateau, that "there are only two seasons here: July and winter." Of course, as autumn approaches, this change in seasons has different meanings to people. For the NACIS community, this means the next annual NACIS conference isn't too far distant. I hope you are making plans to attend this year's conference held in Missoula, Montana.

In this issue of *CP* you will find a mix of cartographic writings which I hope you will find interesting. For those of you in attendance at last year's NACIS meeting in St. Louis may recall of a broadside called *Right MAP Making* by Steven Holloway. Steven's broadside presents five precepts that "articulate the fundamental principles of ethical conduct in mapping & maps and to stimulate 'right action'" (Holloway 2007, http://www.tomake.com/future/fivewaystomakemaps.html). The broadside was printed on heavyweight paper and distributed at no cost to those interested at the St. Louis conference. I was one

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In this Issue

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The Cover

Title: The Wound

Steven R. Holloway
Artist & Mapmaker
toMake Studio & Press
www.tomake.com

Description of matrix and printing
Three-colour stone lithograph in an edition of eleven on Kawara with chine coleé on Someret Velvet White. 15" by 22". Editioned in the "Mapping the World" series of maps by toMake Press; edition #88. Printed at Kala Art Institute, Berkeley, California by the artist 2007. The edition is limited to eleven prints signed as: E.V. 1/11 to E.V. 11/11 and to 3 trial prints signed as T.P. 1/3 to T.P. 3/3.

1. Stone lithograph drawn with asphaltum and shop black dripped over two stones one on top of the other with a lithotine wash done in response to the east bay creeks flowing beneath the asphalt street structure. Editioned in Crayon Black and Green toner in March 2007.
2. Stone lithograph drawn with asphaltum in Shop Black mix and alchohol on K-16. Editioned in Ma!e Black in October-November 2007.
3. Stone lithograph placed below the first stone drawn at the same with the asphaltum and shop black drip. Editioned in Fire Red and Crayon Black in November 2007.
4. Monoprinted. Kawara lithograph trimmed back to a full bleed of 11" by 16.25." The top edge is hand dipped through Sun Red and Litho Varnish #3 in November 2007.

Source material and Client
Source: direct observation of the east bay system of streets and creeks from walking and biking by the artist. Client: independent artist.

Inspiration
The experience of stopping to observe the place.

Location and Discussion
East Bay, San Francisco Bay, the creeks (otherwise the EBMUD: East Bay Municipal Utility District). Formally free creeks flowing down from the Oakland Hills into San Francisco Bay part of the oak and redwood lined valleys and marshes but now confined and su"ocating beneath the asphalt of street networks, vehicles and storm drains. The Wound" refers to the bleeding of life from this once complex, dynamic and interwoven flow of water asking, begging, to be daylighted and restored.

Website
www.tomake.com

(*letter from the editor continued*)

of the many who took a copy of the broadside home. I distributed the broadside to students in my advanced cartography class which resulted in discussion and comments. If you haven't seen the broadside and read its contents I encourage you to do so by visiting the URL listed above as this forms the basis of two opinion pieces in *CP*. The first two pieces in this issue are opinions expressed in a point – counterpoint of sorts. Mark Denil took time to consider the meaning and implications of *Right MAP Making* and wrote a response. I offered Steven Holloway the opportunity to give a reply to Mark's comments. Steven's reply is included in this issue as well.

Following these opinion pieces are the featured articles. The first article entitled *Addressing Map Interface Usability: Learning from the Lakeshore Nature Preserve Interactive Map* is written by Robert Roth and Mark Harrower. This article focuses on the ever present usability issue that is central to many online mapping products. The second article entitled *Automation and the Map Label Placement Problem: A Comparison of Two GIS Implementations of Label Placement* is penned by Jill Kerns and Cynthia Brewer. Anyone who has spent time placing text via a computer will be interested in reading this article. As we read in their paper, automation has certainly brought about many time saving shortcuts in text placement and seems to perform reasonably. Next in this issue are the individual sections. Inside the Cartographic Collections section there is an article by Christopher Winters. His article, entitled *Building a Web Site at the University of Chicago Map Collection*, discusses the trials and tribulations involved in the development of the Univer-

(*continued on page 4*)

(*letter from the editor continued*)

sity of Chicago Map Collection's Web site. The Mapping Methods and Tips section includes an interesting piece from Michael Peterson entitled *Choropleth Google Maps*. In its most rudimentary form, Google Maps is a very common online mapping application that assists people where a specific address, for example, is located. However, there is considerable potential in the variety of cartographic applications to which Google Maps can be put. This article describes one such application: choroplath maps. In this article, a map mashup is discussed that can be implemented to create choropleth maps using Google Maps. While simple in concept, the implementation of this choropleth map mashup process is not necessarily trivial. However, Michael Peterson presents us with a concise overview for those curious enough to venture into the world of creating choropleth map mashups in Google Maps.

A few items of note will close out this letter. First, I am very happy to report that the scanning and digitization process of old issues of *CP* has been given the green light. This is the first step in making older issues of *CP* available to the broader NACIS community that may not have access to a specific electronic database subscription available through, for example, a university library. The digital collections/document preservation people at the University of Wisconsin Libraries are going to take paper copies of old issues of *CP* (reportedly, the first 30 issues), break them apart, and scan them in so that they will eventually be available in electronic format. When this process is complete, users should be able to view each issue in its entirety and if desired, download it in PDF format. The scanning process is slated to begin this fall. I will keep you updated as this project continues. Second, article submissions to *CP* have picked up considerably since the last issue was put in the mail. I can say that content for the next two issues looks pretty good. However, we should not become complacent in this fact as the journal's future is always tenuous. The health of *CP* is solely based on continued submissions from the cartographic community and beyond. I encourage each of you to consider *CP* as the publication outlet for your peer-reviewed papers, opinion pieces, information on map libraries, mapping methods and techniques, and visual fields. I know there is much that is happening in the mapping world out there. *CP* and its readership would like to hear about it.

I offer this issue to you for your contemplation and reading pleasure. I welcome your questions, comments, and discrepancies.

Manifestos

Mark Denil
Cartographer at Large
mark_denil_maps@hotmail.com

At the 2007 NACIS conference, Steven R. Holloway displayed and distributed a letterpress broadsheet/ poster titled *Right Map Making*. The text was a manifesto, of sorts, setting out five precepts the author "intended [would] articulate the fundamental principles of ethical conduct in mapping & maps and to stimulate 'right action'" (Holloway 2007, http://www.tomake.com/future/fivewaystomakemaps.html).

Several NACIS-ites traveled home from Saint Louis with one or more copies of this broadsheet under their arms, and some may have gone so far as hanging one on a wall once they were there. One wonders how many of these people read or subsequently re-read the entire text, and what they made of the whole idea. Cartography has not, traditionally, been a realm where one encounters manifestos. Controversy in our field has generally been hidden under a blanket of purported objectivity and dispassion, while a manifesto is, by definition, a vehicle for proselytization and declamation. While maps (the things most map makers spend most of their time making) can play a part in stoking a call to action, it is relatively seldom that the call to action comes from the mappers themselves, and the mappers generally seem uncomfortable when such calls come. The memory of Arno Peters proselytizing over the (unmitigated?) Gall/Peters projection might be a case in point, although that blast came primarily from outside the cartographic community.

Manifestos have gone in and out of fashion over the years (mostly, if truth be told, out), but nonetheless they have at times been the clarion call of monumental changes. When Parisians opened their *Le Figaro* on 20 February, 1909, and read:

> We have been up all night, my friends and I, beneath mosque lamps whose brass cupolas are bright as our souls, because like them they were illuminated by the internal glow of electric hearts. And trampling underfoot our native sloth on opulent Persian carpets, we have been discussing right up to the limits of logic and scrawling the paper with demented writing . . . .
> (F.T. Marinetti. 1909. "First Futurist Manifesto" http://www.cscs.umich.edu/~crshalizi/T4PM/futurist-manifesto.html)

did they realize they had read the opening lines of the birth announcement for all twentieth century art?

There have been other manifestos of significance as well. Thus begins another:

> When in the Course of human events it becomes necessary for one people to dissolve the political bands which have connected them with another and to assume among the powers of the earth, the separate and equal station to which the Laws of Nature and of Nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation. ...
> (Jefferson, et.al. 1776. *Declaration of Independence*. http://www.ushistory.org/declaration/document/)

Mr. Holloway, then, is in good company, even if he is not proclaiming the shifting of all paradigm and convention; his is not of the stamp of that manifesto which begins, "A spectre is haunting Europe . . ." (Marx and Engels. 1848. *Communist Manifesto*.). His manifesto is simpler, shorter (certainly), and directed not at society at large, but at certain people engaged in certain practices. One assumes, good *CP* reader and maker of maps, that he is addressing you and me, and that he intends his precepts to shape our practices and our maps.

Right Map Making has been placed before us, whether as a guide, as a challenge, or as a lone crazed voice crying in the street one must decide for oneself. Still, it may be useful to examine Mr. Holloway's manifesto, and to compare it to others of similar ilk. As it happens, an appropriate comparison can well be made between *Right Map Making* and the two existing versions of the design manifesto, *First Things First*. This paper will attempt both the examination and the comparison. We should begin by reviewing the text of *Right Map Making*.

Right Map Making

"The most obvious characteristic of our age is its destructiveness."
T.H. MERTON

THE PROBLEM for the maker of maps being that our maps are, in part, engaged in the active and wanton destruction of the world. Thus AWAKENED, we VOW to take the right effort & engage in cartographic disobedience, map making "for a future to be possible" T.N.HANH. Unacceptable it is not to ACT.

Five Ways to MAKE MAPS for a future to be Possible

REVERENCE; *the first precept of right map making*

From the awareness that our maps are, in part, responsible for the great and unnecessary destruction of life taking place in the world today. We vow to map and comment on spatial relationships in a manner non-harming, with reverence and with respect, and to reflect and reveal the beauty of life in a manner non-objectified, where the economic, the non-economic, and the unseen elements are given voice. We vow to recognize and incorporate story with the arguments on our maps. In agreement with M. Gandhi's "first . . . non-cooperation with everything humiliating," we vow to refrain from economicism, the objectification of sentient beings, and cartographic pornography. Such mapping and maps reflect agreement with the first principle of right action: REVERENCE.

THE PRACTICE of GENEROSITY; *the second precept*

From the awareness that our maps are, too often, in our self-interest, greedy consumptions of endless desire, human biased and nationalistic. We vow to engage in a mapping of that which desires to be mapped and shared, not taking that into map form that which does not belong to us, desiring to remain unmapped. We vow to be generous to all sentient beings on our maps and in our mapping. Where generosity is also the courage to leave blank on the page that which does not belong to us, not mapping to take what is not ours, and honoring the sanctity of the commons. Leviticus: "fields are not to be reaped to the border." Such mapping and maps show agreement with the second principle of right action: GENEROSITY.

COMMITMENT TO THE RELATIONSHIP WITH THE PLACE; *the third precept*

From the awareness that our maps are, in part, reflective of a lack of relationship and commitment to the place in which we reside and map. We vow to resist the temptation to map places with which we have no intimate or committed relation. We seek to remember and honor our relationship to the place; mapping with an honesty of lines, colours, and shapes, the naming of places, the unnaming as well, without gossip or intent to harm, or to divide, but rather with a clarity of intent to all sentient beings with whom we are committed to with & in the relationship. Such mapping and maps show agreement with the third principle of right action: COMMITMENT TO THE RELATIONSHIP WITH THE PLACE.

DEEP LISTENING THROUGH DIRECT-CONTACT & STOPPING; *the fourth precept*

From the awareness that our maps are, in part, a failure to deeply listen and have been made without stopping to directly contact and listen to the place we are mapping. We vow to refrain from mapping what we do not know to be the truth, to first stop to experience the interconnected, ever-changing and interwoven space we are privileged to map. These maps acknowledge the intimate Other, the desire for the awakened heart and mind with & in direct contact with the place itSelf. Such mapping and maps show agreement with the fourth principle of right speech: DEEP LISTENING THROUCH DIRECT-CONTACT AND STOPPING.

ON BELONGING TO ONE BODY; *the fifth precept for a future to be possible*

From the awareness that our maps are, in part, disconnected from the body of the earth. How can this be? Kabir says, "Whose Body is it anyway?" We vow to make our maps about the body living, our own body, the body in motion, ever-changing and interconnected, the body free from addiction and enslavement to the toxicity of drugs,ownership, objectification, disconnection, greed, capitalism, all the isms. We vow to map that delight in the body that serves to reduce suffering and misery. Maps, and the making of maps that respect all sentient beings, the living breathing air, the changing clouds, and the wind and the tides in motion, the soils, the interwoven rocks, the waterways and the water bodies entwined & circling, mountains rising & falling, compost building. Maps respecting and awakened to belonging to the OneBody without separation. Such mapping and maps show agreement with the fifth principle, oikos as the ecologic, economic and ecumenical whole of right livelihood: BELONGING TO ONE BODY.

We see that the five precepts are:
Reverence
The Practice Of Generosity
Commitment To The Relationship With The Place
Deep Listening Through Direct-Contact & Stopping
Belonging To One Body

These seem, on their face, to all be good and laudable attributes: reverence, generosity, commitment, listening, belonging. They would be welcome to find in a marriage, and one imagines they would be welcome precepts in a map-making practice, but one wonders just how these somewhat abstract precepts would be manifested in that practice? The text does not say.

The text does refer to shortcomings that would be corrected by implementation of the positive precepts. In fact, there are some very serious charges leveled against map making in *Right Map Making*. For instance, it says that maps are "responsible for the great and unnecessary destruction of life taking place in the world today." They are not only "greedy consumptions of endless desire, human biased and nationalistic," but they are also "reflective of a lack of relationship and commitment to the place in which we reside and map." Furthermore, they are "a failure to deeply listen and have been made without stopping to directly contact and listen to the place we are mapping," and, to top it all, they are "disconnected from the body of the earth."

These are profoundly disturbing charges.

The charges are also disturbingly vague. How exactly are "our maps" responsible? How are they greedy? In what way do they fail to listen? How are they disconnected? How at all, let alone "too often," or "in part"? That is hard to say; the text itself says little about how, but only focuses on an awareness of the existence of these purported facts. It assumes the existence of the facts, assumes the awareness, and, significantly, it assumes the locus of the shortcoming.

Each precept discussion begins with the formula: "From the awareness that our maps are . . . .. This formula clearly pins each problem squarely on "our maps." Is this realistic? Have our maps run amok? Have the maps seized control and placed the Smurfs in charge? This seems problematic; it would seem to deny human agency and human responsibility, but that is not quite so. This is because, at the same time, this shortcoming of our maps can be corrected by improving ourselves: WE are making destructive maps because WE are imperfect. We must seek the better way, this somewhat ambiguous five-fold way. Somehow, too, this is a way of "cartographic disobedience," but disobedience to whom, or to what? It is all very unclear.

The ambiguity is centered, it would seem, on the prayerlike form the manifesto takes. It opens with a quotation from a Catholic mystic and proceeds to insert a single, disembodied phrase from another mystic source ("for a future to be possible") into its preamble. The prayerishness of *Right Map Making* becomes even clearer when one encounters the companion *Vow of the Bodhisattva as MAP Maker* (Holloway, http://www.tomake.com/future/vowbodhisattva.html), but, as discovered in *Right Map Making* itself, the mystic overtones are not, at first, so apparent. Still, the problem as forwarded by *Right Map Making* is a personal problem, and a problem of sin.

That is problematic as a guide for action. Mapping, as a professional activity, is transactional: We make maps for clients with their own agendas, and we make maps for users who will read into and onto our maps narratives and understandings of their own. A map that honors the land and respects the people who do not desire to be mapped can still be used to facilitate a mountaintop removal.

This is not to deny that problems, even the very problems to which *Right Map Making* alludes, exist. The difficulty lies rather in the way the problems are framed and presented: What should be a sharp and focused reflector is more of a fun house mirror.

Generally, manifestos identify problems and lay out the causality of agency and correction more specifically than this. We should look to the *First Things First* graphic design manifestos for a model of what a workable, actionable manifesto can be.

In 1964, British designer Ken Garland first issued his manifesto titled *First Things First*. Dashed off during a meeting of the Britain's Society of Industrial Artists, and declaimed from the podium at the meeting's close, it was met with prolonged applause. Signed by twenty-one of his colleagues, it was first published in an edition of 400. *First Things First* was an appeal to graphic designers to reject the lure of advertising and high-pressure selling in favor of what was defined as socially useful graphic design work. It came at a time when design was evolving into a professionalized industry, and the frenetic, screaming, saturating tsunami of branding, selling, and advertising which has engulfed our society today was just beginning in Britain and Europe, and was still in its early stages in North America. Many designers were disturbed by the way their craft was changing, and *First Things First* pointed to a criteria for judging the validity of practice. Not everyone welcomed the manifesto, and much (but certainly not all) of the established design industry was openly hostile to the manifesto's denunciation of trivial, commercial design work. Nonetheless, news of the manifesto spread, and copies and translations proliferated across Europe, Britain, North America, and around the world.

As Andrew Howard wrote in an article titled: "There is Such a Thing as Society" that appeared in Issue 13 (Summer 1994) of the design journal *Eye*:

> It is crucial that we recognize that there is a direct correspondence between the condition of our culture and the ways we organize the production of materials. The form of economic organization we refer to as capitalism ceased long ago to be simply that, and has become a means of organizing the consciousness necessary for that economic system to flourish. As designers whose work is concerned with the expression and exchange of ideas and information and the construction of the visual vocabulary of day-to-day culture, we must establish a perspective on where we fit into this scheme. We must ask in what ways our function helps to organize consciousness. We must also discover to what extent and in what ways the solutions, vocabularies, and dialogues that we are able to conceive and construct are determined for us. The *First Things First* manifesto was an attempt at least to address these issues. (http://www.eyemagazine.com/feature.php?id=42&fid=53)

First Things First 1964: a manifesto

> We, the undersigned, are graphic designers, photographers and students who have been brought up in a world in which the techniques and apparatus of advertising have persistently been presented to us as the most lucrative, effective and desirable means of using our talents. We have been bombarded with publications devoted to this belief, applauding the work of those who have flogged their skill and imagination to sell such things as: cat food, stomach powders, detergent, hair restorer, striped toothpaste, aftershave lotion, beforeshave lotion, slimming diets, fattening diets, deodorants, fizzy water, cigarettes, roll-ons, pull-ons and slip-ons.
>
> By far the greatest effort of those working in the advertising industry is wasted on these trivial purposes, which contribute little or nothing to our national prosperity.
>
> In common with an increasing number of the general public, we have reached a saturation point at which the high-pitched scream of consumer selling is no more than sheer noise. We think that there are

other things more worth using our skill and experience on. There are signs for streets and buildings, books and periodicals, catalogues, instructional manuals, industrial photography, educational aids, films, television features, scientific and industrial publications and all the other media through which we promote our trade, our education, our culture and our greater awareness of the world.

We do not advocate the abolition of high-pressure consumer advertising: this is not feasible. Nor do we want to take any of the fun out of life. But we are proposing a reversal of priorities in favour of the more useful and more lasting forms of communication. We hope that our society will tire of gimmick merchants, status salesmen and hidden persuaders, and that the prior call on our skills will be for worthwhile purposes. With this in mind we propose to share our experience and opinions, and to make them available to colleagues, students and others who may be interested.

Signed:

Edward Wright	Geoffrey White	William Slack
Caroline Rawlence	Ian McLaren	Sam Lambert
Ivor Kamlish	Gerald Jones	Bernard Higton
Brian Grimbly	John Garner	Ken Garland
Anthony Froshaug	Robin Fior	Germano Facetti
Ivan Dodd	Harriet Crowder	Anthony Clift
Gerry Cinamon	Robert Chapman	Ray Carpenter
Ken Briggs		

(http://www.xs4all.nl/~maxb/ftf1964.htm)

The editors of the Canadian journal *Adbusters* re-discovered the *First Things First* manifesto through that "There is Such a Thing as Society" *Eye* article, and re-published it in 1998. The editors then, in consultation with the late Tibor Kalman and the original author, Ken Garland, decided to update and renew the declaration as *First Things First Manifesto 2000*. This new manifesto appeared in the Autumn 1999 issues of *Adbusters*, *Emigre,* and the *AIGA Journal* in North America, in *Eye* and *Blueprint* in Britain, in *Items* in the Netherlands, and in *Form* in Germany.

According to the editorial accompanying the new manifesto in *Eye*:

> The aim is to stimulate discussion in all areas of visual communication–in education, in practice, in the organizations that represent design's aspirations and aims–as well as outside design. The changing relationship of advertising, graphic design, commerce and culture poses some profound questions and dilemmas that have recently been overlooked. If anything, these developments are accepted as an unproblematic fait accompli. (Barnbrook, et al. 1999. "First Things First Manifesto 2000." *Eye* 33, Autumn. http://www.eyemagazine.com/feature.php?id=18&fid=99)

First Things First Manifesto 2000

We, the undersigned, are graphic designers, art directors and visual communicators who have been raised in a world in which the techniques and apparatus of advertising have persistently been presented to us as the most lucrative, effective and desirable use of our talents. Many design teachers and mentors promote this belief; the market rewards it; a tide of books and publications reinforces it.

Encouraged in this direction, designers then apply their skill and imagination to sell dog biscuits, designer coffee, diamonds, detergents, hair gel, cigarettes, credit cards, sneakers, butt toners, light beer and heavy-duty recreational vehicles. Commercial work has always paid the bills, but many graphic designers have now let it become, in large measure, what graphic designers do. This, in turn, is how the world perceives design. The profession's time and energy is used up manufacturing demand for things that are inessential at best.

Many of us have grown increasingly uncomfortable with this view of design. Designers who devote their efforts primarily to advertising, marketing and brand development are supporting, and implicitly endorsing, a mental environment so saturated with commercial messages that it is changing the very way citizen-consumers speak, think, feel, respond and interact. To some extent we are all helping draft a reductive and immeasurably harmful code of public discourse.

There are pursuits more worthy of our problem-solving skills. Unprecedented environmental, social and cultural crises demand our attention. Many cultural interventions, social marketing campaigns, books, magazines, exhibitions, educational tools, television programmes, films, charitable causes and other information design projects urgently require our expertise and help.

We propose a reversal of priorities in favour of more useful, lasting and democratic forms of communication--a mindshift away from product marketing and toward the exploration and production of a new kind of meaning. The scope of debate is shrinking; it must expand. Consumerism is running uncontested; it must be challenged by other perspectives expressed, in part, through the visual languages and resources of design.

In 1964, 22 visual communicators signed the original call for our skills to be put to worthwhile use. With the explosive growth of global commercial culture, their message has only grown more urgent. Today, we renew their manifesto in expectation that no more decades will pass before it is taken to heart.

Signed:

Jonathan Barnbrook	Nick Bell	Andrew Blauvelt
Hans Bockting	Irma Boom	Rudy VanderLans
Bob Wilkinson	Max Bruinsma	Siân Cook
Linda van Deursen	Chris Dixon	William Drenttel
Gert Dumbar	Simon Esterson	Vince Frost
Ken Garland	Milton Glaser	Jessica Helfand
Steven Heller	Andrew Howard	Tibor Kalman
Jeffery Keedy	Zuzana Licko	Ellen Lupton
Katherine McCoy	Armand Mevis	J. Abbott Miller
Rick Poynor	Lucienne Roberts	Erik Spiekermann
Jan van Toorn	Teal Triggs	
Sheila Levrant de Bretteville		

What was the effect of the *First Things First Manifesto 2000* on the world? Certainly, there has been no epiphany in graphic design; no great turning away from the more debased forms of advertisement-based design. Nonetheless, it has served as a rally point, a day mark or beacon for anchoring other calls and other actions. It has established itself as a position to be reckoned with: Designers cannot simply pretend there is no other road.

> Design is not just an "industry": it goes to the heart of what it means to be human. The ability to use our creativity to transcend our limits as individuals and as a society is surely needed now more than ever [. . . .]
>
> One of the most organized expressions of designers' collective desire to do the right thing is the *First Things First* manifesto [. . .], which pointed to a different set of priorities for graphic designers. The revived *First Things First 2000* (see *Eye* no. 33 vol. 9, 1999) created a stir, but that was eight long years ago. The time for pledges has gone and it is time for action. Graphic communication cannot be limited to the process of selling commodities; it is a powerful tool for both re-imagining the world, and expressing the truth of our situation [. . . .] (Noel Douglas. 2007. "Whose Space?" *Eye* 66, Winter. http://www.eyemagazine.com/feature.php?id=152&fid=657)

In both versions of *First Things First*, there is a clear and unambiguous setting of the stage. Each says, there is *this* problem, caused by *these* forces and circumstances; *this other* set of concerns are more important and more deserving of our attention and expertise. In the manifestos there is established a conception of *design as marketing* set against an antithesis of *design as communication*: design to *create desires* against design to *meet needs*. Through this dichotomy is forwarded a plan of action that privileges the second term and counters the prevailing paradigm's myopic focus on the first.

The situation laid out in *Right Map Making* is, by contrast, more diffuse. It sets forth the position that something is rotten, somewhere, and we should stop doing it and try to be better. The opposition it sets up is of *mapping as alienated* verses *mapping as connected* and, frankly, equates the former with evil and the latter with good without offering much in the way of explanation or justification. All we are left with as guidance are the worldviews we already hold. Both the evils and the curing precepts remain in the eye of the beholder, to each be defined any which way. There is nothing in *Right Map Making* that can compare to Tibor Kalman's call: "Designers . . . stay away from corporations that want you to lie for them" (Kalman. Quoted in *Adbusters* 27, Autumn 1999, back cover).

How are consequences approached in these manifestos? *First Things First* addresses them rather plainly: Designers are helping build ". . . .a mental environment so saturated with commercial messages that it is changing the very way citizen-consumers speak, think, feel, respond and interact. To some extent we are all helping draft a reductive and immeasurably harmful code of public discourse" (*First Things First 2000*). Obviously, the danger anticipated is an erosion in the mental environment, brought about by a poisoned public discourse. *Right Map Making*, in its turn, speaks of an attempt to "make a future possible" (RMM). Not a good future, not a better future, but *any* future. The opposite of any possible future is no future whatsoever. That is dire indeed, but how would this loss happen? The manifesto is silent on this point.

Conclusion

What, in the end, can be said of *Right Map Making*? Clearly, it falls a bit short in terms of a manifesto for better practice, but it is far from worthless or pointless. Mr. Holloway is pointing to some real problems, although his indicating gestures are a bit inscrutable. He is proposing some valid and wholesome precepts, albeit somewhat obscure ones open to a good deal of interpretation. Taken as a whole, or ingested only in parts, *Right Map Making* is a sort of theological text; its value may lie more in the discomforts of digesting it than in its actual pronouncements.

There is, clearly, a place for a manifesto of map making. In this era of not only ubiquitous maps but of ubiquitous map making, there are few guideposts to assist individual map makers in grappling with the very serious fundamental questions. There are lots of books on using software, quite a few technical map-making manuals, a few good theoretical assessments, and a whole lot of chatter on cartographic message boards, but very little to answer the question, "Should I do as I am asked?" Cartographers have, on the whole, rather ignored that question. In a large part, it could be because there is a real coincidence and identification of the end, interests, and ideologies between the mapmakers and their employers or clients. Ambivalence is a useful refuge and camouflage, and few cartographers are in much of a position to disagree with their masters. Nonetheless, it is important for each individual mapmaker to look at her situation and ". . . discover to what extent and in what ways the solutions, vocabularies, and dialogues that we are able to conceive and construct are determined for us" (Howard, 1994, *Eye* 13, Summer. http://www.eyemagazine.com/feature.php?id=42&fid=53) and just what we think of the world we are helping create.

Graphic designers have had to do this, although it was and is still a struggle and effort. It is far easier to think in terms of tasks and deadlines than in terms of right and wrong. As Rick Poynor remarked in his *Adbusters* introduction to *First Things First 2000*:

> When the possibility is tentatively raised that design might have broader purposes, potential and meanings, designers who have grown up in a commercial climate often find this hard to believe. "We have trained a profession," says [Katherine] McCoy, "that feels political or social concerns are either extraneous to our work or inappropriate." (Poynor. 1999. "First Things First: A Brief History." *Adbusters* 27, Autumn 1999, 56)

The cartographic profession, on the whole, is very much the same—in spades.

Poynor further observes that:

> What's at stake in contemporary design, the artist and critic Johanna Drucker suggests, isn't so much the look or form of design practice as the life and consciousness of the designer (and everybody else, for that matter). She argues that the process of unlocking and exposing the underlying ideological basis of commercial culture boils down to a simple question that we need to ask, and keep on asking: "In whose interest and to what ends? Who gains by this construction of reality, by this representation of this condition as 'natural'?" (Poynor. 1999. "First Things First: A Brief History." *Adbusters* 27, Autumn 1999, 56)

is apt as well, and speaks directly, it would seem, to the concerns raised in *Right Map Making*. At its core, one can discern in *Right Map Making* the key questions as framed above by Drucker: "In whose interest and to what ends? Who gains by this construction of reality, by this representation of this condition as 'natural'?" (Drucker, quoted in Poynor. 1999. "First Things First: A Brief History," *Adbusters* 27, Autumn, 56), but they are obscured by the prayer-like presentation.

It would appear, then, that *Right Map Making* is a good, noble, and necessary declaration, despite its mysticism and obscurities. It raises some questions, albeit obliquely; it offers some solutions, albeit cryptically. Maybe it can act as a jumping-off point for a sharper, more actionable manifesto. We need it.

Just to Make Clear "Where the Roots Come From": A Response to Mark Denil's "Manifestos"

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whatever you have to say, leave
the roots on, let them
dangle

And the dirt

just to make clear
where they came from

Charles Olson. 1973. "These Days," Archaeologist of morning]

"Right MAP Making: Five Ways to Make Maps for a Future to be Possible" needs to be practiced to be better defined, and this is more than I alone can give to it. It needs your help and effort. That said, I willaddress the dirt, to make clear "where the roots came from." The broadside draws its inspiration from Buddhist ethics, ecofeminist, and ecotheology theory, the deep ecology, conservation and wilderness movements, the beauty of the earth, water, blank spaces, the unconscious, the Beloved Other, Mozart, and a JOY and love both for and within the world it-Self. It follows from a personal practice of making maps, teaching art, observation, and cartography, and a love for the body of the earth. There are many pressing concerns in the world: sex, class, society, population, consumption, environment, water, and disaster, to name but a few. And it is important for the making of maps, responding to the spatial aspects of any one of these concerns, to address and to awaken, in the mapping itself, to ethical issues.

The broadside, "Right MAP Making" derives its form directly, after much consideration and many drafts over several years, from the Five Buddhist Precepts for laypersons. These are not dissimilar to the Jewish and Christian Ten Commandments and similar ethical works. Labeled as a manifesto, it aspires "to make public" the responsibilities of making maps. I think of it as a more personal credo or set of principles addressing the intention of ethical conduct on the part of the mapmaker, saying; "I believe," or "I aspire to map in this manner." Less as credo, it "*is intended to articulate the fundamental principles of ethical conduct in mapping and maps*"; it is an effort to initiate a discussion about the ethics of making maps and to remind us that our making is not isolated and without consequences.

The Five Buddhist Precepts are Not Killing, Not Stealing, Avoiding Sexual Misconduct, Not Lying, and Not Taking Drugs. The Vietnamese Zen

Buddhist Thich Nhat Hanh (1993) has translated these precepts using an affirmative voice as Reverence for Life, Generosity, Sexual Responsibility, Deep Listening and Loving Speech, and Diet for a Mindful Society (For a Future to Be Possible: Commentaries on the Five Mindfulness Trainings.). In addition to his own essay in this collection, there are contributions from fourteen other scholars and writers. The phrase "*for a future to be possible*" comes from the writings of Thich Nhat Hanh. The broadside uses the five ethical trainings for the layperson in the affirmative as "five ways to make maps." In this manner the five ways can be considered to form the foundation for a practice of right map-making, a form of right speech and right action.

All religions have ethical guidelines that work to form the basis for the functioning of society. I intentionally selected voices from each of the world's major religions to set this work in a spiritual context, because it is essentially a spiritual issue. I chose the specific form (the five lay Buddhist Precepts) for several reasons: because it was not the more familiar Christian one; because it could be easily stated in an affirmative, less preachy tone; because it was more neutral; and because it worked. Like the Ten Commandments, "*You shall not*," the Five Precepts are most often stated as "*Avoid*," or "*Not to*." I did consider a more lengthy manifesto with, "Hey, cartographers. Stop making maps that kill people," but I was inspired to be less critical, less judgmental, and, in composing this work, to use the personal, "*Thus awakened*."

"Thus awakened" implies that we are or have been asleep to something. In Mark Denil's reply to this broadside, he writes, "*It [the broadside] assumes the existence of the of the facts, assumes the awareness, and, significantly, it assumes the locus of the shortcoming*." I decided not to write a manifesto that would spell out the arguments, the rationales, my rationale, the shortcomings. I did not want pause at the doorway. I wanted to go right forward into the room where "best of all is to awake." I do not believe that we need to stand around a doorway of indecision. That something to which we have been asleep, that something if it indeed matters, is up to you, Reader: The great and unnecessary destruction of life? Greedy consumption of endless desire? Faceless violence from self-righteous anger? "*From the awareness that our maps are, in part, responsible.*" I could not agree more with Mr. Denil in stating that these "*are profoundly disturbing charges*." I meant them to be. But I want to stress here the words "in part" because Mr. Denil omits these in his restatement. "And thus awakened: unacceptable it is not to act."

> If it is good to live,
> then it is better to be asleep dreaming,
> and best of all,
> mother, is to awake.
>
> Antonio Machado. 1971. The Sea and the Honeycomb. Translated by Robert Bly.

The influential Catholic author and Trappist monk Thomas Merton opened his 1960 essay, "Theology of Creativity," with these lines: "*The most obvious characteristic of our age is its destructiveness. This can hardly be doubted*" [The Literary Essays of Thomas Merton, 1981). He continues, "*We must begin by facing the ambivalence which makes so much of our talk about creativity absurd because it is fundamentally insincere.*" His essay is on creativity, the theology of creativity, and as the makers of maps who enjoy the use of the words "art," "artistic," "creative," and "original" to refer to our maps, I recommend reading this thoughtful work. Cartography today is embedded in a changing but dominant paradigm, a pseudo-scientific, but not artistic, corporate worldview, where roads, boundaries, and structures often dominate. I do NOT wish to imply that such maps are not a practice of right map-making. Indeed there are many beautiful, inviting and thoughtful maps being produced from the technology of cartographic craft.

But this is not the right place to discuss art and the creativity of map-making. I used Merton's words as a doorway of sorts, as an invitation on this broadside about love. We cannot protect, bring wellbeing, or care for what we do not love (David W. Orr. 2005. Ecological Literacy: Educating Our Children for a Sustainable World, and 1992, Ecological Literacy: Education and the Transition to a Postmodern World). Nor can we engage in a practice of right map-making without loving the world.

> Let me say this before rain becomes a utility that they can plan and distribute for money. By "they" I mean the people who cannot understand that rain is a festival, who do not appreciate gratuity, who think that what has no price has no value, that what cannot be sold is not real, so that the only way to make something actual is to place it on the market. The time will come when they will sell you even your rain. At the moment it is still free, and I am in it. I celebrate its gratuity and its meaninglessness . . . .Nobody started it, nobody is going to stop it. It will talk as long as it wants, this rain. As long as it talks I am going to listen.
> (Thomas Merton. 1964. "Rain and the Rhinoceros." Raids on the Unspeakable)

Do you stand to make a nice profit on the rain in Brazil? I was pleased to see that Mr. Denil also addressed to this issue:

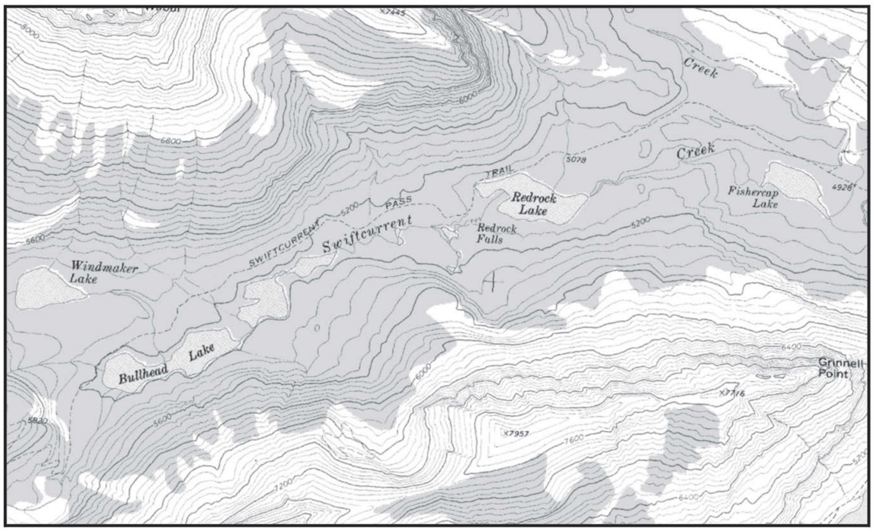
> There are lots of books on using software, quite a few technical map making manuals, a few good theoretical assessments, and a whole lot of chatter on cartographic message boards, but very little to answer the question, "Should I do as I am asked? Cartographers have, on the whole, rather ignored that question.

If you are waiting at the door, then you are waiting at the door. There are many invitations to enter into the new body. They could be these lines from the Buddhist scripture Sutta Nipata: *"Greed . . . is a great flood; it is a whirlpool sucking one down, a constant yearning, seeking a hold, continually in movement*." The question on the door—was there one? Is the client always right? Isn't their agenda also ours? These shortcomings—are they all that problematic? Best of all is to awake to the knowledge that our maps are, in part, responsible. "*Unless our waiting implies knowledge and action, we will find ourselves waiting for our own destruction and nothing more*" (Thomas Merton. 1964. "Letter to an Innocent Bystander." Raids on the Unspeakable).

Mr. Denil raises a good point in his observation that this "*is somewhat ambiguous*," and "*is all very ambiguous*." This is most clearly evident in my not having defined what I have intended by cartographic disobedience. Cartographic disobedience is to act with reverence and to refrain from a mapping that humiliates and objectifies the great beauty of life of which we are members. It is non-cooperation with such mapping. Paul W. Taylor (1986) does a good job of developing ethical principles of what it means "not to kill" (Respect for Nature: A Theory of Environmental Ethics*).* In part, this is to explore the spatial nature of the world as "I - Thou" and to question the "I – It" relationship (Martin Buber. 1970. "I and Thou") that, as John Cobb suggests, is the one religion in the world today, economism.

From the mid-seventeenth century to the mid-twentieth century nationalism was the dominant force in Western history. It took over from Christianity when Christian fanaticism plunged Europe into appalling and intolerable conflicts. The era of nationalism came to an end when it, in turn, plunged Europe and the whole world into appalling and intolerable conflicts. After World War II the institutions that rose to dominance were economic ones: The International Monetary Fund, the World Bank, and the General Agreement on Tariffs and Trade. Although the United Nations is a partial exception, it also devotes much of its attention to the global economy. When the heads of the most powerful nations gather, they call their meetings Economic Summits. Western Europe reorganized itself as the European Economic Community . . . . Economism is leading us into catastrophes even worse that the religious wars of the early seventeenth century and the Second World War in our own. The number of people who recognize this is increasing, and their passionate protests in the name of the Earth have gained some hearing .. . .

(John Cobb. 1998. "Economism as Idolatry." Religion Online)

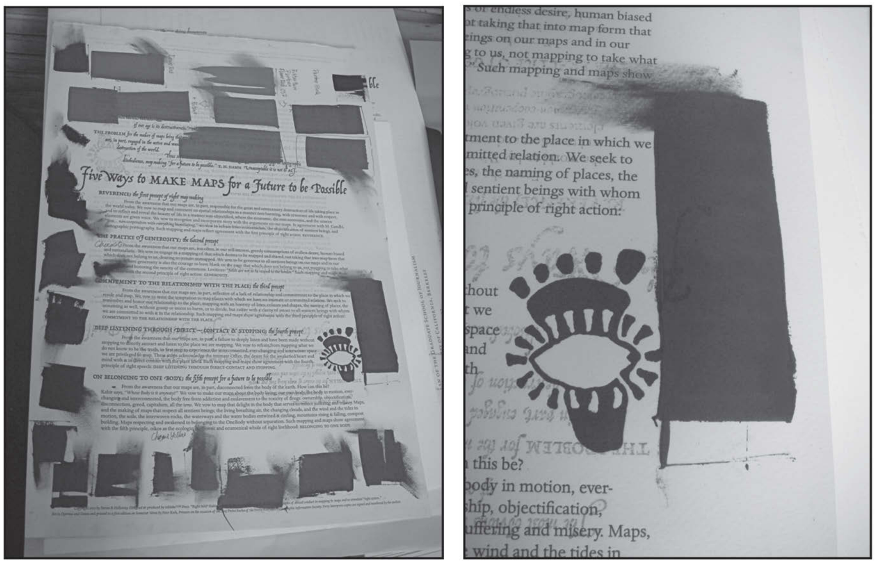


71/2 minute USGS Quad, northern Montana

Along the Highline trail in Glacier-Waterton International Peace Park

A map can communicate a lot, and our maps do, but all too often they remain imprisoned within the illusion and limitations that the dynamic polyphonic world of interrelated events is no more than what we see. A place is no more simply relief and place name than I rise five foot ten inches and am Steven R Holloway. I desire that I am known as more than this, and the earth likewise. What does it mean to tell the spatial story and communicate the spatial argument of a place with reverence? The possibility of mapping and maps can and should endeavor to do this. I do not want to suggest that maps be replaced with images because images do more, rather I am suggesting that the 'I – It' relationship all too often imbedded within the nature of the mapping craft and the maps of economism be replaced with the experience of the 'I – Thou.'

What does reverence mean in spatial terms? What does non-harming mean for a mapmaker? I used the words of the Hindu practitioner of non-violent action Mohandas K. Gandhi because I liked the simple and direct manner in which he addressed this issue. *"The first principle of nonviolent action is that of non-cooperation with everything humiliating."* [Non-Violence in Peace and War, 1948.] And economism, and maps, that enforce, objectify and divide, is just that, humiliating. Non-cooperation. Therefore: practice cartographic disobedience or resistance with everything humiliating. This is the first precept of right map-making.



Colour mixing draws for the broadside, this is not CMYK!

I am in favor of Robert Bly's "dropping the reader" and his "leaping poetry." This is a leaping broadside that avoids having the reader "*staggering along under lines swelled with the rhetoric of . . . in short, the world of prose*" (1971. Robert Bly. "Dropping the Reader." The Sea and the Honeycomb; see also Leaping Poetry, 1972.] I trust in the intelligence and curiosity of the reader. The broadside is an invitation to explore a space created by having been dropped. If you did reread the text, as Mr. Denil wonders, where did it drop you? The piece was intended as words, as colours, as texture, as image, as shape and size, as fonts, as physicality all polyphonic, all individual, all changing (e.g.,the edition varies), all "disturbingly vague" and all with many "purported facts."

The Commons. *"And when ye reap the harvest of your land, thou shalt not wholly reap the corners of thy field, neither shalt thou gather the gleanings of thy harvest"* (Leviticus 19:9. Old Testament. King James Bible). The corners of fields, vineyards, and olive groves were not to be reaped, and harvest accidentally left was to remain for the poor. Not to steal or take that which is not ours becomes, in turn, a practice of generosity. Not everything is ours to map, to name, to take and sell. There are places that desire to remain unnamed and unaccounted, "blank spaces on the map." This goes in the face of modern cartography, the history of mapping and surveying, of SUV ads, and the GPS-cell phone wilderness experience. This act of generosity in mapping is to abstain from mapping what is not ours to be mapped. How can we know? We can stop and listen. Years ago I wondered what it was like to canoe in the border lakes of Minnesota and Ontario without the knowledge that maps provided. I spent the winter visiting with Sigurd Olson, Robert Bly, Gary Snyder, and others in an effort to learn a new way, and in the following spring and summer I left my maps behind and explored the place in a new body. Delight is in the making of maps from direct observation and experience.

There are multiple kinds of maps serving a variety of purposes and needs, and my need to experience a place without a map is and results in one such mapping, mapping with and in. We, as professionals, need to do more of this kind of personal mapping. I rather like Edward S. Casey's *Four Ways To Map* (see "Mapping It Out With/in the Earth." Earth Mapping. 2005): mapping of, mapping for, mapping with/in, and mapping out. Cross-pollinate your bookcase. Get your feet wet? There is a balance somewhere between the map and the mapped and in leaving unmapped a blank space. Although I am personally in favor of the destruction of all maps, images, and remote sensing of off-road lands in designated Wilderness, National Park, and World Heritage sites, there is value in both the mapped and that left unmapped.

> "Everybody in the world is looking for something," said Jachin-Boaz to Boaz-Jachin, "and by means of maps each thing that is found is never lost again. Centuries of finding are on the walls and in the cabinets of this [map] shop."
> (Russell Hoban. 1973. The Lion of Boaz-Jachin and Jachin-Boaz)

Mr. Denil writes that there "*is nothing in Right MAP Making that can compare to Tibor Kalman's call*: "*Designers . . . stay away from corporations that want you to lie for them.*" I must take exception to this. Perhaps because I chose to avoid the "Do not lie" in favor of "deep listening," it escaped his attention that I was, in fact, addressing this very issue: "*We vow to refrain from mapping that which we do not know to be the truth . . . .*" Map that which you have stopped to take the effort to experience and love. Practice the generosity of mapping the economic and the uneconomic, practice the generosity of blank spaces, of fields not reaped to the border. Develop this ethical precept for mapping that addresses what it means not to steal, not to take that which is not ours.

> The smoke of my own breath,
> Echoes, ripples, buzz'd whispers, love-root, silk-thread, crotch and vine
> My respiration and inspiration, the beating of my heart, the passing of blood and air through my lungs,
> The sniff of green leaves and dry leaves, and of the shore and dark color'd sea-rocks,
> and of hay in the barn,

The sound of the belch'd words of my voice loos'd to the eddies of the wind,
A few light kisses, a few embraces, a reaching around of arms,
The play of shine and shade on the trees as the supple boughs wag,
The delight alone or in the rush of the streets, or along the fields and hill-sides.
The feeling of health, the full-noon trill, the song of me rising from bed and meeting the sun.

Have you reckon'd a thousand acres much? have you reckon'd the earth much?
Have you practis'd so long to learn to read?
Have you felt so proud to get at the meaning of poems?
Stop this day and night with me and you shall possess the origin of all poems,
You shall possess the good of the earth and sun, (there are millions of suns left,)
You shall no longer take things at second or third hand, nor look through the eyes of the dead,

nor feed on the spectres in books,
You shall not look through my eyes either, nor take things from me,
You shall listen to all sides and filter them from your self.

(Walt Whitman. 1892. "Song of Myself." *Leaves of Grass*)

The practice of right map-making is not about the questions that concern the shortcomings or even questioning "if we should do this." It is about the activities that surround right action and the practicing of right map-making. It is neither argument nor explanation. It is a doorway asking the questions of how do we as mapmakers develop and practice ethical principles and still pay the mortgage on our house. What rivers and mountains should be left unnamed, unmapped in the practice of generosity? How much a role should second- and third-hand information play in the construction of a map? What ways can we learn to listen to a place in the practice of deep listening? How do "belonging to one body" and land ownership or resource allocations co-exist? What does it mean "not to map that which is not ours to map?" It is a leaping, and where did you land, dear Reader? Right MAP Making may not, as Mr. Denil says, present the arguments, the problems, and the solutions but it was never intended to do this. I do not think that Right MAP Making is, as Mr. Denil eludes, "*a fun house mirror*." It was intended *"to articulate the fundamental principles of ethical conduct in mapping and maps, and to stimulate right action*." It was and it is intended to foster map-making not as a task, but as a response where "political, environmental, and social concerns are no longer extraneous or inappropriate." That we as cartographers need to consider this, Mr. Denil seems to agree. "The *cartographic profession, on the whole, is very much the same* [such political and social concerns being extraneous and inappropriate*]; in spades*."

To be a lay monk, exposed in the grayness of the world, is very difficult. Most laypersons today do not vow to practice all of the precepts, and there are more than five. They select one or two and commit to fully practicing these. As mapmakers we can also do this. Mr. Denil ends his comments in referring to the broadside as a jumping-off point. I could not agree more. By selecting one of the five ways" and practicing this in the making of our maps, we can help to bring clarity and understanding to the difficult and challenging issue of right action in the world today. We can become part of the assembly of mapmakers practicing right MAP making. We should all endeavor to act as coyote (Barry Gifford. 1967. “XLV.” Coyote Tantras).

Coyote drew a map
  of the world

He split it into three parts,
      forest, desert & plain,
        with rivers, streams & creeks
              running thru
  “What about the ocean?”
        askd Coyote’s woman

  “Well I ain’t never seen it,”
        answered Coyote,
  “and I can’t put down what
            I don’t know about!”

  That night Coyote left to find the ocean

Automation and the Map Label Placement Problem: A Comparison of Two GIS Implementations of Label Placement

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The placement of feature name labels on maps has challenged mapmakers throughout history. Before the development of mapping software, placing labels in manual map production could consume up to half or more of overall map production time. This paper explores the extent to which current GIS software can place labels legibly, without overlap, and with good visual association between features and labels. This evaluation takes place in the context of a densely featured municipal sewer utility map book. The primary research objective is to evaluate the ability of current GIS software to automate label placement; the research also identifies factors that make manual refinement of automated label placement necessary in order to complete the labeling process. The research compares map-labeling tools from ESRI ™'s ArcMap™ 9.2: the Standard Labeling Engine and the Maplex™ labeling extension. Label placement success is assessed by both quantity and quality metrics, using a methodology developed and tailored specifically for evaluation of sewer map label placement. The research found that Maplex placed almost seven percent more labels overall than the Standard Labeling Engine. For the labels they did place, both products provided equally good quality label placement: About 93 percent of labels were placed with no overlap, and virtually 100 percent of labels were placed in their preferred position. After conversion to annotation, manual label position refinement eliminated all overlaps but at the cost of a nine percent decline in the preferred position metric.

Key words: Map label placement, automated label placement, utility map labeling, map design, GIS mapping.

INTRODUCTION

The placement of feature name labels on maps has posed a significant challenge throughout cartographic history, consuming up to 50 percent or more of overall map production time (Yoeli 1972). Different types of features–point, line and area–involve different labeling challenges. Point features have received specific attention because of the difficulty of placing labels legibly and without overlap in densely featured maps while still maintaining unambiguous visual association of labels with their features (Hirsch 1982; Wu and Buttenfield 1991; Christensen, Marks, and Shieber 1995).

The literature on automation of map label placement presents three primary themes: rules for label placement, the development of automated algorithms applying those rules to maps, and the measurement of label placement quality when employing automated algorithms. Each of these

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themes is examined in turn in the sections that follow. The paper then describes research evaluating two current GIS tools for high-quality labeling in the context of production of a densely featured municipal sewer utility map book. The primary research objective is to evaluate automated label placement in commercial, off-the-shelf GIS software. The research also identifies factors that make manual refinement of automated label placement necessary in order to complete the labeling process.

"The primary research objective is to evaluate automated label placement in commercial, off-the-shelf GIS software."

Label Placement Rules

Imhof (1962, 1975) compiled an initial set of map label placement rules that have influenced the development of label placement automation from its earliest days. Imhof's guiding principles included legibility, clear association between labels and the features to which they apply, and avoidance of overlapping or obscuring other labels or other map features, while also satisfying aesthetic criteria. Imhof provided separate, specific rules and examples for point, line, and area features, as well as overall design considerations.

"Imhof (1962, 1975) compiled an initial set of map label placement rules that have influenced the development of label placement automation from its earliest days."

Freeman and Ahn (1987) revisited Imhof's rules for placing labels on maps with an eye to automating map annotation from a rule-based, expert system perspective. An expert system is "an artificial intelligence application that uses a knowledge base of human expertise . . . and a set of algorithms or rules that infer new facts from knowledge and from incoming data . . . to aid in solving problems. The degree of problem solving is based on the quality of the data and rules obtained from the human expert" (Howe 1996).

Freeman and Ahn expanded upon and modified Imhof's rules, creating a system of name placement rules applicable to automated labeling of point, line, and area features, while recognizing that an automated system must also allow flexibility in modifying or defining additional rules specific to particular applications. Area feature name placement being most difficult, Freemen and Ahn placed those labels first, followed by point and then line feature labels. They also permitted backtracking to resolve any overlaps that may have arisen.

"Freeman and Ahn expanded upon and modified Imhof's rules, creating a system of name placement rules applicable to automated labeling . . ."

Wood (2000) also extended Imhof's rules, supplying detailed rationale and sample illustrations regarding name placement for a variety of specific feature types not addressed by Imhof. For example, where Imhof provided general guidance on placement of areal feature names, Wood extended the discussion with specific suggestions for labeling lakes, islands and island groups, capes and points, channels, gulfs, bays, and lagoons.

Yoeli (1972) proposed a scheme to prioritize eight potential positions of labels around a point feature, with top priority for placement above and to the right of a feature (Figure 1). This is now considered standard practice in cartography texts (e.g., Robinson et al. 1995; Dent 1998; Slocum et al. 2005). Yoeli referenced Imhof and others as providing useful directions for placing point feature labels but does not offer specific support for his label placement position priorities. Imhof himself simply referenced Krummil and Eckert: "Where space allows, it is best to have the name beginning to the right of the symbol or sign" (Imhof 1975, 131). Freeman and Ahn (1987) provide the clearest rationale for preferring placement above and to the right:

"Yoeli (1972) proposed a scheme to prioritize eight potential positions of labels around a point feature, with top priority for placement above and to the right of a feature. This is now considered standard practice in cartography texts."

> It is preferable for the name to read away from the feature (e.g., for the first character to be the one closest to the feature), as this achieves the closest possible association between the feature and its name. Since in the English language there are more ascenders than descenders, it is preferred for a name to be placed above rather than below a feature.

This suggests that the most desirable position of a point-feature name is to the right and slightly above the feature. (132)

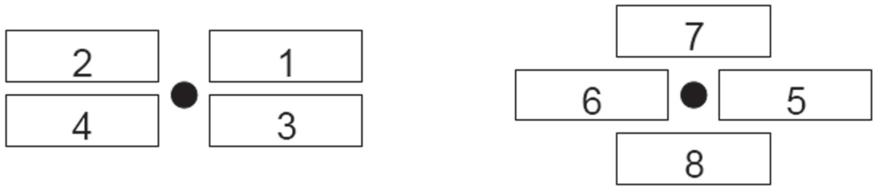

Figure 1. Discrete point-feature label position priorities (Yoeli 1972).

Wu and Buttenfield (1991) revisited Yoeli's point feature label placement rules to determine whether the label positions and priorities on which they were based were valid, through examining the label placement practices of three road map publishers. They found that only four of the eight Yoeli positions were used by a majority of labels and concluded that the complexity of the many other map features affecting name placement demands much greater flexibility in label positioning than allowed in Yoeli's system.

"Shortridge (1979) showed that map readers can reliably discriminate between font sizes which vary by 34 percent or more . . ."

Guidance is also provided in the literature regarding sizes of lettering used for map labels. Shortridge (1979) showed that map readers can reliably discriminate between font sizes which vary by 34 percent or more, or differing by 2 to 2.5 points at typical map label sizes. For example, 10-point type is about 34 percent larger than 7.5-point type. Shortridge also found that linework interrupted for lettering does not reduce the ability to discriminate type sizes and that providing a window or mask around letters superimposed on graphic patterns enables map readers to maintain their ability to distinguish font size differences.

Sadahiro (1995) applied visibility and legibility ratios to measure the loss of information resulting from varying label font size, providing "a basis for determining the size of labels to be used in a GIS" (Sadahiro 1995, 39). The study identified ratio values of 95 percent for visibility and 90 percent for legibility as being desirable. A 95 percent visibility ratio indicates that 95 percent of the letters of the labels are visible on-screen (not lying off-screen on the GIS display); a 90 percent legibility ratio means that 90 percent of the labels are not overlapping other labels. Sadahiro's legibility ratio is a useful guide for determining an acceptable threshold of overlap. The visibility ratio seems a more limited metric, however, relating as it does to on-screen displays; for printed maps, labels are generally constrained to be placed entirely within the map's margins.

"Following articulation of rules for label placement, rules-based algorithms were introduced . . ."

Algorithms to Automate the Label Placement Process

Algorithms for automated label placement have developed significantly since exploration of possible approaches began in the early 1970s. Following articulation of rules for label placement, rules-based algorithms were introduced, and they began to evolve toward expert systems. Simulated annealing and genetic algorithms emerged as viable research directions in the 1990s, while exploration of slider-based label placement began around the turn of the millennium. More recent developments have emphasized force-directed methods for ensuring labels are not placed too closely to one another, as well as ways of speeding label placement for dynamic on-screen map displays. The following sections explore each of these developments in turn.

Early Research

Early research into automation of label placement on maps looked into the feasibility of automation and explored the potential for development of appropriate algorithms and their implementation in software. Yoeli (1972) proposed basic logic to automate the placement of labels for point, line, and area features. Hirsch (1982) addressed point feature label placement in the context of Yoeli's three-step label placement process: selection, layout, and final placement. Hirsch simulated the label layout phase with an algorithm that sought to place names according to Imhof's rules. The algorithm allowed feature names to be placed in any position around the circumference of a point feature, in contrast to Yoeli's approach of limiting label placement to eight specific positions around each feature. The Fortran algorithm Hirsch developed for the simulation implemented an iterative process to resolve label conflicts and demonstrated the feasibility of automating point feature label placement. This work is now seen as a precursor to the force-directed approach to the slider model, which will be discussed in a later section.

"Yoeli proposed basic logic to automate the placement of labels for point, line, and area features."

Zoraster (1986) took an optimization approach to point label placement. He developed an automated algorithm which used integer programming to resolve label overlaps and applied it to petroleum industry basemaps containing both point and line features. Five iterations on a map with 273 point labels were required to resolve 170 pairwise overplots; the algorithm also successfully placed over 2000 labels, resolving more than 700 conflicts.

Rule-Based Label Placement Automation

Freeman and Ahn (1984, 1987) compiled rules for label placement and developed a rule-based "expert" automatic name placement system in Fortran, called AUTONAP. Testing on small-scale maps produced acceptable results while falling short of the quality that a skilled cartographer could achieve. The program placed labels for area features first, then point, and finally line features without backtracking, which the authors identified as a limitation on its ability to effectively label high-density maps with high quality. In a production setting, a small amount of interactive post-editing was expected to be required.

Jones (1989) and Cook and Jones (1990) extended Freemen and Ahn's approach by applying a logic programming language, Prolog, to the label placement problem, with the goals of "maintaining clear graphic association and avoidance of overlaps" (Jones 1989, 46). This type of language provided the ability to implement a set of rules for name placement, identifying trial positions for labels and resolving conflicts among these. The language included an inference mechanism that sought a solution to satisfy all rules, in contrast to other approaches using, for example, iterative techniques as in Hirsch (1982) or Zoraster (1986). Jones was able to reduce overall processing time using Prolog, creating priority-order lists of potential positions for each name in advance of final placement

"Freeman and Ahn compiled rules for label placement and developed a rule-based "expert" automatic name placement system . . ."

As noted above, in the 1980s rule-based systems such as these began being referred to as expert systems. Zoraster (1991) disputed this appellation due to the lack of inclusion of knowledge engineering and the fact that mathematical optimization techniques can substitute for rule-based approaches to the map label placement problem. Among those applying the term *expert system* were Ebinger and Goulette (1990), who reported on the automated name placement system used for the 1990 US Census. For the Census to produce an estimated 1.3 million map sheets under strict deadlines with limited resources, they required a non-interactive approach. Because development began in 1985 before rule-based approaches had developed sufficiently, the Census Bureau instead employed a completely automated process coded in Fortran 77, a non-recursive (no backtracking or iterations) language. The software used point, line, and area feature placement algorithms to place names according to a hierarchy of label-type importance, testing alternative placements sequentially to find the first non-overlapping position.

Doerschler and Freeman (1992) continued applying rule-based systems to maps of increasing feature density. The three-part system they described included:

- a map database containing all map data to be processed and labeled;
- a rule database containing the order of and rules for name placement, as well as placement quality measurements; and
- a rule processor which applies the rules, tests the aesthetic quality of the resulting placement, and continues applying additional rules and placements as needed to achieve acceptable quality.

"Christensen, Marks, and Shieber, Edmondson et al., and Zoraster applied simulated annealing to the label placement problem."

The system was implemented in Fortran 77 and was able to place over 2000 characters, labeling half of the 400 features on a 1:19,500-scale street map of Troy, New York. On a denser 1:875,000-scale regional map of Central New York State, the program placed approximately 18,000 characters.

Mower (1993) applied the emerging technology of parallel computing to the map label placement problem, developing a point-feature label placement algorithm for the CM-2 massively parallel computer from Thinking Machines, Inc. He sought to overcome the lengthy execution times of labeling algorithms for large data sets by assigning each name or feature its own processor. He found that increasing feature density became the driving factor in increasing execution time, rather than increases in the overall number of labels to be placed, as with serial-processing systems.

Simulated Annealing

Christensen, Marks, and Shieber (1994, 1995), Edmondson et al. (1996), and Zoraster (1997) applied simulated annealing to the label placement problem. Earlier methods took an iterative or recursive approach to finding locally optimal label placement but did not allow for temporarily worse label placement in order to find a globally better solution. Simulated annealing is defined by the National Institute of Standards and Technology (NIST) as "a technique to find a good solution to an optimization problem by trying random variations of the current solution. A worse variation is accepted as the new solution with a probability that decreases as the computation proceeds" (Black 2004).

"The authors concluded that simulated annealing was preferred when the quality of the labeling solution was important, and that it was also a relatively easy algorithm to implement."

Christensen, Marks, and Shieber (1994) found that a test map with 120 point features resulted in forty-two conflicting labels using iterative local improvement, versus two conflicting labels using simulated annealing. They concluded that this method finds better results at all label densities and provides competitive execution times as well. Christensen et al. (1995) proposed methods based on discrete gradient descent and simulated annealing, and compared these and other existing labeling algorithms. Gradient descent is defined by the authors as choosing "from among the set of available operations the one that yields the most immediate improvement" (Christiansen, Marks, and Shieber 1995, 209), whereas the term "operation" refers to the placement of a single label. Gradient descent repeatedly applies the most-immediate-improvement operation to significantly improve the original trial label placement solution. The authors concluded that simulated annealing was preferred when the quality of the labeling solution was important, and that it was also a relatively easy algorithm to implement.

Edmondson et al. (1996) sought to overcome the fact that the more powerful, recently developed name placement algorithms were too inefficient for production use by proposing a general algorithm that combines "expert" cartographic rules with effective label placement optimization. The rules were summarized into a scoring function to evaluate the quality of alternative individual label placements before overall placement is optimized using simulated annealing. Zoraster (1997) followed this proposal by applying simulated annealing to the oil field base maps on which he previously (1986) had tested an integer programming approach. He found that simulated annealing both computed results more quickly and resulted in fewer deletions to resolve overlapping labels.

Wagner et al. (2001) provided an approach to label placement that was independent of feature type and of label size and shape. Their algorithm first applied a series of rules in order to label as many features as possible while reducing candidate-label sets for those remaining; it then reduced the number of candidates to a maximum of one per feature. A comparison of this approach with five other methods, using datasets up to 3000 points, showed that their rules-based method was equivalent to simulated annealing in quantity of labels placed, but much faster, showing potential for application to fast Internet labeling.

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Slider-Based Label Placement Algorithms

Van Kreveld, Trijk, and Wolff (1999) took the approach of relaxing the Yoeli-style requirement of limiting point feature label positions to a few fixed locations, allowing continuously sliding labels. The algorithm's objective was to optimize the number of points receiving non-overlapping labels. In a comparison with Christensen, Marks, and Shieber (1995), Van Kreveld's algorithm "yields almost equal results as simulated annealing for less than 750 points, and is always better beyond 750 points" (Van Kreveld et al., 43), while also running considerably faster.

Kameda and Imai (2003) presented a refined slider algorithm, designed to avoid packing labels so tightly as to be difficult to read by separating labels as much as possible within a continuous labeling space for each point or line feature. With the objective of maximizing the number of labels placed, they found that more labels could be placed using continuous labeling spaces. The authors applied an additional algorithm for labels with leader lines in densely featured areas where there is no labeling space for a particular point.

"With the objective of maximizing the number of labels placed, they found that more labels could be placed using continuous labeling spaces."

Force-Directed Label Placement Algorithms

Ebner et al. (2003) developed a force-based simulated annealing algorithm for maximizing the number of labels placed. Their approach "uses repulsive forces between labels … labels are not placed close to each other if possible and the method achieves a good distribution of the labels in the available space" (Ebner et al. 5). This force-directed method is combined with simulated annealing, which allows worse intermediate label placements to avoid being trapped in local minima. The results showed label placement numbers close to optimal, with better label distribution than algorithms that maximize total number of labels placed. The algorithm also solved large problems quickly, with results that "often look similar to those of a human cartographer" (Ebner et al.,11).

Stadler et al. (2006) applied a different two-step approach, using morphological image processing for initial point-feature label placement and an iterative force-directed method for final placement. The first stage involves pixelizing the map and excluding regions around point and line features to avoid overlaps before placing labels to produce an initial, feasible configuration. The second step resulted in placement of most labels closer to their associated point features and farther from other point features and labels. The authors indicated that the use of simulated annealing would further improve the outcome, particularly for label- and feature-dense maps where "the force-directed method might not exhibit enough flexibility to rearrange the labels." (214)

""The genetic algorithm operates as an iterative procedure on a fixed size population or pool of candidate solutions. The candidate solutions represent an encoding of the problem into a form that is analogous to the chromosomes of biological systems.""

Genetic Label Placement Algorithms

Genetic algorithms are also being applied to the challenge of map labeling. Verner et al. (1997) summarized the approach as follows: "The genetic algorithm operates as an iterative procedure on a fixed size population or pool of candidate solutions. The candidate solutions represent an encoding of the problem into a form that is analogous to the chromosomes of biological systems." (4). Their algorithm outperformed other labeling algorithms, including placing up to 7 percent more labels without overlapping than simulated annealing. Yamamoto and Lorena (2005) apply a variant, constructive genetic algorithm and reported additional improvements of 2 percent over the results of Verner et al.

Van Dijk et al. (2004) examined the proposal that design rules can be applied to the development of competent selecto-recombinative genetic algorithms, in the context of a map-labeling case study. Such algorithms are based on finding (selecting) and combining building blocks and are considered competent if they reach good quality (e.g., 97 percent of optimum), with reasonable (e.g., linear) scale-up of solution time with size of problem. The authors laid out a series of design rules on which they based development of their genetic algorithm, then compared the performance of their algorithm to simple genetic algorithms and other types of labeling algorithms such as simulated annealing, finding that the scale-up behavior of their algorithm matched that predicted by theoretical models.

Label Placement Quality Measures

"Van Dijk et al. reviewed existing rules for map labeling, identified quality criteria relevant to automated label placement, and developed a quality function to measure how well a particular algorithm placed labels on a map. Their four resulting quality parameters were (1) aesthetics; (2) label visibility; (3) feature visibility; and (4) label-feature association."

Van Dijk et al. (1999) reviewed existing rules for map labeling (e.g., Imhof 1975; Yoeli 1972), identified quality criteria relevant to automated label placement, and developed a quality function to measure how well a particular algorithm placed labels on a map. Their four resulting quality parameters were (1) aesthetics; (2) label visibility; (3) feature visibility; and (4) label-feature association. They also provided specific evaluation criteria for each of the four parameters.

- Aesthetics refers to the quality of a line or area label's shape as it follows the shape of the associated feature. More than one inflection point and excessive curvature represent poor quality. Point features, having no curvature, are not evaluated for aesthetics.
- Label visibility refers to how visible a label is given other features and labels in its vicinity. Quality is defined as the percent of the label's text block that is not overlapped by other labels, or by features.
- Feature visibility for line and area features is defined as the percent of its line or area not overlapped by labels, excluding the feature's own label; for point features, any label intersection equals poor quality.
- Association quality defines how clear the association is between a feature and its label. Van Dijk et al. provide separate, increasingly complex criteria for the quality of point, line, and area feature association.

Based on the approach of Van Dijk et al. (1999), Table 1 shows the type of quality criteria used to evaluate the effectiveness of various name place-

	Type of Label Quality Criteria Applied in Article			
Research Article	**Aesthetics**	**Label Visibility**	**Feature Visibility**	**Association**
Hirsch (1982)		Y	Y	Y
Freeman and Ahn (1984, 1987)	Y	Y	Y	Y
Zoraster (1986, 1991)		Y		
Jones (1989)		Y	Y	Y
Ebinger and Goulette (1990)		Y		
Doerschler and Freeman (1992)	Y	Y	Y	Y
Mower (1993)		Y		
Christensen et al. (1994)		Y	Y	
Christensen et al. (1995)		Y		
Freeman (1995)		Y	Y	Y
Sadahiro (1995)		Y		
Edmondson et al. (1996)	Y	Y	Y	Y
Pinto and Freeman (1996)	Y			Y
Zoraster (1997)		Y	Y	Y
Wagner and Wolff (1997)		Y		
Van Kreveld et al. (1999)		Y		
Chirie (2000)		Y	Y	Y
Barrault (2001)	Y	Y		Y
Wagner et al. (2001)		Y		
Huffman and Cromley (2002)		Y	Y	Y
Ebner et al. (2003)	Y	Y		Y
Kakoulis and Tollis (2003)		Y		
Kameda and Imai (2003)		Y		Y
Freeman (2004)		Y	Y	Y
Van Dijk et al. (2004)		Y		
Been (2006)		Y		
Kakoulis and Tollis (2006)		Y		Y
Ribeiro and Lorena (2006)		Y		
Stadler et al. (2006)		Y	Y	Y
Mote (2007)		Y	Y	

Table 1. Types of quality criteria applied in map labeling research articles.

ment algorithms presented in the literature. The most frequently evaluated quality criterion has been label visibility, which in practice became label-to-label overlap. Specific overlap measures employed included number of features labeled without overlap (e.g., Van Kreveld et al. 1999; Ebner et al. 2003; Kameda and Imai 2003), percent of features labeled without overlap (e.g., Sadahiro 1995), and number of conflicting labels (e.g., Christensen et al. 1994). Least frequently evaluated has been aesthetics, an admittedly challenging criterion to measure objectively. One pair of authors also opined, "nowadays there is an increasing need for large, especially technical maps for which legibility is more important than beauty" (Wagner and Wolff 1997, 388). Van Dijk et al. concur, stating that for technical maps "the visibility of labels and a good label-feature association is more important than aesthetics or the visibility of objects that constitute the map background" (62).

". . . for technical maps "the visibility of labels and a good label-feature association is more important than aesthetics or the visibility of objects that constitute the map background"".

Nevertheless, development of labeling quality measures continues. Barrault (2001) proposed a new quality measure for evaluating how well the shaping as well as the placement of an area map label fits, spreads across, and thus effectively represents that feature. The author, referencing Freeman (1995) and Pinto and Freeman (1996), among others, described criteria for evaluating area label coverage of the feature, a process for computing alternative label support lines (circular arcs) for labels and for assessing the area coverage each support line provides against those criteria. The algorithm was tested in labeling a variety of simple, complex, and extremely long area features, as well as in situations where the algorithm had to work around other obstructing labels, producing legible and aesthetically pleasing automated label placements.

"Barrault proposed a new quality measure for evaluating how well the shaping as well as the placement of an area map label fits, spreads across, and thus effectively represents that feature."

Others continue to pursue different objectives in label placement. Huffman and Cromley (2002) developed a model for applying labels to point features with the goal of placing the maximum number of labels possible. The model incorporated several labeling criteria and allowed for the relative weighting of the criteria. Ribeiro and Lorena (2006) addressed the issue of minimizing label overlap when all features must be labeled. They presented a binary integer linear programming model and examined three constraint relaxation approaches that provided near-optimal solutions to problems up to 1000 points. Kakoulis and Tollis (2006) extended their 2003 framework for automatically labeling any set of graphical features, including maps and other types of diagrams, with specific requirements related to the placement of multiple labels per feature. Applying two different algorithms to circular, symmetric, and orthogonal drawings produced similar results, with their flow method performing faster with same-sized labels; a more flexible, iterative approach performed better for labels of variable size or with strict constraints on order.

Dynamic Map Labeling and the Need for Speed

Whereas much prior research has focused on automating and optimizing label placement quality and/or quantity in static maps, modern dynamic displays demand *speedy* labeling. Freeman (2005) reviewed the evolution of cartographic labeling rules as applied to automated labeling software, closing with a look forward to the challenge of dynamically labeling electronic map displays with pan and zoom.

Been et al. (2006) introduced a series of desired characteristics for providing consistency in dynamic map labeling, as well as a labeling framework to address the additional dimension of scale in the dynamic labeling situation. Their algorithm included a dynamic placement and selection phase in pre-processing and a filtering and display phase during interaction.

"Whereas much prior research has focused on automating and optimizing label placement quality and/or quantity in static maps, modern dynamic displays demand speedy labeling."

Mote (2007) provided a fast, efficient, scalable method for real-time point feature labeling on dynamic maps without pre-processing. Mote subdivided the map space into a trellis structure of rows and columns; each trellis cell was associated with the features within its boundaries, significantly limiting the search for label conflicts. Labels were prioritized, with priorities revised upward as alternative candidate positions for a feature's label were eliminated by other labels. Re-prioritization was also weighted for proximity when zooming to increased view magnification. Resulting labeling speed increased by orders of magnitude over most other approaches in the literature and was up to 10 times faster than the fastest results reported to date while testing up to 130,000 features to be labeled, where previously reported tests examined 20,000 or fewer.

Literature Review Summary

The literature demonstrates ongoing interest in advancing the speed of map label placement along with the quality of the results. Freeman (2007) surveyed the history of problems faced when attempting to automate map label placement, including leadering, key numbering, labeling short or divided roads, as well as special-purpose labeling such as for elevation contours and soil maps. Freeman highlighted a variety of specific automation challenges, concluding that dedicated efforts to address such apparently simple yet computationally complex issues have produced impressive advances over the past quarter century.

Since Yoeli first postulated that map label placement could be automated via algorithms based on cartographic best practices, researchers continue to apply new techniques while building on existing knowledge. In 2006, for example, Stadler applied image-processing techniques along with force-directed methods from the literature of 2003, with the potential to derive further benefit in future work from simulated annealing which emerged in the mid-1990s.

Development has advanced to the point that sophisticated label placement tools are available in commercial mapping software. ESRI's Standard Labeling Engine and Maplex's extension to its Arc™ suite of products represent one family of such offerings. The basic capabilities of Maplex were laid out in a white paper (ESRI 1998) and have continued to be developed throughout ESRI's releases of new versions of ArcGIS.

"Freeman highlighted a variety of specific automation challenges, concluding that dedicated efforts to address such apparently simple yet computationally complex issues have produced impressive advances over the past quarter century."

Benchmark Data

As development of map label placement algorithms has progressed, the use of benchmark data has evolved as well. Early researchers utilized what might be termed internal benchmark data by presenting papers over time that tested increasingly sophisticated algorithms against the same or similar datasets. Zoroaster (1991, 1997) applied different approaches to petroleum industry basemaps, while Kakoulis and Tollis (2003, 2006) utilized test graphics devised by earlier researchers. Standard labeling tasks have also been undertaken, such as labeling 1000 or so US cities with their names (van Kreveld et al., 1999 and Stadler et al., 2006).

More recently, the Internet has enabled fast and easy sharing of standard datasets, such as those used by Ebner et al. (2003) and Ribeiro et al. (2006). Researchers also make use of publicly available Internet-based data (Barrault 2001), which can then be incorporated into other studies. While many researchers generate their own test data, and others (including the authors of this paper) work in the context of locally available real-world data, benchmark data sets are emerging as a way to provide apples-to-apples comparisons between different approaches to labeling.

"More recently, the Internet has enabled fast and easy sharing of standard datasets . . ."

". . . benchmark data sets are emerging as a way to provide apples-to-apples comparisons between different approaches to labeling."

Research Objectives

The primary goal of this research was to evaluate the extent to which current GIS software can automate the placement of feature labels on densely labeled maps. The research also attempted to identify factors that make manual label placement necessary in order to complete the labeling process and satisfy the map's intended use.

The research focused on the development of a GIS-based sewer utility map book from the Town of Concord, Massachusetts, and compared the labeling capabilities of two map labeling engines found in ESRI's ArcMap 9.2. Real-world data was utilized rather than benchmark data in order to conduct research wherein the findings would be applicable in a practical setting. The balance of this article will review the research context, process, and findings, including recommendations for future research.

"The primary goal of this research was to evaluate the extent to which current GIS software can automate the placement of feature labels on densely labeled maps."

Research Context

At the start of this project, 11-by-17-inch, printed copies of the Town of Concord's sewer map book were used daily by the dozen or so members of the Water & Sewer Division crew to identify the correct sewer mains or manholes on which to work. The map books are printed in black and white from 1970's-era drawings on Mylar. Though the drawings are updated manually when new or replacement sewer mains or ties are installed, the crew's paper versions are reprinted only every year or two, when they get too tattered to use. The Water & Sewer Division would like to start printing the map book from the GIS to allow for more timely and accurate updates. Ultimately, the Water & Sewer Division intends for their crews to take a rugged laptop into the field with the latest GIS data available.

Sewer Infrastructure Features and Labels

The sewer infrastructure features on these maps include:

- sewer manholes, which provide access to the underground sewer mains;
- the large sewer main pipes themselves; and
- smaller pipes called sewer service ties, which link buildings into the sewer system.

At least one and as many as four labels must be placed on sewer manholes. Each manhole has:

- A unique facility identification number;
- A station number, which shows the distance in feet down a particular sewer branch in which the manhole is located;
- A rim elevation, which is the elevation of the top of the manhole; and
- An invert elevation, which is the elevation of the bottom of the manhole.

"The Water & Sewer Division would like to start printing the map book from the GIS to allow for more timely and accurate updates."

Key attributes to be labeled for the main sewer pipes are:

- Size, which is the diameter of the pipe; and
- Material, or the composition of the pipe, such as vitreous clay or PVC.

For sewer mains, an additional label is required for slope. An arrow indicates the direction of flow, and a numerical slope label must also be placed that reads in the direction of flow (Figure 2). The placement of numerical slope labels reading in the direction of the sewer's flow may be said to defy cartographic labeling conventions, which require labels to be placed more-or-less right side up for legibility. This is, however, standard, accepted, and indeed expected practice within the utility community. The numerical label in this case can be considered a symbol, the placement of which provides a critical visual cue to utility workers: A single glance at the arrow and slope immediately conveys the direction of flow.

The final element of sewer infrastructure is the service tie to each building. The only attribute label for this pipe is the service number, which is the crew's index to all related customer information.

Sewer Labeling Quality Metrics and Evaluation Methodology

The quality metrics for this research project are based on label placement rules from the literature, modified by the needs and expectations of the users of the map–the sewer field crew. Three general types of metrics are employed, relating to:

- Quantity of labels placed;
- Preferred positioning of labels; and
- Overlap.

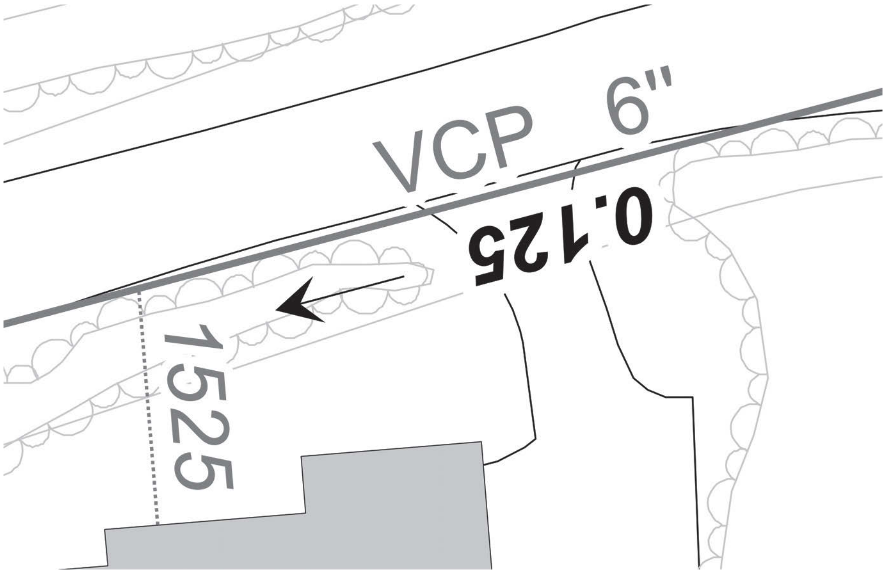

Figure 2. Sewer main with inverted slope label and arrow. (see page 87 for color version)

Regarding the first category, Quantity, the following data are gathered for each iteration of the labeling process:

- Total number of labels placed; and
- The percent of labels placed versus the ideal number (that is, all possible labels needing placement).

In the category of Labels in Preferred Position, each type of sewer infrastructure feature–manhole, main and service tie–has a specific preferred placement criterion:

- Manhole: Up to four labels (facility ID, invert elevation, rim elevation, station number) to be placed in a north-south-east-west configuration around the point feature (Figure 3).
- Main: Up to three labels (size, material, and slope) to be placed parallel to and either above or below the line feature.
- Service Tie: One label (service number) to be placed parallel to and either above or below the line feature.

Finally, two Overlap criteria are also tracked throughout the research process:

- Label-label overlap; and
- Labels overlapping service ties, which must be fully visible to the crew.

As noted earlier, Van Dijk et al. suggest four categories of label placement quality metrics: label visibility, feature visibility, association, and aesthetics. The metrics employed in this project, apart from the quantity measurements, correspond to these categories as follows:

- Label visibility is measured by *label-label overlap;*
- Feature visibility is measured by *labels overlapping service ties;*
- Association is measured by the ability to place labels in their *preferred position* without the use of leader lines.

Aesthetics are not measured explicitly, although the preferred position criteria also reflect the desired aesthetics from the perspective of the field crew using these maps.

During the course of the research and measurement process, the density of the features and labels on the maps involved were such that the same label was often involved in overlapping both a key feature (service tie) and one or more other labels. In consequence, the label visibility and

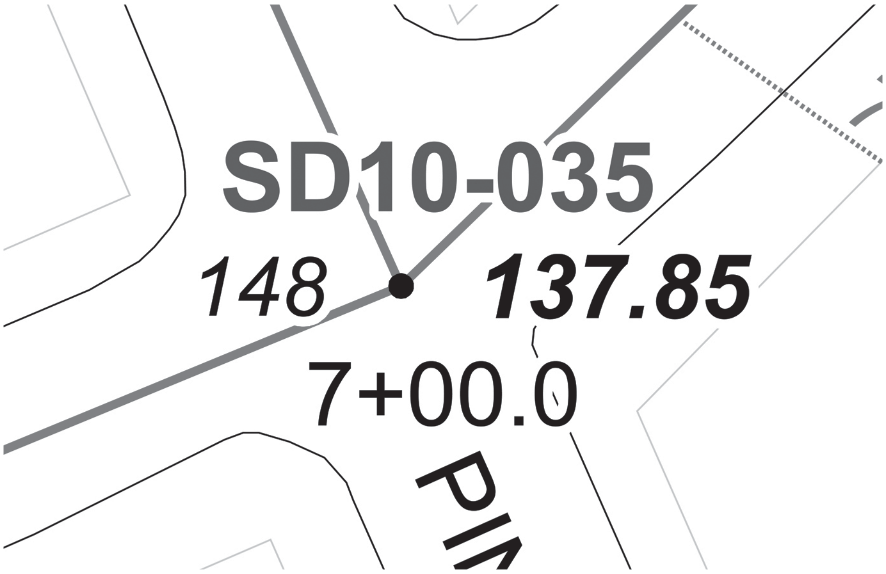

Figure 3. Ideal sewer manhole label positioning. (see page 88 for color version)

"From the 121-page sewer map book, three representative pages were selected. Criteria for selection included a range of feature and label density, from low to very high on each page and a variety of orientations of sewer mains to fully exercise the labeling software's capabilities."

feature visibility measures were combined into a single overlap metric, to avoid overstating the degree of overlap through double counting.

- Where one label overlapped one service tie feature, one overlap occurrence was recorded.
- Where multiple labels overlapped each other and/or overlapped service tie features, one overlap occurrence was recorded for each label involved.

From the 121-page sewer map book, three representative pages (Figures 4-6) were selected. Criteria for selection included a range of feature and label density, from low to very high on each page and a variety of orientations of sewer mains to fully exercise the labeling software's capabilities. The streets (and hence the sewer mains–symbolized as red lines–buried beneath them) on page D10 (Figure 4) lie mostly at right angles to one

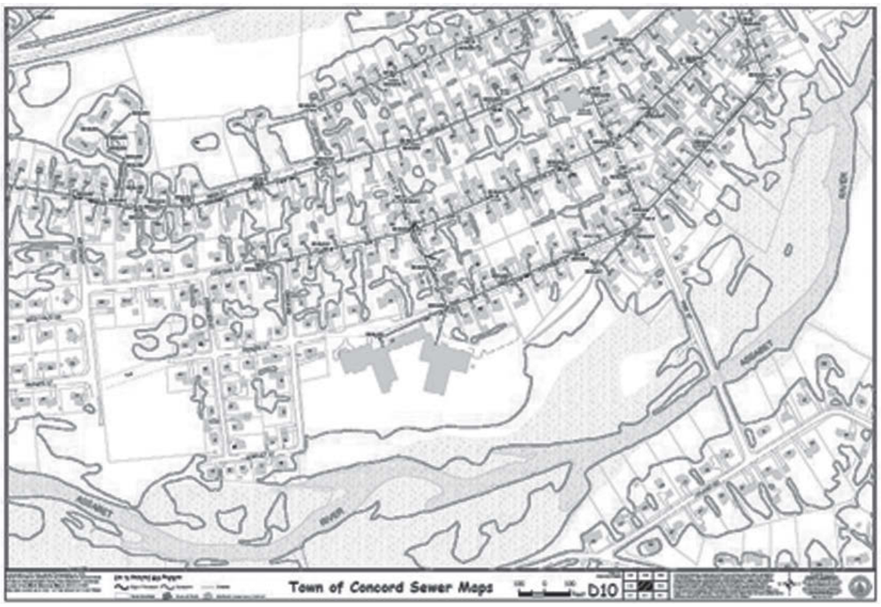

Figure 4. Sewer map book page D10. (see page 88 for color version)

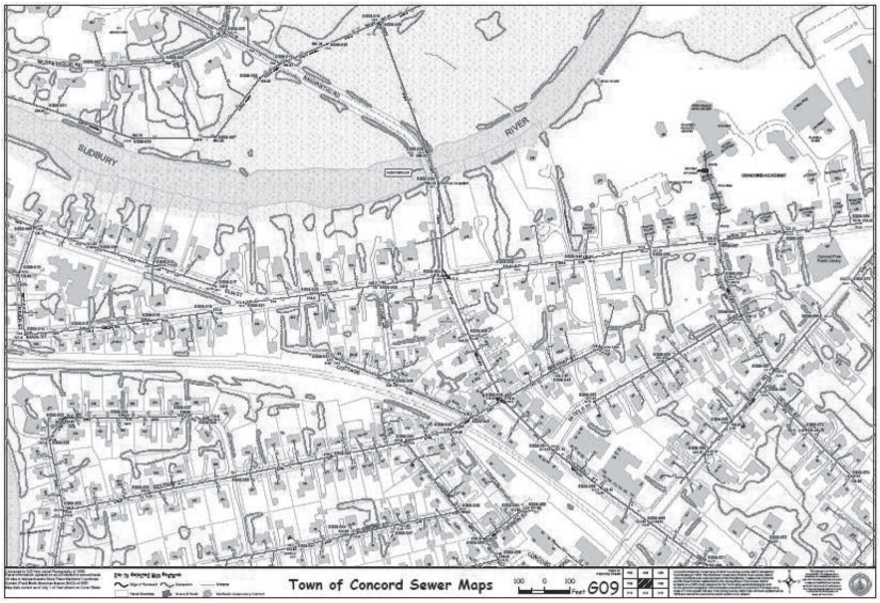

Figure 5. Sewer map book page G09. (see page 89 for color version)

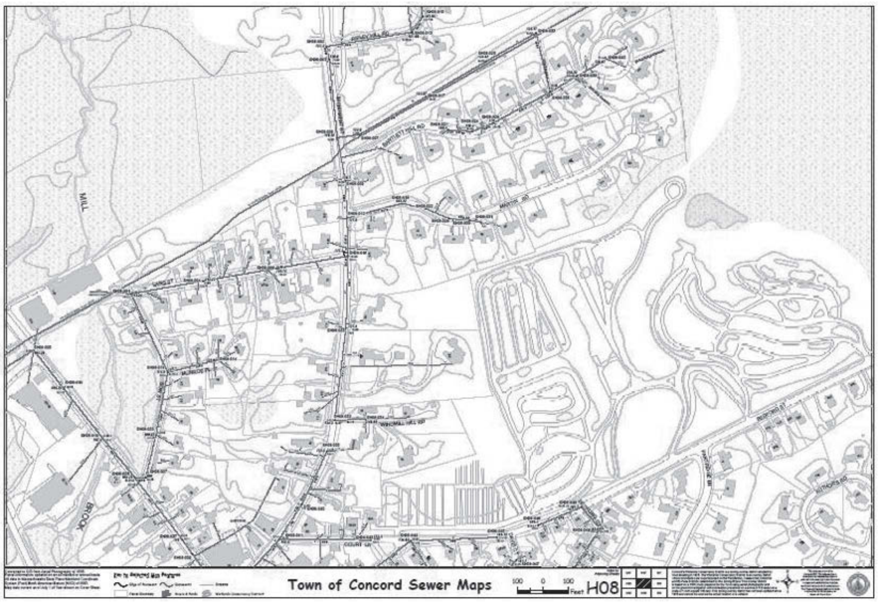

Figure 6. Sewer map book page H08. (see page 89 for color version)

another, while pages G09 (Figure 5) and H08 (Figure 6) each encompass a wider range of sewer main orientations.

Label density varies considerably across each of these maps. For example, page H08 (Figure 6) contains an area of very low label density near the top of the page: a long straight stretch of sewer main (red line) with widely spaced manholes (black points) and no service ties. In contrast, the label density for the neighborhood just to the south is nearly double, due to more closely spaced manholes and numerous service ties (dashed red lines).

As is evident from the three figures just discussed, these real-life maps contain large areas with no sewer infrastructure, where no labels are to be placed. In order to provide useful label density measurements, density calculations have been limited to buffered zones around the sewer mains. These "buffer segments" represent the areas where virtually all sewer infrastructure labels will be placed and provide a more consistent baseline for density comparisons than using the entire map area. A buffer width of 80 feet (map units) along both sides of sewer mains encompasses 97.8 percent of sewer infrastructure labels to be placed. Only labels falling within these buffer segments were considered in the density and quality measurements.

"For each buffer segment, the total number of feature labels available for placement was calculated. This figure represents the Ideal Label Count for each buffered segment and served as the baseline for the quantity metrics."

For each buffer segment, the total number of feature labels available for placement was calculated. This figure represents the Ideal Label Count for each buffered segment and served as the baseline for the quantity metrics. A total of 1474 labels were available to be placed across these three map book pages, and ideal label densities ranged from 196 to 424 labels per million square feet on the ground, or from 2110 to 4564 labels per square kilometer.

Research Process

The research was conducted in three stages: (1) automated labeling; (2) conversion to annotation; and (3) manual refinement of label placement. The first, automated portion of the process applied two suites of automated ESRI labeling tools to the three selected case study maps in parallel, ArcGIS 9.2's Standard Labeling Engine and its Maplex labeling extension. ESRI's products were utilized for this research primarily due to their ready availability. These products are widely used in GIS applications in a variety of business sectors, including government and utility, and specifically by the Town of Concord. No other automated labeling products were available to the researcher at the time of this study.

"The research was conducted in three stages: (1) automated labeling; (2) conversion to annotation; and (3) manual refinement of label placement."

After developing initial label engine settings, the research proceeded through four automated labeling iterations. After each iteration, the quality of the labeling results produced by each of the two engines was measured, adjustments were made to the label engines' settings to attempt to improve label placement quantity and quality, and the labeling process was repeated. Once automated labeling results could be improved no further, the higher-quality result was converted to annotation and taken forward into the final, manual refinement stage of the process. Details of these iterations and their impact on metrics are presented next.

Automated Label Placement Iterations

Initial label engine settings for the Standard and Maplex labeling engines are shown in Tables 2 (Standard) and 3 (Maplex), as are settings for all subsequent automated iterations; results for this and all subsequent iterations appear in Table 4. The objective of the initial settings was to place all sewer feature labels automatically, while satisfying the No Overlap and Preferred Position metrics described earlier. While Maplex placed 91% of the ideal number of labels compared to the Standard Engine's 79.4%, both engines produced relatively high-quality results in both overlap and preferred position metrics.

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In the second automated iteration, labeling expressions were added for the sewer main labels for both engines to suppress placement of labels on extremely short (>80 feet) lengths of sewer, observed to be a key source of overlap in the first iteration. Orientation of sewer size and material labels in Maplex were changed to align with the map rather than the direction of the pipe; sewer slope labels remained oriented to pipe flow direction. Also in this iteration, street name labels were placed automatically by both engines rather than as static annotation (first iteration), to provide additional flexibility for label placement. While these changes resulted in

			Standard Labeling Engine		
Label Type	**Label Manager Category**	**Label Placement Factor**	**Iteration 1**	**Iteration 2**	**Iteration 3**
Sewer Manhole	Placement Properties	Point Setting	Offset label horizontally around point		
			Top Right Only (Facility ID)		
			Top Left Only (Invert Elevation)		
			Bottom Right Only (Station Number)		
			Bottom Left Only (Rim Elevation)		
	Conflict Detection	Label weight	High		
		Feature weight	High		
		Buffer	0		
		Place overlapping labels	No		
Sewer Slope	Placement Properties	Orientation	Parallel		
		Orientation system	Page		
		Position	Below		
		Offset (map units)	2		
		Remove duplicate labels	Yes		
		Location along line	At Best		
	Conflict Detection	Label weight	High		
		Feature weight	Low		
		Buffer	0		
		Place overlapping labels	No		
	Label Expression			Do not label if length < 80 feet	Label < 80 feet with leader line
Sewer Size and Material	Placement Properties	Orientation	Parallel		
		Orientation system	Page		
		Position	Above		
		Offset (map units)	2		
		Remove duplicate labels	Yes		
		Location along line	At Best		
	Conflict Detection	Label weight	High		
		Feature weight	Low		
		Buffer	0		
		Place overlapping labels	No		
	Label Expression			Do not label if length < 80 feet	Label < 80 feet with leader line
Sewer Service Number	Placement Properties	Orientation	Curved		
		Orientation system	Line		
		Position	Left or Right		
		Offset (map units)	2		
		Remove duplicate labels	Yes		
		Location along line	N/A		
	Conflict Detection	Label weight	High		
		Feature weight	High		
		Buffer	0		
		Place overlapping labels	No		
Street name	Placement Properties	Orientation	Static annotation	Curved	
		Orientation system		N/A	
		Position		On the line	
		Offset (map units)		N/A	
		Remove duplicate labels		Yes	
		Vary font size		Yes (via expression)	
		Location along line		N/A	
	Conflict Detection	Label weight		High	
		Feature weight		None	
		Buffer		0	
		Place overlapping labels		No	

Table 2. Standard Labeling Engine Settings for Automated Labeling, by Iteration.

fewer labels being placed by both engines, the quality of label placement increased for both.

In the third iteration, leader line labeling was attempted for both engines, with Maplex producing more aesthetically pleasing results for the few such labels that were able to be placed in this fashion. As noted in Freeman (2007) with regard to leadering, the task is more complex than it might appear, as both space for the label and a path for the leader must be found, and the leader must touch the feature without crossing more than one or two other features in the process. While the Standard engine seemed constrained to connect leaders only to the center point of the line feature, Maplex offered more flexibility in both leader and label placement.

			Maplex			
Label Type	**Label Manager Category**	**Label Placement Factor**	**Iteration 1**	**Iteration 2**	**Iteration 3**	**Iteration 4**
Overall setting	Maplex Labeling Mode		Fast			Best
Sewer Manhole	Label Position	Position options	North (Facility ID) East (Invert Elevation) South (Station Number) West (Rim Elevation)			
	Label Fitting Strategy	Stack label	No			
		Reduce font size	No			
		Abbreviate label	No			
	Conflict Resolution	Feature weight	100			
		Background label	No			
		Remove duplicate labels	No			
		Never remove label	Yes			No
		Label buffer (% font height)	15			
Sewer Slope	Label Position	Position options	Street placement - offset straight			
		Label offset (map units)	2			
		Label orientation	Align label to direction of line			
		Repeat label	No			
		Spread characters	No			
		Spread words	No			
	Label Fitting Strategy	Stack label	No			
		Overrun feature	No			
		Reduce font size	No			
		Abbreviate label	No			
		Minimum feature size for labeling (map units)	0			
	Conflict Resolution	Feature weight	100			
		Background label	No			
		Remove duplicate labels	No			
		Never remove label	Yes			No
		Label buffer (% font height)	15			
	Label Expression			Do not label if length < 80 feet	Label < 80 feet with leader line	Do not label if length < 80 feet
Sewer Size and Material	Label Position	Position options	Street placement - offset straight			
		Label offset (map units)	2			
		Label orientation	Align label to direction of line	None		
		Repeat label	No			
		Spread characters	No			
		Spread words	No			
	Label Fitting Strategy	Stack label	No			
		Overrun feature	No			
		Reduce font size	No			
		Abbreviate label	No			
		Minimum feature size for labeling (map units)	0			
	Conflict Resolution	Feature weight	0			
		Background label	No			
		Remove duplicate labels	No			
		Never remove label	Yes			No
		Label buffer (% font height)	15			
	Label Expression			Do not label if length < 80 feet	Label < 80 feet with leader line	
Sewer Service Number	Label Position	Position options	Street placement - offset straight			
		Label offset (map units)	2			
		Label orientation	None			
		Repeat label	No			
		Spread characters	No			
		Spread words	No			
	Label Fitting Strategy	Stack label	No			
		Overrun feature	Yes			
		Reduce font size	No			
		Abbreviate label	No			
		Minimum feature size for labeling (map units)	0			

Table 3. Maplex Settings for Automated Labeling, by Iteration.

	Conflict Resolution	Feature weight	100		
		Background label	No		
		Remove duplicate labels	No		
		Never remove label	No		
		Label buffer (% font height)	15		
Street Name	Label Position	Position options	Static annotation	Street placement - center curved	
		Offset along line		At best position along line	
		Label orientation		None	
		Repeat label		No	
		Spread characters		No	
		Spread words		No	
	Label Fitting Strategy	Stack label		No	
		Overrun feature		No	
		Reduce font size		No	Yes
		Abbreviate label		No	
		Minimum feature size for labeling (map units)		0	
	Conflict Resolution	Feature weight		0	
		Background label		No	
		Remove duplicate labels		No	
		Never remove label		No	
		Label buffer (% font height)		15	
	Labeling Options - Maplex	Enable connection of line segments into continuous features		No	Yes - Unambiguous
All other features (no labels)	Conflict Resolution	Feature weight	0		

Table 3 (continued). Maplex Settings for Automated Labeling, by Iteration.

Standard Engine	Automated Iteration 1	2	3			
% of ideal number placed	79.4	78.7	78.7			
% placed without overlap	90.8	92.4	93.7			
% placed in preferred position	98.4	99.5	99.7			
Maplex	**Automated Iteration 1**	**2**	**3**	**4**	**Conversion to Annotation**	**Manual Refinement**
% of ideal number placed	91.0	87.8	87.3	85.3	85.7	99.7
% placed without overlap	91.1	93.1	90.9	93.5	93.5	100.0
% placed in preferred position	89.8	97.9	96.8	100.0	100.0	91.4

Table 4. Labeling Metric Results by Iteration.

Also in this iteration, street name font size was varied by street width for both engines in an attempt to reduce overlap with edge-of-pavement lines, and placement of duplicate street names was eliminated. These changes improved quality metrics for the Standard engine, while reducing both quantity placed and quality metrics for Maplex (leader line labeling reduces the preferred position metric).

The dual iteration process was stopped at this point, as no further opportunities for significant improvement in the Standard labeling engine were identified. One further iteration was undertaken with Maplex on parameters with no equivalent settings in the Standard engine: The overall Fast versus Best toggle was changed from Fast to Best, and the setting for Never Remove Labels was set to No for all label classes.

After completion of these iterations, Maplex had placed almost 7 percent more labels overall than the Standard Labeling Engine–85.3 percent

"After completion of these iterations, Maplex had placed almost 7 percent more labels overall than the Standard Labeling Engine–85.3 percent and 78.7 percent of ideal, respectively. For the labels they did place, both products provided equally good quality label placement: About 93 percent of labels were placed with No Overlap, and virtually 100 percent of labels were placed in their Preferred Position."

and 78.7 percent of ideal, respectively (Figure 7). For the labels they did place, both products provided equally good quality label placement: About 93 percent of labels were placed with No Overlap, and virtually 100 percent of labels were placed in their Preferred Position. Both labeling engines placed nearly 100 percent of point feature labels (Figure 8), while Maplex placed about 15 percent more line and area feature labels than the Standard Labeling Engine.

Although publicly available information about these two labeling engines does not reveal the algorithms that drive them, a comparison of Tables 2 and 3 makes it clear that Maplex offers considerably more opportunities for adjusting label placement parameters. The user must decide when the time devoted to (or potentially wasted in) tweaking and fine-tuning the many options has yielded sufficient improvement in the automated labeling stage before moving on to manual placement and editing.

Conversion to Annotation

Because the Maplex engine placed more labels than the Standard Labeling Engine, and with equally high quality, the Maplex labeling was taken forward into the manual refinement stage of the research, through conversion

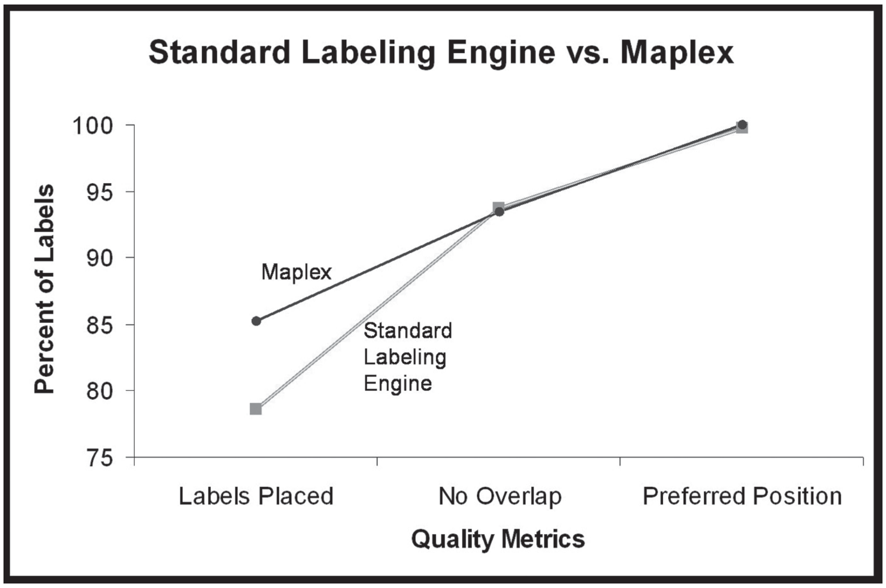

Figure 7. Comparison of quality metrics after automated labeling: ESRI Standard Labeling Engine versus Maplex Labeling Engine.

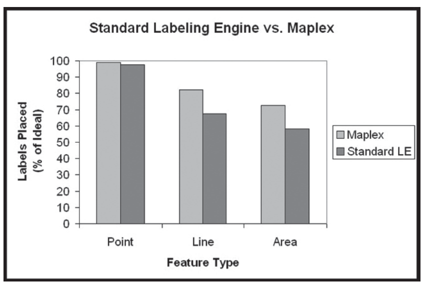

Figure 8. Comparison of percent labels placed by feature type after automated labeling: ESRI Standard Labeling Engine versus Maplex Labeling Engine.

of labeling to annotation. Two aspects of the conversion process proved critical in preserving label position for these dense maps:

- Converting all the labels on each page in one step rather than layer by layer, since each new layer of annotation creates a barrier to the labeling of subsequent layers; and
- Performing the conversion in Layout View (rather than Data View), so that the labels of all features on the page (the current extent) would be converted at once.

In fact, the conversion process automatically placed a few additional labels.

After conversion to annotation, all missing labels were added manually to the three case study maps. Individual label positions were then adjusted in two rounds of refinement, to (1) eliminate overlaps; and (2) maximize the preferred position quality metric.

Manual label position refinement resulted in placement of 99.7 percent of the ideal number of labels, with six redundant street name labels not placed (Figure 9). After 477 manual position adjustments, the No Overlap metric was improved to 100 percent. The tradeoff was a 9 percent decline in the Preferred Position metric, to 91.4 percent, primarily due to use of leader lines for labels unable to be placed next to their feature due to crowding. With regard to feature types, manual refinement resulted in placement of 100 percent of both point and line feature labels (Figure 10). As noted above, a choice was made not to place six repetitive street name labels, but area feature label placement still improved to 90.9 percent.

"Manual label position refinement resulted in placement of 99.7 percent of the ideal number of labels . . ."

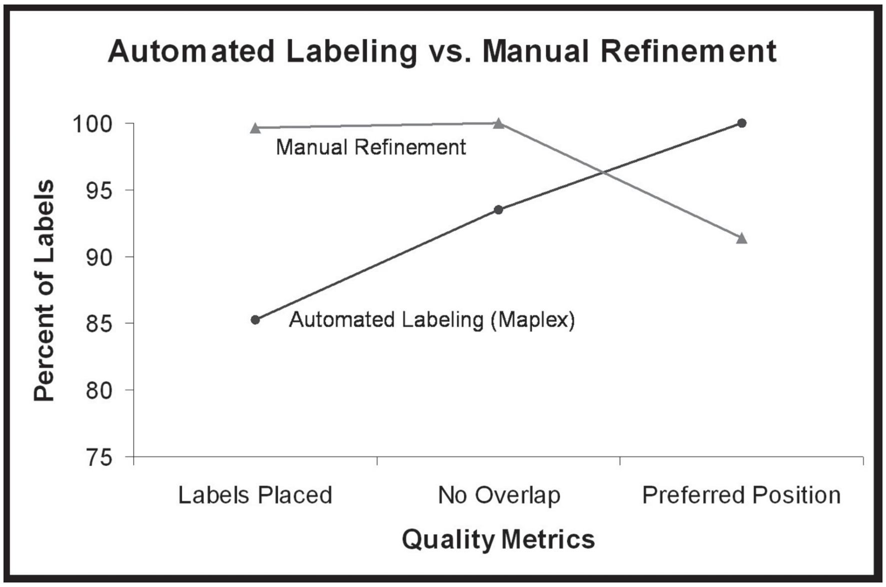

Figure 9. Comparison of quality metrics after manual refinement of label placement: Automated label placement using ESRI Maplex Labeling Engine versus manual refinement.

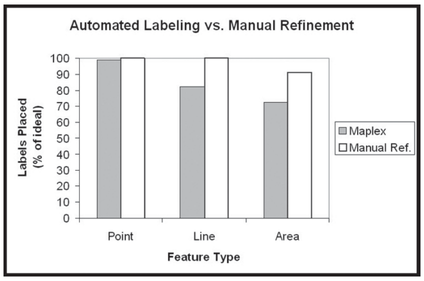

Figure 10. Comparison of percent labels placed by feature type after manual refinement of label placement: Automated label placement using ESRI Maplex Labeling Engine versus manual refinement.

Research Limitations and Potential for Future Research

This research was conducted on labeling engines within ESRI's ArcGIS 9.2 only. Future research could compare different software products (for example, those offered by MapText, Inc., MapInfo Corp., Spatial Projects and Avenza Systems, Inc.) as well as testing follow-on versions of ArcGIS, such as the recently released 9.3. Also, only one type of map was tested, leaving open the question of how well these labeling engines perform across a variety of types of densely labeled maps.

An additional avenue worthy of exploration revolves around the question of time. As noted earlier, Yoeli (1972) estimated that manual labeling of paper maps could consume up to 50 percent or more of total map production time. How might one construct a test of this proportion when constructing and labeling a map via software? The primary time sinks in this research, though not quantified, lay in (a) developing initial label classes and label engine settings; (b) manually eliminating overlaps remaining after automated label placement; and (c) manually placing leader-lined labels. Additional potential time sinks for many labeling projects will be the initial learning curve associated with the many label engine settings available, particularly with Maplex, and the development of a clean database of label names to be applied to map features.

This research also highlighted possibilities for further development of labeling software capability to further reduce the necessity of manual label placement. These include automated leader-line labeling in situations where:

"This research also highlighted possibilities for further development of labeling software capability to further reduce the necessity of manual label placement."

- Feature spacing is too tight to permit placement of a single legibly sized label in the preferred position;
- Feature spacing is too tight to permit placement of a legibly sized label cluster in the preferred position (e.g., around manholes, as in Figure 3);
- Line feature length is too short for legible label placement;
- Area feature width is too narrow for legible label placement; or
- Labels must not obscure "non-feature" elements (e.g., sewer main-service tie junctions).

Such nuances of automated label placement have, for the Town of Concord, become somewhat less critical. In the time that has elapsed since this research commenced, the sewer crew has begun using a rugged laptop in the field to view the sewer map book data. Because ArcMap provides unlimited zoom-in capability, the crew can always zoom in close enough for live automated labeling to appear–a tribute to the development of speedy labeling in dynamic mapping applications, as referenced in the literature review. A few crew members are not yet completely comfortable with the laptop, however, so the paper map book remains a useful tool for the time being.

CONCLUSION

The ultimate goal for label placement within GIS software should be live automated labeling, without going to annotation and manual refinement, that equals both the quantity and quality of manual label placement in significantly less time overall. The software tested here performed quite well on dense utility maps, placing 85.3 percent of labels overall, with high quality: 100 percent in preferred positions; 93.5 percent with no overlap. However, opportunities remain to further perfect the automated labeling process, particularly through automatically leader-lining labels in spots where features are too close together for legibly sized labels to be placed in ideal positions.

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Addressing Map Interface Usability: Learning from the Lakeshore Nature Preserve Interactive Map

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These are exciting days for cartography, as emerging technologies have greatly expanded the possibilities of online, interactive maps. These developments, however, now require cartographers to think about issues that only a few years ago fell solely in the domains of human-computer interaction (HCI) and web design. Further, given how fast these changes have occurred, there are few tried-and-true guidelines for building digital maps. This paper reports on the design, development, and evaluation of the University of Wisconsin-Madison Lakeshore Nature Preserve Interactive Map (www.lakeshorepreserve.wisc.edu) and outlines many of the insights gleaned from this process. The purpose of this article is to strengthen the important bridge between cartography and usability evaluation (i.e., how we study the way in which users interact with their maps and how we measure the success of those interactions) so that the efforts of a team of developers and stakeholders can be coordinated in a way that ensures the map works equally well for all potential end users. We outline the relative merits of two broad categories of evaluation techniques, arguing that there is no single, correct evaluation technique appropriate for all evaluation scenarios, and then detail the specific strategy adopted for evaluation of the Lakeshore Nature Preserve Interactive Map. We conclude by offering four design guidelines for online, interactive maps revealed during the evaluation of the Lakeshore Nature Preserve Interactive Map: two positive strategies we recommend for consideration when designing map interfaces (inclusion of cascading interface complexity and provision of map browsing flexibility) and two pitfalls we caution to avoid (minimalist design of interface widgets and employment of a lorem ipsum map during development).

Keywords: map interaction, interface design, usability evaluation, cascading information-to-interface ratio, map browsing flexibility, ipsum lorem map, Lakeshore Nature Preserve Interactive Map

INTRODUCTION

The pervasiveness and rapid maturation of personal computing devices combined with decentralized, network-based, and wirelessly accessible geographic information are creating new opportunities for cartographers. These developments are part of larger, far-reaching changes in how and by whom geographic data is *generated* (e.g., volunteered geographic data), where and how it is *accessed* (e.g., on a cell phone, or on large multi-touch screens), where and how the computing work is *performed* (perhaps as a collection of disparate Web services that are connected via a thin client running locally), and how a map reader *interacts* with the maps and how we measure the success of a map-use session. Given unprecedented (and unregulated) progress and diversification of these areas in just the

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past year or two (with new map innovations occurring almost weekly now), there is feeling among those of us who develop online, interactive maps that we are trying to build the plane while it's flying. Worse, we're not even sure where the plane is headed or what tasks it may be asked to perform in the future. While these are exciting days for interactive and web-based mapping, mapmakers are now faced with new challenges that fall far beyond the traditional boundaries of cartography and that were previously addressed by the domains of human-computer interaction (HCI) and web design.

It is the final development—how users interact with maps and how we can measure the success of those interactions—that is the focus of this article. Central to this development is the concept of *usability,* an area of research concerned with improving both the usefulness of a set of interface tools for completing a map-based task and the ease of use of the map interface itself. The challenge of usability is to tap into established map interface conventions in order to improve the transparency of the interface, yet to remain innovative and creative in design and to avoid the propagation of inefficient interface solutions. These are still pioneering days for online, interactive mapmaking and we should be exploring new ideas, yet from a usability perspective there are obvious advantages to having some level of consensus about user-map interactions so that people do not have to learn entirely new skills for each map they encounter (much as desktop software has coalesced around similar keyboard shortcuts, e.g., copy, print, save).

"The challenge of usability is to tap into established map interface conventions in order to improve the transparency of the interface, yet to remain innovative and creative in design and to avoid the propagation of inefficient interface solutions."

Usability evaluation is addressed using the case study development process of the Lakeshore Nature Preserve Interactive Map (www.lakeshorepreserve.wisc.edu) by the University of Wisconsin-Madison Cartography Laboratory. The online, interactive map, built entirely in the Flash authoring environment, marks the most significant effort to date by the University to establish an online presence for the Preserve, enhancing public appeal and legitimizing the often-contested boundary demarcations. Figure 1 provides an overview image of the map interface. The Lakeshore Nature Preserve Interactive Map follows the strategy of other exhibit-like websites such as the Theban Mapping Project (http://www.thebanmappingproject.com) and Monticello Explorer (http://explorer.monticello.org), using a central map to organize a variety of spatial and historical themes about a place or region. The purpose of this class of maps is not simply to provide a viewer for disjoint data layers overlapping in a particular spatial extent, as is the case for many of the mash-up mapping websites currently available on the Internet, but instead to tell a series of detailed, interwoven geographic stories via maps that are necessary for complete understanding of the complex characteristics and discourses concerning a given place or region.

The paper begins with a review of usability evaluation, drawing heavily from the literatures of HCI and web design. Following a brief description of the Lakeshore Nature Preserve Interactive Map, a synopsis of the usability evaluation strategy is provided, detailing both the informal evaluation conducted during development and the structured verbal protocol analysis (VPA) administered on the beta release. The paper concludes with the enumeration of several design guidelines for developing online, interactive map applications not currently offered in the cartographic literature. This set of guidelines is by no means implied to be exhaustive, nor appropriate for usage for all applications; rather, these guidelines summarize our experiences from the Lakeshore Nature Preserve Interactive Map project that may be of use for future cartographers when preparing for similar undertakings.

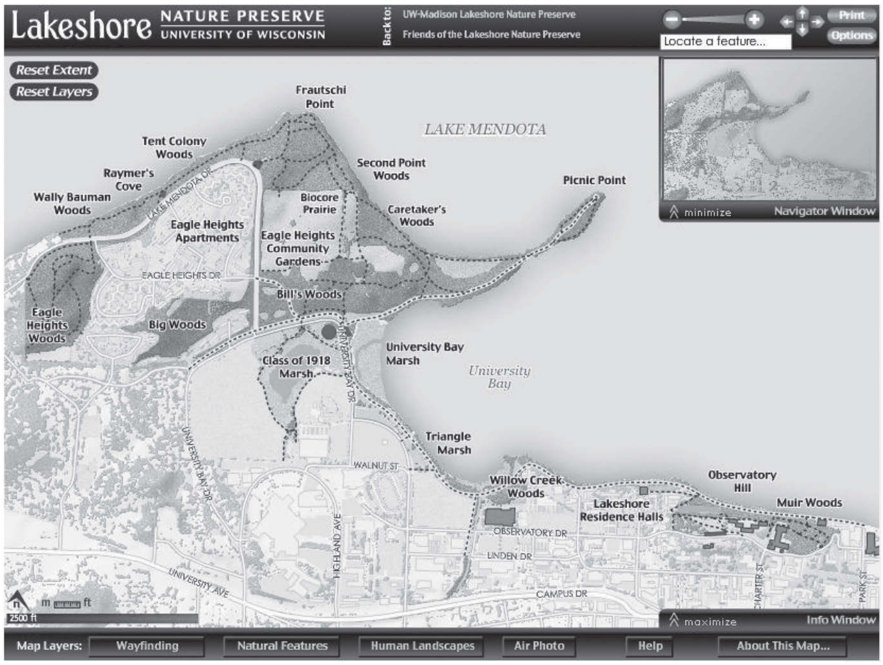

Figure 1. The Lakeshore Nature Preserve Interactive Map (www.lakeshorepreserve.wisc.edu). (see page 90 for color version)

A Primer on Usability Evaluation

Understanding the user's needs and expectations of a map application is essential for effective and transparent interface design (Cooper and Reimann 2003). Consideration of these needs and expectations during development has been termed *user-centered design* (Norman 2002) and relies heavily upon an iterative process of interface evaluation at all steps of development (Krug 2000). More broadly, evaluation is not only a way to determine the success of a single application, but it is also a necessary step in the application of theory, producing the three-part validation system of theory, applications, and evaluation for interactive and web-based cartography (Figure 2). User-centered design and evaluation specific to usability testing borrow heavily from the disciplines of human-computer interaction (HCI) and web design, although there is a quickly growing body of research on usability within GIScience, particularly for geovisualization applications (see Slocum et al. 2003, Fuhrmann et al. 2005, Harrower and Sheesley 2005, and Robinson et al. 2005, for example).

The literature discriminates between user testing and controlled experimentation as the two modes for conducting interface evaluation (Haug et al. 2001, Plaisant 2004, Saraiya et al. 2004). As Plaisant (2004, 2) writes, "Usability testing and controlled experiments remain the backbone of evaluation." This research defines the term *evaluation* to describe any implementation of usability testing or controlled experimentation that "is about understanding, stating, and serving user needs" (Greinstein et al. 2003, 606). *Controlled experimentation* follows the traditional positivist model of science, where a task is simplified to allow for the isolation and control of independent variables and the quantitative measurement of dependent variables (Kerlinger and Lee 2000). The results of controlled experiments are generalizable to any situation with similar control conditions and repeatable in any location, at any time, and by any investigator (Castree 2005). In order to achieve generalizability and repeatability,

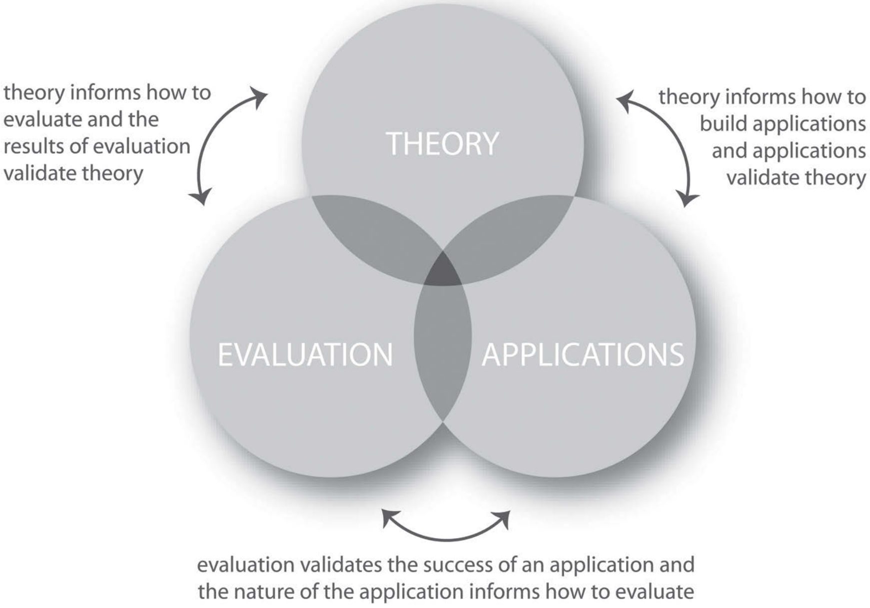

Figure 2. The three-part validation system of theory, applications, and evaluation for interactive and web-based cartography. Evaluation serves the dual purpose of validating the general theory-of-use described in the literature and the success of a particular application.

such controlled experimentation requires an extremely large sample size and testing in an often artificial environment. In contrast, *usability testing* (also referred to as usability assessment, usability inspection, or user testing) requires a much smaller sample size, typically between three to ten participants (Shneiderman and Plaisant 2006) and relies on the collection of qualitative data in a realistic, perhaps even real-world, setting for the purpose of improving a single application (Krug 2000). There is growing consensus that this second type of evaluation is superior to the first, with Shneiderman and Plaisant (2006) arguing that the transition to the study of a small number of individuals in greater depth reflects the broader transition to a post-positivist model of science.

When comparing different descriptions of usability testing and controlled experimentation, it becomes clear that there is no clear dividing line between the two methodologies; rather, particular methods fall along a continuum between strictly controlled experimentation and in-depth usability testing. Figure 3 illustrates this continuum and, for reference, positions along it many commonly used evaluation methods. The antipodes of the continuum hold several opposing characteristics that are useful for placement of methods along the continuum. First, this continuum represents the transition from quantitative methods, designed to generate summary statistics concerning the influence of an independent variable on the usability of an application, to qualitative methods, designed to collect detailed, personalized accounts of user experience with the interface. It is important to note that several of the methods along the center of the continuum can generate both quantitative and qualitative data. Second, the continuum represents a transition from a large sample size, possibly in the hundreds or thousands, to a sample as small as perhaps only one individual (e.g., Robinson et al. 2005). Small sample sizes are appropriate for usability testing due to the diminishing returns provided by additional subjects when looking for fatal interface errors and the budget limitations of an iterative approach to evaluation (Krug 2000). Third, the continuum

"When comparing different descriptions of usability testing and controlled experimentation, it becomes clear that there is no clear dividing line between the two methodologies; rather, particular methods fall along a continuum between strictly controlled experimentation and in-depth usability testing."

portrays a movement from a detached and hidden investigator to one that is salient and directly engaged with the participants in their natural environment. Fourth, the continuum illustrates the shift in the research goal from *universal usability* (Plaisant 2004), or generalizable design guidelines applicable to all mapping projects, to one focused solely upon revision of a single application. Results from usability testing can still be used to inform design decisions on other projects, but they cannot do so with the same degree of predictability awarded controlled experimentation.

Finally, the continuum represents a shift from summative evaluation to formative evaluation (Gabbard et al. 1999, Robinson et al. 2005). The purpose of *summative evaluation* is to provide an overall ranking on aspects of usability after construction is completed, allowing for direct comparison with similar applications (see Kobsa 2001, for example). Examples of summative evaluation on interface workload include the NASA TLX (Task Load Index) Worksheet (Hart and Staveland 1988) and GOMS (Goals, Operators, Methods, Selection rules) (Card et al. 1983). In contrast, the purpose of *formative evaluation* is to ensure that interface prototypes are meeting user needs and expectations. In formative evaluation, both the usability (i.e., how easy it is to use) and the utility (i.e., how useful is it) are evaluated (Grinstein et al. 2003). Formative evaluation is administered multiple times throughout the development process, improving the prototype iteratively (Krug 2000, Fuhrmann et al. 2005). As Robinson et al. (2005, 253) remark, "The evaluative effort must mirror the development effort, in that it should be constant throughout the progress of the project." Slocum et al. (2003) offer a framework for an iterative design process, illustrating the importance of evaluation at each stage of development.

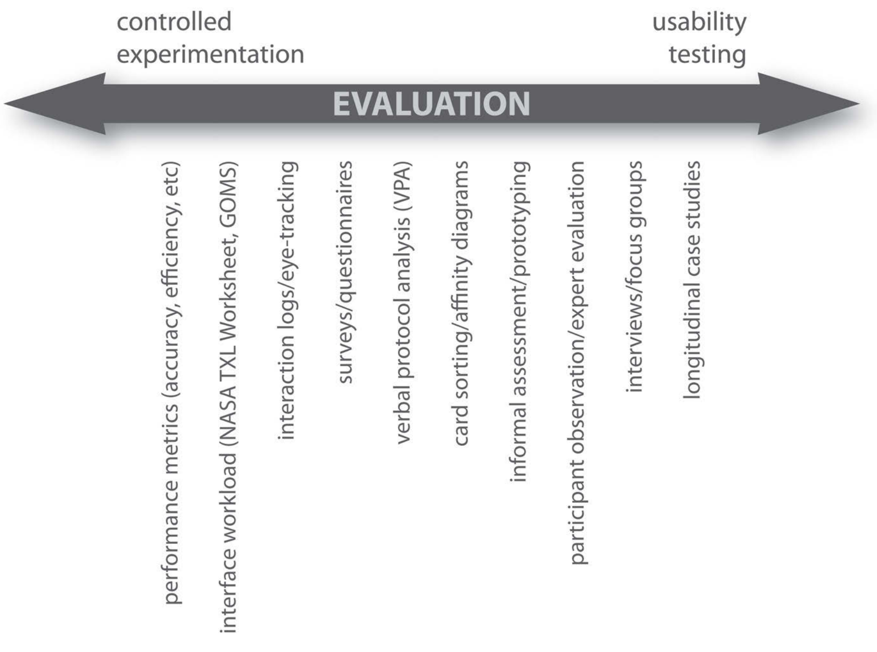

Figure 3. A continuum of evaluation methods, with strictly controlled experimentation and in-depth usability testing forming the antipodes. The positions of the more common evaluation methods are approximated along the continuum for reference. The positioning of these methods may change slightly depending on the specific binary used for ordering (quantitative versus qualitative, large versus small sample size, hidden versus salient investigator, universal usability versus improvement of a single application, and summative versus formative evaluation).

Usability Evaluation of the Lakeshore Nature Preserve Interactive Map

Description of the Lakeshore Nature Preserve Interactive Map

The University of Wisconsin-Madison Lakeshore Nature Preserve is a 300-acre continuous stretch of land along Lake Mendota, forming nearly one-third of the total campus area. The Preserve is the amalgamation of multiple donations from private landowners to the university over the past 150 years and is comprised of a mosaic of forest, prairie, and wetland ecosystems. The vision of the Lakeshore Nature Preserve Interactive Map was to offer multiple readings of the Preserve's physical and cultural landscape through various map layers. Each map layer provides a spatial overview of the many individual features important to a particular reading of the Preserve. The map interface acts as a catalogue for all of the spatial and attribute content about the Lakeshore Nature Preserve, allowing users to first see only several attributes of each map feature instance (its location in the Preserve and a label) and then request additional information if desired.

Navigation begins with selection of a map feature displayed on the map or with input of a feature name in the search box. After selecting a feature, the map user receives additional information about the theme and how it applies to the selected instance. This additional information, in the form of text, photographs, and diagrams, is populated in the information window along the right side of the application. From the information window, the user can then jump out of the map interface to the main website for a complete account of the selected feature. Figure 4 illustrates the navigation of the map interface during the browsing of content with a focus of providing more detail as the user drills down to a feature of interest. This navigation design permits the user to quickly filter out a vast majority of the available information, following Shneiderman's (1996, 337) mantra of "overview first, zoom and filter, then details-on-demand." Such design allows the user to "get lost in the content" and provides a new reading of the Preserve, and therefore a different experience, each time the user visits the website.

The Development Process and Informal Assessment

Evaluation for the Lakeshore Nature Preserve Interactive Map was conducted in two stages: informal assessment iteratively throughout the development process and a verbal protocol analysis (VPA) on the beta release of the application. Informal assessment occurs when a small group of stakeholders provide input on unpolished prototypes and offer comments, questions, and design ideas for their improvement (Robinson et al. 2005). Typically, the application developers conduct the informal assessment themselves, coupling each development step with an evaluation step, although project supervisors, outside consultants, and important end users may also be asked to participate in this formative evaluation. Teams responsible for the development process and informal assessment may be separated completely in large-scale, well-funded projects. Informal assessment is unstructured and often conducted in a brainstorming meeting or via email. The goal of informal assessment is not to provide detailed usability analysis at regular intervals during development for tracking the improvement of a summative usability metric, but rather to ensure that prototypes are following the original vision, to gain valuable input from stakeholders at all stages of design, and to avoid the obvious "head slappers" that could become fatal to the map if left unchecked (Krug 2000).

Most of the formative evaluation for the Lakeshore Nature Preserve Interactive Map occurred during the informal assessment stage. Stake-

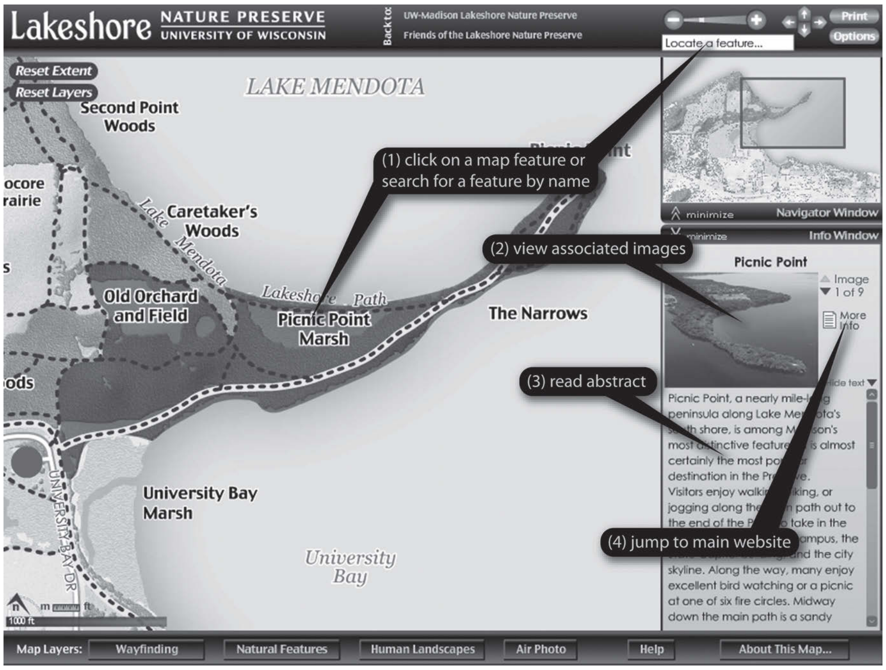

Figure 4. Navigation for the map interface, following Shneiderman's (1996, 337) "overview first, zoom and filter, then details-on-demand" mantra. *(see page 91 for color version)*

holders for informal assessment of the interactive map included the team of developers (responsible for initial development, evaluation, and revision), a group of supervisors, and an important set of end users involved in maintenance of and fundraising for the Lakeshore Nature Preserve. Meetings were held on a bimonthly basis, with smaller subgroup meetings taking place when needed. While the face-to-face meetings were used to clarify feedback and solidify future development directions, much of the informal assessment concerning specific map features or interface tools took place via email between bimonthly meetings. An online collaborative environment called DocuShare (http://docushare.edutech.org) was used to share and store documents during the informal evaluation, although actual communication via DocuShare was infrequent. Initial informal assessment focused upon determining user needs and identifying the list of core functionality for the application. It is reported in the literature that allocating ample time and resources for finalizing a carefully thought-through feature list is essential for avoiding *feature creep*, the requesting of additional features from the client related to working features that are available, and *feature loops*, features that require the development of additional, unforeseen features (37signals 2006). Central to this process was the "activity of getting to know the characteristics of people who will later use the software" (Henry 1998, 250). Materializing from the first several bimonthly meetings was a series of documents itemizing the features necessary for completing core user tasks, an estimation of the difficulty in implementing each feature, and a rough timeline for completion of these features. Amendments or clarifying descriptions of the map layers and interactivity included in the feature list were circulated through email.

After solidification of a feature list, interface mockups were prepared for informal commenting and revision. Initial interface mockups of interface widgets and layouts were generated using pen and paper. The *paper sketch* approach allows for immediate and rapid prototyping, providing a means for stakeholders to externalize their conceptualizations on how par-

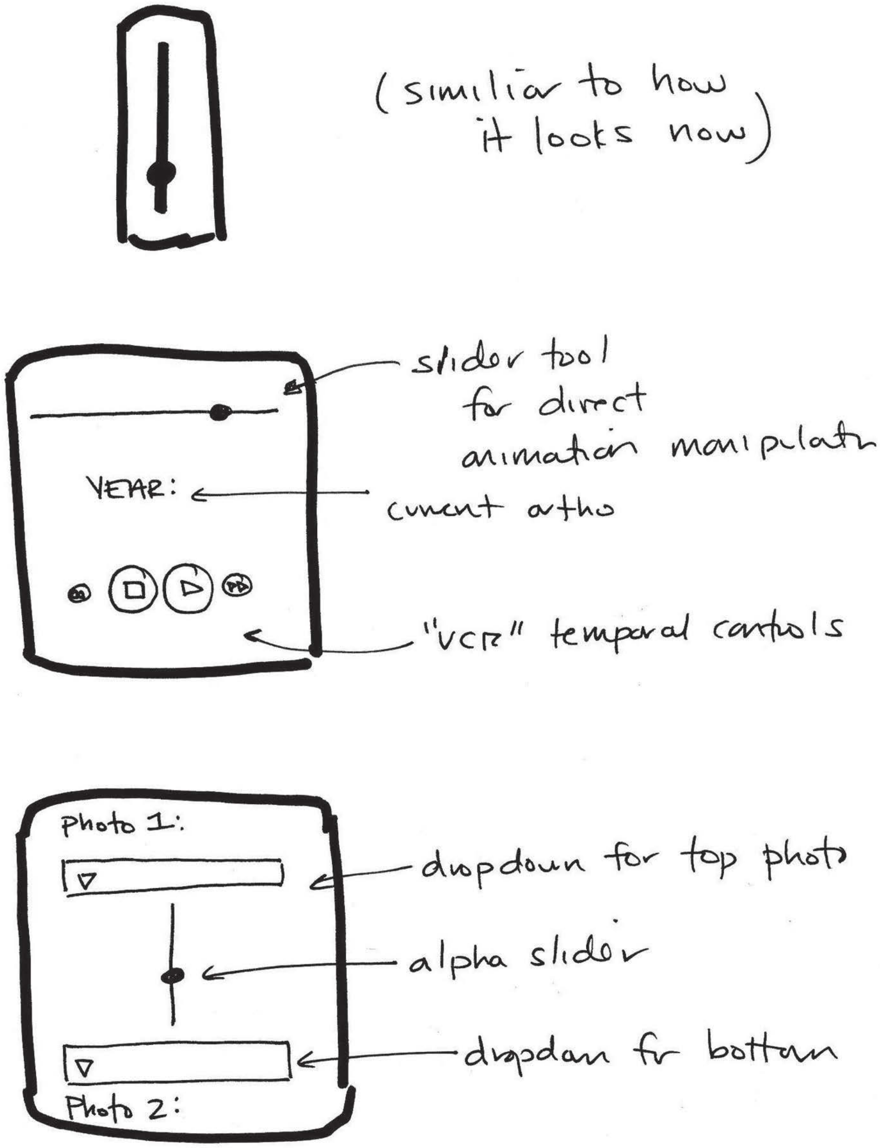

Figure 5. Paper sketch mockups for the air photo interface widgets that were circulated during the informal assessment stage. The top image shows a mockup for the transparency slider, the middle image shows a mockup for the historical orthophoto animation controls, and the bottom image shows a mockup for the analytical comparison tool.

ticular features should look and function without requiring any familiarity with graphic design programs (37signals 2006). Figure 5 shows several paper sketch designs for the air photo interface with descriptions of how the components function, and Figure 6 shows a paper sketch positioning these widgets in the application layout. During the bimonthly meetings, copies of the paper sketch mockups were distributed to everyone in attendance to allow for direct annotation when explaining design revisions and were collected when concluding the meeting. Once design ideas were formalized, the paper sketches were recreated using the graphic design program Adobe Illustrator and then exported to Flash for insertion into the application. A primary function of the email communication between bimonthly meetings was to relay annotated or corrected mockups discussed during the meetings. Figure 7 portrays the revisions to the future vegetation layer stemming from one such email thread.

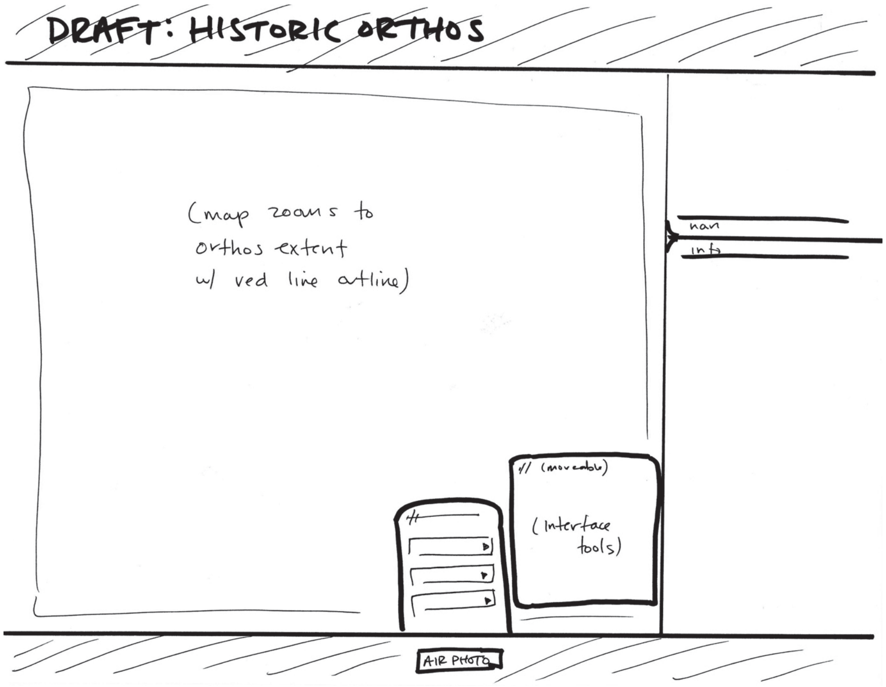

Figure 6. A paper sketch mockup showing the positioning of the air photo interface widgets in the larger application layer.

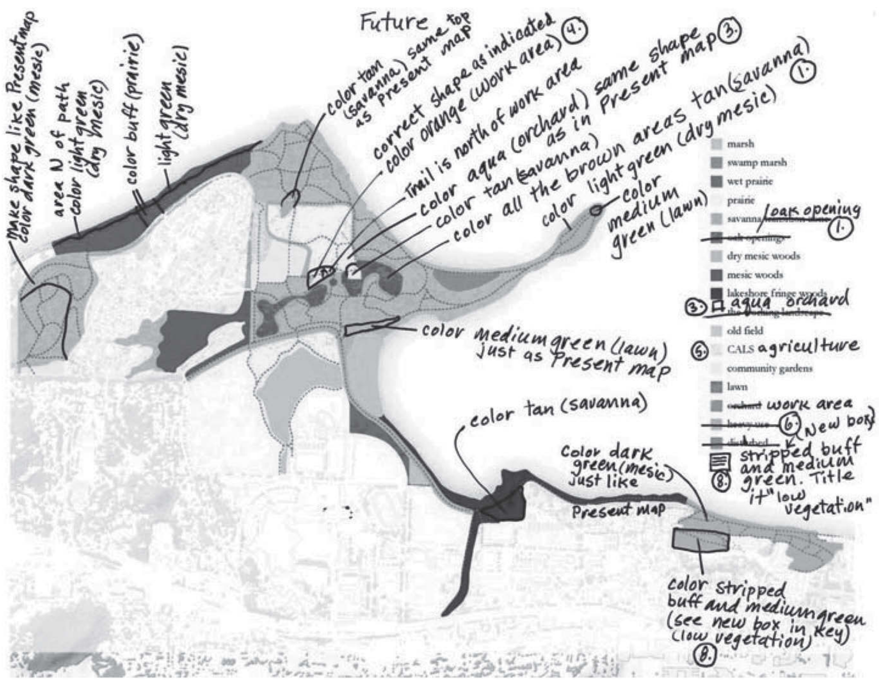

Figure 7. An annotated mockup circulated in an informal assessment email showing revisions and comments to the future vegetation layer. (see page 92 for color version)

Once development begins, feedback is received through a series of application releases. There are two release stages prior to the full product release: the alpha stage (composed of numerous pre-alpha and alpha releases) and the beta stage (and associated beta releases) (van der Hoek et al. 1997). Features are added to the application during the alpha stage of development and are debugged and polished during the beta stage of development. *Pre-alpha releases* of the application are those that are not feature complete, but offer an initial implementation of a particular functionality. Prototype versions that include the full feature set, but are unstable and untested, are termed the *alpha releases*. Generally, pre-alpha and alpha releases are closed versions of the application, viewable for evaluation only to the group of stakeholders, while the *beta releases* are opened for evaluation by a broader group of end users in real-world settings. This software release cycle allows for continued usability evaluation from the beginning of development through product release.

The final wave of informal assessment was upon pre-alpha and alpha releases of the application. For the Lakeshore Preserve Interactive Map, pre-alpha releases were demonstrated in the bimonthly meetings for feedback and circulated privately via email to the group of stakeholders when available. In sum, a total of sixty-five pre-alpha and alpha releases were evaluated either internally by the developers or by the entire group of stakeholders. During informal assessment of the pre-alpha and alpha releases, a running list of necessary revisions was maintained to document both usability issues and programming bugs as feedback was attained. The revision database logged the date the problem was identified, the date the problem was fixed, the person who identified the problem, a description of the problem, the person who fixed the problem, and a description of the solution. Table 1 displays several examples from the revision database. We continued to maintain this revision database during the beta releases and even after the product release, causing the developers to spend one week on revisions and updates approximately four months after the product release.

Verbal Protocol Analysis

Formal evaluation was completed on the beta release of the interactive map using verbal protocol analysis (VPA). VPA, also called talk aloud or simply protocol analysis, is a method for determining knowledge bases and problem solving strategies of users by asking them to speak aloud as they complete pre-determined tasks with the interface and is a common method for usability evaluation (Ericsson and Simon 1993, McGuinness 1994, Howard and MacEachren 1996, Haug et al. 2001, Saraiya et al. 2004, Fuhrmann et al. 2005, Robinson et al. 2005). VPA is triumphed as a method for moving beyond the recording of interaction outcomes, as with interaction logging, and instead generates data that describes the cognitive process itself (Ericsson and Simon 1993). Although VPA may be used for cognitive testing to examine how previous experiences and mental schemata are employed to solve complex problems (Howard and MacEachren 1996), VPA is also valuable for allowing "participants [to] subjectively comment on the prototype, [supporting] the identification of flaws and errors in the user interface" (Fuhrmann et al. 2005, 562).

"VPA, also called talk aloud or simply protocol analysis, is a method for determining knowledge bases and problem solving strategies of users by asking them to speak aloud as they complete pre-determined tasks with the interface . . ."

During VPA, participants are given a series of tasks to complete and are asked to describe what they are thinking as they attempt to solve them. Reflection from the user on what they are trying to accomplish provides insight into the expectations of the application (Robinson et al. 2005), allowing for recognition of widgets that are transparent and those that are not. Transparent interfaces allow users to focus upon the task at hand, rather than on learning how to manipulate the provided widgets correctly (Cooper and Reimann 2003). This difference in cognitive focus between the actual task and interface manipulation should be evident during VPA, highlighting which feature implementations are inefficient or unclear.

Eight subjects were recruited for participation in the VPA on a beta release of the map. The participants were purposefully selected to reflect

Date Added	Logged By	Date Fixed	Fixed by	Description	Solution
8/14	Mark	8/25	Andy	The larger images need to load in their own html window, outside of Flash, to speed their delivery.	Added getURL script
8/16	Bill	8/16	Rob	The eye icon needs to be changed to the words "on/off" to remove ambiguity.	Graphics adjusted
8/18	Mark	8/21	Rob	The user needs to be able to reset the layers and the view extent separately.	Added two interface buttons called "Reset Layers" and "Reset Extent"
8/18	Rob	8/25	Andy	Include tool tips to reduce the ambiquity of small interface widgets by adding textual instructions for use.	Tool tip system added for all interface widgets
8/21	Cathy	8/21	Rob	Need the ability to see both legends when using the analytical comparison tool.	The legend now comes up in the top left corner after a new polygon layer is selected in the dropdown menu.
8/21	Bill	8/21	Rob	There is an error in the position of Edward Young House. A document in the email reflects its appropriate position.	Repositioned accordingly.

Table 1. Several sample entries in the revision database.

the broad intended audience of the map, ranging greatly in age (15-83) and technical expertise. The VPA was also conducted in the subject's natural setting, providing evaluation on multiple operating systems, internet browsers, and screen resolutions. None of the subjects had any previous interaction with the interactive map or any part in the informal assessment, although all subjects were familiar with the Lakeshore Nature Preserve. The VPA began by allowing the participants several minutes to get comfortable with the map, encouraging them to explore core features without any direction from the investigator. After the participants reported feeling acclimated to the interface, they were given a series of tasks to complete using the map and asked to articulate what they were thinking as they worked through each task. The complete VPA protocol is provided in Table 2. Completion of the tasks required participants to interact with both simple and complex widgets, representing the full range of task difficulty associated with the application. The facilitators asked follow-up questions related to the tasks when the participants had difficulty verbalizing their thoughts or when they completed the tasks with unusual or

Task #	Task
Opening	Just explore the map for a few moments on your own to get a feel for it.
#1	Click on Picnic Point on the map. How many children are in the 5th photo about Picnic Point?
#2	What is the soil type at the eastern end of the Howard Temin Lakeshore Path (near Science Hall and the Union)?
#3	Change the scale of the map (zoom in or out).
#4	Using the search engine to answer this (it says "Locate a Feature"), how many fire circles are there at Picnic Point?
#5	Reset the map (make it look like it did when you arrived).
#6	Turn-on the 2004 air photo (make it visible).
#7	Click on Raymer's Cove on the map to zoom into it. Without changing the scale of the map, recenter on Willow Beach.
#8	Within the "Wayfinding" menu, turn-on (make visible) all of the visitor amenity features (phones, benches, etc.).
#9	What year did the Blackhawk Lodge close?
Cognitive Interview	OK, let's talk! Any general comments? Concerns? Ideas?

Table 2. The VPA protocol.

unexpected solutions. The number of tasks in the protocol was limited to ensure that the testing session was less than thirty minutes in length.

The usability assessment concluded with a *cognitive interview*, a practice similar to debriefing (McGuinness and Ross 1995). The cognitive interview allows the participant to discuss his or her experience after the completion of all tasks, allowing the user to share more general comments concerning multiple tasks or specific suggestions not mentioned during the VPA. The cognitive interview was unscripted and optional for the participant. Howard and MacEachren claim that the use of a cognitive interview is an effective approach to usability assessment, "perhaps especially when combined with protocol analysis" (1996, 17). Results from the VPA and cognitive interviews were then analyzed by the developers, informing a final round of revisions to the application. Following Krug (2000), only legitimate interface problems were corrected following the VPA; suggestions for additional features or major reworkings of current features were not undertaken during the final stage of development. The following section summarizes four of the larger design issues revealed by the VPA.

Discussion – Design Guidelines for Usable Online, Interactive Maps

Providing a Cascading Information-to-Interface Ratio

One objective of the project was to develop a map interface that would equally attract new visitors to the Preserve, educate casual visitors on the little known riches of the Preserve, and provide avid visitors and researchers analytical tools that encourage new ways of thinking about the Preserve. During development, these categories of intended users were referred to as the "newbie," the "regular," and the "researcher," respectively. The primary differentiation among the three groupings was the expected level of user motivation. Note that taking an approach based upon motivation is different from one that is based upon level of expertise (e.g., focusing upon either domain knowledge of the Preserve or technical familiarity with online, interactive maps). Saraiya et al. (2004) acknowledge the importance of initial user motivation on the quantity and quality of insights gained from use of the application. We contend that users with low levels of motivation are not necessarily incapable of gleaning large amounts of rich insights from a map application, but rather that they simply do not want to do so. Further, we take the position that it is the duty of the developer to accommodate a large range of potential motivation levels when the expected audience is so varied, rather than filtering potential users by their level of motivation. In this regard, using the map to look up a wayfinding point of reference in the Preserve is an equally justified task to support as using the map for its more complex functions that provide a richer reading of the Preserve.

Understanding how to design for varying levels of user motivation is informed by the concept of information-to-interface ratio. The total screen pixels dedicated to the browser is termed the *screen real estate* (Nielson 2000). The screen real estate can be dedicated to either information content or interface widgets, generating a measure for interface complexity termed the *information-to-interface ratio* (Harrower and Sheesley 2005). In this research, a component that contains information but is also interactive (as in the case of a map that can be directly manipulated) is counted towards the information pixel total, rather than the interface pixel total. Harrower (2002) theorized that there is a direct relationship between the user's level of motivation and a successful degree of interface complexity. This work can be extended to assume that users with low motivation seek a map with a high information-to-interface ratio (i.e., an interface that is not complex), while users with high motivation will tolerate a map with a low information-to-interface ratio (i.e., an interface that is highly complex) to access the accompanying increase in functionality. Figure 8 illustrates the relationship between user motivation and interface complexity.

". . . we take the position that it is the duty of the developer to accommodate a large range of potential motivation levels when the expected audience is so varied, rather than filtering potential users by their level of motivation."

The VPA reflected a varying signal on preferred interface complexity, with several subjects suggesting that there were so many interface controls available that it was unclear where to begin and others requesting additional interface functionality. This finding reflects the variation in self-reported motivation of the participants, with subjects matching most closely with the "newbie" category desiring a streamlined interface with an obvious entry point to the map, and subjects matching most closely with the "researcher" category desiring a more complex interface and advanced features. The VPA reports the two potential failures shown in Figure 8: a situation where the user is unmotivated and the interface is too complicated, and a situation where the user is highly motivated and the interface is too simple. To compensate for this variation, the final redesign attempted to provide a *cascading information-to-interface ratio*, or an interface that provides ascending levels of interface complexity that relate to ascending expected levels of user motivation. A common example of a cascading information-to-interface ratio is in the availability of a regular versus expert mode in software (Cooper and Reimann 2003).

To provide an initial high information-to-interface ratio for the "newbie," all extraneous views (the information window, layer menus, layer legends, etc.) were hidden upon first viewing the map, and the position of the search box on the visual hierarchy was improved. This design ensured

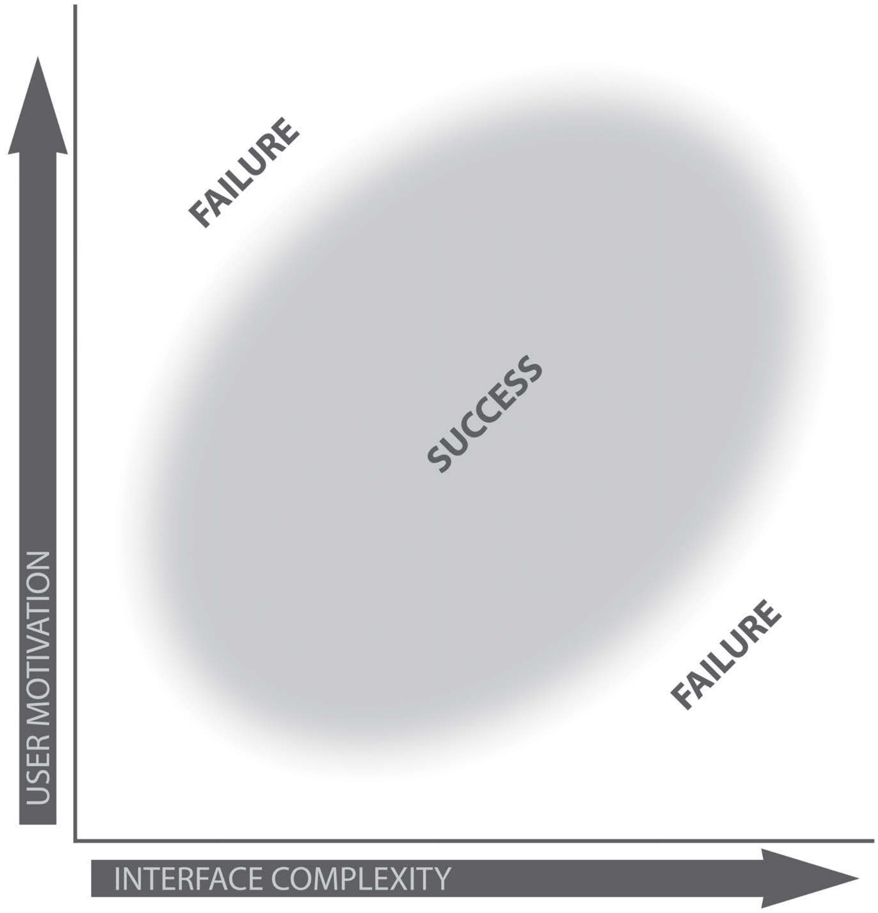

Figure 8. The relationship between a user's motivation and a successful level of interface complexity as described by Harrower (2002).

the largest possible footprint for the central map; comments from the VPA recommend a large map footprint as the default view when unmotivated users are expected to use a map. The "regular" is then able to access additional functionality by clicking on map features, automatically re-centering the map and opening the information window. Finally, the most complex functionality designed for the "researcher," presenting the lowest information-to-interface ratio, was hidden deeply within the bottom menu structure. This cascading information-to-interface ratio strategy implemented in the Lakeshore Nature Preserve Interactive Map is plotted atop Figure 9 as a piecewise function.

Providing Map Browsing Flexibility

A second interesting result of the VPA was the inability to identify a universal method for map browsing that was understood by all participants. *Map browsing* is the combination of panning and zooming of a map document that is too large or too detailed to be viewed by the available screen real estate, and is related to the HCI research on browsing of an information space too immense to be displayed in a single window (Cockburn and Savage 2003). *Panning* is the repositioning of the map document to view sections of the document space not currently visible or to center on a map feature of interest, while *zooming* is the act of changing the scale of the map, effectively shrinking or enlarging the map image onscreen; the two are often implemented in tandem (van Wijk and Nuij 2003). Harrower

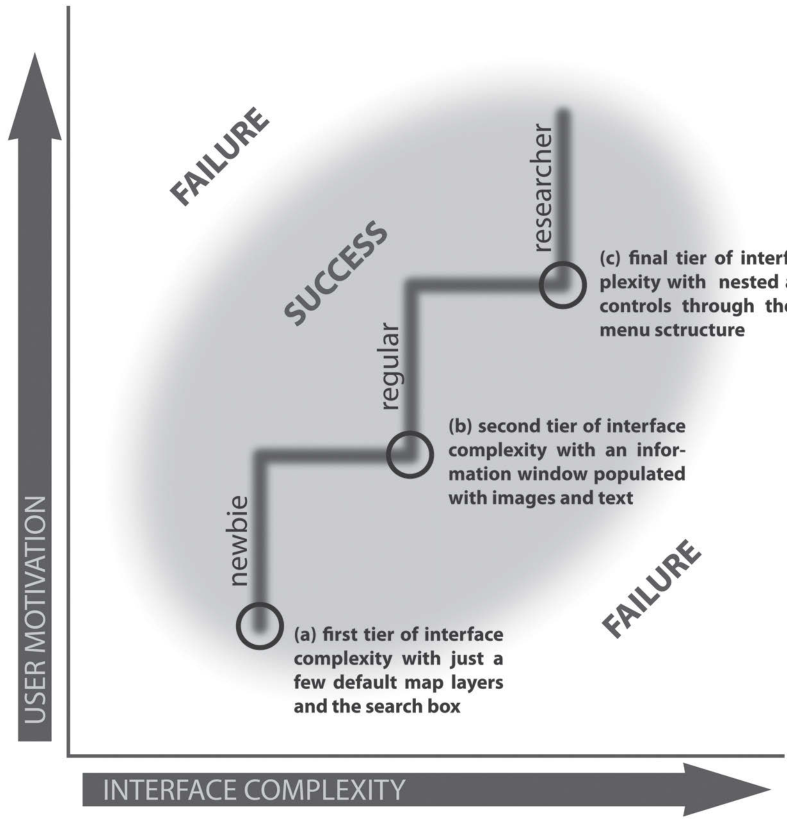

Figure 9. The cascading information-to-interface ratio strategy implemented in the Lakeshore Nature Preserve Interactive Map is modeled as an abstracted piecewise function atop this graph. The new image reflects the three tiers of interface complexity and their associated target users. This path reflects a hypothetical pairing of user motivation to interface complexity in the Lakeshore Nature Preserve Interactive Map; deviation of "newbies" from the simple interface is not only hoped for and expected, but, more importantly, would show that the initial positive experience with the simple interface has increased motivation to use the site.

and Sheesley (2005) identify nine different solutions for map browsing: 1) directly re-positioning the map ("grab and drag" or "direct manipulation"), 2) smart scroll bars, 3) rate-based scrolling, 4) keyboard controls, 5) zoom and re-center under mouse click, 6) navigator tabs/interactive compass, 7) navigator window, 8) specify explicit coordinates or scale, and 9) zoom box (for simultaneous pan and zoom). While explanation of each of these is outside the scope of this paper, it is important to note that preliminary research suggests that the appropriate implementation of map browsing depends on two factors: the map browsing task and the size of the document to be browsed (Cockburn and Savage 2003). In short, there is no ideal, context-independent method of map browsing.

The beta release of the application included three map browsing implementations: 1) direct manipulation of the map, 2) zoom and re-center under mouse click, and 3) a navigator window. According to Harrower and Sheesley (2005), these three methods exhibit the lowest interface workload and highest information-to-interface ratio and were therefore assumed by developers to be the most important to include. The VPA demonstrated that, while these methods did prove to be highly efficient, they were not entirely self-evident. All participants discovered the zoom and re-centering functionality after some exploration with the interface, but the majority did not directly manipulate the map to pan, and no participant used the navigator window as an interface widget. This finding presents a third constraint to finding a single, ideal method of map browsing: given previous experience with map interfaces, users may or may not be aware of particular implementations of map browsing that are not visually obvious. *Flexibility* is the provision of multiple interfaces by the application to the user to complete a single task, allowing for task completion through multiple paths (Cooper and Reimann 2003). This insight from the VPA caused developers to increase map browsing flexibility by adding two additional methods: 4) navigator tabs in the form of an interactive compass and a zoom slider bar and 5) keyboard shortcuts.

Avoiding Minimalist Design of Interface Widgets

A third issue that was reported during the VPA concerned the graphic design of many of the interface icons. We attempted to follow Tufte's (1983) concept of data-ink maximization when designing small interface icons. The *data-ink ratio* is a measure of the amount of ink devoted to actual information in the graphic compared to the total ink used for the graphic, and *data-ink maximization* is the process of improving this ratio by subtracting unnecessary marks. These concepts challenged the developers to design basic, yet elegant, interface widgets, removing as many embellishments as possible to limit the footprint of the widget. Figure 10 illustrates the initial designs for the layer visibility, the menu tear-away, and window minimize/maximize buttons. However, most attempts at minimalist design were lost upon at least one of the participants in the VPA. In these cases, the simplistic widget design did not provide enough affordances for the user to infer its function. An *affordance* is a visible property of an object and is useful for creating mental mappings between an object's appearance and its functionality (Norman 2002). By extending Tufte's (1983) principle of data-ink maximization to interface widget design beyond its intended application of information graphics, affordances that are necessary for making sense of the interface are inappropriately removed.

"By extending Tufte's (1983) principle of data-ink maximization to interface widget design beyond its intended application of information graphics, affordances that are necessary for making sense of the interface are inappropriately removed."

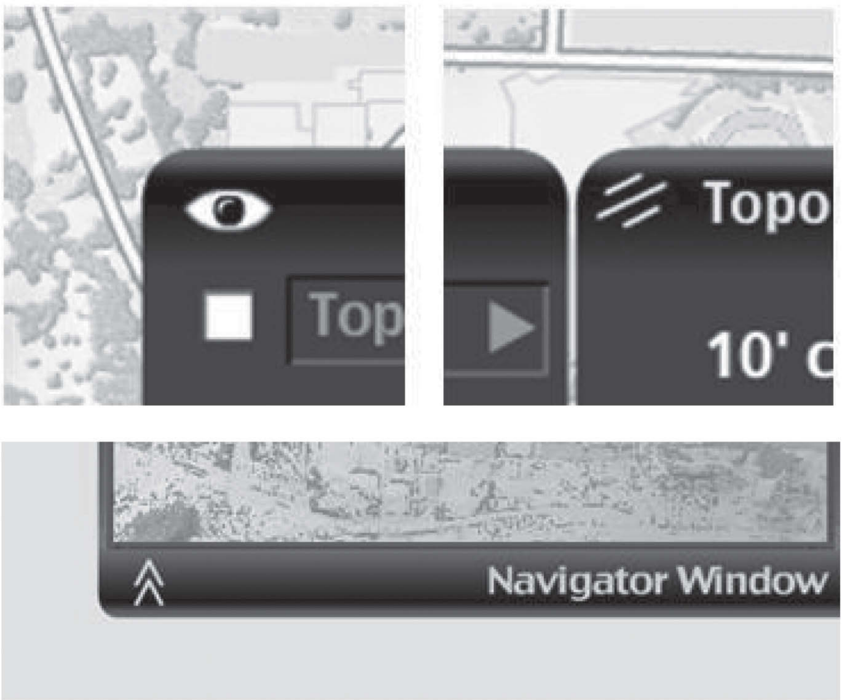

Figure 10. Initial designs for the layer visibility button (top-left), the tear-away menu button (top-right), and the minimize window button (bottom). *(see page 93 for color version)*

This finding from the VPA is confirmed in both the HCI and web design literature. Ware writes that "adding marks to highlight something is generally better than taking them away" (2004, 153). Krug adds, "In general, if you're a designer and you think a visual cue is sticking out like a sore thumb, it probably means you need to make it twice as prominent" (2000, 75). The failure of our minimalist interface buttons caused a fundamental graphical redesign for all widgets. In many cases, explanatory words were added next to the button for clarity (e.g., "minimize") or the icon was completely replaced by text (e.g., "on/off"). In situations where space did not permit textual descriptions, extra graphical affordances were added, making the widgets either larger or more complex. A system of tool tips also was developed to provide added instruction when a user pauses over an interactive portion of the application. Figure 11 illustrates the redesigns for the menu close, menu tear-away, and window minimize/maximize buttons based upon recommendations from the VPA.

Figure 11. Redesigns for the layer visibility button (top-left), the tear-away menu button (top-right), and the minimize window button (bottom) added words to explain the function of the widget and sometimes did away with the vague icon altogether. Tool tips (top-right, in yellow) also appear after pausing over a widget for one second to further prompt the user about the widget's function. (see page 93 for color version)

It is important to note that a call for added affordances does not necessarily have to contradict our recommendation to provide a large information-to-interface ratio upon initial entry into the map. While designing for a particular information-to-interface ratio is a holistic way of determining an appropriate number and collective size of interface widgets onscreen, the Tufte critique and the concept of affordances refer to the design of interface widgets on an individual level. We concede that one way to reduce the collective size of the map interface, and thus to improve the information-to-interface ratio, is to remove affordances from individual widgets in such a way that reduces their pixel footprint. However, given the feedback for the VPA, we recommend the removal of widgets in their entirety before the removal of affordances if a higher information-to-interface ratio is desired. In short, when designing for a high information-to-interface ratio, it is better to provide only a few, essential widgets that are immediately obvious and easy to use than have an abundance of ambiguous and difficult-to-understand ones.

Avoiding the Lorem Ipsum Map

The final design concern revealed by the VPA and subsequent cognitive interviews addressed the look and feel of the application. Multiple comments were offered regarding the contemporary or modern feel of the interface "shell" compared to the natural and historic feel of the map itself. Such comments were not unfounded, as the look and feel of an interface should mimic the look and feel of the content that is being accessed (Cooper and Reimann 2003). The mismatch between map content and surrounding interface shell was a result of the development team's beginning programming on common map functionality before the full feature list was produced. The deviation from appropriate workflow required usage of a *lorem ipsum map*, a dummy map used during interface development as a placeholder. The employment of a placeholder lorum ipsum map for development of the interface is evident in the generic look and poor usability of most GoogleMaps mash-ups, as the user interaction was developed without an understanding of the end content.

Krug (2000) warns about designing the interface structure of a website using placeholder content. It is common for web designers to fill components with the lorem ipsum text string, a series of words resembling Latin but not intended to have an implied meaning, during the development process. Krug (2000) argues against this practice, stating that it reduces usability, as designers never think about the kind of content that will be populating the components. Instead, the content should be developed first, and the interface should be designed around it second. This design approach is similar to the concept of *epicenter design*, where the most important content is first established and peripheral user interaction is then added around it (37signals 2006). Designing the map content first would not only have provided a consistent look and feel between the map and the interface shell, it would have also helped inform how the interface widgets in the shell should function.

CONCLUSION

If we want our interactive maps to work well, we must place the user front and center throughout the entire development process and gather input from them at all stages of work, not merely as an after-thought once the system is built. By only asking for feedback after development is complete, user input can do little more than confirm or challenge decisions which would be too expensive to change (and make us kick ourselves for not seeking that feedback earlier). The "feedback loops" we built into development of the Lakeshore Nature Preserve Interactive Map strongly shaped both what the map does (its purpose) and how it behaves (its functionality). As we have shown here, feedback can range from initial brainstorming sessions from a small group of invested stakeholders (who can represent their constituency of end users) to a more structured verbal protocol analysis with a sample of end users.

From the user's perspective, the usability of the map interface is absolutely crucial. No matter how interesting and robust your data may be, the map will not succeed if the user cannot figure out how to access the data or understand what the data is saying. Minimizing usability problems should be the keystone of any development approach. Although this commitment to user-centered design and continuous evaluation appears to be both time-consuming and expensive, it instead accelerates development by allowing the design team to quickly focus their energy on core functionality and reduces the cost of a project by minimizing wasted work hours implementing functionality that is later altered or removed. The Lakeshore Nature Preserve Interactive Map was built, start to finish, including all research, programming and evaluation, in only three months with mostly student part-time labor, offering anecdotal evidence that constant evaluation improves development efficiency.

Perhaps a difficult fact to accept is that the basic metric for determining the success of an interface is not whether we, the developers, think the design of the map is brilliant (or even if we receive accolades from our peers for this brilliant design), but whether the target audience understands the map—both the content and the interface to that content—and if they enjoy using the map. One example from the development of the Lakeshore Nature Preserve Interactive Map was the need to redesign the clever, yet minimalist interface icons in such a way that made them immediately obvious. While we still like our original icons and feel that they are a more elegant way of connecting form to function, we did not hesitate to eliminate them when our testing showed they just did not work. This concern makes early and ongoing evaluation even more important, as it is only human nature for the developers to become increasingly partial to and defensive of their own designs with time. If cartographers only seek feedback following completion of the application, it will be difficult for us to ever see our online, interactive maps for what they may actually be: useless and unusable.

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Reviews

Bomb After Bomb: A Violent Cartography
by elin o'Hara slavick
Foreword by Howard Zinn, essay by Carol Mavor, interview by Catherine Lutz.
Milano, Italy, Edizioni Charta, 2007.
111 pp., 13 figures, 48 plates, annotations, endnotes, author's bibliography, sources, exhibitions.
$34.95. Softbound
ISBN 9788881586332

Reviewed by Daniel G. Cole
Smithsonian Institution, Washington, DC

Let me start by stating that this is an unusual book, and an especially unusual one to be reviewed in this journal. This book was not compiled by a cartographer, nor was it meant for use by cartographers alone. Slavick's bibliographic sources are a mix of artists, historians, political scientists, and geographers. She is an artist who employs cartography in her paintings and exhibitions to illustrate the horrors of war. The book is primarily a collection of slavick's cartographic artwork, along with an accompanying foreward, an art essay, and an interview with the artist.

Howard Zinn notes in the foreword that even though she does not show us "bloody corpses, amputated limbs, skin shredded by napalm . . . her drawings, in ways that I cannot comprehend, compel me to envision such scenes" (9). He also points out how her artistic cartography reminds us that while "[t]he horrors of the means are certain, the achievement of the ends [are] always uncertain" (11).

The essay by art historian Carol Mavor, "Blossoming Bombs," is presented as a series of topical discussions tangentially related to slavick's artwork. In Mavor's first discussion, subtitled "Flowers," she posits that like the wildflowers that blossom after nuclear devastation, a blossoming of memories is extracted from slavick's paintings. In "Memory," Mavor explains that, "Scratched, smudged, layered like the residue of toppled buildings after an air strike; these maps are worthless for actual navigations. Without legends, without clear markings of any kind, they are, instead, maps for thinking or rethinking" (15). Further, she notes that slavick's depressing artwork was made with the hope for peace by focusing on places that the U.S. has bombed, either at its testing grounds or in war.

Within "Hiroshima," Mavor presents a comparison of slavick's abstract drawings of Hiroshima's epicenter and other bombed and nuclear test sites to other war remembrance images. The "Abstract," "I Do Not Understand," "Beauty," and "I Am Looking for Summer inside a Black Marble" sections try to help us understand the horrors of war through art, photography and prose. For example, Mavor discusses the photograph of a Japanese woman "who was violently mapped with abstractions" of her kimono patterns burned onto her skin by exposure to the atomic bomb (25). Mavor finishes with "Terrible Beauty," where she finds four intermittently spaced pressed pansies within the pages of *Hiroshima and Nagasaki: The Physical, Medical, and Social Effects of the Atomic Bombings,* followed by "Terrible Beauty by Air" in which she describes the beauty of air flight contrasted with the seductive and destructive impersonal power of aerial bombing.

Slavick's map paintings are exhibited on plates covering the center of the book's fifty-three pages. Unfortunately, the short descriptive annotations to the works fall on the eight pages following the plates, whereas they could have easily been placed in the white space above or below the plates to facilitate the reader's understanding of these artistic maps. The first map, also reproduced on the book's cover, presents a non-facsimile world in an Armadillo projection (but with no credit to Erwin Raisz cited) illustrating selected locations of U.S. bombing and bomb testing from 1854 onward, covered by watercolor blotches of red and black symbolizing explosions and smoke. She uses plenty of cartographic license here with landmasses that were obviously rendered independent of the graticule, and some locations deviate greatly from reality.

The artist's next cartographic drawing is of Nicaragua, a country of multiple episodes of intervention along with multiple epicenters of bombings. This image is followed by a number of World War II maps of the fire bombings of Dresden and Tokyo, numerous battle sites in the European and Pacific theaters, and the hypocenters of Hiroshima and Nagasaki. Interspersed within these pages are mapped paintings of bombing ranges and test sites in Puerto Rico, the mainland U.S., and islands in the South Pacific. Additional plates cover large and small wars to the present in Korea, Central America, Southeast Asia, the Caribbean, Peru, the Belgian Congo, Southeast Europe, and the Middle East. One domestic aerial bombing is painted, that of the 1985 firebombing of MOVE in Philadelphia. Again, sprinkled within these pages are nuclear test site locations in map drawings of Nevada, the South Pacific, Mississippi, and Alaska.

Anthropologist Catherine Lutz interviews slavick concerning the exhibited map drawings. Several statements in this interview are instrumental to understanding slavick's motivations, concerns, and point of view. Slavick states that "[t]he drawings are also beautifully aerial to seduce and trap the potentially apathetic viewer, so that she will take a closer look, slow down, and contemplate the accompanying information that may implicate her. I also chose the aerial view to align myself, as an American, with the pilots dropping the bombs, even though I would not drop them. As a photographer aware of the military's use of the aerial view that flight and photography provide, using the aerial view seems like a natural choice. I utilize surveillance imagery, military sources and battle plans, photography and maps, much of which is from an aerial perspective" (97). She feels that her drawn maps "are a *visual* interpretation or depiction of, reaction against, reflection on, and emotional response to the world around us" (99). She also comments upon how her artworks "protest the age-old power of maps; power utilized by governments and individuals in the name of private ownership, border control, and imperialism" (100).

While slavick's slim volume is aimed more at the general public than at our profession, cartographers should be aware of how maps can be used in art and elsewhere to transmit powerful messages to the viewing public. Hers are not maps to be judged on their accuracy; nonetheless, they are drawings to spatially communicate the fractures and effects of war and war preparations. Indeed, her maps are terrific or terrible reminders of the manner in which spatial data and imagery are displayed, be it in historical atlases of war or in art exhibits.

Bomb After Bomb: A Violent Cartography
by elin o'Hara slavick
foreword by Howard Zinn, essay by Carol Mavor, interview by Catherine Lutz.
Milano, Italy, Edizioni Charta, 2007.
111 pp., 13 figures, 48 plates, annotations, endnotes, author's bibliography, sources, exhibitions.
$34.95. Softbound
ISBN 9788881586332

Reviewed by Mark Denil
Cartographer at Large

Bomb after Bomb is an atlas of aggression. It is built around a folio of individual maps depicting sites of bombings carried out by United States government agencies—primarily federal military agencies, but in one case a domestic municipal police force. As a thematic atlas, it is a clear and well-focused compendium of individual works that hangs together exceptionally well and carries a forceful and unambiguous argument about its central issue. This book should be on the shelf, and regularly in the hands, of every practicing cartographer.

This small (6¾ x 9½ inches, ½ inch thick) atlas is divided into six sections. A foreward by the historian Howard Zinn introduces the work, and a longer essay by British art historian Carol Mavor frames some of the issues that could be raised by the works for an engaged reader or viewer. The forty-eight map works selected from the series *Protesting Cartography: Places the United States Has Bombed* make up the bulk of the volume with one work to each page, except for a single two-page spread and three pages given over to lightly manipulated source material. Each original map is 30 x 22 inches, and each is reproduced in color on the page at 5½ x 4 inches (except, of course, the one double spread). After the maps comes a short section of annotations for each work, which is itself followed by an interview with the artist carried out by Catherine Lutz (co-author, with Jane Collins, of the book *Reading National Geographic*). *Bomb after Bomb* closes with an appendix that includes a short biography, a bibliography, and list of exhibitions for the artist, plus source notes for the works and annotations.

The maps themselves are produced in ink and watercolor on Arches paper. In most of the works, a ground of color stains and blotches is overlaid with linear drawing and more hard-edged colored areas, often outlined (*cloisonné*). The source material is either another map or an aerial photograph, and often some vestige of that source is carried into the final work: an unlabeled grid (*The Firebombing of Tokyo, Japan, 1945* (53)), the wreckage of assorted map furniture (*Eniwetok Atoll, Republic of the Marshall Islands, 1948–1958* (55)), troop movement arrows (*D-Day or Invasion Beaches, Normandy, France, Operation Overlord, 1944* (45)), or a hand-drawn photogram metric aid (*Hypocenter in Hiroshima, Japan, 1945* (48)). Some, like *Johnston Atoll, US*, 1958-1962 (62), are clearly based on high oblique photo images. Slavick's maps themselves are tortured and stricken, echoing or displaying the fate of the represented place. The stains and streaks evoke explosions and conflict, and the smeared and bleeding line work connotes the smashing and smearing of the land and infrastructure by high explosive.

Certainly, this is not the usual type of publication one finds reviewed in *Cartographic Perspectives*. Similarly, elin slavick's presentation at the 2007 NACIS conference (and, indeed, the entire presentation session of which it was a part) was not the usual fare one expects at a cartographic conference. Nonetheless, *Bomb after Bomb* is the kind of work with which it is advantageous for a practicing cartographer to be familiar. But why should that be? Only a tiny fraction of mapping jobs involves such topics and situations, and in general one is enjoined to present maps that appear dispassionate and detached. Nonetheless, these maps deal with "facts on the ground," facts that can be presented cartographically but whose expression may well not fall within the day-to-day vocabulary of many cartographers.

No one, or at least no one in the cartographic community, would mistake this for the work of a professional cartographer. The work abounds with cartographic naiveté and innocence; for instance, the only map with a recognizable graticule (the only world map in the collection) has landmasses clearly lifted from some other projection and some sections of the landmasses seem to owe more to the era of Al-Idrisi than to more recent centuries. The map of Christmas Island (Kiritimati) on page 68 was also a little confusing, and I puzzled over it for some time. I have myself mapped that island, and the country of Kiribati of which it is a part, and this just didn't look right. It finally dawned on me that this was a *different* Christmas Island: the one in the Indian Ocean, south of Java, and controlled by Australia (it is where the Australians imprison their "illegal" immigrants, amongst the hills of guano), and not the island south of Hawaii in the Pacific, where the bombs went off!

Why then, would this book be of any interest whatsoever to a cartographer? That reason lies in its facile evocation of the power of maps in the service of a proposition. We know that all maps forward a position of some sort; they are rhetorical constructs that place a cogent, accessible, and persuasive argument before an audience. They naturalize a parochial position and allow or encourage the map user to internalize that position as truth. This *Bomb after Bomb* does with aplomb. I would compare this atlas to J. F. Horrabin's 1935 *An Atlas of Current Affairs*, a similarly small book of maps with short explanations of the history and situation for the very many flashpoints around the world at that time. Yes, the style is quite different; yes, Horrabin's captions are more loquacious; yes, there is any number of differences: yet, each atlas centralizes and makes obvious and natural a particular worldview (as it happens, not too very different ones).

Perhaps this power is reinforced by the atlas format; one wonders if individual works would be as powerful alone; although, on the other hand, at full size slavick's individual works would be 5½ times larger.

Zinn's foreward focuses on the visceral response evoked by slavick's work. He writes of how these maps had the power to stun him by foregrounding the effects, results, and consequences of the very sort of bombing missions in which Zinn himself had played so significant a part in the 1940's. As a bombardier, he would, without a doubt, have seen and handled a good many maps in the course of his tasks, charts focused on the assigned target as just that: a target. Such maps strictly circumscribe the reality on the ground, and do not allow infiltration of anything that might distract from the job at hand (such as contemplation of the consequences of actions). Slavick's maps, by contrast, come freighted with poignancy: consequence is writ large upon them.

This freighting occurs due, in part, to the way slavick's maps grow from and subvert the more recognized and expected forms of map. What elin slavick does is to manipulate the outward trappings and accouterments of what is generally a strictly formalized and tightly structured form to produce something all the more startling for its familiarity. The very maps the artist sources are the ones the planners and perpetrators of the actions employed. It is into this "dispassionate" material that slavick inserts the boot marks of the players. It breaks the "clean-cut" image of the map and makes strange the familiar. This observation is hardly a new one (all the texts in *Bomb After Bomb* mention it in some manner or form), and it is often mentioned in discussions of "map art," but it is, in this case, quite apt.

The breaking of the familiar (the unexpected subversion, the failure of the trusted strength) has a power of its own, and when the legitimacy of familiarity is as strongly entrenched in the psyche as is official or military mapping (and the more strongly accepted as it is less understood), the subversion itself is disturbing. One is reminded of the 1826 painting *Greece on the Ruins of Missolonghi*, by Eugène Delacroix, which depicts a young woman with her arms spread out in sadness and incomprehension, with a triumphant Turk in the background.

Zinn, Mavor, and slavick herself all refer to this subversion, sometimes obliquely, in the atlas texts. Zinn writes of the haunting knowledge of complicity born of the contrast between experiences on opposite sides of the event. In that vein, he compares it to the shock of the 2001 events and the stunned national acquiescence to the subsequent random military revenge strikes that followed.

In Mavor's series of essays, themes of memory predominate. Memories of her own, memories of others, and, eventually, fantastical memories of a highly improbable nature no one could ever have had. She seems at times quite punch drunk on the concept of memory, and in the tizzy of her passion she badly fumbles what is, no doubt, supposed to be a passage of some significance concerning pressed flowers in the pages of a dry report on the after-effects of the Hiroshima bombing.

Despite this, and despite a few other absurdities (I am sorry, Ms. Mavor, airplanes did *not* "perfect cartography"), these essays are not a waste of time. Her comparison of these works to the map works of Yves Klein is useful, and the parallel of maps with the power of Gilles Deleuze's Sensuous Sign is apt (albeit barely explored).

The Lutz interview, "What We Cannot See," is of greater interest than Mavor's essays. In the interview slavick is able to discuss her working method, the origins and development of this series of paintings, and the relation of these works with other works in her oeuvre. Her discussion of the decision to employ drawing, painting, and the abstraction of the map form is especially interesting. She worries "about the use of abstraction to address such a magnitude of destruction"(98), and quotes W. G. Sebald about the "the construction of aesthetic or pseudo-aesthetic effects from the ruins of an annihilated world" (98). Her references to Goya's *Disasters of War,* Picasso's *Guernica*, and the work of Sue Coe address the aesthetic, but not, I think, the abstraction issue. Slavick's discussion of the decision to employ the map form, that abstractly extreme, strictly formalized, semantically rich, semiotically complex, historically laden, and culturally embedded class of text and image making, is rather lightly passed over (in a single sentence) as protest against hegemonic power. Perhaps this lack of examination is not so very surprising. There is little enough in either the cartographic or art literature dealing with the underlying motivations for such a decision, and much of what has been written tends not to be particularly helpful.

Examined critically or not, ontological cartographic issues raised by these maps are significant. All maps carry intention; no map has been made, or could ever be made, innocent of intention (which is not to say a map may not be discovered in a seemingly unintentional artifact — but that discussion is for another day, but any map reading is an intersection of intentionality between the preparer of the artifact (the map maker) and the user (map reader). Each party is capable of leading interpretation and of hijacking interpretation through manipulation of expectations and evidence, and either party can accept, ignore, or subvert the conventions and paradigms. We have seen many, varied examples of this, amongst them: Gordon and Del Tredici's *Nuclear Map of Canada*, *NoZone IX* (*Empire*), Counter Cartographies Collective's *disOrientation Guide*, and now *Bomb After Bomb*.

A cartographer generally has a collection of resource materials: technical manuals, various data tables, some drafting implements (I hope I am not dating myself with that one), and, amongst the most useful, maps, lots of maps. Examining, consulting, measuring, and simply looking at maps is part of what keeps the cartographic practitioner connected to his or her practice and alive to possibilities. One should see slavick's *Bomb After Bomb* as a useful and thought-provoking atlas that could hold a place in any cartographer's resource collection. It would hold this place not only for its thematic content, but as an example of a reasonable, accessible, and persuasive way of making maps. All maps should not look like these; of course not—no more than all maps should look any particular way, but *Bomb After Bomb* shows us valuable ways a map can look.

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London: A Life in Maps
by Peter Whitfield
London, The British Library, 2007.
208 pages, approx. 100 maps, 45 photos, 110 engravings and paintings.
Price approx. $25.00, Soft-cover
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Reviewed by Julia Siemer
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London: A Life in Maps was published in connection with an exhibition of the same title held at the British Library in 2006-2007. The book provides a panorama of London's history from the middle ages, when the first images of London in the form of maps were published, to the present day.

The book is divided into four sections: London Before the Fire (1252–1676), The Age of Elegance (1745–1780), The Victorian Metropolis (1814–1900), and The Shock of the New (1900–today). Each section includes between eleven and twenty unique topics. In the first section we find, among others, "Medieval London: The Earliest Images of the City," "Shakespeare's London," and "The Great Fire and the Map of London." The second section includes topics such as "The London that Wren Never Saw," "Fashionable Suburbs," and "The Gordon Riots." The third section shows maps such as "Regency London," "Victorian Cemeteries," or "Mapping Wealth and Poverty." The last and shortest section is made up of maps and photos on topics such as "The Underground," "The City Blitzed," and "Planning the Capital."

Each section starts with a four to eight-page overview of major events of the era covered in the subsequent pages. Following these introductions, significant events and related maps from each period are shown and discussed, typically on a double page. The majority of these maps are colorfully complemented by engravings, paintings, or photos. The book also includes an index as well as a select bibliography for further reading on some of the maps and historic events discussed.

London: A Life in Maps illustrates London's history through sixty-four historically significant events and describes these and their impact on the development of the city of London by means of contemporary maps. Although the historic events are the focus of this book, where possible these events are also linked to important developments in cartography.

One very interesting example of such an event, described in the first section of the book, is the great fire of 1666, which changed the look of the city considerably. Cartographic examples used to describe this event and its impact are the maps of London by John Leake (1666), Newcourt and Faithorne (1658), and Ogilby and Morgan (1676).

In the summer of 1666 London was hit by a disastrous fire which laid waste to 400 acres of the city and destroyed a total of 13,000 houses and 87 churches. After the fire, the lord mayor and the city aldermen quickly commissioned a survey to plan the rebuilding of the city. One result of this survey was the map published by John Leake in 1666, which was also sold throughout Europe to give news about the fire. Town maps of this era traditionally show individual buildings drawn in elevation, as can be found on the earlier Newcourt and Faithorne map of 1658. The aim was to give a picture of a city by showing streets and buildings as if seen from above. Typically, the buildings were not shown from one perspective only and often covered parts of streets or other buildings, which made detailed interpretation quite difficult. Such plans were not necessarily based on a consistent scale and so were not suitable for measurements or determining the exact locations of features. Leake's map (1666) shows the parts of London unaffected by the fire in this traditional way. In addition, the destroyed parts of the city, due to the devastation and subsequent lack of buildings, were shown as a simple plan of streets as it would be seen in modern orthographic views. This very clear and precise display very likely affected Ogilby and Morgan when they created their map of London a decade later, in 1676. The latter map is drawn in a consistent scale of 1:1,200, and for the first time pictorial elements were abandoned in favor of a more functional depiction of the entire city. This map, due to its clear and precise manner, was immediately recognized as a new era in the mapping of London and introduced a new type of city map: the scaled plan for a more scientific use. These maps, taken together, are a perfect example of how a particular event affected not only the city but also changed cartographers' work.

Another very different example of the use of maps in this book is a map in the second section which provides background information on the Gordon Riots of 1780. This most violent outbreak is illustrated by an old map and overlay of troop concentrations during the riots. The Gordon Riots are named for Lord George Gordon, a young Member of the Parliament, who assembled about 50,000 supporters to protest against the government's proposal to repeal some earlier anti-Catholic laws. In the course of several days of uproar, 11,000 troops were brought into London. The map on this double page illustrates the riot locations and some major troop movements.

The third part of the book includes a section of the famous map by Charles Booth, often referred to as the "Wealth and Poverty Map," which was originally part of a series of maps published with his work *Life and Labour of the People in London* between 1889 and 1903. Based on extensive research, including thousands of interviews and door-to-door inquiries, Booth identified seven social groups of people based on their financial living conditions. The map shows the color-coded results of his analysis of social data per building block throughout London. This very detailed thematic map is not about London's layout or new geography but, for the first time, shows the social composition of the city in detail. Booth's work and his map, together with other factors, led to the development of state pensions for the elderly. Today, demographic mapping is still being employed as an indicator of social status. (For example, it is used by insurance companies to establish rates for household policies, based on location.)

The last section of the book addresses newer developments in London's history. It lacks the mapping focus of the previous sections, and relies more on air photos and drawings to illustrate the changes and developments of the city in the twentieth century.

This section provides a critical view of the influence that commercialization of life has had, and still has, on London since the beginning of the twentieth century. One important factor for these developments is the tube system, which offers a flexible transportation option, nowadays even more important than before. The history of the development of the underground system is illustrated by an early map of the railway system which shows the geographic layout of the city and the different railway lines. This kind of display seems very unfamiliar to us, as we nowadays expect to see a more diagrammatic display of an underground network. The typical visualization of such a network originates from the map of London's underground system designed by Henry Beck in 1932. His original, very schematic, display of the underground network was limited to straight lines constrained to 45 degree angles, and used color coding for the different lines. The map focused on relative locations, stations, and connections rather than on representation of geographic reality. Various cities around the world copied Beck's schematic map design, more or less successfully, to display their transportation networks. Unfortunately, Beck's original map is only mentioned in the discussion of the development of London's underground system but not included. This map would have been another example of innovative map design that had significant influence not only on London but also on the design of transportation network maps around the world.

As you would expect from a publication of the British Library, this book is of very high quality. Not only was high quality paper used, but the paperback edition is also bound by thread stitching, which makes it a pleasure to handle. Generally, the facsimile reproductions are also of very high quality, with only a very few exceptions where a relatively low scan resolution was used. Another minor point of critique is that some of the maps lack an indication of their date in the captions, a fault which is mainly found with newer maps (notably, in the fourth section, The Shock of the New).

I highly recommend this book. Even for someone like myself, who is neither very familiar with London's history nor a distinct historic/old map enthusiast, this book is fascinating and enjoyable to read. It is well written and gives concise, colorful descriptions of major historic events of significance to London. The fact that maps are not used only as decoration but to enhance explanations of historic events should please cartographers. In some cases these events are even used to explain changes in cartographic techniques, which makes this book even more valuable for someone who has an interest in cartography.

Maps: Finding Our Place in the World
James R. Akerman and Robert W. Karrow, Jr. Eds.
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Hardback List price: $55.

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This absolutely drop-dead gorgeous, more-or-less authoritative volume promises "a far-reaching examination of the human endeavor of mapmaking." Its eight essays, including the introduction, are accompanied by more than one hundred maps and map-related artifacts (newspaper and magazine advertisements, charts, graphs, globes, etc.) to insist upon mapping as an idea both of wayfaring (finding our place in the world) and what might be called way-understanding—knowing that place in its parts.

Finding our Place in the World is the companion volume to a comprehensive festival of maps mounted in 2007 jointly by Chicago's Field Museum and Newbury Library during that city's annual Humanities Festival. The quality of reproduction is exceptional and the rendering of the wealth of images reason enough to pay the price for this book. No less important are the essays by eight authors supposedly expert in map history and map things. Taken as a whole, the book suggests how far the field of map studies has come over the last generation, and, more importantly, how far serious thinking about maps has yet to go.

It would seem reasonable to compare this new volume to Arthur H. Robinson's seminal, 1982 *Early Thematic Mapping in the History of Cartography*, also published by University of Chicago Press. Robinson knew what maps were: representations of the world. The cartography he discussed was a narrow and specific Eurocentric tradition arguing specific classes of data. The idea of thematic maps was, at that time, a relatively new one introduced by Nicolas Creutzburg in the 1950s and in general use in by 1960, replacing such earlier adjectival cartographies designated "special" and "applied" (Palsky 1998). Robinson knew his maps and fashioned an orderly, mannered lineage of their progress. A work of scholarship, *Early Thematic Mapping* imposed upon a generation of map *aficionados* the assumption that maps framed, but did not make, the world.

That idea was challenged by critical geographers like Brian Harley, and more importantly, Denis Wood with John Fels, whose 1992 *The Power of Maps* provided a wholly different view of maps as semiotic artifacts constructing power and world perspectives. A new view of mapping was proposed, one in which the map was an artifact of power relations utilizing a sophisticated set of codes to organize the world in a way that seemed natural but was thoroughly constructive. That maps in fact create the worlds they then argue on the basis of self-conscious assumptions was new, radical, and seemingly opposed to Robinson's perspective.

This new volume is self-consciously international, with examples of mapping from a range of nations whose work Robinson did not consider. Its definition of maps and mapping is far broader than the one dictating Robinson's thematic text. Quotations from Harley and Wood are sprinkled through chapters in which everything from religious mandalas to coxcomb graphics compete with more traditional cartographic images. Maps are described, on every page, as artifacts of world makers, perhaps, but not really themselves world creators: maps are for way finding and seeking our place in the world, rather than constructing the world in the map author's image. They are, the introduction says, "artifacts of—and witnesses to—history" rather than active agents in that history.

Thus, while the book promises a new view of cartography, it offers, in its organization, an old, narrow vision of maps as representative instruments that are passive artifacts rather than active agents. Simultaneously, the idea presented in this volume of what a map might be is too ecumenical by half. If every cosmological image and every chart of data fits within the definition of the map, then the map itself becomes simply one more graphic instantiation of this or that dataset. Chapter after chapter of this edited volume proclaims "the map is" but never, really, what the map might be. That is too bad, because what is needed in a volume like this is a way of sorting through the imagery to distinguish the map from other graphics. In a reading of the different authors, although each has a slightly different view, all are tied somehow to the idea of "way finding" and "finding one's way in the world." Only a few are clearly engaged by the broader perspective of the map's making of the world.

James R. Akerman's extremely thorough chapter on "Finding Our Way," for example, provides a section on Yellowstone National Park and finding one's way there by car (and in earlier times, by train). This discussion can be compared with the dynamic deconstruction, and reconstruction, of the parks as artificially constructed places of nature to be found in Denis Wood and John Fels' *The Natures of Maps*, published by University of Chicago Press. In the later volume, the park map creates a natural place through the assertion of an area of official beauty linked by roads to the greater U.S. Ackerman considers the different ways one may travel to Yellowstone—airplane, train, and automobile—and the maps used to get people there, but that the park itself is a cartographic construct brought forth to argue a natural aesthetic encroached upon by travelers is …off the map.

One finds a similar disjunction in a section of Diane Dillon's chapter on "consuming maps" where she considers maps related to the 1893 World's Columbian Exposition in Chicago. This is a lovely example of late nineteenth century cartography and map usage of which she says, "If railroad brochures, like guidebooks, nudged tourists toward a standardized vacation experience, consumers were often quick to put the maps to their own purposes" (321). But it is not simply that the maps in brochures and guidebooks "nudged tourists" toward an experience, but that they *created* an experience and a perspective on the world that was the rationale for the Exposition itself. Yes, maps helped people get to Chicago and to navigate the Exhibition, but they also created an idea and ideal of the city and the world that permeated all the materials in the Exposition, making its themes real.

Dillon's chapter is, perhaps, most interesting where it considers the relationship between the human body and the maps on which figures were often placed. "The map-body connection becomes all the more central when we cognized that users experience cartographic materials haptically (through the sense of touch) as well as optically" (329). Here the map is a physical agent, engaged by the senses in a way that is complex and subtle and yet, essentially, clear as well. In the way of many edited volumes, this idea of body and map is lodged, half-formed again, in other articles. Denis Cosgrove's chapter on "Mapping the World," for example, considers Oronce Fine's 1536 cordiform map of the world (108-110). What is needed from these authors, and what we do not get, is a real discussion of the argument in the maps that fashions the world on the basis of, and as a reflection of, an understanding of human anatomy.

"For what has a map to do with the surface of the earth more than to afford its several objects their situations?" asked eighteenth-century physician and cartographer Christopher Packe. "And what is its whole design more than a collection of the names of cities, towns, villages etc. set upon a plane surface at a proper distance and in due bearing to one another . . . ?" (qtd. in Campbell 1949). These are questions this book's chapters raise in their many parts but answer in none of them. If maps are way finders, they are also world makers; they are artifacts of a history they helped create. In the main, these essays give only half of that equation.

The most ambitious chapter in the book is Michael Friendly and Gilles Palsky's chapter on "visualizing nature and society." Here mapping is one of many forms of data presentation, a graphic medium among others. Think Arthur K. Robinson meets Edward Tufte with just a hint of Brian Harley thrown in. The authors are expert on the use of graphs and charts and their history, but not of mapping as a distinct form. They assert a Robinsonian "thematic cartography" as one kind of graphic data category among others. However, in evoking a thematic cartography, the authors do not think to ask what an un-thematic map might be, and thus what distinguishes the map from the chart or graph.

Were the authors less expert in their description of non-cartographic tables and graphs the whole would be infuriating. As it is, this is the most classically Robinsonian of the chapters, including with citations to his work several maps that were in Robinson's 1982 volume. That is unfortunate, because the chapter offered an opportunity to distinguish the nature of the mapped argument from those that may be distilled in graphs and charts. One might argue, I suppose, that there is no difference, but that, too, would be the argument for the chapter to make in a text like this. Maps with charts or graphs embedded, of which there are many, would have provided the opportunity for the discussion that does not, alas, occur.

In this chapter is one of those galling errors that always grate, the assignment of coxcomb diagrams to Florence Nightingale (247-248). Florence Nightingale did not, however, create these images; rather, they were the genius of British apothecary and statistician William Farr. The attribution failure is the more severe because Farr made supreme use of maps in his 1852 study of cholera, developing innovative cartographic techniques that remain, today, exemplary.

Another error is the editors' assertion that "Finding Our Place" is the first major map exhibit since the 1952 exhibition at the Baltimore Museum of Art, "The World Encompassed" (vii.). This is piffle, as it ignores Wood's "The Power of Maps" exhibition in the early 1990s, first at the Cooper-Hewitt National Design Museum in New York City and later at the Smithsonian in Washington, DC. In that omission one sees as well the failure to consider seriously the arguments of the academic, critical geographers who have labored for a generation to reform the idea of the map.

Beside these details, however, the primary difficulty with this volume is the ideal of mapping, which, as presented, is at once too conservative and too ecumenical. The whole is too conservative because, although it makes a bow to the critical cartographers and their work, it holds, in many of its parts, to a more traditional view of maps as thematic representations of a world that might be illuminated by maps, but not one in which maps form the idea of the world in which we live. At the same time, it is all too ecumenical because it refers to a religious mandala as a map. A mandala is an attempt to create a graphic representation of an imagined cosmology but … is it a map? Does it even "way find" in the way which, say, early religious travel maps to the Holy Land provided direction and a route for crusaders or pilgrims? These arguments may be made, I suppose, but here it is simply assumed.

Similarly, how do we join in one class a world centered on Jerusalem (as were traditional T&O maps), travel strip maps (for railroads or medieval travelers to the Holy Land), a map using Peters' projection, and a fourth based on ocean currents in Polynesian waters? The T&O map and the mandala may be way finding tools, guides to Christian-centered world building and to other levels of existence, respectively. But are they maps of the same class and order as those used to track influenza strains across the globe, or the path of armaments from manufacturers to war zones? It would be nice if, sometime, those who insist upon the ecumenical world of maps might distinguish its borders more clearly.

None of this denies the real pleasure this volume gives, or the real data that its chapter authors present. This is a good book and almost certainly the best survey since Robinson's 1982 text. But, just as Robinson's book argued a mapping that was already being transformed by social theorists, this book presents a world of mapping as a constructive tool of the world, one half-evolved.

What this text needs is the same thing mapping needs, a way of integrating critical cartography and its antecedents in a cohesive view of the map as a medium that makes the world and all its paths, a map that constructs out of the many paths the world in which we live and which the map argues as natural, inevitable, and real. We need a volume whose title will be not *Finding Our Place in the World* but one that proclaims *Maps: Making Our Place in a World*.

Tom Koch is an adjunct professor of geography at the University of British Columbia and the author of *Cartographies of Disease: Maps, Mapping, and Medicine* (2005).

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Cartographic Collections

Building a Web Site at the University of Chicago Map Collection

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The University of Chicago Map Collection's Web site (at http://www.lib.uchicago.edu/e/su/maps), launched in 1994, at first included little more than a description of the Collection and a few links to major reference sources. It is now one of the most elaborate university map library Web sites. These paragraphs describe how it acquired its current form. The first major addition to the Web site was a set of locally compiled GIS maps of Chicago. The mid-1990s were the period when the Map Collection's still-new GIS facilities were serving an unusually large number of patrons. It was clear from the beginning that not everyone needed the personal attention that library GIS requires. Most local users were primarily interested in the Chicago area, and many simply wanted a map of ethnicity or income of the sort one could easily find for earlier decades in atlases such as the *Urban Atlas* series. We had set up our GIS facilities so that we could produce such maps quickly, but, to obtain these, patrons still had to visit in person. We turned to Web as way to serve this series of maps to its patrons? In 1995, we put together what amounted to an urban atlas of Chicago in 1990, and it was an immediate success, garnering thousands of users a month, attracting more hits in one month than the library's online catalog.

As part of their work with patrons of its GIS facilities, Map Collection staff had created several specialized Chicago files, e.g., for Chicago ward and community boundaries that were not then available from any other source. Because many users were interested in historic GIS data not then easily available at all Map Collection staff also constructed a 1980 census tract boundary file of Chicago from the 1990 files, persuaded the local social science computing group to generate data from its archive, and put together some maps showing changes in Chicago in the years from 1980 to 1990. These files were also added to the Web site, as were the results of a cluster analysis of 1990 census data.

When the first 2000 Census results were released, Map Collection staff added similar maps to a separate set of pages, including, in 2003, a statistical analysis of Chicago social data. Eventually, we added all our data sets as well.

Plans by the Digital Library Development Center to add scans of material in the Collection were delayed. As a result, high-quality, clear images of large files were not immediately available. Eventually, in 2005, we added Zoomify, software that allows the display of large files not by compressing them, as MrSID does, but by breaking them into thousands of small jpg files. One disadvantage is that it does not create downloadable compressed files.

Map Collection staff took advantage of the availability of Zoomify to put scans on the Web of one of the many local products in its holdings: a set of maps produced by the Social Science Research Committee (SSRC) portraying Chicago on the basis of 1920, 1930, and 1934 Census data. These maps, the result of work by scholars associated with the Chicago School of Sociology, arguably constitute the first atlas of any U.S. city. The Map Collection held a set of fairly pristine copies of these. Unfortunately, other available copies of the maps published in book form were nearly unusable. Since the maps mostly dated from the years after 1922, permission had to be obtained to use them. Because the SSRC no longer existed, it was not clear who owned the copyright. After considerable discussion with University lawyers and other parties, permission from the Department of Sociology, arguably the closest descendent of the SSRC, was deemed sufficient. This permission was readily given.

We have added more Web pages in the last couple of years, focusing again on materials not widely held that would form reasonably coherent groups for distinctive Web pages. Inevitably, most of the items chosen for inclusion were acquired during the Collection's most ambitious and best-funded collecting years, the late 1920s and 1930s, when material from the late nineteenth and early twentieth centuries was the focus of acquisition efforts.

In planning work on the Web site, we have had to keep labor costs in mind. The Map Collection may have the smallest staff in proportion to its size of any large university map library in North America. Only limited help was available from elsewhere in the Library. The kind of encyclopedic, large-scale projects that the Library of Congress and David Rumsey have undertaken would not have been possible even if the Collection's holdings justified that kind of effort.

All of the additional Web pages created focused either on Chicago or on other urban maps. A group of Chicago maps from the 1890s and an anthology of social science maps of Chicago were added in 2006. A set of Chicago maps from the early years of the twentieth century and a collection of late nineteenth/early twentieth-century maps of Asian cities were added the following year. Recently we have created pages devoted to Chicago maps from the period of the Fire (1871) and late nineteenth/early twentieth-century maps of Latin American cities.

Dealing with the earlier maps has required a surprising amount of hands-on physical effort. Many of the maps are very large, some are in poor shape, and most had been encapsulated. It took quite a lot of fiddling with the scanner to create reasonably good images of these maps. The machine fell out of calibration easily; bits of map and ink could get caught in the roller and cause streaks; and reflections from the Mylar of encapsulated maps turned out to be a major problem. (We ended up de-encapsulating several sheets.)

All of the maps are cataloged both on OCLC and in our local catalog. Local cataloger Renette Davis had served on the committees that established the protocols for the Digital Library Federation/OCLC Registry of Digital Masters, and we attempted to follow its guidelines, adding not only URLs to the records but also information on the technical standards employed in digitization and limitations on access.

In coming years anthologies of African urban maps and, if permission can be obtained, maps produced by local government agencies in Chicago in the 1920s and 1930s are logical candidates for inclusion. It would also be desirable to find some way to add download capability, at least of medium-quality images of material unambiguously out of copyright.

Over the last year the Web site has been getting more than half a million hits a month, if jpgs and gifs are included in the count, and about 25,000 hits a month if they are not. The first figure exaggerates usage, since the counts multiply quickly given that the Zoomified files consist of hundreds of tiny jpgs. But the second figure may under-count, since the jpgs and gifs are the major point of the Web site. The first figure amounts to more than half the usage of subject-specific Web sites at the University of Chicago Library, the second about 15 percent, still the most-used pages on the Library site. The figures are all the more striking in that map libraries do not usually come in first in usage statistics. Perhaps the problem all along has been not a lack of demand for cartographic material, but the process by which map libraries have had to quickly adjust to deciding how maps are best integrated into web-based services to adequately serve the needs of its patrons. I'm really delighted that the University of Chicago Map Collection has been able to take advantage of a new medium to share some of its resources with a wide audience.

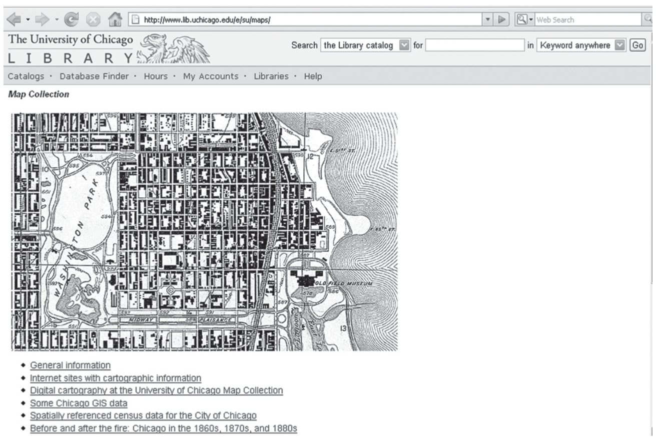


Figure 1. Screen shot of the University of Chicago Library Map Collection home Web site. (see page 94 for color version)

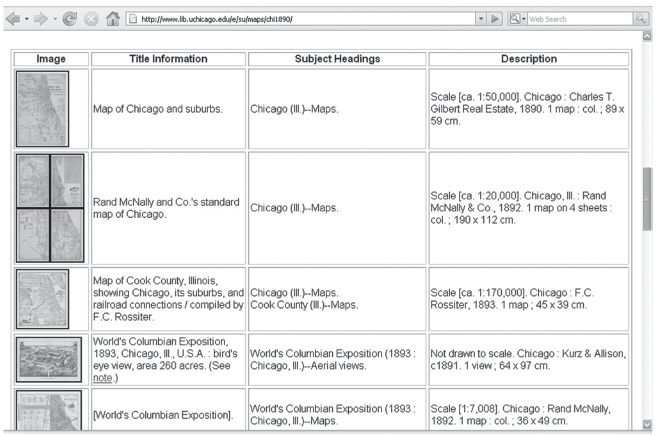


Figure 2. Screen shot of University of Chicago Library Map Collection online index with metadata fields. (see page 94 for color version)

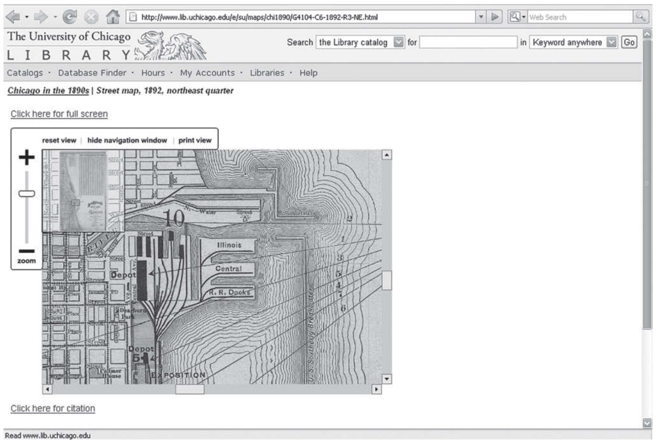


Figure 3. Screen shot of University of Chicago Library Map Collection online map of Chicago showing Zoomify capabilities. (see page 94 for color version)

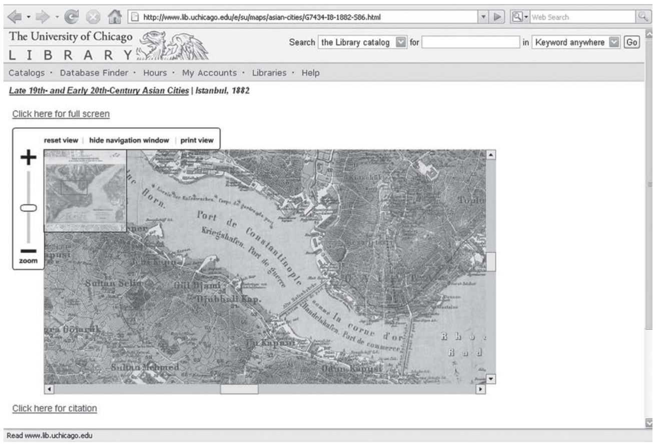


Figure 4. Screen shot of University of Chicago Library Map Collection online map of Istanbul showing Zoomify capabilities. (see page 94 for color version)

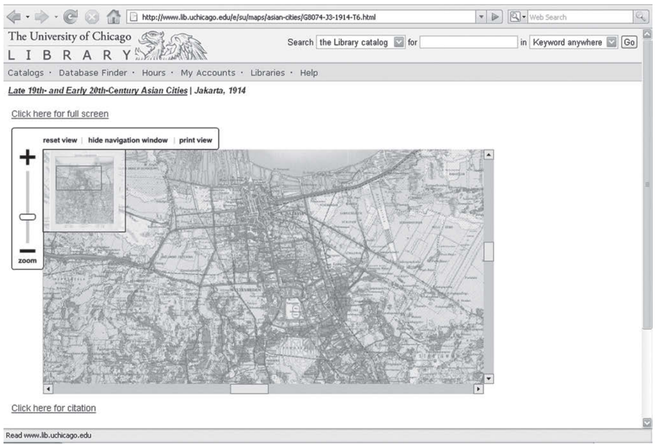


Figure 5. Screen shot of University of Chicago Library Map Collection online map of Jakarta. (see page 94 for color version)

Mapping: Methods & Tips

Choropleth Google Maps

Michael Peterson
Department of Geography/Geology
University of Nebraska at Omaha

Introduced in 2005, Google Maps offers 18 maps of the world at different scales, varying from approximately 1:85 million to 1:4,800 at the equator at a screen resolution of 100 dpi. Each map has been tiled into individual raster squares that are downloaded separately, often from different servers. A typical Google Map might download map tiles from seven or eight different IP addresses, each associated with a different server that could be located in different Google data centers. Subdividing the map into tiles improves the perceived map download time and allows the map to be easily panned. Google Maps also makes use of the Asynchronous JavaScript and XML (AJAX) server/client technology that maintains a constant connection to the map server, a major improvement in server/client performance.

Maps and imagery in Google Maps have been projected with the Mercator projection. The limitations of this projection have been well-documented, and its distorted depiction of the world has been a major cause for concern. For example, Greenland is represented as being larger than Africa when, in fact, Africa is 14 times larger than Greenland. Scale varies continuously from the equator to the polar areas. Changes in scale in the Google Maps display can be observed by examining the scale bar when moving north or south from the equator. The change in map scale is particularly noticeable at the extreme latitudes. The distortion caused by the Mercator projection is not noticeable with larger scale maps.

In 2006, Google introduced an Application Programming Interface (API) that includes a series of functions that may be invoked by the user. These functions control the appearance of the map, including the scale, position, and any added information in the form of points, lines, or areas. The API makes it possible to incorporate Google Maps on Web sites, and to overlay information from other sources – a process referred to as a "map mashup."

One application of the Google Maps API is the construction of choropleth maps by super-imposing shadings. Current examples include maps of London by the UCL Centre for Advanced Spatial Analysis (CASA) and election result maps by county or state (see Web Resources). The UCL CASA provides Google Map Creator, a freeware application for thematic mapping with Google Maps (see Web Resources). One advantage of choropleth mapping with Google is that the underlying map can remain visible, providing some geographic context to the representation of the data. Normally, thematic maps lack the necessary background map to properly interpret the locational component. While it can be argued that stripping background information may result in the better formation of spatial patterns by the map user, providing more locational information may be viewed as a necessary component for all thematic maps. The purpose here is to demonstrate how choropleth maps can be made with Google Maps.

JavaScript and the Google Map API

API functions may be used with a variety of programming languages. The examples presented by Google use JavaScript. Originally developed for the Netscape browser, JavaScript is a compact, object-based language for developing client-side applications. It is not a computer language that makes executable code, like C++ or Java. Rather, the browser interprets JavaScript statements that are embedded in, or referenced from, an HTML page. The JavaScript program is executed when the browser page is opened. This was initially viewed as a problem because it slowed down the execution of the program. With today's faster computers, there is no longer a major advantage to pre-compiling computer code. JavaScript can reside within an HTML file or a reference can be made to an external file. The external file that contains JavaScript functions can be on the same computer as the HTML file, or it can be on another computer or server. This is how Application Programming Interface (API) code is distributed. One reference to a library of API code makes it possible for a Web page designer to access thousands of mapping functions.

To use the Google Map API, a free numeric key must be requested from Google. This is a unique identifier that is matched to the website. Google has a number of terms of use, including that there be no more than 500,000 page views per day without prior warning, a limit of 15,000 geocode requests (finding street addresses), no advertising, free accessibility to end users, no altering or obscuring the logos in the map, and no illegal activity. The key gives Google some control in how their API is used and provides data on the amount of usage by website. Google Map functions begin with the letter "G." All functions revolve around GMap2, a central class in the API that is used to initialize the map.

Polygon Conversion

Encoding polygon outlines is a very time-consuming task. Fortunately, there are many polygon files available that can be converted for use by Google Maps. Once the polygons are defined, shadings can be assigned to indicate the value of the area.

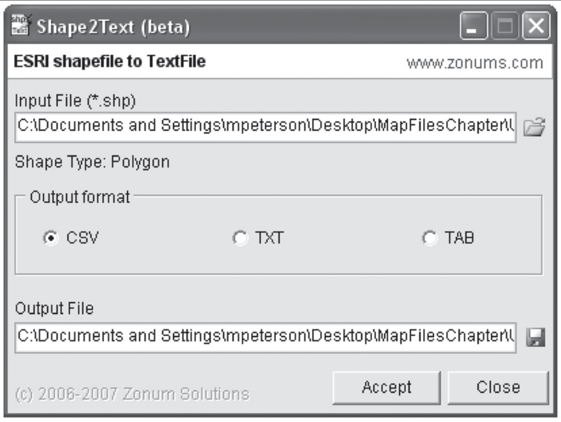
The most common format for map files is the so-called shapefile (.shp), a format developed by ESRI– the major distributor of GIS software. Developed in the early 1990s, many files in this format are available through the Internet from libraries and other online portals. Shapefiles can be very large with many points. For example, a shapefile with the boundaries for the counties of Nebraska, a state with many rectilinear county outlines, has over 25,000 x,y coordinates. JavaScript would require a considerable amount of time to read this many coordinates from a file.

One option to speed the display of the map is to reduce the number of coordinates in the file. Map-Shaper.org is an online resource for the generalization of lines within shapefiles. Using a simple interface implemented with Adobe Flash, the website uploads a shapefile and then asks the user to specify the amount of generalization. Following this, the shapefile can be downloaded to the user's computer.

The conversion of the shapefile to a text file is necessary for use by Google Maps. A program called Shape2Text extracts the coordinates and places them into an Excel file. The points then must be put into the proper XML format as shown in the bottom of Figure 1. The map in Figure 2 shows the 93 polygons for Nebraska plotted with Google Maps.

Choropleth Map

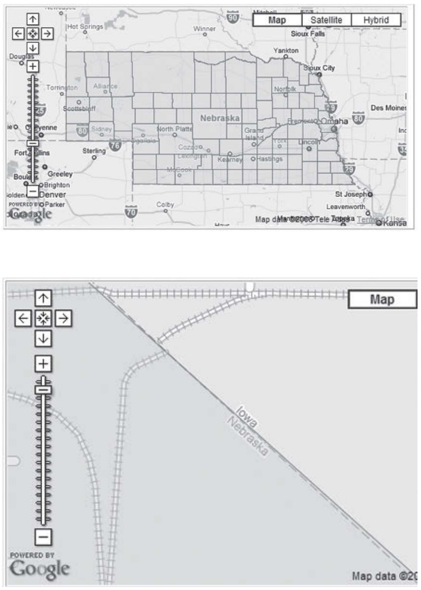
Altering the shading of each polygon based on a data value would result in a choropleth map. In this case, we map out population data for the state of Nebraska. The population values could be input through another XML file. To simplify matters, we simply put the 93 population data values into an array (see Figure 2). These population values are listed in alphabetical




```
12      Nodes
-122.9679783  48.44379451
-123.0952329  48.47942282
-123.1597199  48.52184222
-123.1698993  48.56256471
-123.1410538  48.62364712
-123.1037214  48.60837712
-123.0120949  48.55747774
-123.0086988  48.53371932
-122.9679800  48.52693332
-123.0222711  48.51335968
-123.0188829  48.48960517
-122.9679783  48.44379451
```

```
<poly linecolor="#008800" linewidth="4" lineopacity = "1.0" fillcolor=
"#FFCC00" fillopacity = "0.5" html="State">
  <point lat="-122.9679783421" lng="48.4437945085"/>
  <point lat="-123.0952328681" lng="48.4794228153"/>
  <point lat="-123.1597199251" lng="48.5218422237"/>
  <point lat="-123.1698993372" lng="48.5625647146"/>
  <point lat="-123.1410538081" lng="48.6236471212"/>
  <point lat="-123.1037213929" lng="48.6083771192"/>
  <point lat="-123.0120949153" lng="48.5574777421"/>
  <point lat="-123.0086987596" lng="48.5337193216"/>
  <point lat="-122.9679800006" lng="48.5269333223"/>
  <point lat="-123.0222711218" lng="48.5133596826"/>
  <point lat="-123.0188828947" lng="48.4896051705"/>
  <point lat="-122.9679783421" lng="48.4437945085"/>
</poly>
```

*Figure 1. The Shape2Text conversion process leading to the creation of an XML file. The program asks for the location of the *.shp file, the output format, and the output location. A single polygon with 12 points (nodes) is shown in the upper-right. These points are then converted into the proper XML poly format using the Excel concatenate function. (see page 95 for color version)*




```
// Put the population data for the counties into the popdata array
      popdata = new Array
(33185,6931,372,783,492,5668,11132,2185,3354,43954,7341,8595,25963,8819,3811,5934,9865,
50,892,3710,8812,267135,35865,749,656,497,35279,7954,5171,3705,7247,4650,15747,2804,299

// Find the min and max population values for the 93 counties after doing a non-linear
      var min=100000000;
      var max=-100000000;
      for (var i = 0; i < 93; i++) {
        popdata[i] = Math.log(popdata[i])
        if (popdata[i] < min) { min=popdata[i] }
        if (popdata[i] > max) { max=popdata[i] }
      }
// Find the range in the data values
        var range = max-min
// Compute the opacity for each county, a value between 0 and 1
        opacities = new Array ()
        for (var i = 0; i < 93; i++) {
          opacities[i] = 1-((max - popdata[i]) / range)
      }
```

Figure 2. A shapefile map of Nebraska by county mapped with Google Maps after line coordinate thinning with MapShaper and conversion to a text file by Shape2Text. The state border between the shapefile and the Google Map matches nearly perfectly, although the underlying map from Google may have errors along the border as with the discontinuity in the railroad line that is visible in the enlarged map. *(see page 95 for color version)*

order by county, the same as for the polygons in the map file.

After the data have been assigned to the pop data array, they are converted to their natural log value using the "Math.log" function. The log conversion compensates for the extreme population values for the counties that contain the cities of Omaha and Lincoln. The minimum and maximum values are determined in the same loop. A second loop computes the opacities for each county based on the maximum data value and the range of the data. As such, the map represents an unclassed choropleth map because the data values have not been put into categories. The opacity of each county is directly proportional to the log of the population. The zoomed-in map in Figure 3 shows how the background map is visible in the less populated counties.

The online version of the Nebraska population map using variations in opacity (see Web Resources). The source code for the program can be viewed by selecting View or Page Source. The XML file that contains the map of Nebraska is also available (see Web Resources).

Summary

The Google Maps API represents a powerful mapping tool. By providing base maps and imagery at multiple scales as a backdrop, all manner of information can be added to the foreground of the map. While we have little control over the base map, Google provides a great deal of flexibility in what may be added on top of the map. With competition from sites like Microsoft Live and Yahoo! Maps, there will be a great deal of development in this area. It is unfortunate, however, that all of these online mapping sites are providing APIs that are incompatible with each other.

There are a number of ways to speed the display of the map. The major approach, and the one favored by Google, is to pre-compile the map and convert it to a tiled representation at 18 different scales – just as is done for the base Google Map. This tiled map can be as quickly displayed as the base map.

Web Resources

CASA's Google Map Creator:
http://www.casa.ucl.ac.uk/software/googlemapcreator.asp

Iowa Presidential Caucus Results:
http://maps.google.com/maps/mpl?moduleurl=http://www.google.com/mapfiles/mapplets/iowacaucus/iowacaucus.xml&utm_campaign=en

Nebraska Population Map Example:
http://maps.unomaha.edu/GoogleMapGallery/Nebraska/Population.html

XML Source Code File:
http://maps.unomaha.edu/GoogleMapGallery/Nebraska/Nebraska.xml

* From an upcoming book by the author on online mapping to be published by Springer Verlag.

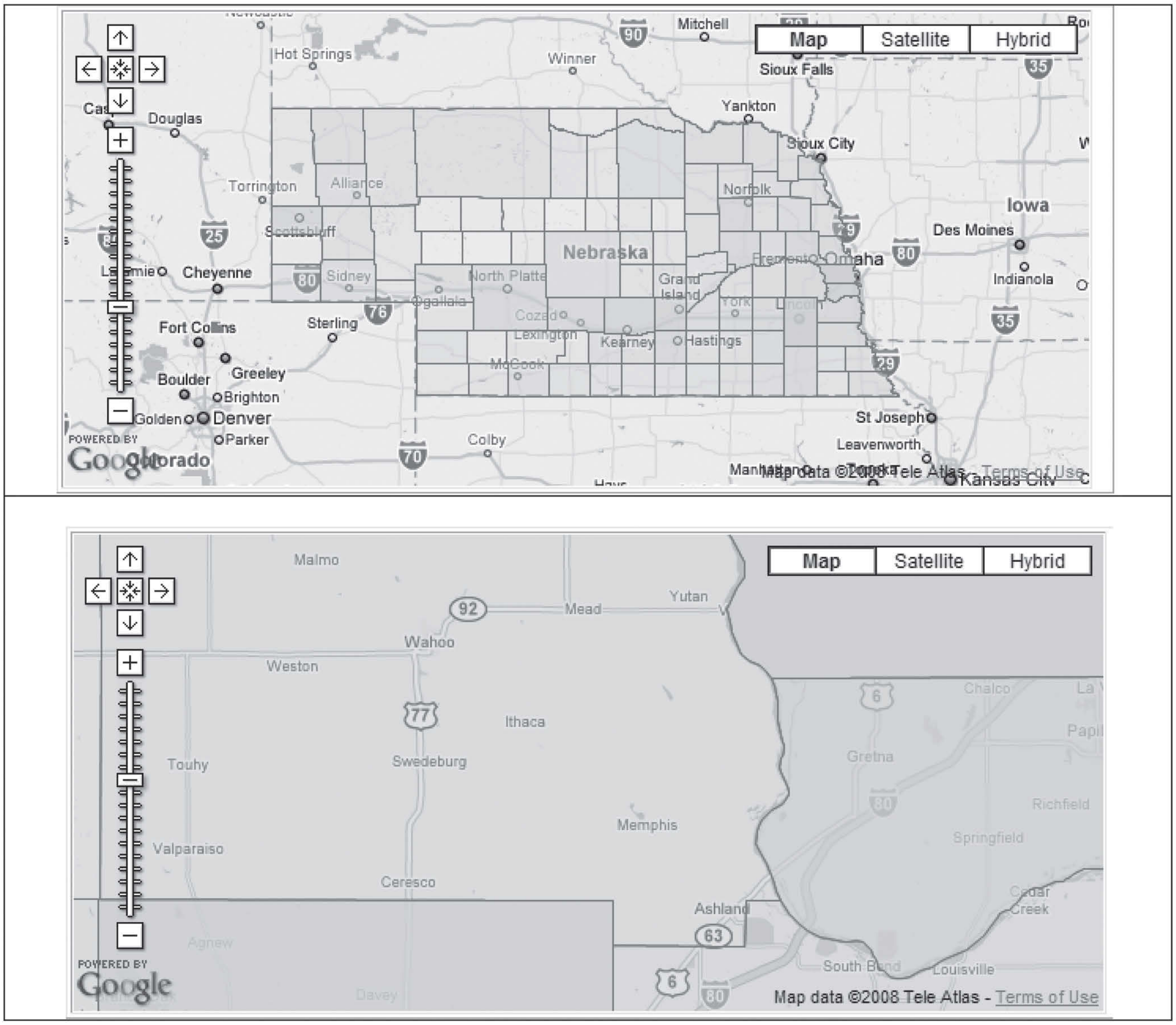


Figure 3. A population map of Nebraska. The opacity of the color that is assigned to each county is proportional to its population. The data have been converted to a log value to compensate for the skewed population distribution caused by the two largest cities, Omaha and Lincoln. The zoomed-in map on the bottom shows that place locations are visible in the less populated counties that have been assigned a lower opacity value. (see page 96 for color version)

Visual Fields

2007 CaGIS Map Design Competition
Best of Category: Reference Map

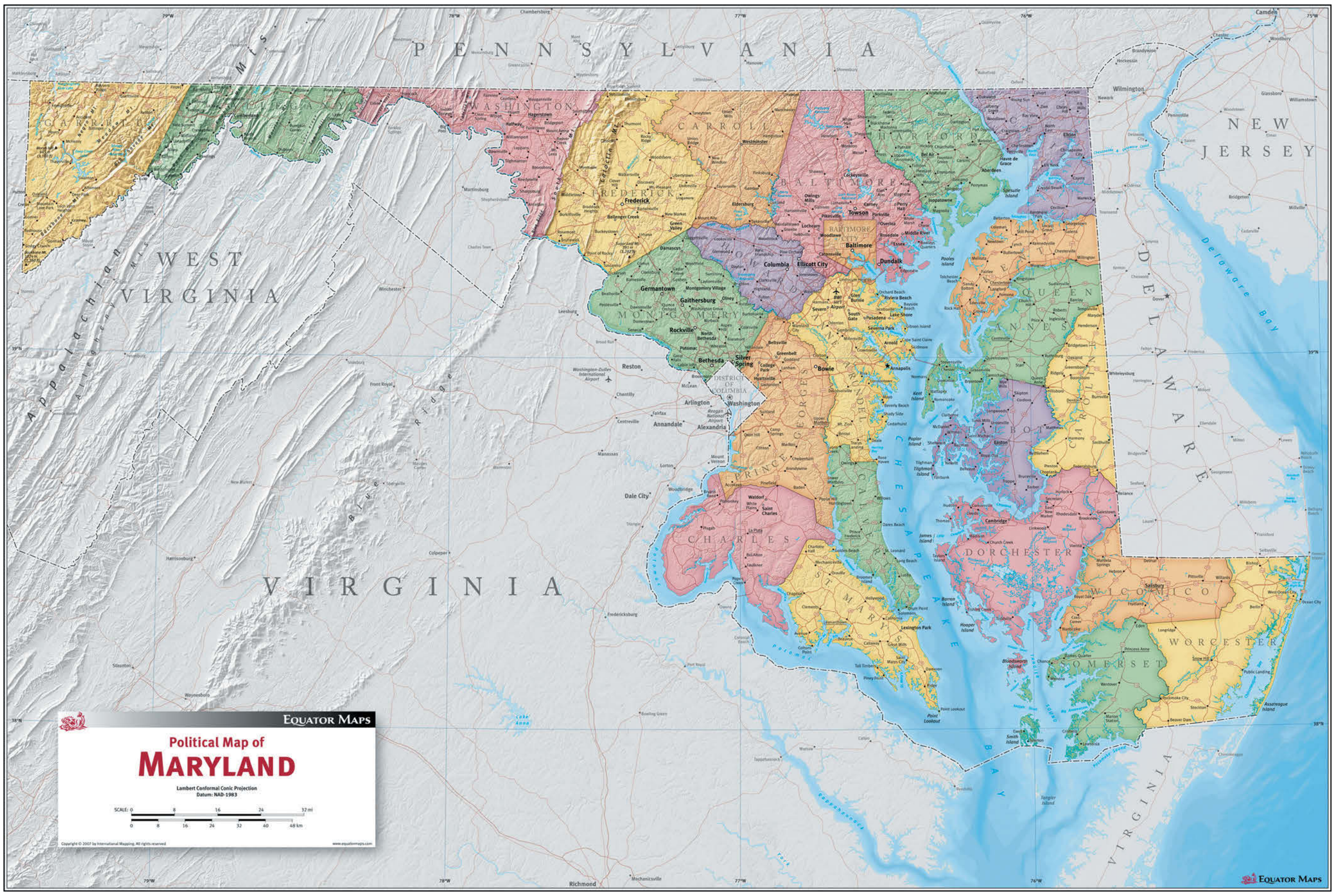
Political Map of Maryland

Created by: Alex Tait, Scott Edmonds, Mike Means, and Judy Nielsen
International Mapping
5300 Dorsey Hall Drive, Suite 201
Ellicot City, MD 21042

International Mapping has recently started a reference map series under the *Equator Maps* brand. The Political Map of Maryland is the first in a series of general reference state and country maps emphasizing political subdivisions. Colorized shaded relief, detailed road network and a city and town dataset complete the primary reference information.

During the design process for this map we needed to balance the desire for some continuity of information with the goal of a strong figure for the political subject, in this case the state of Maryland. By continuing the strong relief shading into the surrounding states and maintaining some, but not all, of the highway and city/town data in those areas, we tied Maryland into its surrounding landscape. We used bold color fills for the Maryland counties and a wealth of detailed city/town data to draw the eye to the subject area and set it off. The map strongly says "Here's the state of Maryland" and at the same time provides a context of the surrounding states and waters.

The production process we used is a familiar one to today's production cartographer: data compilation and sorting and preliminary specifications in ArcGIS, export to Adobe Illustrator and Photoshop for final graphic enhancements, and shaded relief rendering using Natural Scene Designer. Our primary datasets were from the State of Maryland and the USGS but our cartographers played a prominent role in the refinement of the selection of features.

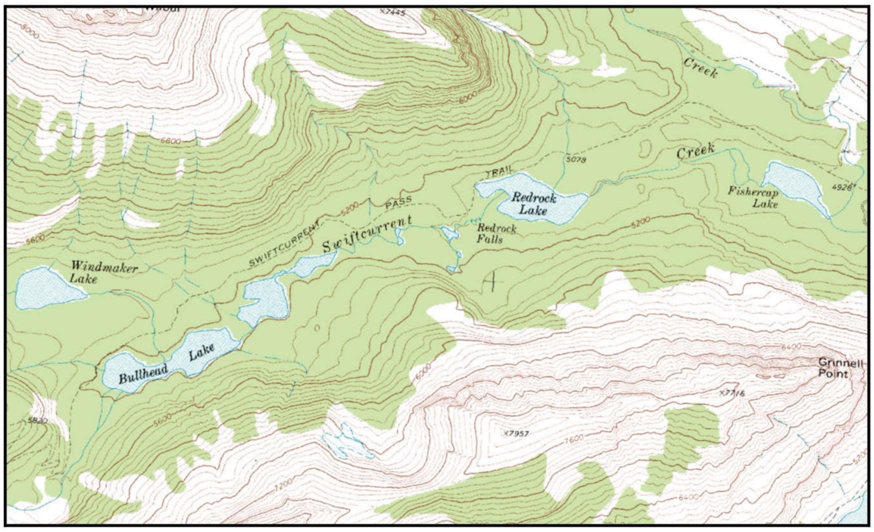



77°W
76°W
SYLVANIA
Gettysburg
Hanover
Shrewsbury
Waynesboro
Littlestown
Blue Ridge Summit
Quarryville
Wakefield
Oxford
FREDERICK
Frederick
CARROLL
Westminster
BALTIMORE
Towson
BALTIMORE CITY
Baltimore
HARFORD
Bel Air
Aberdeen
Havre de Grace
CECIL
Elkton
HOWARD
Columbia
Ellicott City
MONTGOMERY
Germantown
Gaithersburg
Rockville
Bethesda
Silver Spring
DISTRICT OF COLUMBIA
Washington
Arlington
Alexandria
Annandale
Reston
Washington-Dulles International Airport
Reagan National Airport
Manassas
Dale City
Fredericksburg
PRINCE GEORGE'S
Bowie
Upper Marlboro
ANNE ARUNDEL
Annapolis
BWI Int'l Airport
Glen Burnie
Dundalk
CALVERT
CHARLES
Waldorf
Saint Charles
La Plata
ST. MARY'S
Lexington Park
Leonardtown
Saint Marys City
KENT
Chestertown
QUEEN ANNE'S
TALBOT
Easton
CAROLINE
Denton
DORCHESTER
Cambridge
CHESAPEAKE
Potomac
Pooles Island
Kent Island
Tilghman Island
Poplar Island
James Island
Barren Island
Hooper Island
Bloodsworth Island
Taylors Island
Catoctin Mt.
Sugar Loaf Mt. 391 m (1,282 ft)

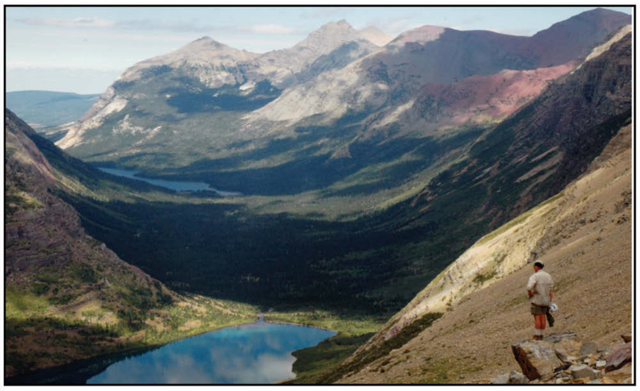
Color Figures

Just to Make Clear "Where the Roots Come From": A Response to Mark Denil's "Manifestos"

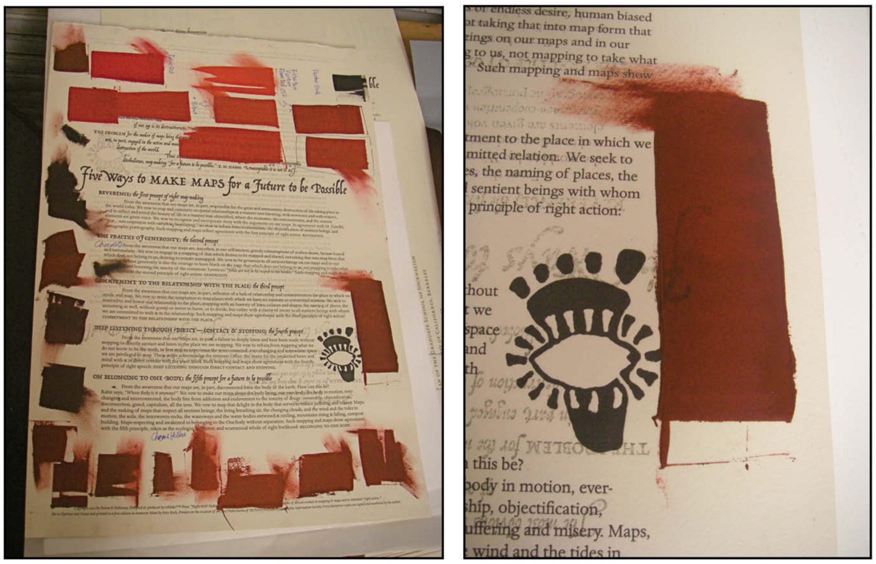
Steven R. Holloway



71/2 minute USGS Quad, northern Montana



Along the Highline trail in Glacier-Waterton International Peace Park



Colour mixing draws for the broadside, this is not CMYK!

Automation and the Map Label Placement Problem: A Comparison of Two GIS Implementations of Label Placement

Jill Phelps Kern and Cynthia A. Brewer

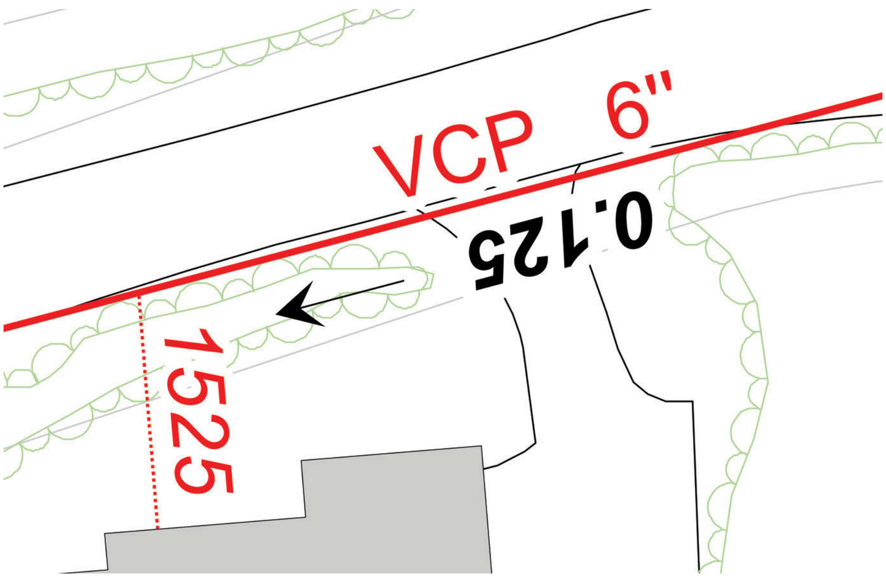


Figure 2. Sewer main with inverted slope label and arrow.

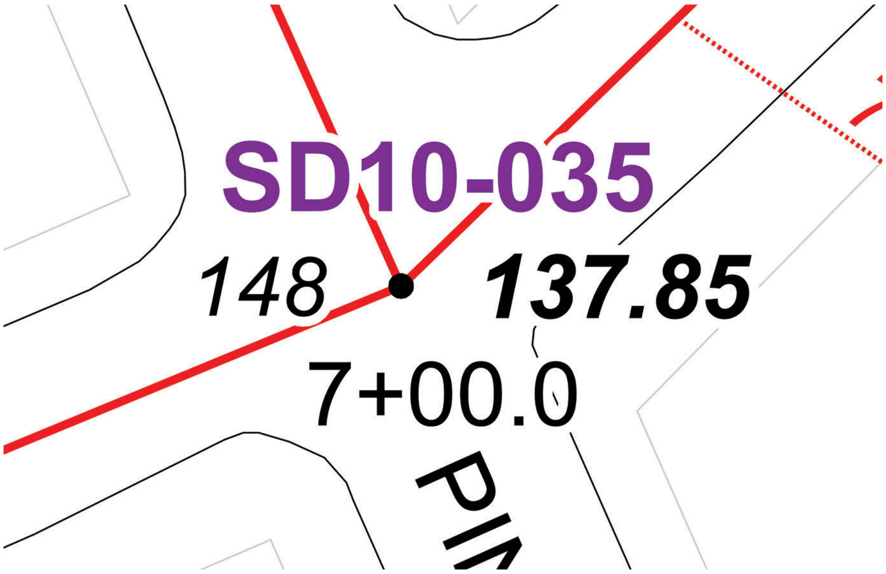


Figure 3. Ideal sewer manhole label positioning.

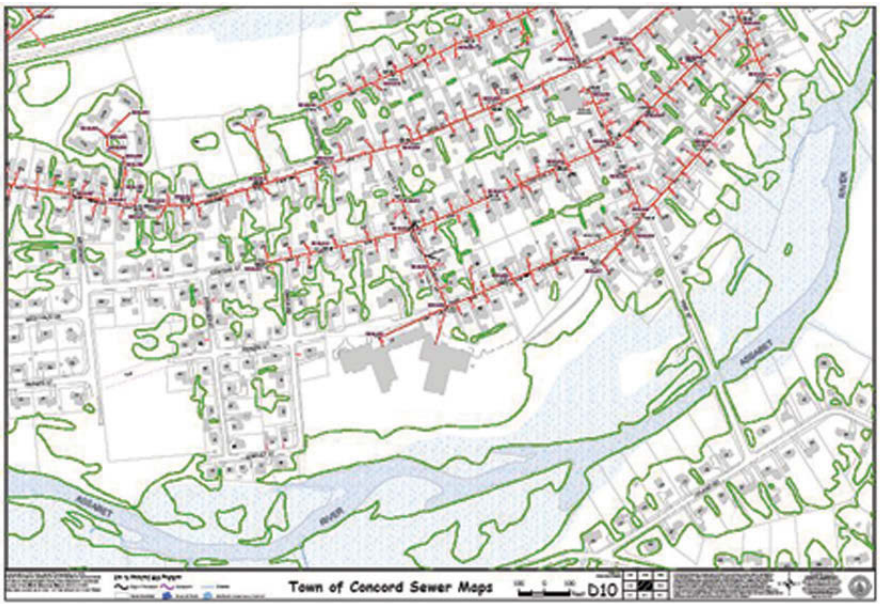


Figure 4. Sewer map book page D10.

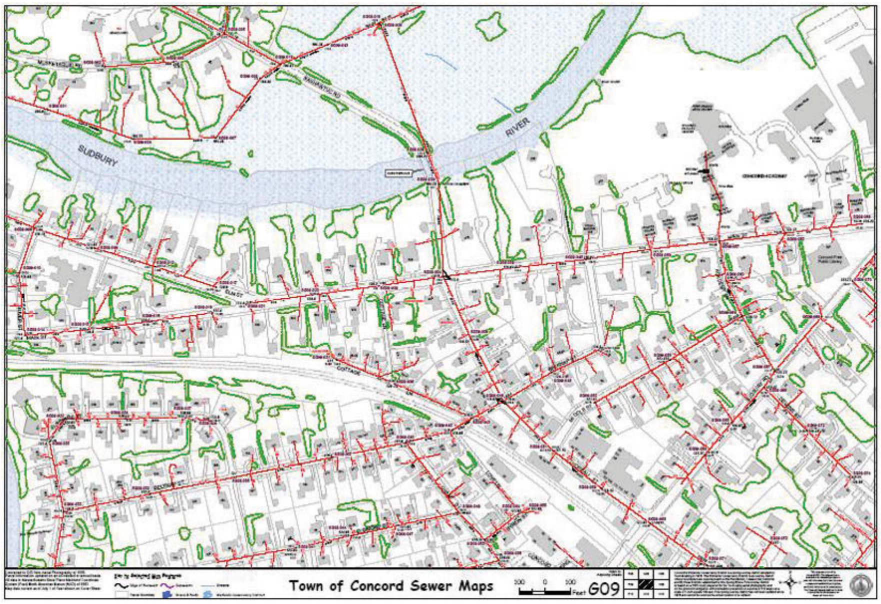


Figure 5. Sewer map book page G09.

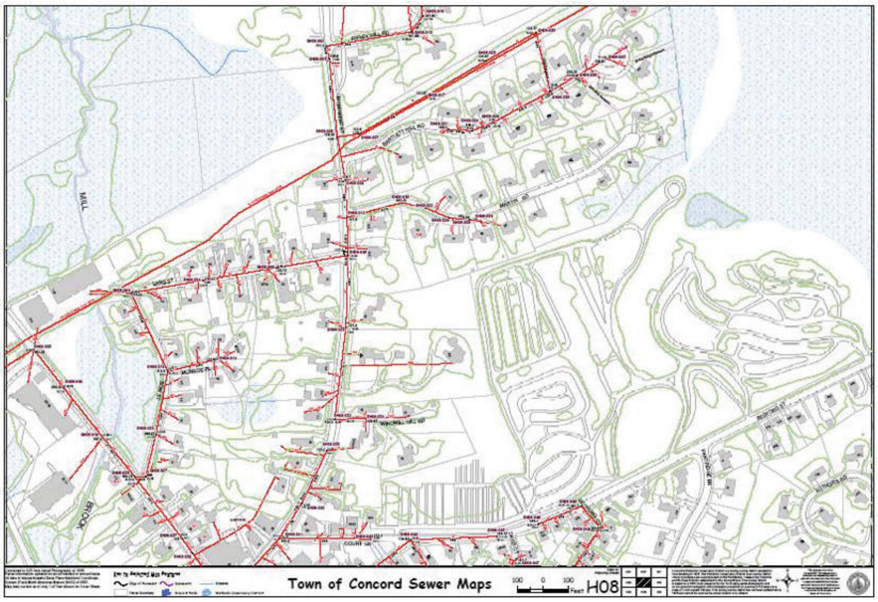


Figure 6. Sewer map book page H08.

Addressing Map Interface Usability: Learning from the Lakeshore Nature Preserve Interactive Map

Robert E. Roth and Mark Harrower

Figure 1. The Lakeshore Nature Preserve Interactive Map (www.lakeshorepreserve.wisc.edu).

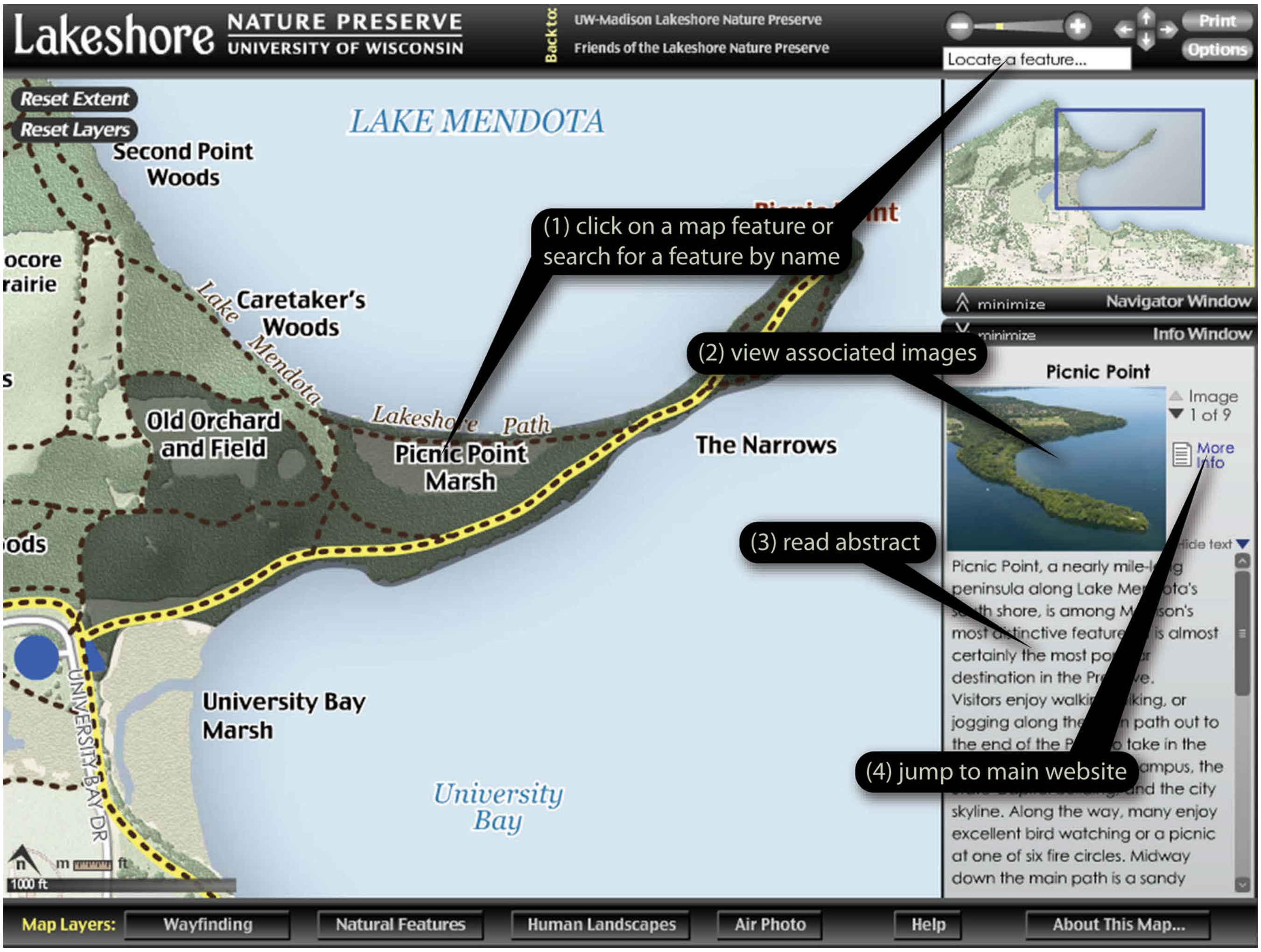


Figure 4. Navigation for the map interface, following Shneiderman's (1996, 337) "overview first, zoom and filter, then details-on-demand" mantra.

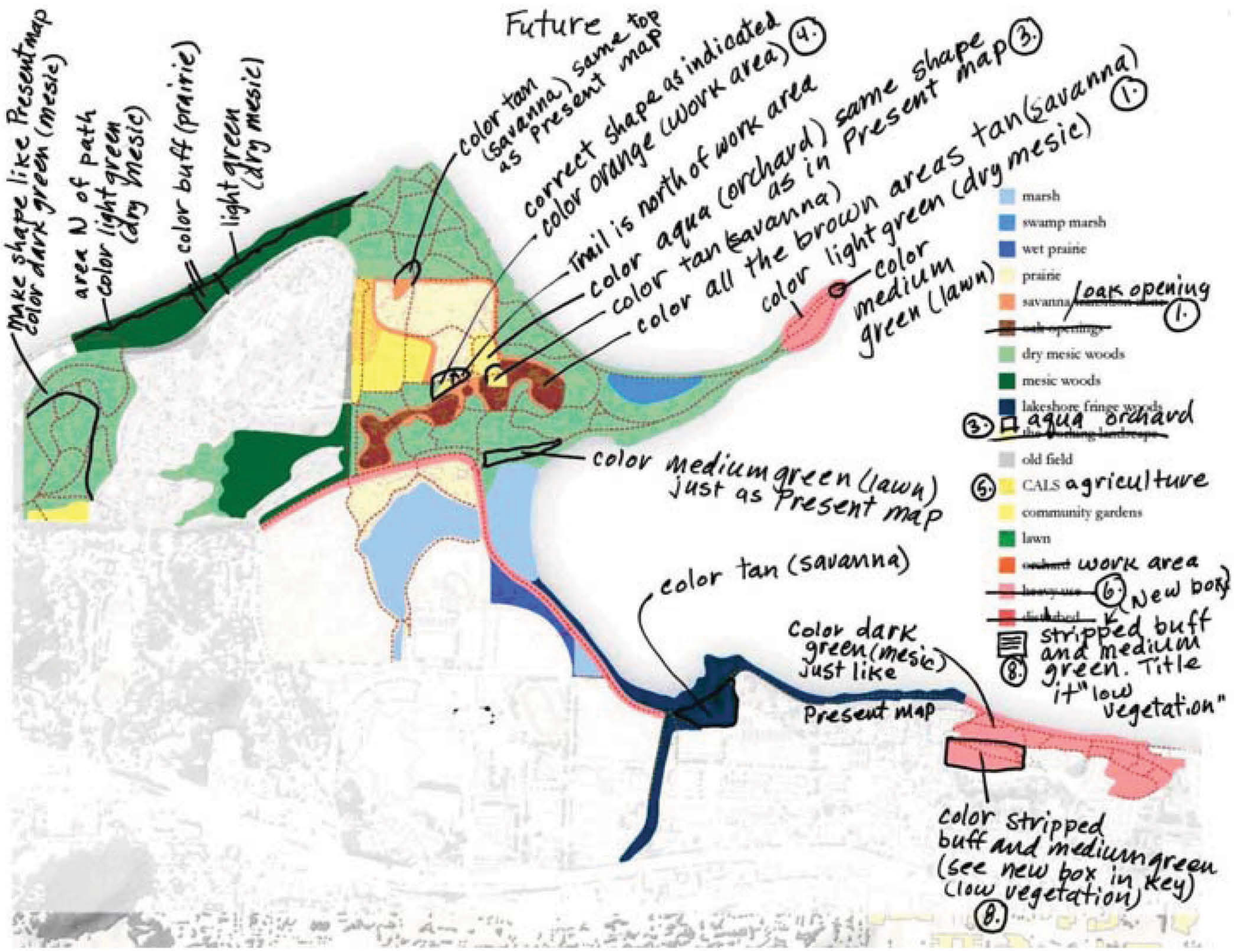


Figure 7. An annotated mockup circulated in an informal assessment email showing revisions and comments to the future vegetation layer.

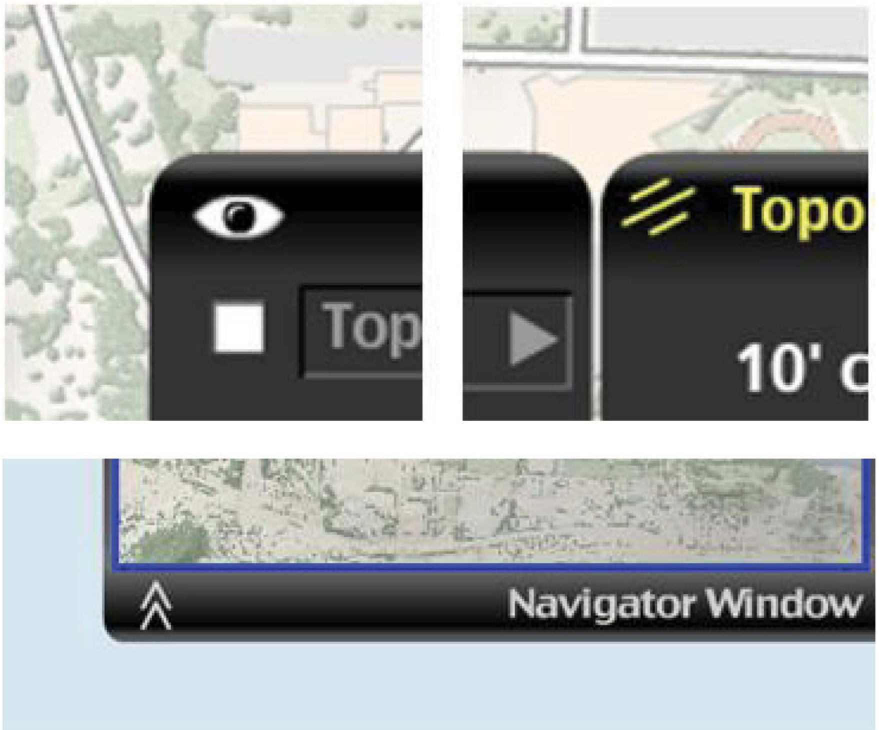


Figure 10. Initial designs for the layer visibility button (top-left), the tear-away menu button (top-right), and the minimize window button (bottom).

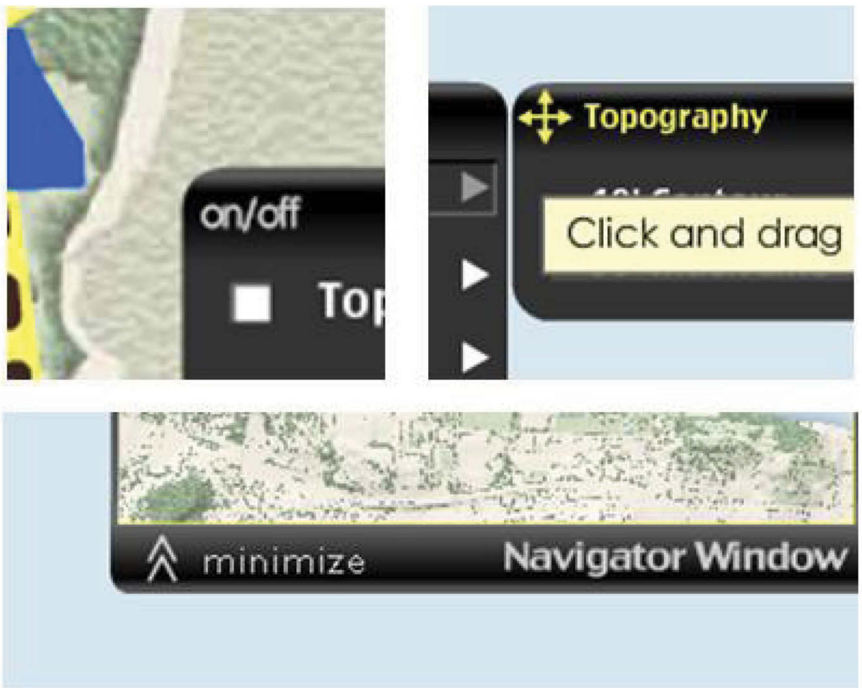


Figure 11. Redesigns for the layer visibility button (top-left), the tear-away menu button (top-right), and the minimize window button (bottom) added words to explain the function of the widget and sometimes did away with the vague icon altogether. Tool tips (top-right, in yellow) also appear after pausing over a widget for one second to further prompt the user about the widget's function.

Building a Web Site at the University of Chicago Map Collection

Christopher Winters

Figure 1. Screen shot of the University of Chicago Library Map Collection home Web site.

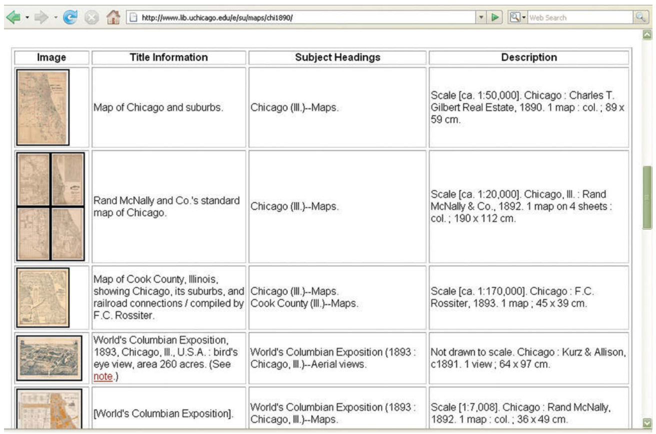


Figure 2. Screen shot of University of Chicago Library Map Collection online index with metadata fields.

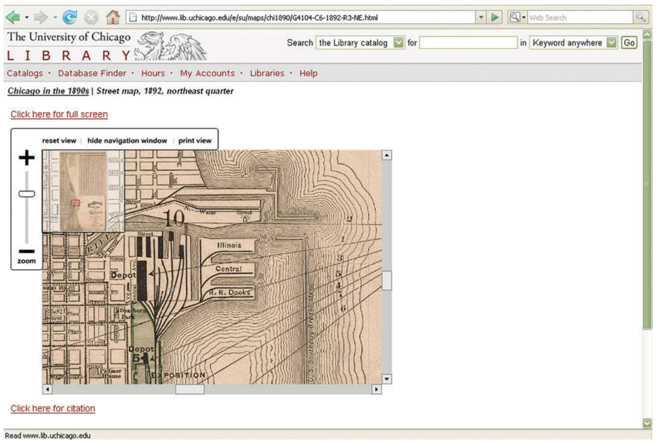


Figure 3. Screen shot of University of Chicago Library Map Collection online map of Chicago showing Zoomify capabilities.

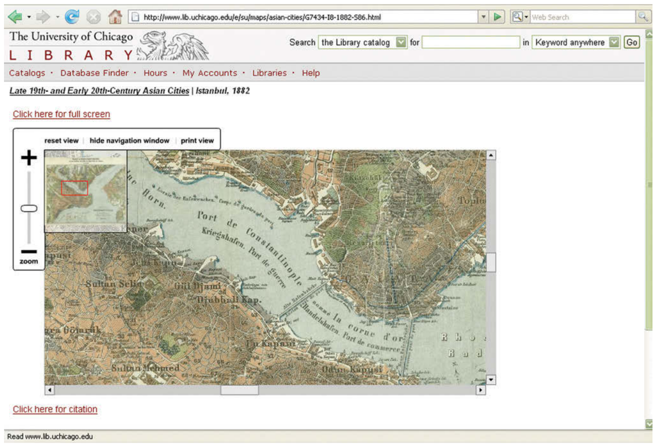


Figure 4. Screen shot of University of Chicago Library Map Collection online map of Istanbul showing Zoomify capabilities.

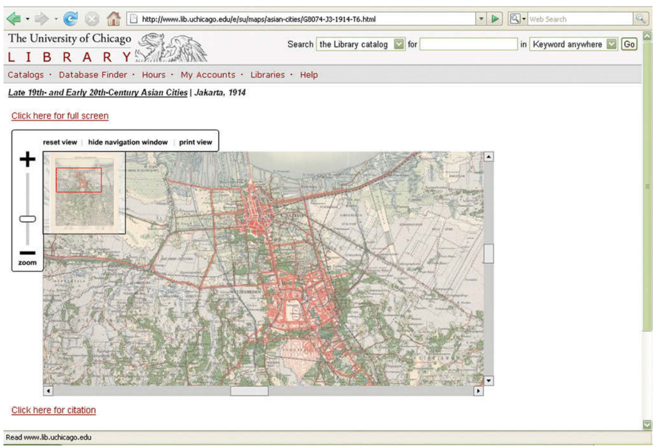
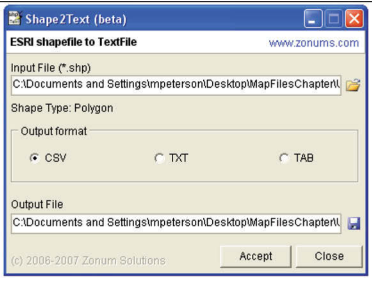


Figure 5. Screen shot of University of Chicago Library Map Collection online map of Jakarta.

Choropleth Google Maps

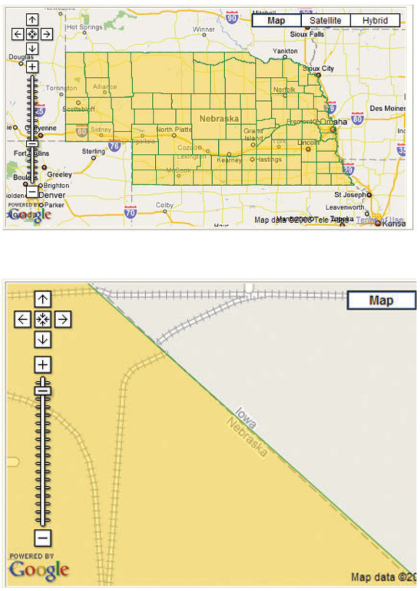
Michael Peterson




```
12      Nodes
-122.9679783  48.44379451
-123.0952329  48.47942282
-123.1597199  48.52184222
-123.1698993  48.56256471
-123.1410538  48.62364712
-123.1037214  48.60837712
-123.0120949  48.55747774
-123.0086988  48.53371932
-122.9679800  48.52693332
-123.0222711  48.51335968
-123.0188829  48.48960517
-122.9679783  48.44379451
```

```
<poly linecolor="#008800" linewidth="4" lineopacity = "1.0" fillcolor=
"#FFCC00" fillopacity = "0.5" html="State">
  <point lat="-122.9679783421" lng="48.4437945085"/>
  <point lat="-123.0952328681" lng="48.4794228153"/>
  <point lat="-123.1597199251" lng="48.5218422237"/>
  <point lat="-123.1698993372" lng="48.5625647146"/>
  <point lat="-123.1410538081" lng="48.6236471212"/>
  <point lat="-123.1037213929" lng="48.6083771192"/>
  <point lat="-123.0120949153" lng="48.5574777421"/>
  <point lat="-123.0086987596" lng="48.5337193216"/>
  <point lat="-122.9679800006" lng="48.5269333223"/>
  <point lat="-123.0222711218" lng="48.5133596826"/>
  <point lat="-123.0188828947" lng="48.4896051705"/>
  <point lat="-122.9679783421" lng="48.4437945085"/>
</poly>
```

*Figure 1. The Shape2Text conversion process leading to the creation of an XML file. The program asks for the location of the *.shp file, the output format, and the output location. A single polygon with 12 points (nodes) is shown in the upper-right. These points are then converted into the proper XML poly format using the Excel concatenate function.*




```
// Put the population data for the counties into the popdata array
      popdata = new Array
(33185,6931,372,783,492,5668,11132,2185,3354,43954,7341,8595,25963,8819,3811,5934,9865,
50,892,3710,8812,267135,35865,749,656,497,35279,7954,5171,3705,7247,4650,15747,2804,299

// Find the min and max population values for the 93 counties after doing a non-linear
      var min=100000000;
      var max=-100000000;
      for (var i = 0; i < 93; i++) {
        popdata[i] = Math.log(popdata[i])
        if (popdata[i] < min) { min=popdata[i] }
        if (popdata[i] > max) { max=popdata[i] }
      }
// Find the range in the data values
         var range = max-min
// Compute the opacity for each county, a value between 0 and 1
         opacities = new Array ()
         for (var i = 0; i < 93; i++) {
           opacities[i] = 1-((max - popdata[i]) / range)
      }
```

Figure 2. A shapefile map of Nebraska by county mapped with Google Maps after line coordinate thinning with MapShaper and conversion to a text file by Shape2Text. The state border between the shapefile and the Google Map matches nearly perfectly, although the underlying map from Google may have errors along the border as with the discontinuity in the railroad line that is visible in the enlarged map.

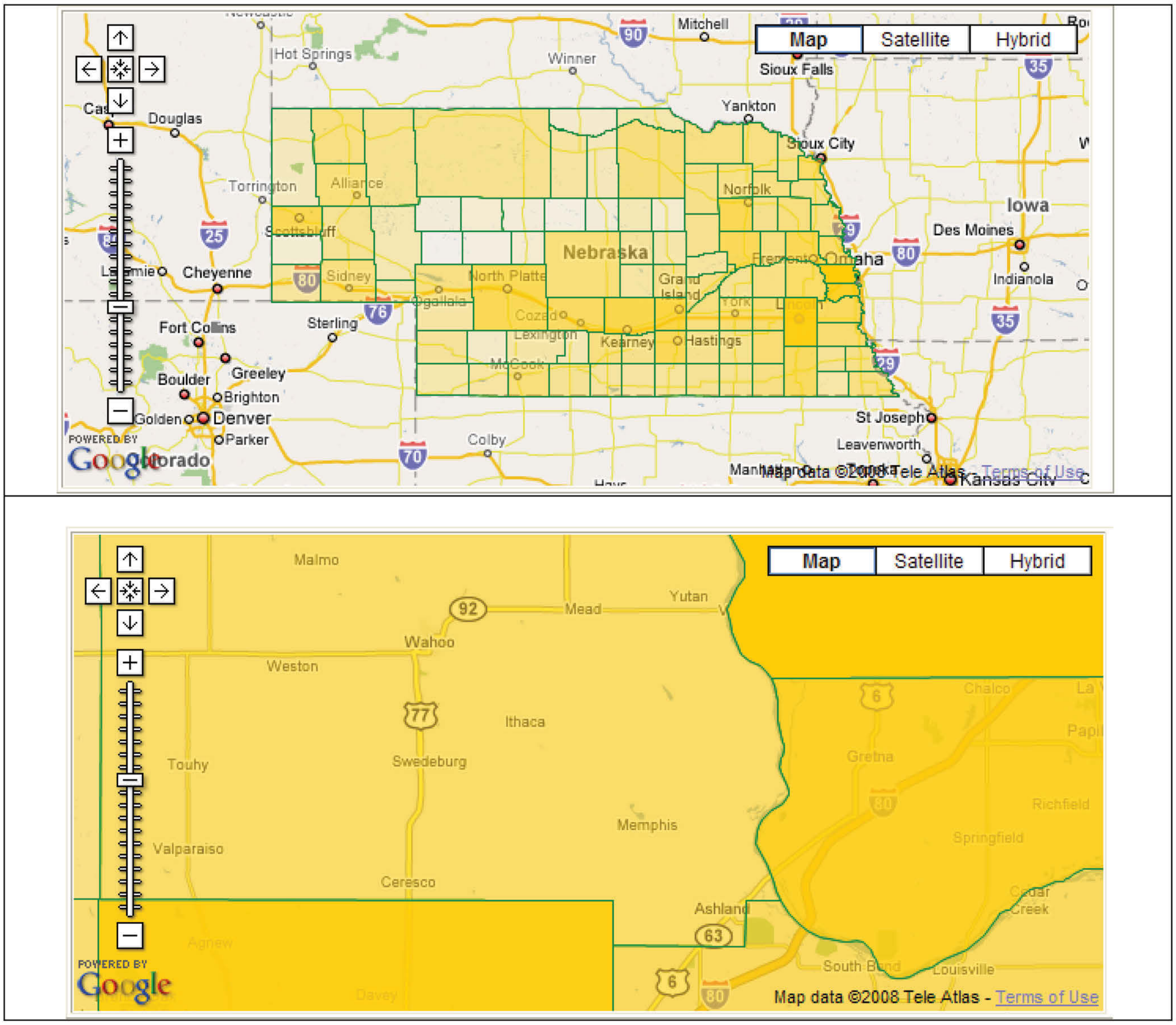


Figure 3. A population map of Nebraska. The opacity of the color that is assigned to each county is proportional to its population. The data have been converted to a log value to compensate for the skewed population distribution caused by the two largest cities, Omaha and Lincoln. The zoomed-in map on the bottom shows that place locations are visible in the less populated counties that have been assigned a lower opacity value.