WEB-BASED GIS TO ENHANCE THE DESIGN OF A STATEWIDE TRAILS NETWORK AS PART OF FLORIDA'S GREENWAYS AND TRAILS SYSTEM

By

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The use of Web-based GIS applications has skyrocketed over the last decade for gathering information, facilitating public involvement, and providing access to government programs. The purpose of our study was to determine whether using Web-based GIS technology enhanced the update of a statewide trails network. We examined various aspects of using Web-based GIS, such as the opportunity for public involvement, difficulty of technology for general users, potential for reaching a broader audience, potential for collaborative group decision-making, and the quality of the final product.

A Web-based application for participatory greenways planning, the Trail Network Update Utility (TNUU), was developed and implemented at the GeoPlan Center at the University of Florida as part of a contract with the Office of Greenways and Trails. Its purpose was to allow as many people as possible to participate in updating the Recreational Trail Network for the State of Florida. Before the Web-based application was developed, the Recreational Trail Network was created and maintained using paper maps. The Web-based application could reduce transcription errors, allow more individuals in various geographic locations to participate in the process, and standardize the data submitted.

To examine the efficiency of Web-based GIS for statewide greenway planning, a survey instrument was created to investigate the TNUU user's degree of satisfaction and how they rated it compared with the original process of drawing potential new trail corridors on paper maps at public meetings. The survey also examined how frequently Web-based GIS is used to prepare for public meetings, and examined the efficiency of workshops for training decision-makers in Web-based GIS.

Results showed that using Web-based GIS enhanced the update of the Recreational Trail Network and helped the public to better prepare for public meetings. Findings also suggested that training can increase a participants' level of satisfaction with Web-based GIS technology. Using Web-based GIS can enhance the planning process in a variety of ways, and Web-based GIS need not compete or do away with direct participation.

CHAPTER 1
INTRODUCTION

The use of Web-based GIS applications has skyrocketed over the past decade for gathering information, facilitating public involvement, and providing access to government programs. The first Web page with an interactive map was published in 1993 by Xerox® Palo Alto Research Center (PARC) as an experiment in interactive information retrieval (Harder, 1998). Since then, GIS technology and the Internet have been integrated to produce an expanding area of research, referred to as Web-based GIS. Web-based GIS facilitated the open use of GIS in three ways: (1) spatial-data access and dissemination, (2) spatial-data exploration and visualization, and (3) spatial-data processing, analysis, and modeling (Dragicevic, 2004). Our study examined the effectiveness of Web-based GIS to enhance the design of a statewide trails network as part of Florida’s greenways and trails system.

Introductory Background Statement

New information technology based on the World Wide Web (WWW) offers excellent means for bringing the public into the spatial decision-making process. Our primary focus was on a Web-based geographic information system (GIS) as a tool for communication among different stakeholders (planners, decision makers, and the public) for designing a statewide trails network. We hypothesized that a community-wide information network (like the WWW) is a new kind of medium offering a real-time, two-directional communication channel between different parties that enhances the quality of the final product.

Designing a Statewide Trails Network

The Florida Greenways Commission began an effort in 1993 to bring together public and private interests to create a vision for a statewide system of greenways and trails in Florida. The concept for recreational linkages emphasized connections among urban areas and natural areas to form a network for the entire state. After a year of meeting with various interest groups and the public, a vision of a statewide network of recreational trails was produced in a series of maps that included Hiking Trail Opportunities, Off-Road Bicycling Opportunities, Equestrian Trail Opportunities, Multi-Use Trail Opportunities, and Paddling Trail Opportunities. Each set of opportunity maps was delineated into logical segments and prioritized based on a set of criteria, including regional significance, ecological connectivity, local connectivity, suitability for specific users, access/proximity, interpretive potential, scenic character, management, and continuity. The opportunity maps were finalized and approved by the Florida Greenways and Trails Council in 1996. The Department of Environmental Protection Office of Greenways and Trails uses these opportunity maps to evaluate grant applications for acquisition of trail corridors. It was understood that the opportunity maps would be periodically revised and updated (FDEP & FGCC, 1998).

The first revision of the opportunity maps began in 2003. The Off-Road Bicycling and Equestrian Opportunity Maps were combined and integrated into Multi-Use Opportunity Maps to reflect their use as connective corridors rather than statewide trails, so the three opportunity maps up for revision included Multi-Use Trail Opportunities, Paddling Trail Opportunities, and Hiking Trail Opportunities. A Web-based GIS system was implemented to enable on-line recommendations for potential trail corridors, and participation of a greater number of stakeholders. Recommendations were taken from representatives of non profit organizations, government agencies, and the general public from September 2003 to February 2004. The new opportunity maps were then approved by the FGTC and prioritized using the same process and criteria used for the original opportunity maps. Today, the Department of Environmental Protection Office of Greenways and Trails uses the updated opportunity maps in their evaluation of grant applications for acquisition of trail corridors (Duever, Conway Conservation Inc., Teisinger, GeoPlan Center and Carr, 2001).

Integrating GIS with the Web for Public Involvement

A Geographic Information System (GIS) is an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display many forms of geographically referenced information (ESRI, 2005). GIS has been widely implemented in various planning problems. Together with the use of the Internet, GIS could be further developed to allow many more people to have access to GIS functionality and to enhance public involvement in decision-making. Public involvement is symbolized by dynamic two-way communication and encourages input from the public to guide the decision-making process in its early stages (O'Connor, Schwartz, Schaad, and Boyd, 2000). Web-based GIS can be used as a tool for communication among different interest groups such as planners, decision-makers, and the public for the design of a statewide trails network.

Rapid growth of the Internet has enabled a community-wide information network to provide highly customized, accessible, and interactive sources of public information. This new means of information transfer is changing the way that people capture and manipulate spatial information. Web-based GIS could provide a means to communicate, capture, and store complex spatial information with a wider audience (Kangas and Store, 2003) for enhancing public involvement and collaboration in decision-making processes.

Statement of the Problem

Between 1994 and 1996, the original vision for a statewide network of trail opportunity corridors was created and maintained by using paper maps. These maps were hand edited at public meetings around the State, using Mylar overlays to trace over statewide maps of Florida. The database was later updated by a GIS technician using free-hand digitization. Various aspects of this method were inefficient:

- It was time consuming (trail segments had to be “drawn” twice: once on the map and once on the computer screen).
- Transcription errors were possible.
- It was difficult to reach a broad and diverse audience.

This process was very successful at enabling collaborative group decision-making. However, we and the Office of Greenways and Trails wished to improve the process by using new Web-based GIS technology.

Research Questions

Our goal was to determine whether using Web-based GIS technology enhanced the update of the statewide trails network. We examined various aspects of the implementation of Web-based GIS, such as opportunity for public involvement, difficulty of technology for general users, potential for reaching a broader audience, potential for collaborative group decision-making, and quality of the final product. The primary research questions that we addressed included:

1. Does using Web-based GIS enhance the design of a statewide trails network?
2. Can Web-based GIS improve the opportunity for public involvement in designing a statewide trails network?

3. Do training workshops improve a participant's satisfaction with Web-based GIS as a planning tool for the design of a statewide trails network?

4. Is there potential for reaching a broader audience for the design of a statewide trails network with the implementation of Web-based GIS?

5. Is Web-based GIS sufficient in providing a forum for collaborative group decision-making about the design of a statewide trails network, or are supplemental activities needed?

Significance of the Study

Information gathered in our study could help the Office of Greenways and Trails and the GeoPlan Center at the University of Florida understand the needs of the people involved in greenways and trails planning. Results of our study could also help in the design and implementation of future Web-based GIS utilities for statewide greenways planning and other spatial planning activities.

CHAPTER 2
BACKGROUND

The United States Greenways Movement

Four Key Stages of the Greenways Movement

Succession of the greenways movement in the United States was explained by Fabos (2004). Fabos divided Greenways literature into four phases. The first phase was the era of Frederick Law Olmsted, Sr.; Charles Eliot, and Horace W.S. Cleveland, who pioneered the greenways movement from 1867 to 1900. The second phase of greenways literature came between 1900 and 1940, mostly from students of Olmsted and Eliot, as well as Benton MacKaye and Robert Moses. The third phase looks at the environmental decades of the 1960s and the 1970s and the works of notable landscape planners such as Philip Lewis and Ian McHarg. The fourth phase is the naming and federal validation of the greenways movement, primarily by the President's Commission of Americans Outdoors in 1987 and Charles Little in his popular book, *Greenways for America* (Little, 1990).

Early Greenway Planning from 1860 to 1900

Frederick Law Olmsted is often referred to as the father of the greenways movement. He was born in Hartford, Connecticut in 1822 and dabbled in many vocations in his youth, ranging from an apprentice civil engineer, a journalist, a Staten Island nurseryman, a seaman, and a Connecticut farmer (Little, 1990). Olmsted was a self-proclaimed social reformer and saw his work as a way to promote social order. He advocated the newly emerging belief that the design of the physical spaces that humans occupy influences human behavior. Olmsted believed that large natural open spaces were essential to metropolitan cities, because they offered opportunities for quiet contemplation in nature. He felt so adamant about the provision of this service that he intentionally precluded more active uses in his parks (Schuyler, 1986).

At the age of 35, Olmsted accepted an administrative job as the superintendent of an unimproved site that was intended to be a “central park” for New York City. This was the beginning of a career as a park builder and a fruitful professional partnership with Calvert Vaux, a British architect. Olmsted and Vaux won a competition to design Central Park, which was a remarkable success and was followed by many contracts to design other urban parks.

Although Central Park was a high profile project for Olmsted, the landscape architecture work that he did in Berkeley, prior to the construction of Central Park, proved to be the Olmstedian source of the greenway idea when he proposed two greenway elements. In designing a plan for the college grounds, now the University of California at Berkeley, and the immediate neighborhood, Olmsted proposed to (1) designate public parkland for recreational use and (2) create a scenic drive from Oakland to the campus (Little, 1990). Other successful greenway projects that Olmsted worked on include Prospect Park and Ocean Parkway in Brooklyn, the Emerald Necklace in Boston and Piedmont Way in Berkeley.

Charles Eliot, a pupil of Olmsted, expanded on his vision when he created a park system for the entire Boston Metropolitan Region. Eliot’s plan connected five large parks on Boston’s outer fringe with five shorter coastal river corridors such as the Charles

River Greenway Corridor to the ocean (Fabos, 2004). The concept of using coastal rivers to connect open space became a forerunner of the current greenways planning approach.

It is important to note that early parkways and linear corridors designed during Olmsted's era were for pedestrians, carriages and horseback riders. Neither bicycles nor automobiles had been introduced into American culture when Olmsted designed Berkeley's Piedmont Way and Brooklyn's Ocean Parkway. In 1910, there were less than 500,000 automobiles in the United States, a ratio of one for every two hundred people. As the mass-produced automobile gained popularity in the U.S., the nature of the 'parkway' would change forever (Little, 1990).

Much of the early greenways planning theory stemmed from concepts that were emerging in Europe at the time. Olmsted and a few of his contemporaries had traveled in Europe extensively and drew many of their ideas from examples previously implemented there. In the United States, the term greenbelt conveys any swath of open land, but in Britain, where the original concept emerged at the turn of the century, the greenbelt served to separate communities to preclude "conurbation," as Lewis Mumford points out in *The City in History*. The idea originated with Alfred Marshall, a British economist who made the point in an 1899 paper: "We need to prevent one town from growing into another or into a neighboring village; we need to keep intermediate stretches of country in dairy farms, etc., as well as public pleasure grounds." Marshall's concept of stretches of land that separated cities was rooted in Ebenezer Howard's idea of a "garden city," which he introduced in *To-Morrow: The Peaceful Path to Social Reform*. Howard proposed an agricultural "country belt" around the garden city to maintain its urban integrity by maintaining the rural integrity. Howard's concept of a garden city was unique because he was not concerned with creating a city *of* gardens but rather a city in a garden – a city contained within a permanent agricultural landscape. Cleveland, a contemporary of Olmsted, designed what some believe is the finest example of a network of open space in a metropolitan area with the Minneapolis-St. Paul metropolitan park system, completed in 1895 (Little, 1990).

Regional Greenways Movement from 1900 to 1950

Robert Moses (1888-1981) has been credited with creating more parks and parkways than any other person in the history of the world (Little, 1990). Moses created many public works projects during his time, including bridges, housing projects, dams, and a multitude of other side projects, such as the world's fairgrounds in Queens and the site of the United Nations in Manhattan. Moses built many recreational trails and greenways during his career, but towards the end of his career he found himself at odds with conservationists. The automobile became more popular and highway design to accommodate an increasing number of vehicles traveling at much faster speeds started to take precedent over greenway design. Parkways began to overpower, if not obliterate the natural scenes they were meant to celebrate. The tensions over greenway versus parkway design culminated with the Richmond Parkway, which Moses intended to construct along a beautiful wooded ridge of the escarpment on Staten Island. In 1963, citizens mobilized to protest the construction of the highway and instead, proposed a Staten Island Greenbelt with a recreational trail, the Olmsted Trailway, running through the middle. The conservationists succeeded in blocking Moses's highway and the Staten Island Greenbelt remains one of the most politically supported greenways in the United States.

Four very influential landscape architects in the early 1900's were the two sons of Olmsted, known as the Olmsted Brothers, Henry Wright, and Charles Eliot II, the nephew of the first Charles Eliot. The majority of the works by these landscape architects would be considered greenways by today's standards. The Olmsted Brothers are well known for the 40-Mile Loop in Portland, Oregon they designed in 1903 to honor the Lewis and Clark Centennial. The 40-Mile Loop now covers 140 miles and is described by Little in *Greenways for America* as, "one of the most creative and resourceful greenway projects in the country" (Little, 1990, p. 77). Henry Wright gained respect as a "regionalist" particularly for his input on the Regional Plan for the state of New York in 1926. He has also been recognized for work in community planning, which involved the design of an interconnected network of open space and greenways for Radburn, New Jersey. Charles Eliot II was the first landscape architect for the Open Space Commission for the Governor of Massachusetts in 1928. During this time he drew up the first open space plan for the state of Massachusetts. Most of the land mapped out by Eliot II has been preserved and acts to connect major wetlands and drainage systems in the region (Fabos, 2004).

Benton MacKaye was an important figure in the regional-planning movement of the 1920's. He is best known as the pioneer of the Appalachian Trail, which he proposed in a 1921 magazine article in *The Journal of the American Institute of Architects*. MacKaye was also the cofounder (with Aldo Leopold, Robert Marshall, and others) of the Wilderness Society in 1936 and was an active member of the Regional Planning Association of America. MacKaye was a visionary because he saw the connection between greenways as a way to guide development as well as provide recreational opportunities to large metropolitan populations. He combined recreation with the use of corridors that followed natural landforms to control urban growth, which added significant detail to the country belt idea of Ebenezer. Howard MacKaye was a proponent of hiking trails provided in open spaces that encircled and connected urban areas (Little, 1990).

MacKaye's plan for the Appalachian Trail was an expansion of the open-way greenbelt concept, because it was on a regional scale rather than local scale. MacKaye did not design the Appalachian Trail to be a walking route; he envisioned it as the starting point for a giant dam and levee system for the entire Eastern Seaboard. The trail was originally intended to follow a wide belt of protected open land that would have lateral greenways descending eastward and connecting to coastal cities. Although MacKaye's primary open-way concept for the Appalachian Trail was never implemented, the two thousand mile trail from Maine to Georgia was completed. Interest in the original design for the open-way concept was reignited in the 1970s, but the revisitation of MacKaye's Appalachian Greenway never took off (Little, 1990).

Influence of Ecological Planning: 1950 to 1970

The post World War II development boom can be characterized as a race between conservationists and developers to obtain tracts of open space on the metropolitan fringe. As undeveloped parcels became increasingly scarce, many farmers, ranchers and owners of large estates on the urban fringe sold to developers, rather than passing their holdings on to the next generation. Uncontrolled growth began to take over the countryside, which lead to increasing taxes to cover the demand for new municipal services. In the spirit of conservation, people who were concerned with protecting natural areas began to apply for grants and raise funds to purchase the tracks of land on the urban fringe that were at risk of being developed. Some landowners were persuaded to donate their land as nature sanctuaries or open space. This type of conservation leads to fragmented open space, varying in size and shape and lacking any continuity. It also prompted criticism from civil rights activists, who charged that land conservation wasn't consistent with social need and mostly benefited the well off who lived in estate country. Very little newly acquired conservation land was in the urban inner city or even the older suburbs, leaving the greenways movement with few supporters (Little, 1990).

In the 1960s, the ecological approach to greenway planning and design emerged in response to the disorganized conservation that was characteristic of the 1940s and 1950s. Ecological planners and landscape architects recognized the need to protect corridors, mostly to mitigate the loss and fragmentation of natural areas (Smith and Hellmund, 1993). In the early 1960s, Philip Lewis Jr., a professor of landscape architecture at the University of Wisconsin at Madison emphasized the need to establish a statewide pattern of resource values so that important natural features were protected as man-made changes quickly spread over the landscape. Lewis and his colleagues took advantage of the 10 year $50 Million Resource Development and Outdoor Recreation Act to observe and inventory the Wisconsin landscape. The detailed landscape analysis was possibly the first of its kind in the U.S. in terms of comprehensiveness and detail (Lewis, 1964).

The first stage of Lewis's work was to compile data of the natural and cultural resources of Wisconsin, then map all features at the same scale. Lewis was then able to use overlay maps to evaluate natural resources for the entire state of Wisconsin (Lewis, 1964). Drawing different data maps such as soils, vegetation, slope, and hydrology at the same scale then overlaying them creates an overlay map. The practice of drawing overlay maps can be traced back to Warren Manning who used overlay maps in a study done for the town of Billerica, Massachusetts in 1912 (Steinitz et al., 1976). In Lewis's work, individual elements of the landscape such as wetlands, vegetation, water, and topography were combined using overlays, which produced a composite map. The composite maps revealed a pattern in the spatial distribution of valuable natural resources. Lewis discovered that high concentrations of natural features were distributed in a linear pattern along waterways due to the elements and glacial action. These corridors were called "Environmental Corridors" and are described as the "basic units of research for recreational planning" (Lewis, 1964, p.104). The term "corridor fringe areas" was later coined to describe the adjacent lands paralleling the environmental corridors. The purpose of mapping these natural resources and identifying a spatial pattern to their distribution was to encourage a holistic approach to environmental planning rather than piecemeal or haphazard land conservation (Lewis, 1964).

Ian McHarg has been described as the best-known practitioner of ecological planning (Little, 1990) for his systematic approach to land-use planning according to the relative ecological value and sensitivity of each element of the landscape (Smith and Hellmund, 1993). McHarg was a professor at the University of Pennsylvania and published the seminal book, *Design with Nature* (1969). The premise of *Design with Nature* is that without a systematic, scientific approach to conserving land, we will quickly deplete the landscape of its ecological value. In the absence of any ecological planning, the normal expectation is that

> "growth will be uncontrolled, sporadic, representing short term values, with little taste or skill. Slowly nature will recede, to be replaced by growing islands of development. These will in time coalesce into a mass of low grade urban tissue, having eliminated all natural beauty, diminished rare excellences, both historic and modern" (McHarg, 1969, p. 80).

> "You can confirm an urban destination from the increased shrillness of the neon shrills, the diminished horizon, the loss of nature's companions until you are alone, with me, in the heart of the city, God's Junkyard – or should it be called Bedlam,

> for cacophony lives here. It is the expression of the inalienable right to create ugliness and disorder for private greed, the maximum expression of man's inhumanity to man" (McHarg, 1969, p. 23).

Yet, McHarg does not offer the country as the remedy for the industrial city; rather he applies the ecological view to the selection of open space in the metropolitan area. He suggests that lands reserved for open space in the metropolitan region must be selected based on their unique natural processes and that they have intrinsic ecological value. McHarg's basic method is to create overlay maps of areas that show the suitability or value of each feature. Each physiographic feature – the location of wetlands, for example, or waterways, forested valleys, or unforested plateaus – is individually plotted with a transparent color on a clear Mylar sheet (McHarg, 1969).

McHarg contributed his expertise to the Plan for the Valleys outside of Baltimore, Maryland, a citizen lead movement to protect their community from becoming a no-place, somewhere, U.S.A. The Plan uses *physiographic determinism*, which suggests that development is guided by the natural processes of the land. In this study, McHarg uses lighter shades to represent areas that have low ecological value and darker shades translate a higher ecological value. When the maps were overlaid, the lightest areas depicted regions that were most suitable for urban uses, while the darkest areas had a high ecological value and were most suitable for conservation (McHarg, 1969).

Great advances in ecological planning were made during the 1960s and 1970s. The key idea that emerged during these decades was that systematic analyses was essential for the study of ecological resources and would encourage informed and responsible decision-making (Zube, 1976). The ecological planning approaches developed by Lewis and McHarg have been further developed and are now components of complex computer models that are used today for environmental decision-making.

Economic Downturn and the Naming of the Greenway's Movement: 1980 to 1990

The recession of 1982-83 greatly restricted the amount of money available for the acquisition of public land. Funding for numerous public programs was cut severely or eliminated; these included the open-space grant program of the Department of Housing and Urban Development, and the Interior Department's grant-making Land and Water Conservation Fund. In the mid 1980's private money was restricted as well by tax reform laws that limited the deductibility of donated land or money used to buy it. The Gramm-Rudman-Hollings Act was passed in 1985 as a United States budget deficit reduction measure. This Act drastically reduced the number of open-space grants that would be granted from the federal level (Little, 1990).

On January 28, 1985, Ronald Reagan issued Executive Order 12503, which created an advisory commission to review the state of Americans Outdoors and to give recommendations on the public need for outdoor recreation. Two years later, the Presidents Commission on Americans Outdoors released *Americans Outdoors*, a report that calls attention to the need for more recreation space. "Accelerating development of our remaining open spaces, wetlands, shorelines, historic sites, and countryside's, and deferred maintenance and care of our existing resources, are robbing future generations of their heritage which is their birthright" (President's Commission on Americans Outdoors, 1987, p. 14). The President's Commission was very clear that not enough was being done to protect the remaining open spaces in the United States and even if only for the health of the American people, a conscious and fiscal effort should be made by the government to protect America's ecologically sensitive areas. At the beginning of the report, the President's Commission states their primary assumption, which is that "the outdoors is a statement of the American condition" (President's Commission on Americans Outdoors, 1987, p. 9).

A cloud of controversy hung over the President's Commission from the beginning to the end, because environmentalists and conservationists were underrepresented. There was concern that the Report would mostly stress private commercial development of outdoor resources and give little attention to resource protection. At the beginning of the report, it is stated that there was not complete unnaninimity and not all statements reflect the views of all members. The Chairman of the Commission was Lamar Alexander, the Governor of Tennessee and the Vice-Chairman was Gilbert Grosvenor, the President of the National Geographic Society. There were thirteen additional members on the Committee, representing different interests in outdoor education.

Many positive statements for the environment were made in the President's Report and a strong emphasis was placed on the importance of public participation. The published document shows a great deal of regard for the environment and an understanding of the research that had been conducted by proponents of the ecological view, such as McHarg and Lewis. "We have a vision for delivering outdoor recreation opportunities close to home for all American's: a network of greenways, created by local action, linking private and public recreation areas and linear corridors of land and water" (President's Commission on Americans Outdoors, 1987, p. 14). The President's Commission called for a prairie fire of local, community-based public participation.

Charles Little's book *Greenways for America* (1990) was a very popular and comprehensive book that helped to rally support for the greenways movement. Little gives William H. Whyte credit for inventing the term, *greenway* in his 1959 monograph published by the Urban Land Institute, titled *Securing Open Space for Urban America* (Little, 1990). Little illustrates the power of local action in sixteen summaries of current greenways projects in the United States. This seminal book gave a name to the greenways movement and helped to motivate environmental planners and landscape architects around the country. Little categorized greenways into five major types:

- Urban riverside greenways
- Recreational greenways
- Ecological corridors
- Scenic and historic routes
- Comprehensive greenway systems based on the natural topography of the land

Florida Greenways Program: History and Review of its Legal, Ecological and Economic Origins

The Florida Greenways and Trails System has its roots in the Florida Trail Association, Florida Recreational Trails System, the Florida Canoe Trail System, and the public parks, forests, refuges, wildlife management areas and water management areas created to protect Florida's natural heritage.

The planning and construction of the Florida National Scenic Trail grew out of the efforts of James Kern who, in 1966, founded the Florida Trail Association (FTA) to create hiking and backpacking opportunities in Florida. To advance the building of the statewide trail, the Florida Trail Association initiated the creation of the Florida National Scenic Trail (FNST) through the Florida Congressional Delegation in the mid-1970s. The efforts of the Florida Trail Association volunteers attracted interest from the United States Department of the Interior. Their three-year study of the trail, completed in 1980, resulted in the enthusiastic endorsement of the Florida Trail to become one of eight

National Scenic Trails in the United States. On March 28, 1983, the FNST was officially designated by public law 98-11 by the U.S. Congress. When Congress approved the Florida National Scenic Trail (FNST), they designated the United States Department of Agriculture Forest Service as the administrative agency for that trail (Florida Trail Association, 2005). The U.S. Forest Service completed a comprehensive plan for the FNST in 1985 (FDEP & FGCC, 1998).

The Florida Canoe Trail System, created by the Governor and Cabinet in 1970, consisted of 36 canoe trails on 949 miles of natural rivers and streams. In 1981, a managing agency was identified for each canoe trail, which was designated by the Governor and Cabinet in accordance with the administrative rule that existed at the time. The managing agencies that were identified included the Division of Recreation and Parks, the Game and Fresh Water Fish Commission, and the Division of Forestry (FDEP & FGCC, 1998). Their responsibilities were: inspection of the entire length of the trail, clearing to allow the passage of canoes at normal water levels, maintenance of existing canoe trail facilities, and enforcement.

In 1979, the Florida Recreational Trails System was created by the Legislature. "It was intended to provide the public with access to and enjoyment of outdoor recreation areas; and to conserve, develop and use the state's natural resources for healthful and recreational purposes" (FDEP & FGCC, 1998). The Florida Recreational Trails System was influential in designating canoe trails.

In 1987 the federal government deauthorized the Cross Florida Barge Canal (CFBC), formally the Cross Florida Ship Canal. The Canal was a depression-era work project whose funding was discontinued in 1936. During the building of the canal, large tracks of land were excavated (Thomason, 1999). The project was officially deauthorized in 1991 by the State of Florida and became known as the Cross Florida Greenways State Recreation and Conservation Area (A Community Resource Guide for Greenway Projects, FDEP & OGT).

In 1987, the Legislature amended Florida Statute 260 to allow the state to acquire abandoned railroad rights of way for conversion into trails (FDEP & FGCC, 1998).

In 1988, the Florida Recreational Trails Council was created by the Department of Natural Resources to advise the Department about issues related to the trails system, especially trail acquisition projects (FDEP & FGCC, 1998).

In the 1990s, Florida greatly enhanced its ability to protect its remaining endangered and environmentally sensitive lands. It created the Preservation 2000 program allowing the state to spend $3 billion over a ten-year period to acquire land (A Community Resource Guide for Greenway Projects, FDEP & OGT).

Preservation 2000 was created in 1990 to establish annual funding for the Rails to Trails Acquisition Program and the Florida Greenways and Trails Acquisition Program. The program was expanded in 1991 to include acquisition for the National Scenic Trail (FDEP & FGCC, 1998). There were various ways to fund greenways and trails projects under the Preservation 2000 program. These sources of funding included, the Greenways and Trails Land Acquisition Program, which was funded by bonds issued from the sale of documentary stamps and the Florida Communities Trust (FTC) which was created to help local governments implement elements of their comprehensive plan which were related to conservation and recreation (Messersmith, 1999a). During the 1990’s, the Office of Greenways and Trails (OGT) received approximately $3.9 million per year for the purchase of land which met the definition of greenway or trail as defined in Section 260.13, Florida Statutes:

> "Greenway" means a linear open space established along either a natural corridor, such as a river front, stream valley, or ridgeline, or over land along a railroad right-of-way converted to recreational use, a canal, a scenic road, or other route; any natural or landscaped course for pedestrian or bicycle passage; an open space connector linking parks, nature reserves, cultural feature, or historic sites with each other and populated areas; or a local strip or linear park designated as a parkway or greenbelt.
>
> "Trails" means linear corridors and any adjacent support parcels on land or water providing public access for recreation or authorized alternative modes of transportation (Messersmith, 1999b).

In 1991, 1000 Friends of Florida and The Conservation Fund created the Florida Greenways Project, which later evolved into the Florida Greenways Program. This initiative was designed to help create a statewide system of greenways for the protection of natural ecosystems, wildlife and for human enjoyment (FDEP & FGCC, 1998). Under the umbrella of the Florida Greenways Project, many people and organizations worked together to accomplish two primary goals, (1) determine the ecological, cultural/historic and recreational components of a statewide greenways system and (2) identify which tools and techniques were available to implement a Statewide System. The four-year project was successful in raising support from private foundations such as the Surdna Foundation, the John D. and Catherine T. MacArthur Foundation, the Elizabeth Ordway Dunn Foundation, and the American Express Foundation, as well as public funding through the Florida Department of Transportation's ISTEA Enhancement Program.

One of the primary accomplishments of the Florida Greenways Project was the distribution of information about greenways. The Project was influential in the development of the greenways movement in Florida by keeping the public informed about issues and projects related to greenways through a quarterly newsletter and by sponsoring workshops and roundtables related to greenways and trails planning. The Project directed a lot of it's funding towards four prototype greenways projects: the Loxahatchee Greenways Project in north Palm Beach and south Martin counties; the Suncoast Greenways Project in Hillsborough and Polk counties; the Apalachee Greenways Project, in the six-county region around Tallahassee; and the Broward Urban River Trails Project in the intensely developed area of Ft. Lauderdale (FDEP & FGCC, 1998).

The state's trail designation program was transferred to the Office of Greenways and Trails (OGT) from the Division of Recreation and Parks in 1993 (FDEP & FGCC, 1998).

In early 1993, Governor Lawton Chiles created the 40-member Florida Greenways Commission (FGC) by Executive Order, giving the Commission a three-year period to develop a coordinated approach for protecting, enhancing, and managing a statewide system of greenways (FDEP & FGCC, 1998). The FGC began an effort to bring together public and private partners to create a statewide system of greenways and trails with recreational connections between urban and rural areas and ecological linkages between state and national parks, forests and other protected areas, and rivers and wetland systems (FDEP & FGCC, 1998). Lt. Governor Buddy MacKaye was appointed chair of the Commission and Nathaniel Reed was the vice chair. In late 1994, the Secretary of DEP Virginia Wetherell, was appointed second vice chair by Lt. Governor MacKaye. The Commission represented a variety of interests, with member affiliations including: conservation and the environment, recreation, business and development, forestry and agriculture, education and the general public. Members were also drawn from government agencies including: Florida's five Water Management Districts, a regional planning council and local governments. Mark Benedict was appointed Executive Director and also served as the Director of the Florida Greenways Project.

An example of a public/private partnership that was coordinated by the FGC is the Hillsborough Greenways Task Force, which was designed to protect the resources of the Upper Hillsborough River Basin-Green Swamp Corridor. The Task Force was initiated by the owner of the largest tract of privately owned land in the area, Hillsborough County, The Nature Conservancy and 1000 Friends of Florida, but grew to include the Hillsborough County City-County Planning Commission, the Hillsborough River Interlocal Planning Board, phosphate and utility companies and transportation agencies (Florida Greenways Commission, 1994).

When the Florida Greenways Commission met in September 1993, they created four working committees: Greenways Identification and Mapping; Program Integration; Community Action; and Partners, Awareness and Involvement (Florida Greenways Commission, 1994).

The Greenways Identification and Mapping Committee was charged with answering the question "what is a greenway" and with creating a state-wide map of existing and proposed greenway connections. This committee also developed greenway definitions and a classification system, discovered where greenways already existed and what important connections were missing. The 12-member group was chaired by Florida Department of Transportation Secretary Ben Watts and had members from Florida Department of Transportation, Florida Department of Environmental Protection, 1000

Friends of Florida, University of Florida Landscape Architecture Department and University of Florida Urban and Regional Planning Department. The formation of this Committee marked the beginning of a long partnership between the Department of Environmental Protection and the University of Florida's Department of Landscape Architecture and the Department of Urban and Regional Planning.

The Program Integration Committee looked at how the state's existing conservation and recreation programs fit into the greenways picture. Their goal was to look at both public and private greenways projects and put the pieces of the program puzzle together. The final product was a recommendation for an institutional framework to help state, regional and local greenway efforts (public and private) to work together. The committee was chaired by George Willson of the Nature Conservancy and included members from the Florida Department of Transportation, 1000 Friends of Florida and Florida Infinity, Inc.

The Community Action Committee surveyed communities to find out which had greenways and what made their projects successful. It was chaired by Sally Thompson, a board member from the South Florida Water Management Districts and included members from the Florida Department of Community Affairs, 1000 Friends of Florida and the South Florida Water Management District. Particular attention was given to the Pinellas Trail where organizers had organized and advisory group, acquired over $8 million in county government funds and $200,000 in private donations, and was ranked one of the top urban rail-trails nationwide. Many of the strategies used to promote urban recreational greenways were adapted and used to help gain public support for rural greenways.

The Partners, Awareness and Involvement Committee identified groups and individuals interested in working on greenways projects. This committee aimed at distributing information to non-traditional groups like city-dwellers and minorities and was chaired by Margaret Spontak of the St. Johns River Water Management District and included members from the Department of Commerce, 1000 Friends of Florida and the St. Johns River Water Management District (Florida Greenways Commission, 1994). This Committee identified important obstacles or barriers to greenways that would need to be tackled for a successful greenways program to exist in Florida. The primary obstacles to greenways at the time of the study include crime concerns, political opposition, development patterns, private property rights, road projects, funding, and long-term maintenance (Florida Greenways Commission, 1994).

Then in December 1994, the Commission recommended to the Governor and Legislature that Florida create a statewide system of greenways, a system that would link natural areas and open spaces, conserving native landscapes and ecosystems and offering recreational opportunities across the state (FDEP & FGCC, 1998). "The planning of Florida's system of greenways and trails began in earnest in 1995 with the passage of Greenways legislation (F.S. 253.787 and 260.012) that mandated a five year implementation plan (Schaller, Norris, Hoctor, Thomas, and Carr, 2004)."

In 1995, Chapter 260, Florida Statutes, which was originally written in 1979, was amended renaming the Florida Recreational Trails System as the Florida Greenways and Trails System. During the 1995 session, the Florida Legislature also created a 26 member Florida Greenways Coordinating Council (FGCC) comprised of business owners, conservationists, land owners, recreation, local and federal interests and state agency representatives and designated the Florida Department of Environmental Protection as the state's lead agency in the greenways program (FDEP & FGCC, 1998). The FGC was dissolved when the Florida Greenways Coordinating Council was created. The FGCC was created to promote greenways and trails initiatives throughout the state with technical support, leadership, education, advocacy, and other service-oriented efforts.

In order to accomplish the initial goals of the FGCC, the Council and DEP created the Florida Greenways and Trails Seed Grant Program. The Department of Community Affairs (DCA) provided funding for the program in the amount of $60,000. Under policies adopted by the Council and DEP, grants of up to $5,000 were given to projects that stimulated support for greenways and trails initiatives. In order to meet the criteria for the grant program, an applicant had to be able to (1) match the amount requested in cash, in-kind services, or donated materials; (2) identify/propose a greenway with relative significance that would be affected by the project; (3) assure the grantee's administrative capability; (4) demonstrate the education potential of the project; and (5) demonstrate the value of the project and anticipated economic benefits. During the first two weeks of March 1999, the Seed Grant Evaluation Committee met to review the 77 applications that were submitted. The program received applications requesting over $340,000 in funds, but only had $60,000 available to distribute. Clearly, there was a need for a greenways land acquisition program in Florida (Lippert, 1999).

In the 1996 Legislative session, the Preservation 2000 program and the trails acquisition program was expanded to include greenways (FDEP & FGCC, 1998).

In 1998, the Florida Department of Environmental Protection (FDEP) and the FGCC completed their five-year implementation plan titled *Connecting Florida's Communities with Greenways and Trails: The Five Year Implementation Plan for the Florida Greenways and Trails System*. It included a set of six maps representing the physical opportunities for an Ecological Network and five Trail Networks: Hiking, Off-Road Bicycling, Equestrian, Multi-Use Trail and Paddling. The report also contained specific recommendations, strategies and actions to be used to set about capitalizing on the opportunities represented on the maps (Schaller, et al., 2004).

At the end of 1998, Fred Ayer, the original Director of the Office of Greenways and Trails retired. His work began on the Canal Authority in 1987 and continued as he worked to gain support for greenways and trails in Florida. Deborah Parrish was named Director of the Office of Greenways and Trails shortly after Ayer's retirement ("DEP Welcomes New Secretary," 1999).

The Office of Greenways and Trails experienced a lot of change in 1999, beginning with the appointment of David Struhs as Secretary of the Department of Environmental Protection by Governor Jeb Bush on January 8, 1999. Struhs previously served as Commissioner of the Massachusetts Department of Environmental Protection from 1995 to 1999. Prior to Struhs' employment at Massachusetts DEP, he served as vice-president at Canyon Group, Inc., a Los Angeles-based management and consulting firm that specialized in the electric and gas utility industry. Struhs also served as Chief of Staff to the Council on Environmental Quality under President George Bush's administration in 1989 ("DEP Welcomes New Secretary," 1999).

The Preservation 2000 program was drawing to a close at the end of the 1990s, which called for an evaluation of the program and a fresh look towards the future. During the Preservation 2000 program, over 1 million acres of land in Florida were acquired and protected including many greenways and trails. The program was seen as largely successful, and was superseded by an even more powerful program when the Legislature passed Senate Bill 908 in 1999, which created the Florida Forever Program. This authorized the issuance of $300 million in bonds each year over a period of ten years for the purposes of conservation, recreation, environmental restoration, historical preservation, water resource development, and capital improvements to land and water areas. The Greenways and Trails acquisition program benefited from the new allocation of funds; OGT's portion of the funding increased from $3.9 million to $4.5 million per year. Furthermore, the funding for DCA's Florida Communities Trust (FCT) program was expanded from $30 million annually to $72 million. No less than 5% ($3.6 million) of FCT's funding was allocated toward recreational trails systems.

Significant legal changes were also made during the 1999 Legislative Session. The Legislature amended Florida Statute 260 to clarify the following issues: (1) waterways and lands could be designated as part of the Florida Greenways and Trails System; (2) all previously designated trails on public lands and waterways were automatically "grand-fathered-in" so that OGT did not need to go through the process again; (3) the Department of Environmental Protection was charged with the responsibility to carry out the five-year implementation plan for the Florida Greenways and Trails System which was adopted by the Florida Greenways Coordinating Council in September 1998; and (4) the new Florida Greenways and Trails Council was created to advise the Department in the execution of its powers and duties as stated in Chapter 260 F.S (Walker, 1999).

As mentioned above, at the 1999 Legislative Session, the Florida Greenways and Trails Council (FGTC) was established to replace both the Florida Recreational Trails Council and the Florida Greenways Coordinating Council (FGCC). This was a significant and controversial merger because the advisory groups for “greenways” and “trails” had not been joined before. There was fear between both advocates of recreational trails and ecological linkages that their priorities would take a back seat to the other interest. The new Florida Greenways and Trails Council was composed of 21 members that represent all stakeholders and advise the Office of Greenways and Trails on greenway and trail related issues. The Council was intended to include ten government representatives, five representatives of the trail user community, five representatives of the greenway user community and one member representing private landowners. The Council is expected to meet four times a year at various locations around the state as provided in Section 112.061, Florida Statutes (Rickman, 1999).

In 1998 The Cross Florida Barge Canal was renamed in honor of the late Marjorie H. Carr an environmental activist whose opposition to the Cross Florida Barge Canal led to the creation of the cross Florida greenway. An important land management strategy was accomplished in late 1999 when the Office of Greenways and Trails developed a Memorandum of Agreement with the Florida Division of Forestry to cooperatively manage the Marjorie Harris Carr Cross Florida Greenway. The Memorandum of Agreement was developed to “balance the need for low impact recreation with the need to protect and enhance natural resources” (Mills, 1999, p. 5).

By January 2000, all 21 members of the Florida Greenways and Trail Council were appointed and their duties were clearly defined to include: (1) Reviewing applications for acquisition funding under the Florida Greenways and Trails Program and recommending projects to be purchased; (2) Reviewing proposals for private and public lands to be formally designated as part of the Florida Greenways and Trails System; (3) Making recommendations for updating and revising the implementation plan for the Florida Greenways and Trails System; and (4) Measuring the overall success of the Florida Greenways and Trails Program. The FGTC held their first meeting in March 2000 in Tallahassee where they adopted bylaws and elected officers. Sally Thompson, who represented the Florida Water Management Districts, was elected Chair and Ken Bryan, who represented trail-users, was elected Vice Chair. Sally Thompson served on both the Florida Greenways Coordinating Council and the Florida Greenways Commission during the development of the greenways program and Ken Bryan previously served on the Florida Greenways Commission and was a long-time active member of the greenways community as the Director of the Florida field office of the Rails to Trails Conservancy (Rickman, 2000).

The 2000 Legislative session didn't have a large impact on the Office of Greenways and Trails. Two bills were passed which affected the office's activities. The most important was the Environmental Reorganization bill, which confirmed the existence of the Office of Greenways and Trails as a special office under the Department of Environmental Protection. The Office of Greenways and Trails was also granted the authority to administer grant programs, which allowed them to give out approximately $1.4 million in trail grants annually. The Florida Forever Glitch Bill was passed, which fixed “glitches” that were found in the previous years’ legislation. The bill was amended to allow OGT to use 10% of Florida Forever funds on capital improvements, whereas before, 100% of the funds had to be spent on acquisition (Weiss, 2000).

The Florida Greenways and Trails Council held their second meeting in May 2000. The meeting was primarily used to inform Council members about the new procedures for acquisition, according to Rule 62S, Florida Administrative Code. The Council passed a resolution at the meeting that supported Urban Transit Greenways as a way to connect metropolitan areas to the statewide system of greenways and trails (Pence, 2000).

At the Florida Greenways and Trails Council’s third meeting in July 2000 the Department of Environmental Protection recommended a process for prioritization of the ecological network within the vision for the statewide greenways and trails system, which was approved by the FCTC (Schaller et al., 2004). The Council also approved the following lands for acquisition (ranked in order): (1) South Brevard Trail Connector, (2) South Tampa Greenway, (3) Winder Springs Town Center, and (4) Texaco Service Station Site (“FGTC Meets in Ocala,” 2000).

On September 30, 2000 the Office of Greenways and Trails celebrated the opening of the Marjorie Harris Carr Cross Florida Greenway Land Bridge with over 1000 trail enthusiasts. The fourteen-month project from groundbreaking to grand opening was federally funded with transportation enhancement money. The $3.4 million project was a symbol of progress for Florida’s greenways movement: it was America’s first land bridge (Berrios, 1999; Graves, 2000; “Land Bridge Opens to Connect the Cross Florida Greenway, 2000-2001).

In November 2000, the FGTC approved a process for prioritization of recreational/cultural features within the vision for a statewide greenways and trails system (Schaller, et al. 2004). The University of Florida Departments of Landscape Architecture and Urban and Regional Planning carried out the prioritization study through a grant from the Florida Department of Environmental Protection. The study sought to prioritize the recreational and cultural features of the statewide greenways vision. The team at the University of Florida determined a Recreational Trails Opportunity Ranking Process that ranked different aspects of potential trail value. The broad categories that the study identified included: regional significance, ecological connectivity, local connectivity, suitability for specific users, access/proximity, interpretive potential, scenic character, management and continuity (Duever et.al., 2001).

In June 2001, upon adoption of the prioritization process by the Florida Greenways Trails Council, the Department of Environmental Protection prepared a plan with specific recommendations for prioritizing greenways and trails for ecological and recreation/cultural significance. This plan detailed the decision making process that would be implemented in order to carry out the prioritization using spatial modeling with Geographic Information Systems (GIS).

When the Florida Greenways and Trails Council met in Tallahassee in January 2002, they approved the designation of 120 state parks, adding 408,434 acres into the Florida Greenways and Trails System. Parks that were solely owned by the Board of Trustees of the Internal Improvement Trust Fund were designated under this agreement. The Council reviewed 20 applications for land acquisition at the meeting, where they recommended 14 projects for final approval. The four top projects were guaranteed for acquisition: (1) West Jacksonville Greenway Connector, (2) White City Bridge, (3) East Central Regional Rail Trail, and (4) Heather Island Preserve ("Florida Greenways and Trails Council Update," 2002).

The FGTC discussed new directions for the Office of Greenways and Trails acquisition program at the meeting in Homosassa Springs in April 2002. The Council agreed that the program should focus on acquiring critical linkages needed to complete the Statewide System of Greenways and Trails. The Council also voted to designate the Suncoast Trail part of the Florida Greenways and Trails System. The Suncoast Trail traverses 44 miles through Hernando, Pasco and Hillsborough Counties (Rickman, 2002a).

The year 2002 was constructive for the Florida greenways movement in terms of grants awarded for greenways and trails. The Office of Greenways and Trails received 36 applications for recreational trails program, requesting a total of $2,984,920. By the end of the acquisition cycle, the Office of Greenways and Trails funded 22 of the 36 projects for a total of $1,970,971. A few of the grant recipients included, Miami River Greenway, Lake Lizzie Nature Preserve in Osceola County, the Boundary Canal Trail in the City of Palm Bay and the Duval County Equestrian Trail ("Recreational Trails Program Grant Awards," 2002). On May 15, 2002 the Florida Communities Trust (FCT) opened the first Florida Forever application cycle. Approximately $66 million was made available for grants to local governments and nonprofit environmental organizations to acquire lands for conservation, open space and outdoor recreation purposes ("Florida Forever Grants," 2002).

The Florida Greenways and Trails Foundation, Inc., a non-profit, citizens support organization (CSO) was created under Section 20.2551, Florida Statutes in the spring of 2002. The main purpose of the Foundation was to help the Office of Greenways and Trails enhance the statewide system of greenways and trails in Florida. The fiscal amount allocated to the Foundation was not disclosed, but Jena Brooks, the Director of the Office of Greenways and Trails expressed optimism for the program in stating "a CSO is an invaluable asset. The Foundation can provide additional resources and assist with special projects…" ("Florida Greenways and Trails Foundation, Inc.," 2002, p. 7).

By April 2002, the entire ecological network had been prioritized and the Florida Greenways and Trail Commission adopted the ten most critical linkages as identified by the study. The Office of Greenways and Trails immediately partnered with the Conservation Trust for Florida in an effort to obtain funds from the Florida Forever Program to acquire the most critical linkages (Wood, 2003).

In the summer of 2002, the Office of Greenways and Trails launched the Online Florida Greenways and Trails Guide. The guide was designed for general users to access quick trail information and view maps that identified the locations of trails and detailed trail maps. At the Florida Greenways and Trails Council meeting in August 2002, the Marjorie Harris Carr Cross Florida Greenway State Recreation and Conservation Area was designated part of the Florida Greenways and Trails System (Rickman, 2002).

In 2003, significant additions were made to the National Trails Recreation System when Secretary of the Interior Gale A. Norton designated 23 new recreational trails, two of which were in Florida. The Fred Marquis Pinellas Trail, in Pinellas County is considered one of the busiest trails in the nation, was designated along with the Peghorn

Nature Park Trails near downtown St. Cloud ("Two New National Recreation Trails Designated in Florida," 2003).

Another important addition was made to the Florida Greenways and Trails System when a private owner designated land for the Florida Greenways and Trails System for the first time in October 2003. The Plum Creek Timber Company designated a 17.6-mile hiking trail in Union and Baker Counties in exchange for the provision of liability coverage to Plum Creek Timber Company for the property ("Private Land Designation," 2003-2004).

The Office of Greenways and Trails continued to make headway when they took over the management role of eight of Florida's most popular State Trails at the end of 2003. These trails included, the Tallahassee-St. Marks Historic Railroad Trail and the Lake Okeechobee Scenic Trail. This transfer of land management responsibilities from the Division of Recreation and Parks to the Office of Greenways and Trails added over 300 miles of recreational trails to the Florida Greenways and Trails System ("OGT Takes On State Trails," 2004).

In 2003, the Office of Greenways and Trails renewed their partnership with the University of Florida to update the Trail Network Opportunity Maps and conduct a new prioritization of the recreational trails and the ecological network. To reach the broadest audience and optimize the efficiency of data collection, the Office of Greenways and Trails used a new web-based technology to update the Trail Network Opportunity Maps. This process and technology will be outlined and described in detail in the methodology section of this paper. The project was very successful, allowing the submission of 223 potential new segments for the new Trail Network Opportunities. The new trail network was discussed at three public hearings in January and February of 2004, where the public submitted an additional 302 segments for consideration. The Florida Greenways and Trails Council approved the new Opportunities at a meeting in March 2004. The new Opportunities were then prioritized using the previous methodology and were approved by the Council in late 2004 (Schaller et al., 2004)

The greenways and trails movement in Florida has been very successful, growing exponentially in the last decade. The Office of Greenways and Trails has acquired large tracts of land and has initiated important partnerships with other state and federal agencies that have helped to expand the statewide system of greenways and trails in Florida. The Office of Greenways and Trails currently has 34 full-time employees and continues to grow.

CHAPTER 3
REVIEW OF LITERATURE

Introduction

This chapter begins with a discussion of how the framework for science and technology decision-making is evolving (Chopyzk and Levesque, 2004) and how the public involvement approach grew from social and political demand (Sarjakoski, 1998). There are three different practices for communicating with the public, (1) public information, (2) public relations, and (3) public involvement. The public information process represents a one-way form of communication between a decision maker and the general public about ongoing issues or developments. A public relations campaign differs from public information in that the emphasis is on the promotion of a particular policy or development but it still represents a one-way stream of communication. This paper deals exclusively with public involvement, which includes elements of both public information and public relations, but it is distinguished by dynamic two-way communication which encourages input from the public to guide the decision making process (O'Connor, Schwartz, Schaad, and Boyd, 2000).

Spatial Decision Support Systems (Densham, 1991; Armstrong, 1994) and Collaborative Decision-Making (Armstrong and Densham, 1995; Coleman and Brooks, 1995; Schuler, 1994) have emerged as powerful models to develop customized and flexible spatial decision-making tools. The widespread availability of Internet connections has further enabled decision-makers to communicate complex spatial information to a wider audience (Kangas and Store, 2002). The integration of GIS technology and the Internet has lead to the development of Web-based GIS, which focuses on disseminating and processing geographic information by means of the World Wide Web. Web-based GIS emerged in the early 1990s (Harder, 1998) and has played an important role in making GIS concepts more open, available, and mobile for everyone, thus facilitating the democratization of spatial data (Kangas and Store, 2002), effective dissemination (Chen, Wang, Rishe, and Weiss, 2000), and open accessibility (Dragicevic, 2004). This chapter provides a discussion of the history of Web-based GIS and the architecture and functionality that have been engineered to serve geographic data and services on the Internet. Various implementations for Web-GIS are then presented to illustrate the variety of ways that Web-GIS can be used for complex societal issues. Finally, the future of Web-based GIS is discussed to show its potential in the fields of spatial analysis and modeling, wireless and mobile services, public involvement, and 3-D data visualization and query (Dragicevic, 2004).

Emergence of Public Involvement in Science and Technology Decision Making

The framework for science and technology decision-making in the United States is shifting from a top down, three-prong form of government, industry, and university to a participatory approach that integrates the public in the decision making process. The traditional model for science and technology decision-making emerged in the United States following World War II. The United States prevailed as the leader in scientific and technological innovations from the 1940s to the 1970s. An informal social contract between science and society emerged during this time, which placed research responsibilities in the hands of university based researchers and was funded by the federal government (Chopyak and Levesque, 2002).

During the 1970s and 1980s, the United States experienced increased competition from Europe and Japan and the research community was under fire for allegations of scientific misconduct. This threatened the insular relationship between government and universities and the realm of science and technology decision making opened up to include industry. Legislation was passed to secure a place for industrial activities, including the Stevenson-Wydler Technology Innovation Act of 1980, the Bayh-Dole Patent and Trademark Amendments Act of 1980, and the Federal Technology Transfer Act of 1986. These amendments allowed for technology transfer and opened the door for university research to be patented for commercial use (Chopyak and Levesque, 2002).

Greater access to educational opportunities has played a role in moving science and technology out of traditional institutions. More people in society are educated at graduate and post-graduate levels and are working outside of universities and government research institutions. These highly skilled professionals are working in commercial areas, public interest and non-governmental organizations. The movement of experts out of typical research institutions and the greater number of educated individuals has lead to a more informed citizenry, which calls for greater accountability in science and technology decision-making. Scientists are no longer trusted to work in the interest of the public good due to the nature of their profession. This has prompted government leaders and policy makers to find ways to effectively communicate scientific and technological issues and to incorporate the public in the decision making process (Chopyak and Levesque, 2002).

The idea of involving the public in decision-making is not new. There was substantial interest in public involvement practices in the 1970s and 1980s, which arose out of a heightened climate of activism. Over the last three decades, new methodologies for including the public have been developed and refined (Chopyak and Levesque, 2002). Many researchers have argued that the value of public involvement has increased since the Equal Opportunity Act of 1964 due to the “maximum feasible participation” clause. But, there has been considerable debate over whether the effectiveness of public involvement has been measured effectively to make such claims (King, Feltey, and Susel, 1998; Carver, 2001; Rosener, 1978). In *Citizen Participation: Can We Measure Its Effectiveness*, Rosener argues that a standardized evaluation research methodology must be established to make it possible to analyze the effectiveness of public involvement programs. Rosener contends that when we ask the questions who, where, what, how and when, the seemingly simple concept, public involvement, turns out to be rather complex (Rosener, 1978).

Public Involvement Techniques before the Information Age

Various approaches to public involvement in the decision making process were proposed by Burke, in *A Participatory Approach to Urban Planning*. The 1979 Burke publication was among the first literature to deal with the growing pressure to decentralize the decision making process. According to Burke, there are five roles that the public can play in the decision making process: review and comment, consult, advise, share decision-making and control decision-making. Burke also addresses the unique characteristics of power in communities, stating that planners must assess the power dynamics of a community to appropriately serve their needs (Burke, 1979).

Many techniques for public involvement were implemented in the early 1980s, including public opinion polls and other surveys, referenda, the ballot box, public hearings, advocacy planning, letters to editors or public officials, representations of pressure groups, protests and demonstrations, court actions, public meetings, workshops or seminars, and task forces (Sarjakoski, 1998). Among the problems encountered with these techniques were low participant numbers, tight schedules, scarcity of resources, the existing conflicts, management of the feedback received and the possibility that the views of the participants did not reflect the opinions of the general public (Kangas and Store, 2002).

Public involvement was given greater importance with the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), which federally mandated early, proactive public involvement with sustained citizen input into the decision making process, particularly for transportation projects. ISTEA's message was reiterated by the passage of the Transportation Equity Act for the 21st Century (TEA-21). ISTEA and TEA-21 evolved from the growing trend in American politics over the last 30 years: the general transfer of power from the federal government to state and local governments and the emergence of the general public as a key player in the decision making process about issues affecting their communities (O'Connor, et al., 2000).

Major conflicts arose in the early days of public involvement, particularly in transportation planning, because the public wasn't involved during the early stages of the decision making process, and that resulted in project delays, lawsuits, and public outcry about the lack of public input. But, the succeeding trend, to thoroughly involve the public in the decision making process, began to overload the publics' ability to respond. Decision and policy makers have relied heavily on public meetings to involve the public, but it has been shown that the concentration of resources on public meetings has lead to the overweighting of the voices of activists who attend and a misrepresentation of the community voice. As articulated by the Committee on Public Involvement in Transportation in *State of the Practice: White Paper on Public Involvement,* decision makers must be prompted to look to new technologies to more effectively involve the public in the decision making process:

> "Improved techniques must be developed to respond to stakeholder time constraints, provide information to help people accurately assess the importance of their issues to their quality of life, and attract and communicate effectively with a broader audience (O'Connor, et al., 2000)."

The Commission specifically points to web-based methods to improve communication with the public.

> "In an age of sound bites and limited attention span, public involvement practitioners must develop ways to capture and maintain public attention and convey complex information, as well as receive complex feedback. In particular, the Internet and new multimedia programs present promising options to communicate complex information effectively and widely (O'Connor, et al., 2000)."

Geographic Information Systems and Public Involvement

A geographic information system (GIS) is a system for management, analysis, and display of geographic knowledge, which is represented using a series of information sets. These information sets include, maps and globes, geographic datasets, processing and work flow models, data models, and metadata (ESRI, 2005). GIS supports planning and the public participation process with planning support systems. Public Participation GIS (PPGIS) can be defined as increased public involvement in the definition and analysis of questions tied to location (Banger, 2001). The use of GIS as a participatory tool raises critical technical, social, and theoretical issues that interest both researchers and practitioners who are concerned with the social consequences of its use. The first PPGIS conference was held in 2002 at Rutgers University to discuss the issues of intersecting community interests and GIS technology (URISA, 2005). This conference was a notable landmark in the research and development of GIS technologies for public involvement.

There are conflicting theories regarding the effectiveness of public involvement through the use of geographical information systems. Carver asserts that the heightened attention to public involvement through geographical information is a waste of time, based on the false assumption that “the general public want to be more closely involved in decision-making, and … that those in positions of decision-making power actually value and therefore would like public input” (Carver, 2001, p 1). Ineffective methods of participation are the key barrier to effective, two-way channels of communication with the public, with public meetings topping the list as the least effective (King, Feltey, and Susel, 1998; Carver, 2001; Kangas and Store, 2002). They are considered ineffective for a number of reasons, that include, meeting scheduling too late in the decision making process (King, et al., 1998), meeting participation by only the most vocal members of the community and meeting times that are often inconvenient for the general public (Carver, 2001).

Spatial Decision Support Systems

In an attempt to integrate the public at an earlier stage of the decision-making process, new frameworks for interactive, two-way communication are being developed. Due to the complex nature of spatial decision-making, problems require numerous, conflicting objectives be met to find solutions. There are a variety of techniques that have been developed to assist decision makers with complex issues, but they require that the problem statement and objectives be well articulated and well structured. Often, this is not the case and decision makers do not start the process with clearly defined goals and objectives, which hinders their ability to articulate the issues to the public (Densham, 1991; Armstrong, 1994). For these reasons, Densham suggests that GIS is not always adequate to answer complex spatial questions. He asserts that, “to assist decision makers with complex spatial problems, geoprocessing systems must support a decision research process, rather than a more narrowly defined decision making process, by providing the decision maker with a flexible problem solving environment” (Densham, 1991, p. 403). Due to shortcomings of GIS, Spatial Decision Support Systems (SDSS) are proposed to offer a more customized and flexible decision-making tool. Two benefits of SDSS, as described by Densham are (1) exploratory tools empower the decision maker to further refine their level of understanding and definition of the problem, and (2) the ability to generate alternative scenarios enables the decision- maker to weigh the possible trade-offs of different objectives and foresee unanticipated and possibly unacceptable characteristics of solutions (Densham, 1991).

The framework for SDSS is modeled after Decision Support Systems (DSS), which are primarily for business applications. The six distinguishing characteristics of a DSS, as defined by Densham citing Geoffrion,

- They are designed to solve problems that the decision maker cannot clearly structure or define.
- They have a user interface that is easy to use and powerful at the same time.
- The system provides a flexible framework for the user to combine analytical models and data.
- The design allows users to explore possible alternatives.
- They are easily adapted to provide new functionalities as the needs of the user arise.
- The systems allow problems to be solved interactively.

Each of these six principles also describes SDSS, but a few additional functions that must be integrated:

- They provide a framework for the input of spatial data.
- They allow accurate representation of complex spatial relations that occur in spatial data.
- Analytical tools specifically designed for spatial and geographic analysis are included.
- They provide for output in a variety of forms such as maps and shapefiles.

SDSS were an exciting new framework to enhance spatial decision making in the early 1990's, but they came with intrinsic shortcomings because it was difficult to reach a broad audience (Densham, 1991).

Collaborative Spatial Decision Making

Collaborative Spatial Decision Making (CSDM) was designed to overcome the limitations of a single user GIS. CSDM has enabled the collaborative production of digital maps and digital data (Coleman and Brooks, 1995) and has provided a mechanism for a bottom-up approach to planning that recognizes the needs of affected people in local communities. CSDM has been widely used in conservation planning and ecological problem solving (Proctor, 1995) because it enables compromise and consensus building (Bennett, 1995). The benefits provided by CSDM include, simultaneous viewing and manipulation of the same file by two or more users in different locations, streamlining data submission (Coleman and Brooks, 1995) and consideration of a greater number and diversity of opinions during the formation of public policies (Armstrong and Densham, 1995). In *Community Networks: Building a New Participatory Medium,* Schuler describes how web-based computer applications can be used to address community needs by fostering a sense of community cohesion, by providing timely information to an informed citizenry, and by promoting and supporting participatory democratic activities (Schuler, 1994).

There are many emerging collaborative GIS-based tools that can be used by different members in the community during the decision making process, but there are concerns with making GIS available to a wider audience. The drawbacks include: the limitations of GIS data including lack of spatial resolution and currency of data, the limited availability of high performance computers, the difficulty in using computers, and the case of creating maps that distort the facts (Armstrong and Densham, 1995).

Web-Based Geographic Information Systems

Generally speaking, Web-based GIS focuses on disseminating and processing geographic information by means of Internet and World Wide Web. The Internet is a network that enables dynamic two-way communication between two or more parties that are not constrained by geographic location (Cartwright, 1998). GIS combined with the Internet has proved to be an effective medium for involving the public in the decision-making process about spatial issues. However, Web-based GIS is not a single technology, it is, in fact, comprised of a number of components including, Object-Oriented Language, GIS software and programming language, HTML, Java, Common Gateways Interface (CGI), and theories about PPGIS. There are currently five different types of web-based GIS applications:

- Map Generators
- Spatial Database and Libraries
- Graphic snapshots of pre-generated images
- Real-time Maps and Images
- Real-time Browsers (Banger, 2001)

These Web-based applications have been widely used in the GIS community to facilitate greater involvement in the decision making process.

History of Web-Based GIS

In 1993, the Xerox® Palo Alto Research Center (PARC) published the first Web page with an interactive map as an experiment in interactive information retrieval. At this time, there were no internet specific programming languages such as Java; the page was purely HTML with links that allowed the user to zoom, pan, and identify (Harder, 1998). In 1994, the first distributed library service for spatially referenced data was established by The Alexandria Digital Library Project, funded by the US National Science Foundation (Dragicevic, 2004). In 1995, Batty was among the first to envision the possibilities of Internet technology to facilitate city planning in his landmark publication, *The Computable City* (Batty, 1995; Sarjakoski, 1998). Over the last ten years, GIS technology and the Internet have been integrated to produce an expanding area of research, which is referred to as Internet GIS, Web-based GIS, On-line GIS, and Internet distributed GIServices. The earliest implementations of this technology were mostly static maps, and then, interactive maps with pan, zoom, and identify functionalities. Web-based GIS has facilitated the open use of GIS in three ways, (1) spatial data access and dissemination, (2) spatial data exploration and visualization, and (3) spatial data processing, analysis and modeling (Dragicevic, 2004).

The most popular types of early web-mapping applications were location services, routing and direction services, electronic atlases, and pubic notification utilities. The Service Corp of Retired Executives (SCORE) contracted Geographic Services Corp to develop one of the first locational on-line map services. The online application, Chapter Locator, allowed the user to type an address or a street intersection into a simple form and a map of the closest Score Chapter would pop-up. Among the first routing and directional services, Zip2 offered point-to-point routing for any location in the United States. Public access websites were also popular in the early days of Web-based GIS. The government of Cabarrus County launched a website called, e-gov, that allowed tax payers to communicate with elected local officials and tax funded agencies via an interactive map in 1996 (Harder, 1998).

Framework and Architecture of Web-Based GIS

The two primary components of Web-based GIS are the server and the client. The server/client system is comprised of two programs that communicate over a network using an established communication language called a protocol. The network can either be the Internet or a secure closed network equivalent called an intranet. The common protocol for communication is Hyper Text Transfer Protocol (HTTP). The client program is typically a web-browser, with the most popular commercial products being Internet Explorer, Netscape Navigator, or Mozilla Foxfire. When the user types a Web address, called a Uniform Resource Locator (URL), into the web-browser, a request is sent to the server computer. At this point, the server loads a file from its disk and transmits it over the Internet to the client web-browser (Harder, 1998). The server is comprised of many technologies working together to provide information and services. The components include a database that stores the raw data, the Web-server, which handles requests sent by the client browser, and middleware, which can be employed with a number of different technologies, but the basic task is to perform the job sent by the Web-server (ESRI, 2001).

Developments in the Field

Development languages for an interactive Web-based GIS have enabled complex Web-based applications to be deployed. Common Gateway Interface (CGI) was developed by the CERN research center in 1992 and Java was developed by the Sun Corporation in 1995. Both languages can accept user input in the form of HTML document components, which enables the server to store user preferences, and allows the user to update the database. However, the two programs have different methods of processing data. CGI has less interactivity than Java, but can be executed much faster. Java has greater flexibility than CGI, but due to the slow processing time, applications with a large amount of information often use CGI to deploy an interactive web-based GIS (Chen, Hong, and Jeng, 1999). The following case studies exemplify the multitude of ways that Web-based GIS applications have been developed and implemented.

In *Evolution of a Participatory GIS,* researchers from Germany describe how they integrated two software tools that were originally developed independently to create a web-based GIS that facilitated both visual data analysis and decision support tools for selection, prioritization, and integration of spatial data. The first tool, CommonGIS, was based on Java technology and could be used on a stand-alone Personal Computer (PC) or on the Internet using Java applets or plug-ins. CommonGIS provided a combination of GIS technology and tools for visual data analysis and decision-making. The Java application, Dito, was developed for knowledge transfer through text based discussions. Dito was basically an on-line forum that users could contribute to via the web or e-mail. The two applications were combined to produce an on-line map viewer that allowed users to add annotated text about the map. The annotated text that users added was then integrated into the decision-making process. The research showed that complex spatial problems could be solved using on-line media to involve multiple stakeholders (Voss, Denisovich, Gatalsky, Gavouchidid, Klotz, Roeder, and Voss, 2004).

The U.S. Environmental Protection Agency (EPA) Office of Water used a different approach when they moved from a static website to a web-based GIS to enhance access to water quality data. Previously, the EPA had a static website displaying Avenue-generated jpeg images that were created for each state, with a separate jpeg image generated for each water body's designated use and the data was distributed on CD-ROM every time it was updated. The EPA quickly outgrew the static application, with issues such as maintenance, frequent updates and inadequate detail due to the size of the jpeg images. When the EPA decided to implement a web-based GIS approach, they chose to create the application using MapObjects 1.2, MapObjects Internet Map Server (IMS) 2.0, Visual Basic 5.0, and SQL Server 7.0. The robust application offered an on-line map viewer and the ability to download the data in shapefile format for further review. Benefits of the web-based GIS included, a more user-friendly way to view the data, enhanced currency of the data, elimination of CD-ROM distribution, and users can query the database and zoom to an extent that is appropriate for their individual needs (Miller and Ilieve, 2005).

In Britain, a group of researchers explored the ways that users of a web-based decision support system responded to spatial data for the site selection of nuclear waste disposal. The Web-based GIS allowed a group of stakeholders to designate a potential location for radioactive waste disposal and use spatial analysis tools to assess the suitability of the site. A detailed user profile was collected to determine how the participants responded to the inclusion of spatial data, whether their decision reflected a sound understanding of the spatial data, if the spatial data inflicted a bias, and how the participants responded to the opportunity to participate in the decision making process. The user profile was also used to address the "Not In My Back Yard" (NIMBY) issue, to determine whether the inclusion of spatial data lead the participants to propose sites away from areas where they live. The study found that although the participants misinterpreted the system to a minor degree, their outlook on the issue was directly influenced by the spatial component of the data. The participants responded positively to their inclusion in the decision making process, made rational proposals for potential nuclear waste sites based on the data and analysis, and did not exibit the use of NIMBY principles to make their decision. The study ultimately showed that when spatial decision support systems provide an avenue for stakeholders to learn about issues and experiment with the consequences of their choices, the tend to make informed and realistic choices (Evans, Kingston, and Carver, 2004).

Chen, Wang, Rishe, and Weiss discuss the development of a high-performance system architecture to provide Web-based GIS access to the general public. The high-performance application, TerraFly, was designed with a specific emphasis on system architecture, data structures, and networking to improve the functionality and the response time for users with little knowledge of spatial data. TerraFly allows users to explore spatial data and perform advanced semantic queries, such as "Find all schools within 20 miles." The researchers developed a model to optimize server CPU and other resources called, Internally Distributed Multithreading Model (IDMT), which compartmentalized and distributed each query based on the type of query being executed. Queries were divided into two types, range queries and nearest neighbor queries. A range query was used to find spatial objects in a specific area around a location determined by the user, for example, "find all rental car companies around Miami International Airport within six miles." A nearest neighbor query was used to find the nearest spatial object to the location specified by the user, such as, "find the nearest rental car company." Once the user sent a query via the client, the middleware on the server would parse the query based on query type and return a response. This framework was achieved through a distributed model, which included, the Java client, a database server, a proxy server, an information server, and a framework for semantic queries. This project provides an example of the architecture that can be deployed in order to offer web-based GIS to a large audience that has little to no knowledge of GIS (Chen, Wang, Rishe, and Weiss, 2000).

Web-based GIS has been helpful in transportation decision-making as well, which has been exemplified by a pilot project for the Florida Department of Transportation, called Efficient Transportation Decision Making (ETDM). The project was spearheaded as a result of the "Streamling" provisions in TEA-21 that mandates early NEPA reviews and approvals, timely decision-making without compromise of environmental quality, public involvement, and meaningful dispute resolution. ETDM implements a web-based tool, called the Environmental Screening Tool (EST), which is used for planning transportation projects, conducting environmental reviews, and developing permitting projects. The EST integrates geographic data from multiple sources into one standard format and provides timely and standardized analyses of the effects of the proposed road projects on natural and cultural resources. The primary GIS functions of the EST are, data entry, GIS analyses, project review, and summary report (URS, 2000). The project started in 2000 and has been highly effective and flexible as users articulate the functionality that is needed.

Future of Web-Based GIS

Web-based GIS has enhanced the potential for research in the fields of spatial analysis and modeling, wireless and mobile services, disaster response and 3D data access and query. Future implementations of Web-based GIS will have the greatest impact on three main groups, the GIS industry, environmental research, and the public. The following section will detail how each of these groups in the GIS community will be impacted (Peng and Tsou, 2003).

Geographic Information Systems industry

The further development of Web-based GIS will have three major impacts on the GIS industry. First, the adoption of dynamic, distributed GIS services will enable the reusability of GIS software and data. The current heterogeneous software and database engines have not been successful facilitating data sharing or mitigating impacts of software incompatibility. Future technological innovations that support software sharing and reusability will generate higher productivity, increased efficiency in software development, and provide a model for software prototyping when developing a new system or technology. Second, the GIS industry will have more flexibility when migrating to new GIS technologies. Using an incremental approach, small components of GIS architecture, such as the database, user interfaces, and core GIS programs can be migrated to adopt new technologies. Finally, as Web-based GIS becomes more widespread, the current monopolized GIS environment will gradually shift to an open, competitive environment. Whereas traditional marketing of GIS technology has always targeted GIS professionals, consulting companies, academic institutions, and government agencies, future marketing of GIS technology will be directed toward the public and end users. This transition could lead to a stronger community of small GIS software companies and program developers. GIS users will have greater flexibility in their choices of GIS platforms as the market opens, due to a more competitive marketplace (Peng and Tsou, 2003).

Environmental research

Web-based GIS provides many opportunities for data sharing. While most people involved in environmental research are primarily interested in complex analyses to further explore data, they are undoubtedly going to spend a great deal of time collecting and processing spatial data. Traditionally, the most expensive part of GIS implementation is data input and conversion. Most environmental research requires the integration of numerous datasets, which necessitate costly generation procedures such as, digitization, re-projection, classification, and image scanning. Web-based GIS provides a framework for data sharing which would reduce the amount of time and resources needed to generate and standardize spatial data (Peng and Tsou, 2003).

The public

As Evans, Kingston, and Carver presented in their research on the use of web-based GIS for site selection of a nuclear waste disposal location, the general public tends to make rational and well-informed decisions when presented with spatial data and analysis tools. This presents potential opportunities for using web-based GIS to involve members of the general public in the decision-making process. “It would seem that to have the input of a broad and interested (but not self interested) group of people into the decision making process is to the benefit of all responsible for managing the public’s environment and risks, and would enhance public interest in the democratic and decision-making process" (Evans, Kingston, and Carver, 2004). But there are also negative impacts that might result if Web-based GIS becomes more ubiquitous in society. Both the positive and negative impacts on the public will be further detailed in this section.

There are two main aspects of daily life that would be greatly enhanced with the implementation of Web-based GIS for public services. As Peng and Tsou describe in *Internet GIS*, Web-based GIS could be integrated into society in a very transparent way. For example, there could be a display board at every bus stop with detailed information such as, when the next bus is coming, if it will be delayed, and the real-time location of the bus. Another very important contribution that Web-based GIS could bring to daily life is real-time services for emergency management. Real-time natural hazard reports and evacuation/rescue plans could be relayed to the public for a more convenient and safe way of life (Peng and Tsou, 2003).

A major problem with implementing Web-based GIS for public services is the inequality of access to technological services such as the personal computer and Internet access. This has been described as the "Digital Divide," which according to the National Telecommunications and Information Administration (NTIA), is one of America's leading economic and civil rights issues. NTIA released a report in 1999, stating that the "Digital Divide" was widening over time, predominately among Black, Hispanic, and female-headed households in the inner city and rural areas (NTIA, 1999). As Web-based GIS becomes more integrated into the social fabric, governments will need to make an effort to provide facilities for the public to access this information at schools, libraries, and community centers (Peng and Tsou, 2003).

After the four hurricanes that hit Florida in the summer of 2004, the Federal Emergency Management Agency (FEMA) asked The URS Corporation and the GeoPlan Center at the University of Florida to adapt the ETDM-EST model mentioned above, to provide spatial decision support to emergency response personnel investigating potential facility location, such as staging areas, temporary and permanent housing, and any other site-selection needs. The model, which was easily adapted within weeks, provided detailed, dynamic maps with buffers around the paths of all four hurricanes and an analysis of potential impacts. The Web-based GIS provided detailed imagery and access to hundreds of statewide data layers from the Florida Geographic Data Library (FGDL). This application exemplifies the three ways that Web-based GIS will change the way the GIS community operates: a pre-existing Web-based GIS application was proven to be reusable and easily adaptable, the level of research and access to hundreds of datasets and detailed analyses enhanced FEMA's emergency response, and response times for hurricane relief efforts were reduced.

CHAPTER 4
A WEB-BASED APPLICATION FOR PARTICIPATORY GREENWAYS PLANNING

Introduction

A Web-based application for participatory greenways planning was developed and implemented at the GeoPlan Center at the University of Florida as part of a contract with the Office of Greenways and Trails (OGT). Its purpose was to allow as many people as possible to participate in the update of the Recreational Trail Network for the State of Florida. The utility was developed during the summer of 2003 and tested by OGT staff. The web-based tool was designed to allow representatives of non-profit organizations, government agencies and the general public to log onto a website, review relevant geographic data and input their suggestions for additions and deletions to the previous opportunities maps. The application integrated geographic information systems (GIS), relational database management systems and Internet mapping technology to provide on-line tools for submitting potential recreational corridors in Florida (Schaller, et al., 2004).

Prior to the development of the Web-based application, the opportunity maps were created and maintained using paper maps. These maps were hand edited at public meetings around the State and the database was later updated by free-hand digitization. The goals of the application were to improve the efficiency of the update process by reducing transcription errors, allow more individuals in various geographic locations to participate in the process, and standardize the data that was submitted. Real decision-making power was not granted to the participants, but they were encouraged to submit their suggestions for consideration.

Objectives

The specific objectives of the project were to:

- Develop a Web-based utility that allows any Internet user with access to a Web browser to acquaint him/herself with the planning area and to support data input.
- Provide relevant geographic data at various extents.
- Set up a utility for OGT personnel to approve potential users of the application.
- Collect all user information in a database.
- Customize the ArcIMS interface to allow users to automatically zoom to the geographic region of their interest.
- Customize the ArcIMS application to allow users to submit spatial and attribute data on potential new trail corridors in Florida.
- Provide an on-line utility for users to upload shapefiles in-lieu of using the digitize tool.

System Architecture

To meet the objectives listed above, the system was designed using an Oracle database, Apache Web server, J2SDK JavaVM, Jakarta-Tomcat servlet engine, and ArcIMS internet mapping software on a Linux Redhat platform. These components provided the foundation for a working ArcIMS site.

The database server stored and served the data using an Oracle relational database management system (RDBMS) and ArcSDE software. An Oracle database is comprised of an instance and a collection of files stored on disk. The Oracle instance is made up of processes and memory structures. ArcSDE is an Oracle client, designed to work with server processes. ArcSDE is used to access large multiuser geographic databases stored in a RDBMS. Each ArcSDE service listens for requests from the user application and cleans up disconnected user processes. ArcIMS is a client application of ArcSDE, and is assigned a process when it connects to ArcSDE. All query and edit requests are submitted to the Oracle database by ArcSDE.

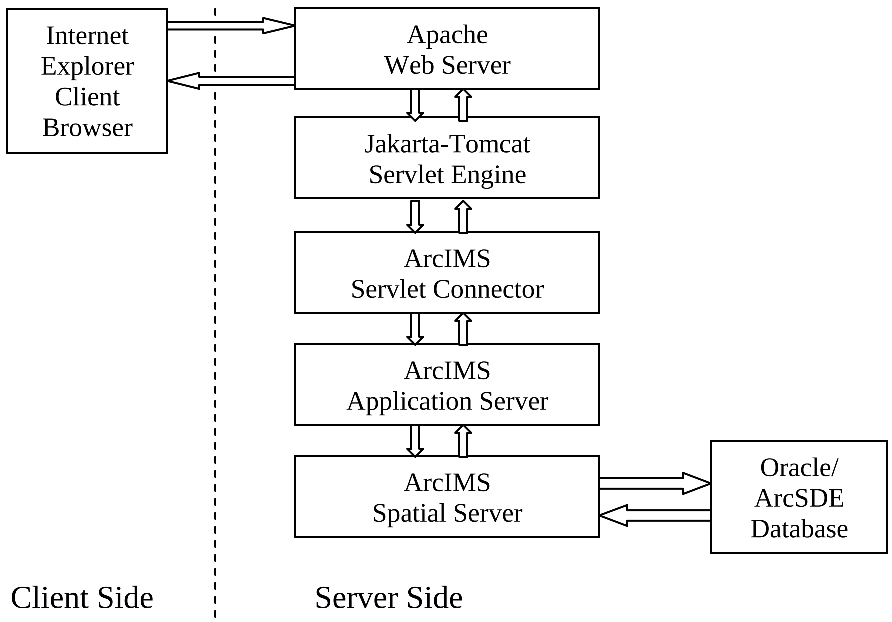

Figure 4-1. System Architecture

The Web server handles requests sent from users with an Internet Explorer browser. The Web server forwards the requests to ArcIMS and sends a response back to the requesting client. JavaVM provides the basic application programming interface (API) for ArcIMS. The servlet engine is an extension to the JavaVM and provides support for the servlets through a servlet API. The servlet engine plugs into the Apache Web server and provides the link between the JavaVM and the Web server.

ArcIMS uses multiple components in conjunction with the system architecture to serve maps, which includes the Application Servlet Connector, the Application Server, and the Spatial Server (Figure 4-1). A single request is made to ArcIMS by the client browser every time an image is requested. For example, when the user zooms to a new extent, pans to a different area, or selects attributes in a map, a new request is made. Each time the user sends a request, it is first handled by the Web server, passed through the ArcIMS Servlet Connector, and then forwarded to the ArcIMS Application Server. The Application Server then dispatches the request to the ArcIMS Spatial Server for processing.

Trail Network Update Utility

The Trail Network Update Utility is an ArcIMS application designed to provide access to geographic data pertinent to greenways planning and a tool to submit spatial and attribute data on potential new recreational trail corridors to a broad audience with little knowledge of GIS. Many components of the Trail Network Update Utility were built upon tools previously developed by the GeoPlan Center and the URS Corporation for the Environmental Screening Tool (EST) for FDOT's Efficient Transportation Decision Making (ETDM) model.

Data

After a series of conversations with OGT staff and the project leader, Margaret Carr, a list of necessary data was compiled for the project (Figure 4-2). This included: Existing Recreation Trails, Existing Trail Network Opportunities, Brownfield Areas, Superfund Hazardous Waste Sites, Points of Interest, Roads, City Limits, Military Lands, Water Bodies, Existing and Proposed Conservation Lands, and Digital Ortho Quarter Quads. The data were first loaded into an ArcSDE database. The ArcSDE database was chosen because it allows hundreds of ArcGIS users to be connected to a single database through an ArcIMS server to access spatial and attribute data.

The contents and graphic presentation of the dynamic map were defined using Arc Extensible Markup Language (XML), which creates an ArcXML (AXL) file. The AXL file points to the location of the networked data, defines map properties, and lists the layers to draw with specific rendering properties (Figure 4-3). In this example, the

ENVELOPE property tag indicates that the map will open at a specified extent based on x and y coordinates and the MAPUNITS property tag indicates that the map units are in meters. The SDEWORKSPACE tag points to the location of the database. Each LAYER tag in the AXL file represents one feature class with detailed rendering properties.

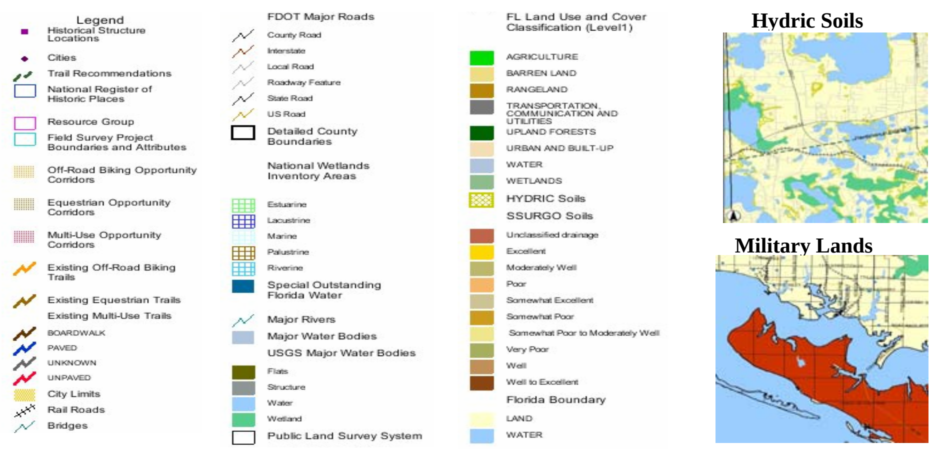

Figure 4-2. Datalayers in Application

```
<MAP>
  <PROPERTIES>
    <ENVELOPE minx="-22892" miny="45682" maxx="799722" maxy="783063" name="Initial_Extent" />
   <MAPUNITS units="meters" />
  </PROPERTIES>
    <WORKSPACES>
        <SDEWORKSPACE name="sde_ws-0" server="oracle.geoplan.ufl.edu" instance="1234"/>
    </WORKSPACES>
    <LAYER type="featureclass" name="Florida Boundary" visible="true" id="Political.FLBND">
      …
    </LAYER>
      <LAYER type="featureclass" name="DEP Districts" visible="true" id="Political.DEP_REGIONS"
             minscale="1:850000">
     …
    </LAYER>
```

Figure 4-3. XML Code for Dynamic Map Display

Since the map is dynamic and we want it to have an appropriate amount of detail at any scale, each layer is assigned scale factors. The next example shows two scale factors, (1:70000 and 1:2000000) for one layer, which indicates that the layer will be visible between a scale of 1:70000 and 1:2000000 (Figure 4-4).

Data were organized into folders in the Table of Contents to provide a logical and systematic way for users to find the data. The folders in the Table of Contents include: Sites, Historical Resources, Political, Trail Recommendations, Off-Road Biking Trails, Equestrian Trails, Hiking Trails, Multi-Use Trails, Paddling Trails, Transportation, Imagery, Natural Resources, and Landuse. Many datalayers were not visible by default, but where available if the user chose to make them visible and to use them for reference.

```
 <LAYER type="featureclass" name="Major Rivers" visible="true" id="Natural Resources.MJRIVL"
minscale="1:70000" maxscale="1:2000000">
          <DATASET name="ETAT.MJRIVL" type="line" workspace="sde_ws-170" />
          <SIMPLERENDERER>
            <SIMPLELINESYMBOL width="1" captype="round" color="0,153,153" />
          </SIMPLERENDERER>
    </LAYER>
```

Figure 4-4. XML Code for Layer Scale Factors

Access

The Utility was initially available to representatives of governmental agencies and non-governmental organizations in Florida. All potential participants received notification of the project and were advised to visit the Office of Greenways and Trails website to obtain a username and password to have access to the ArcIMS application. A username and password was required for this project because users were able to write directly to the database when digitizing new trails; therefore detailed information about the users was pertinent.

When the user requested access to the Trail Opportunity Maps, they were asked to fill out an on-line form (Figure 4-6) with their user information such as, name, address, phone number, e-mail, and organization. If the user chose ‘Other,’ they were prompted to enter the name of their organization. The entry would update the database and the organization name would appear in the dropdown menu. All users were assigned a unique username and password that was stored in an Oracle lookup table (Figure 4-7).

Figure 4-5. Interface to Obtain Username and Password

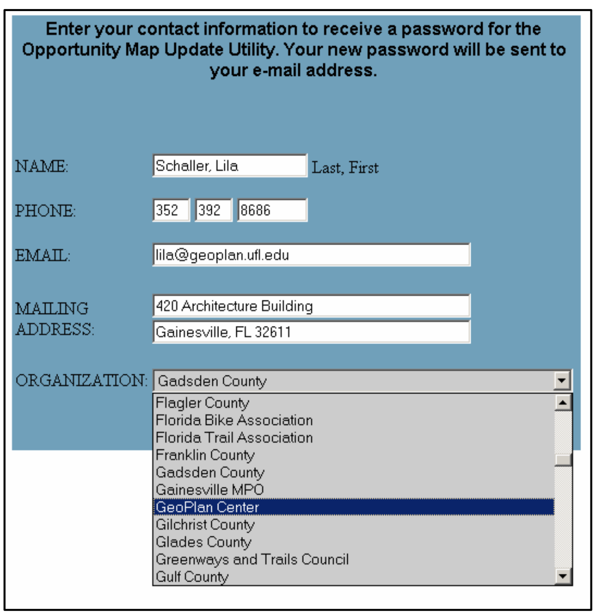

Figure 4-6. Form to Collect User Information

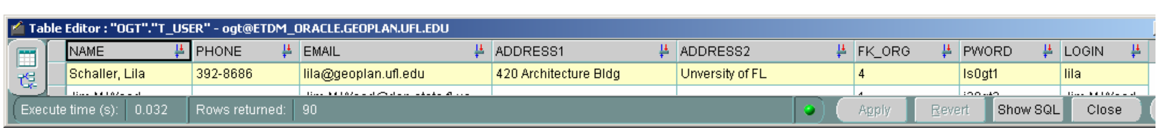

Figure 4-7. Record in Oracle Lookup Table with User Information

When the user filled out the form with their information, an e-mail was automatically sent to the Office of Greenways and Trails using an Oracle Trigger. A Trigger is a block of code that adds functionality to a default application, using one or more SQL statements. When the User Information form was submitted, an event occurred which executed the code in a trigger, thus "firing" the trigger. The purpose of the trigger was to send an e-mail to OGT staff with the User Information, so that a username and password could be granted. It must be noted that, during the course of the submission process, no request for access was denied.

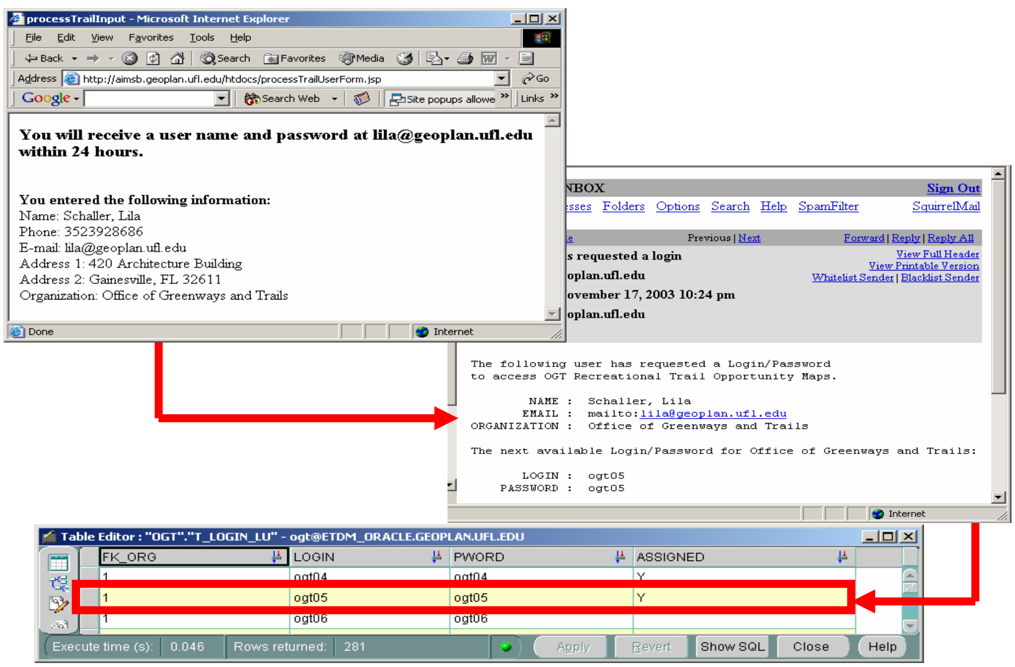

Figure 4-8. Oracle Trigger to Assign Username and Password

The user typically received their username and password by the end of the business day, and was guaranteed to receive it within twenty-four hours. At this point, they were able to log-on to the ArcIMS website in order to view GIS data and digitize potential recreational trail corridors.

Figure 4-9. Interface to Logon to ArcIMS Site

Interface Customization

The ArcIMS interface was customized using JSP, JAVA, and HTML to give users functionality that wasn’t available out-of-the-box.

A series of drop down menus were designed from needs expressed by OGT staff. The drop down menus allowed users to zoom to a Florida Department of Environmental Protection (FDEP) district, a county-wide extent, or to the jurisdictional boundary of their organization. The minimum and maximum x y coordinates for each geographic region were stored in an Oracle lookup table and using an SQL statement, the user was able to zoom to the respective coordinates.

Using an SQL statement, the utility checked to see which organizations had obtained a username and password. The organizations, which were using the application, were the only names that showed up in the ‘ORGANIZATION’ drop down menu. This Office of Greenways and Trails also used this utility to check which organizations were participating in the update process. The last customized drop down menu allowed users to toggle between maps of datasets relevant to multi-use trails, paddling trails and hiking trails (Figure 4-10).

Many tools for viewing and analyzing spatial data were available to the user, including Print Map, Pan, Zoom In, Zoom Out, Zoom to Previous Extent, Show Imagery, View Metadata, Identify, Query, Buffer, Select, Measure, Set Units, and Clear Selection. These tools allowed the user to navigate in the map and perform detailed queries as well as analysis on the data.

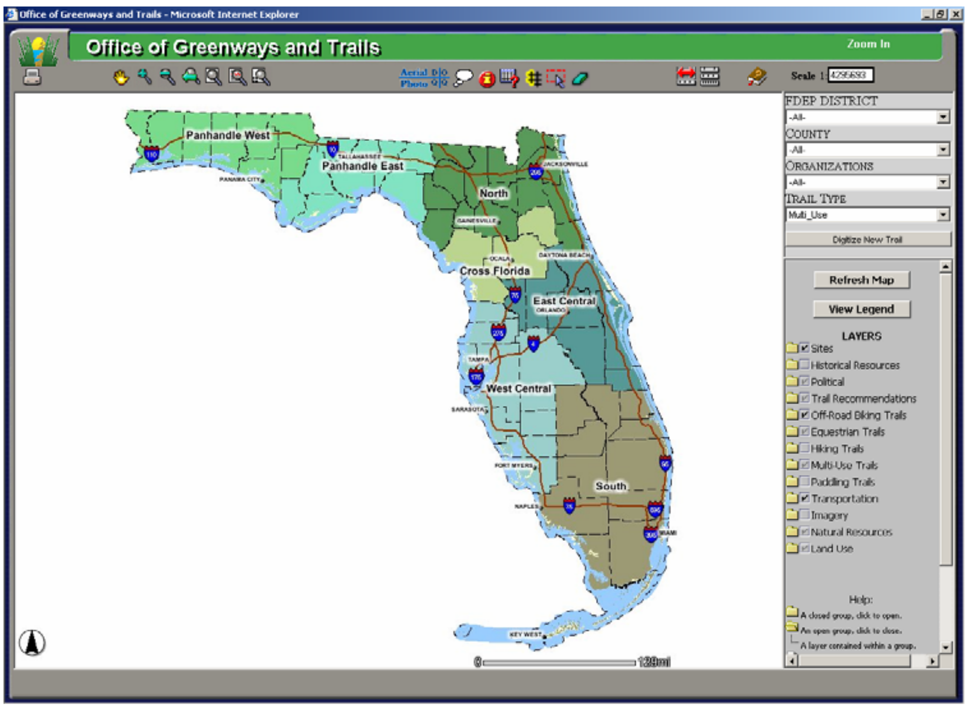

Figure 4-10. ArcIMS Interface

After the user viewed all relevant data and got familiar with their area, they clicked ‘Digitize New Trail’, which opened a new ArcIMS site at the same extent that the user was zoomed to in the viewer.

Submission

Once the user clicked ‘Digitize New Trail’, they were prompted to enter attribute information about their proposed trail corridor (Figure 4-11). The attribute information and spatial coordinates were stored in multiple tables in an Oracle relational database. Once the form was submitted, the user was able to digitize a new trail, with aerial photography in the background to assure accuracy (Figure 4-12). The attribute data and the spatial coordinates were combined on the fly so that the user and all other participants could see the new trail immediately. This helped prevent the submission of identical trails.

In September and October 2003, two training workshops were held in Tampa and Ft. Myers. At each workshop participants were introduced to the web-based application and given assistance submitting trails. Some participants used this time to submit potential trail corridors, while others logged on to the site at a later date to use the web-based application. Technical support was provided throughout the course of the submission process.

During the course of the web-based application, 90 people acquired a username and password for access to the website and 24 individuals submitted a total of 223 trail segments for consideration.

If the user already had data in GIS format, we provided a utility for the submission of digital data. The user was asked to provide attribute data using the same project form as the digitize tool, to provide uniformity of data. Then, the user would send the spatial data in GIS format. The spatial information was then joined with the attribute data that the user previously entered. Eleven sets of digital data uploads were submitted totaling approximately 500 segments (for example a county recreation department submitted its entire set of local trails already in GIS format).

In early November 2003 staff from OGT and GeoPlan met to review the suggested additions and deletions to the multi-use and paddling opportunity maps and to prepare draft updates to be taken to the FGTC for review and approval. The FGTC meeting was held on November 21, 2003 and the drafts were accepted as final by the FGTC with only slight modification.

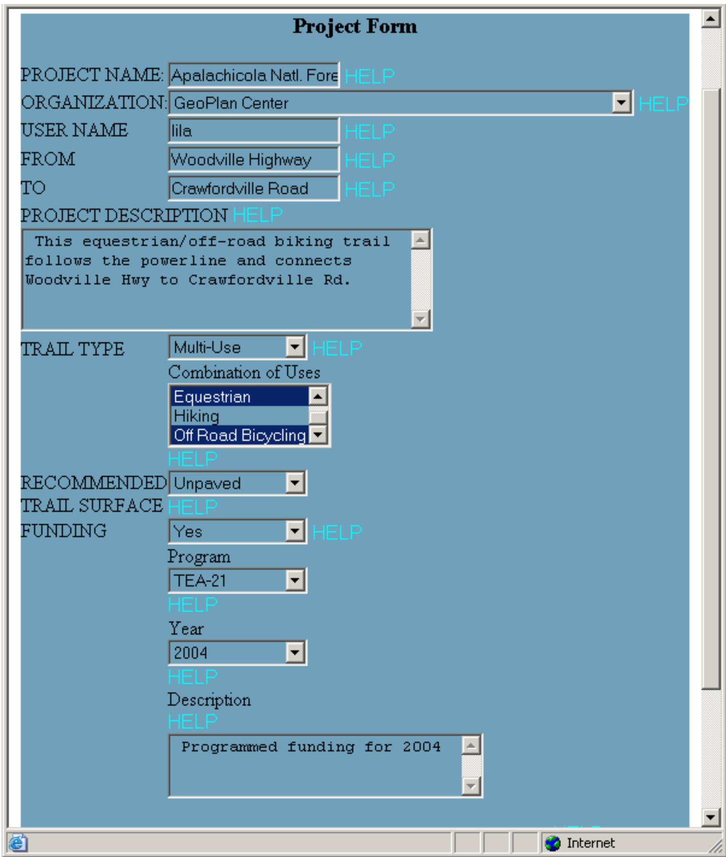

Figure 4-11. Project Information Form

Then the draft updates were posted on the website and a period for public review was widely advertised. Three public meeting were held in early 2004 to collect suggestions; February 3rd in Ft. Myers, February 4th in Orlando, and February 9th in Tallahassee. These meetings accommodated participants who did not have Internet access or who preferred the group collaboration provided in a public meeting. During these meetings staff from GeoPlan and OGT were available to record the suggestions through a customized ArcMap application, which was available on multiple laptop computers. Altogether, 40 individuals submitted 302 new trail segments for consideration during this period.

OGT staff reviewed these additional drafts of multi-use and paddling opportunities and a final version of each was prepared for review and approval by the FGTC. Approval was granted by the FGTC for the multi-use and paddling opportunities at their March 8-9, 2004 meeting with only minor modifications. The final opportunity segments were then prioritized and ranked based on their potential significance to completing the continuous statewide network of recreational trails (Figure 4-13).

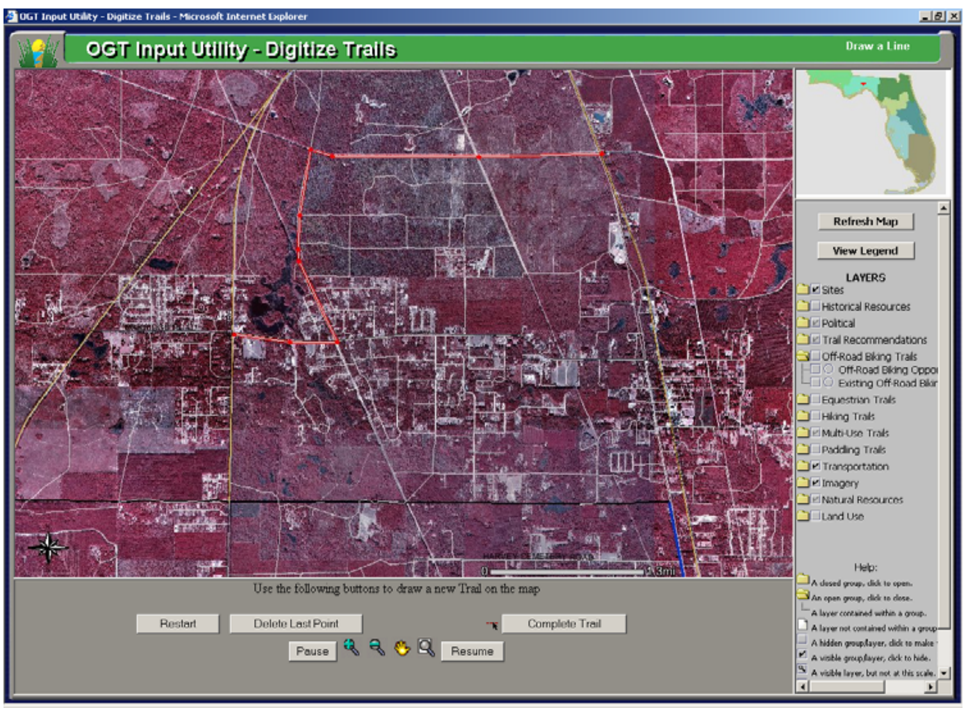

Figure 4-12. Input Utility to Digitize New Trails

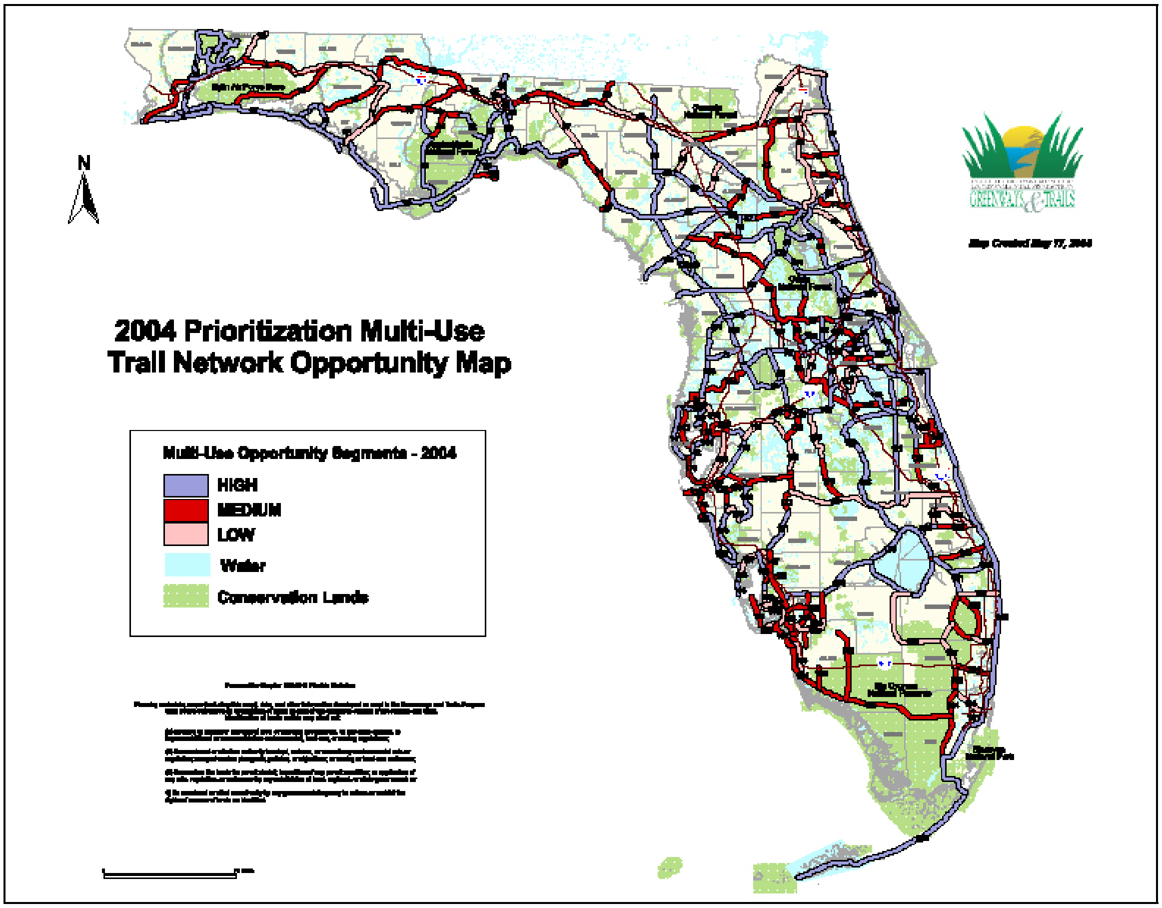

Figure 4-13. Final Prioritized Multi-Use Opportunity Map

CHAPTER 5
METHODOLOGY

The following methodology was designed to examine the efficiency of Web-based GIS for statewide greenways planning. It investigated the degree of satisfaction that users of the Trail Network Update Utility expressed and how they rated it in comparison with the original process in 1994 of drawing potential new trail corridors on paper maps at public meetings. The study also explored the use of Web-based GIS as a tool to prepare for public meetings and the efficiency of training workshops to train decision-makers in Web-based GIS. This chapter will cover the survey population, type of respondents, instrumentation, and statistical analysis for the present study. All procedures, methods, and analyses that will address the goals of examining the effectiveness of Web-based GIS for statewide greenways planning are described.

Population and Sample

Recommendations for additions and deletions of the Trail Network Opportunities were taken over a five month period from September 2003 to February 2004 using a variety of methods, which included, on-line submission using Web-based GIS at training workshops or from any location with Internet access, the submission of existing datalayers on CD-ROM, and the submission of information to a GIS technician at public meetings. The variety of submission methods allowed a participant with any level of experience with GIS or the Internet to participate and contribute their recommendations. During the five-month period, over 110 people participated submitting over 700 new trail segments. Due to the relatively small number of participants, all people who participated in the update of the Trail Network Opportunity Maps were sent a survey to evaluate their satisfaction. Therefore, a sample of the population was not taken, rather the entire population was asked to participate in the study.

Research Design and Subject Recruitment

Due to the diverse nature of the submission process, not all respondents participated in every aspect of the project. The survey was broken into four key components: public meetings, training workshops, the web-based tool, and a comparison of the web-based GIS tool to the manual submission method implemented between 1994 and 1996. The survey was designed to accommodate a respondent who participated in any combination of the update process. The potential survey respondents were conceptually broken into five different user categories, which will be outlined below.

The first potential respondent, from here on referred to as User 1, participated in each step of the update process. User 1 attended a public meeting, went to a training workshop, used the web-based GIS utility, and was involved in the original process for the 1994-1996 Design (Figure 5-1). The second potential respondent, User 2, attended a training workshop, but was not involved in any other portion of the project (Figure 5-2). The third potential respondent, User 3, did not attend a public meeting or training workshop, and was not involved in the original process, but used the Web-based GIS utility (Figure 5-3). The forth potential respondent, User 4, did not attend a public meeting and was not involved in the original process, but went to a training workshop and used the Web-based GIS utility (Figure 5-4). Lastly, the fifth potential respondent, User 5, attended a public meeting, but did not attend training or use the Web-based GIS utility and was not involved in the original process (Figure 5-5).

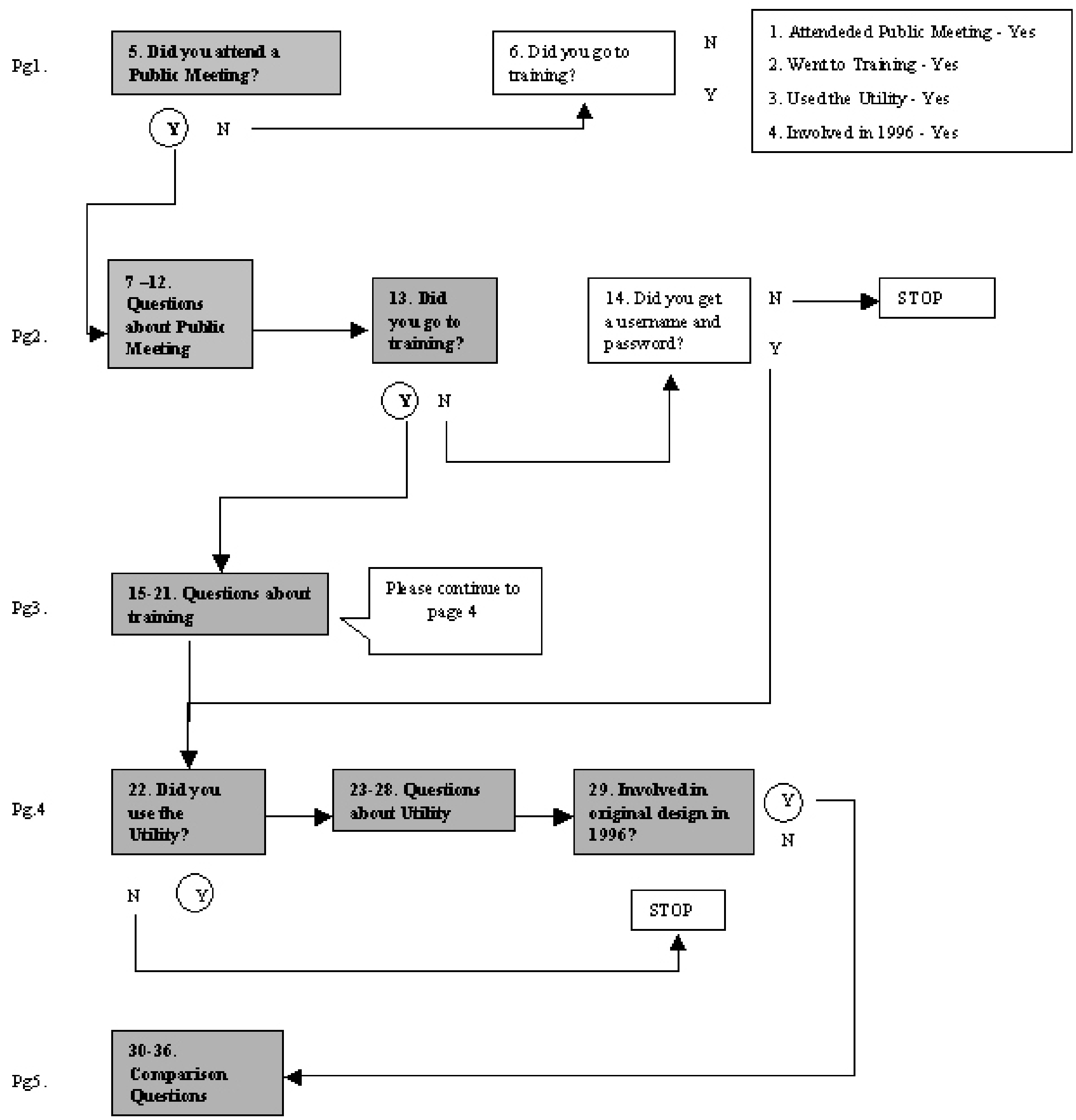

Figure 5-1. User Scenario 1 represents how a respondent would be directed through the survey if they attended a public meeting and a training workshop, used the Web-based GIS tool, and were involved in the original update process.

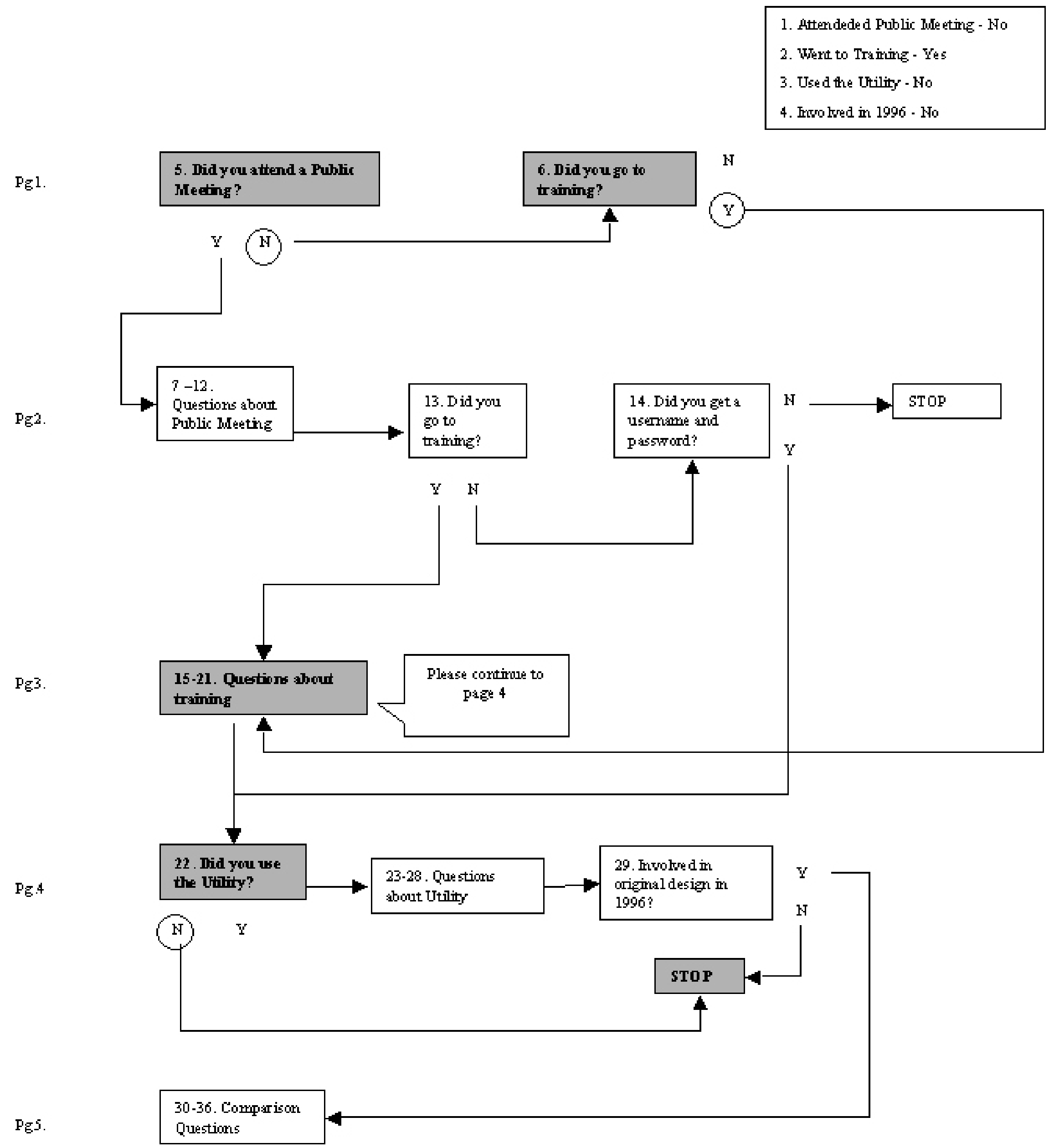

Figure 5-2. User Scenario 2 represents how a respondent would be directed through the survey if they only attended a training seminar, but did not participate in any other aspect of the project.

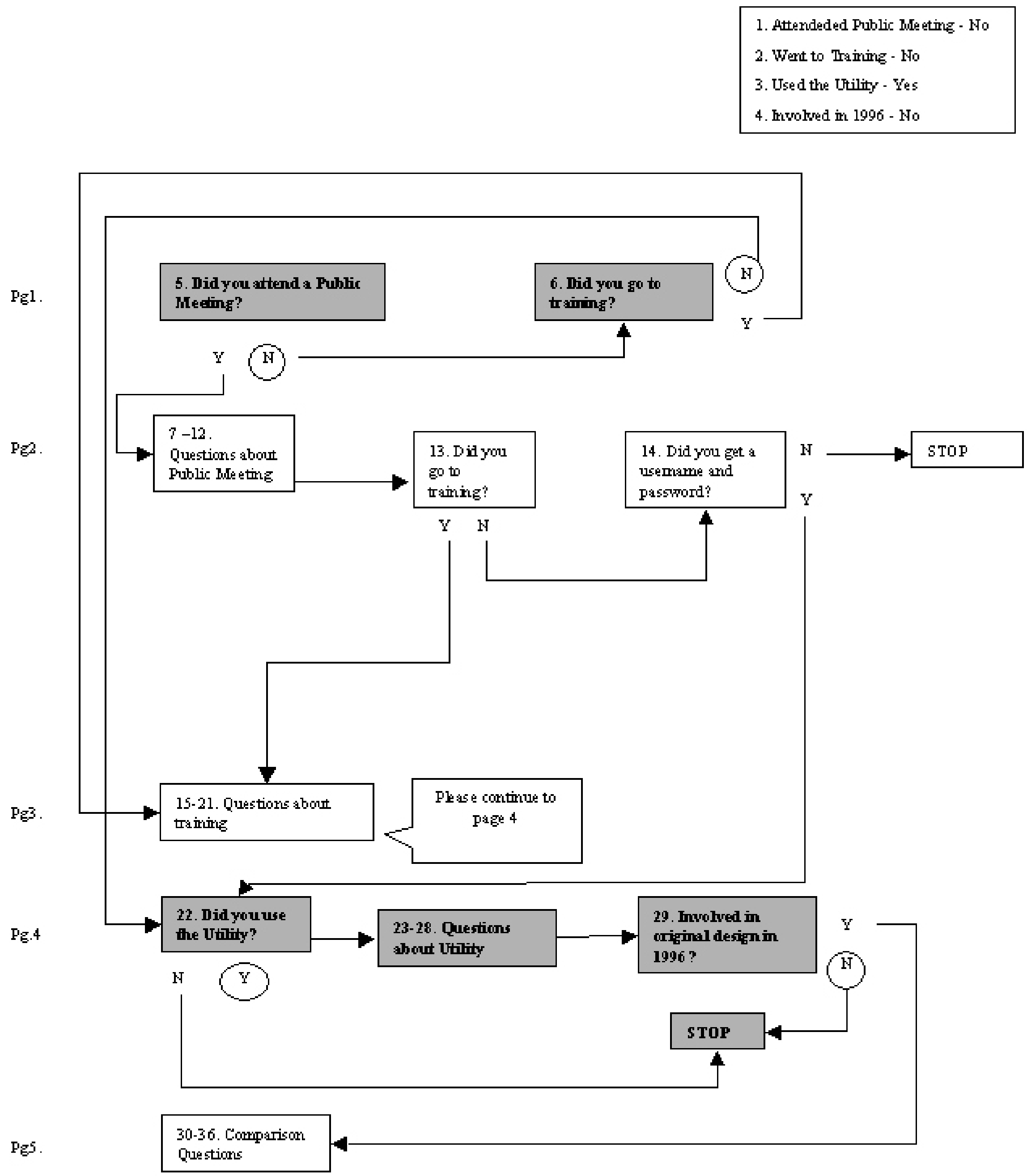

Figure 5-3. User Scenario 3 represents how a respondent would be directed through the survey if they only used the Web-based tool.

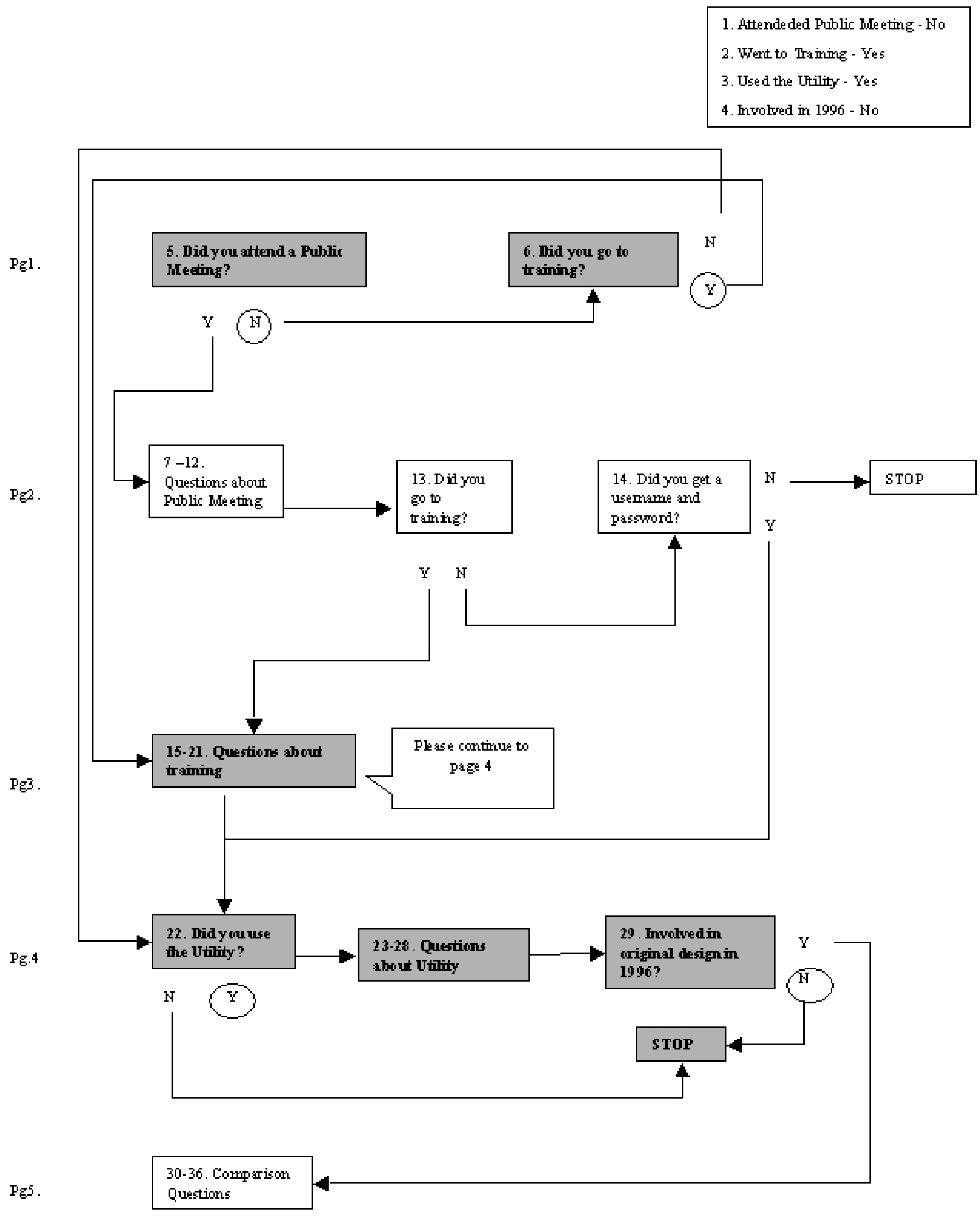

Figure 5-4. User Scenario 4 represents how a respondent would be directed through the survey if they went to a training workshop and used the Web-based utility, but did not attend a public meeting and was not involved in the original process.

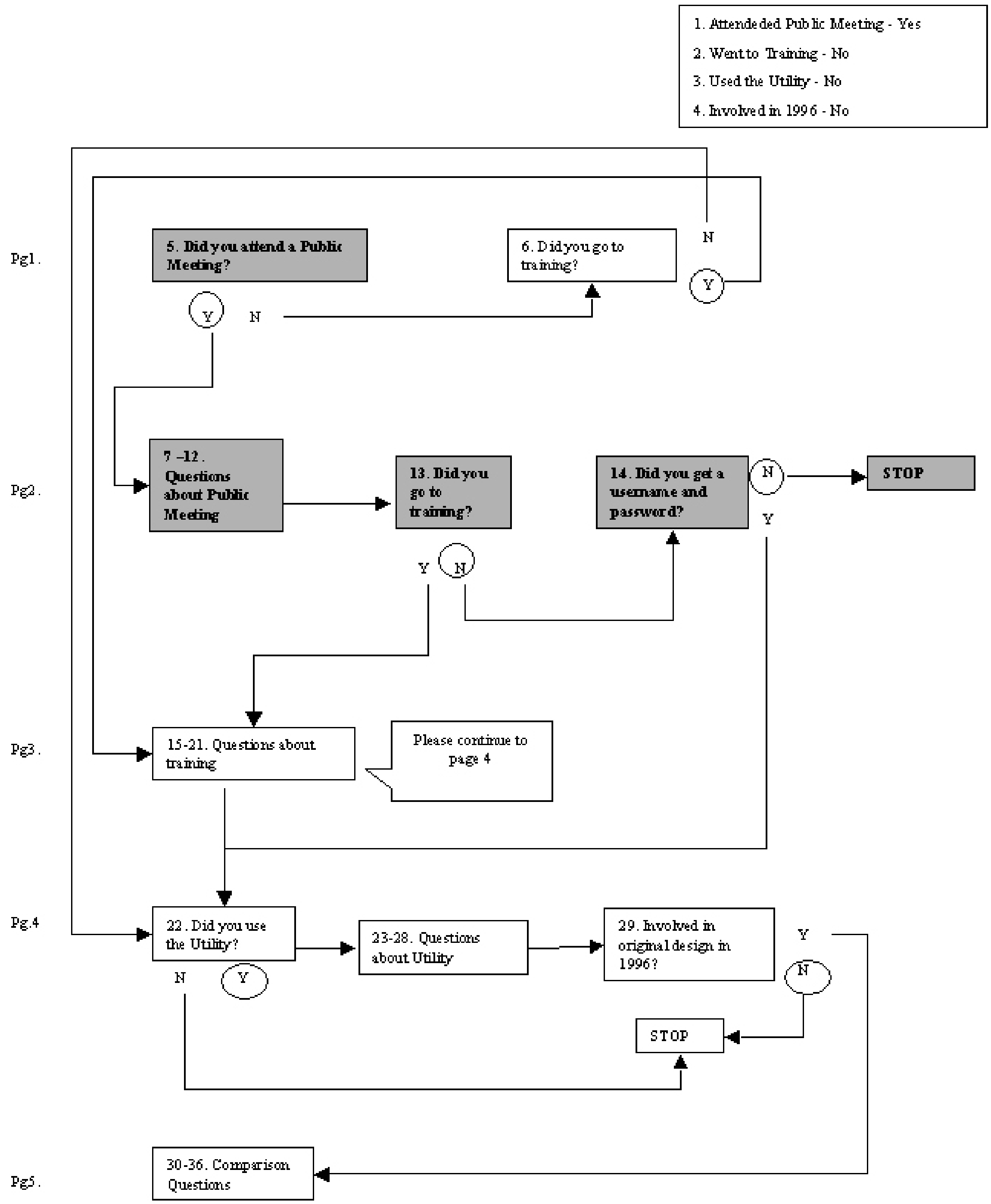

Figure 5-5. User Scenario 5 represents how a respondent would be directed through the survey if they only attended a public meeting.

In each diagram of potential respondents, the shaded boxes represent a portion of the survey instrument that the respondent completed. The yes/no directional questions are intended to direct the respondent only to the parts of the survey that pertain to activities they participated in. The white boxes represent questions they did not answer, because they were not involved in that part of the update process.

The survey was designed to guide each User through the questionnaire with ease, regardless of their level of participation in the project. The primary researcher gave the participants an introduction to the topic, a list of all benefits and risks, the expected length of time for completion, and who to contact with questions or concerns (Appendix B). The survey was sent in the mail in booklet format with graphics of the web-based tool. Participants were given three to four weeks to complete the survey and an addressed, paid postage envelope to return the survey. Jim Wood, Assistant Director of the Office of Greenways and Trails sent an E-mail to all survey participants to show the Department's support and encourage participation.

Instrumentation

The survey instrument (Appendix C) consisted of 36 questions, which were broken into five subject sections, (1) general information, (2) public meetings, (3) training workshops, (4) the web-based tool, and (5) comparison questions. There was an additional blank page at the end of the survey for additional comments. The instrument was revised three times over two weeks after careful examination and lengthy discussions with the primary researcher's thesis committee. Special attention was given to the phrasing of the questions, to assure that little to no bias was introduced. Before circulating the survey, it was pilot tested using five mock participants who met the criteria of Users one through five. Due to the complex nature of these individual questions in this instrument, they will be discussed for further understanding of this study.

General Information

The first background question was the participant's number of years involved in greenways planning. The results from this question were used to analyze the respondents experience with greenways and trails planning. Next, the respondent's job title was requested, to understand what role they played in the greenways and trails planning process. The third and forth introductory questions asked the user to rank their level of comfort with the Internet and GIS on a scale of 1 to 5, with one being the least comfortable and five being the most comfortable. The answers to these questions provided the participants base level of comfort with the technical aspects of the project. Questions 5 and 6 were directional questions, intended to guide the survey respondent to the parts of the survey that matched their experience. Question 5 asked if the respondent attended a public meeting, if so, they were directed to the next section on public meetings, if not, they were directed to the next question. Question 6 asked if the respondent participated in a training workshop; they were directed to the training workshop section if they answered "yes," or to the web-based tool section if they answered "no." The first question in the Web-based tool section asked if the respondent used the tool. This enabled all potential respondents to quickly go to the section that applied to them.

Public Meetings

Questions 7 through 12 assessed the effectiveness of the public meetings and how well the web-based tool prepared the respondent for the public meetings. Question 7 asked which public meeting the respondent attended as a general reference. A major part of the study was to examine respondent's resistance or acceptance of web-based GIS as a planning tool. Therefore, the respondent was asked in question 8 if they chose to attend the public meeting rather than use the Web-based tool. The results from this question were used to examine if participants were avoiding the Web-based tool. It was followed by an open-ended question regarding why they chose to attend the public meeting rather than submit trail corridors using the web-based tool.

Prior to the public meetings, the FGTC approved draft opportunities were posted on an on-line ArcIMS site for anyone from the general public to view, query, and print. Paper maps of the draft opportunities were also available for download as were data in shapefile format. Question 9 asked if the respondent viewed the draft opportunities prior to attending the public meeting and which method they used. If they viewed the draft opportunities using the on-line ArcIMS site, they were asked to rank its effectiveness in preparing for the public meeting in questions 10 through 12. These questions consisted of statements about the ease of access and ease of use of the on-line ArcIMS site and whether the site helped them to better prepare for the public meeting. The respondents had the following choices: “Strongly Disagree,” “Disagree,” “Neither,” “Agree,” “Strongly Agree,” and “I do not have enough information to answer this question.” The last questions in the public meeting section were directional, sending the user to the training workshop section or the web-based tool section, depending on the respondent’s answer.

Training Seminars

Questions 15 through 21 examined the effectiveness of the training seminars. The questions in this section inquired about the participant’s level of satisfaction with the training and whether they used the Web-based GIS tool to submit a trail after the training. Question fifteen asked which training seminar the respondent attended, Ft. Myers or Tampa, as a general reference and to identify issues that were relevant to a particular workshop. The next question, question 16, asked, “Did you use the on-line Trail Network Update Utility to submit a trail after attending the seminar?” The results of this question were used as a general indicator of the respondents overall satisfaction and perceived need for the tool.

The next 5 questions, 17 through 21, focused on the participant’s level of satisfaction with the training. Respondents were asked to rate different elements of the training seminar on a scale of 1 to 5, with the following choices: “1=Very Dissatisfied,” “2=Dissatisfied,” “3=Neither,” 4=Satisfied,” “5=Very Satisfied,” and “0=I do not have enough information to answer this question.” Question 17 inquired about the respondent’s level of satisfaction with the equipment at the training workshop. This question is mostly relevant for the scheduling of future training workshops and less for the purposes of this study. There were significant technical difficulties at the Ft. Myers training workshop and it was important to the primary researcher to ascertain whether dissatisfaction was due to technical problems or the quality of the training itself. Question 18 inquired about the respondent’s level of satisfaction with the training materials, “Were you satisfied that the materials provided you with an adequate understanding of how to use the Trail Network Update Utility?” Questions 19 and 20 asked about the respondent’s level of satisfaction with the allocation of meeting time and the trainers, and question 21 asked for the respondent’s overall level of satisfaction. The results of the training section mostly provided the primary researcher with information about the quality of the training, the results of this section can also be used to evaluate whether participation at the training workshops had an impact on the level of satisfaction with the Web-based tool.

Web-Based Tool

The third section of the survey instrument dealt mostly with participant satisfaction with the Web-based tool for greenways planning. The first and last questions in the section were directional. Question 22 asked whether the respondent used the Web-based Trail Network Update Utility. If they responded “yes,” they were directed to continue to question 23, if they answered “no,” they were directed to stop.

Questions 23 through 28 examined the respondent’s level of satisfaction with different aspects of the Web-based tool, such as documentation, navigability, ease of use, technical support, and time available for data submission. Respondent’s were asked to respond to questions about the Trail Network Update Utility on a scale of 1 to 5, with “1=Very Dissatisfied,” “2=Dissatisfied,” “3=Neither,” “4=Satisfied,” “5=Very Satisfied,” and “0=I do not have enough information to answer this question.” Question 23 asked, “How satisfied were you with the quality of the on-line documentation for the Trail Network Update Utility?” The results of this question were used to assess the respondent’s general satisfaction with the help material. Each of the following questions in this section were phrased in the same manner as question 23. Question 24 asked how satisfied the respondent was with the navigability of the web-based tool. This question was used to evaluate the level of satisfaction with the design of the ArcIMS Interface and general design of the site. The next item, question 25, asked how satisfied the respondent was with the ease of use of the web-based tool. The results of this question were used to examine participants’ level of comfort with using Web-based GIS technology. This question can be easily compared to the respondent’s level of comfort with GIS and the Internet, addressed in the general information section of the survey, to see if there is a correlation between a respondent’s satisfaction with the usability of the tool and their level of comfort with GIS and the Internet. Questions 26 and twenty-seven asked how satisfied the user was with the technical support for the Web-based tool and the time available for data submission. Finally, question 28 asked the respondent to rate their overall experience with the Web-based Trail Network Update Utility. The results of this question were used to analyze the respondent's general experience with Web-based GIS for greenways planning. The last question in this section asked if the respondent was involved in the original design of the statewide trail network in 1996. If they answered "yes," they were directed to the comparison section and if they answered "no," they were directed to stop.

Comparison

The last section of the survey instrument was used to compare the original process used for the 1994-1996 Trail Network Design with the process used for the 2003-2004 Trail Network Design. The process of drawing on maps in the 1994-1996 Design was referred to as 'Manual' and the on-line digitizing process used in the 2003-2004 Design was referred to as 'ArcIMS.' The purpose of this section was to evaluate whether respondents felt the on-line digitizing process was an improvement over the manual method used in the original design.

Questions 30 through 35 asked the respondent to indicate the degree to which they favored one process over the other, using a series of topics such as, ease of submission, quality of the final product, travel time, access to data, and the potential number of participants. Respondents were asked to rate each question on a scale of 1 to 5, with the following categories: "1=Manual Strong," "2=Manual Moderate," "3=Neutral," "4=ArcIMS Moderate," "5=ArcIMS Strong," and "0=I do not have enough information to answer this question."

The first item, question 30, asked "Which process made it easier to submit potential trail corridors to the Office of Greenways and Trails?" The results of this question were used to analyze which method made it easier for the participant to submit data. The Web-based tool made it much easier for OGT and the GeoPlan Center to collect data, so the emphasis was specifically on the ease of submission for the user. The next item, question 31, asked, "Which process resulted in a more complete statewide Trail Network?" This question was used to analyze whether respondents felt that the implementation of Web-based GIS lead to a better final product. Question 32 asked which process required the least amount of travel time. Question 33 asked the respondent which process gave them more access to geographic data on which to base their trail recommendation. This question was important because there is a marked difference in access to data between paper maps and dynamic, on-line mapping. The aim of this question was to get an understanding of whether the user felt that they had access to more data and whether it was useful to them. Question 34 simply asked which process was easier for the respondent, and question 35 asked which process allowed more people to submit potential trail corridors. The final question in this section was intended to assess the general opinion of the overall worth of the Web-based tool. Question 36 asked, "Do you feel that the benefits provided with the 2004 Trail Network Update Utility made changing the process worthwhile?" This was followed by an open-ended question, asking the respondent to convey in their own words what they thought about the two different methods used for the design of the Trail Network. The survey concluded with a blank page for respondents to provide any additional comments and a note, thanking the participant for completing the survey.

Statistical Analysis

The survey data was tabulated and analyzed in SPSS 12.0. The survey responses were recoded and all null values were reclassed to 9, which represented “No Data.” All text-based answers were used to gain a greater understanding of the respondent’s perceptions towards Web-based GIS as a planning tool, but were not included in the statistical analysis. Respondent’s personal comments will be discussed in greater detail in Chapter Six.

Data analysis included basic descriptive statistics of all the questions. Frequencies were run on each question to provide the basic descriptive statistics. Many comparative statistics were run to find correlation between different responses. Fifty-two participants returned the survey, but not all respondents participated in every aspect of the project, therefore responses for each section were lower than the total number of surveys returned. Since the entire population participated in the test, all of the observations about the results are drawn from descriptive statistics.

In order to investigate the primary research question, which asked if the implementation of Web-based GIS enhanced the design of a statewide trails network, the questions in the comparison section were evaluated. The public meeting section was used to answer the secondary research question, which asked if the implementation of web-based GIS improves the opportunity for pubic involvement. A correlation between the questions regarding the training seminar and Web-based GIS tool were used to investigate the tertiary research question, which asked if training influences a participant’s satisfaction with Web-based GIS as a tool for greenways and trails planning.

CHAPTER 6
RESULTS AND DISCUSSION

The primary purpose of this study was to examine how the implementation of Web-based GIS affects the design of the Florida Greenways and Trails statewide Recreational Trails Network. It explored stakeholders' analysis of the Trail Network Update Utility, a Web-based GIS for greenways and trails planning. It also examined the potential for greater public involvement and the influence of training on participant satisfaction. Finally, this study examined whether the implementation of Web-based GIS was an improvement over the former method of drawing on paper maps at public meetings. Specifically, the study observed how the Trail Network Update Utility impacted travel time, access to spatial data, ease of submission, and perception of the quality of the final product by stakeholders who participated in both processes. Results for all of these questions will be discussed in this chapter.

Given the limited number of survey respondents, the primary researcher was not able to draw significant conclusions or test a hypothesis. Therefore, this study does not attempt to answer broad question about the implementation of Web-based GIS for greenways planning, rather it is an analysis of the responses provided by participants regarding the 2004 Update of Florida's Trail Network.

Descriptive Results

Before discussing the analyses of each research question outlined in Chapter 1, a brief description of the participant population follows. From September 2003 to February 2004, approximately 114 individuals submitted potential trails corridors, using a variety of methods. The Trail Network Update Survey was sent to each of these individuals to give them the opportunity to convey pertinent information about the quality of their experience. Of these 114 individuals, 52 responded to the survey, leaving a sample size of approximately 50 (n=52). Most respondents (86.4%) had been involved in greenways and trails planning for ten years or less. This indicates that very few respondents were involved in the original design of the statewide trail network in 1996 (Table 6-1).

Table 6-1. Greenways and Trails Planning Experience

Duration (Years)	Frequency	Valid Percent
0 – 5	32.0	61.5
6 – 10	13.0	24.9
11 – 15	3.0	5.8
16 – 20	2.0	3.8
21 – 25	2.0	3.8
Total	52.0	100.0

Many of the respondents reported a moderate to high level of comfort with the Internet and GIS, with Internet comfort being the highest. All 52 respondents (100%) reported moderate to highest levels of comfort with the Internet (Figure 6-2). While only 43 (82.7%) reported moderate to highest levels of comfort with GIS (Figure 6-3).

Table 6-2. Internet Comfort

Comfort Level	Frequency	Valid Percent
Lowest	0.0	0.0
Low	0.0	0.0
Moderate	3.0	5.8
High	9.0	17.3
Highest	40.0	76.9
Total	52.0	100.0

Public Meetings

This section of the survey asked questions that helped provide information regarding the use of Web-based GIS to prepare for public meetings. Of the 52 survey respondents, 21 (40.4%) attended a public meeting in Ft. Myers, Orlando, or Tallahassee. Due to the fact that administrators such as OGT and GeoPlan staff also participated in the survey, 6 of the respondents attended two or more meetings. (Table 6-4) The following Table (6-4) shows the distribution of public meetings and the number of respondents who attending each public meeting.

Table 6-3. GIS Comfort

Comfort Level	Frequency	Valid Percent
Lowest	3.0	5.8
Low	6.0	11.5
Moderate	13.0	25.0
High	13.0	25.0
Highest	17.0	32.7
Total	52.0	100.0

Table 6-4. Location of Public Meeting that Respondent Attended

Public Meeting Location	**Frequency**	**Valid Percent**
Ft. Myers	4.0	19.0
Orlando	7.0	33.3
Tallahasee	4.0	19.0
All Three	5.0	23.8
Orlando & Tallahassee	1.0	4.8
Total	21.0	100.0

Of those who attended a public meeting, 5 (22.7%) reported that they chose to go to a public meeting rather than use the Web-based Trail Network Update Utility. The predominant reasons for attending a public meeting in-lieu of using the Trail Network Update Utility were ease of coordination efforts, the preference for direct contact, and dissatisfaction with the tool. One planning advocate stated, “(The public meeting was) in town and I prefer direct contact if it is available.” A Parks and Recreation Coordinator expressed that they chose to attend the public meeting due to difficulties coordinating input from the City, the County Greenways Committee, and the County GIS. A planning manager reported that they attended a public meeting because the website was poor and there was no advertisement. These responses indicate a clear need for alternatives to Web-based participatory methods for greenways planning. While Web-based GIS can provide many benefits, which will be discussed in further detail, one-on-one contact is still a desirable component of the planning process and collaborative decision-making.

To evaluate the effectiveness of Web-based GIS as a tool to prepare for public meetings, the participants were asked if they viewed the proposed Trail Network prior to attending the public meeting. A vast majority of respondents, 20 out of 21 (95.2%) viewed the proposed Trail Network prior to attending a public meeting. Of those respondents, 13 (65%) viewed the proposed Trail Network using the Web-based GIS viewer. Participants also viewed the proposed Trail Network by downloading the shapefile (15%) and viewing a paper map (15%).

Table 6-5. Methods of Viewing Potential Trail Network

Viewing Method	Frequency	Valid Percent
Download Shapefile	3.0	15.0
Paper Map	3.0	15.0
ArcIMS site	13.0	65.0
Other	1.0	5.0
Total	20.0	100.0

When asked if the Web-based GIS viewer was easy to access and use, 15 out of 17 (88.3%) reported that they “Agree” to “Strongly Agree” that it was easy to access and use. (Table 6-6; Table 6-7) Furthermore, 11 out of 14 (78.6%) reported that the on-line viewer helped them prepare for the public meeting, while 1 (7.1%) reported that the on-line viewer didn’t help them at all and 2 (14.3%) reported that it didn’t make a difference (Table 6-8).

Table 6-6. Ease of Access of On-line Viewer

Level of Agreement	Frequency	Valid Percent
Strongly Disagree	1.0	5.9
Disagree	1.0	5.9
Neither	0.0	0.0
Agree	7.0	41.2
Strongly Agree	8.0	47.1
Total	17.0	100.0

Table 6-7. Ease of Use of On-line Viewer

Level of Agreement	Frequency	Valid Percent
Strongly Disagree	1.0	5.9
Disagree	0.0	0.0
Neither	1.0	5.9
Agree	8.0	47.1
Strongly Agree	7.0	41.2
Total	17.0	100.0

Table 6-8. Preparation Using the On-line Viewer

Level of Agreement	Frequency	Valid Percent
Strongly Disagree	1.0	7.1
Disagree	0.0	0.0
Neither	2.0	14.3
Agree	5.0	35.7
Strongly Agree	6.0	42.9
Total	14.0	100.0

Training Workshops

Training workshops were held in Ft. Myers and Tampa in the fall of 2003. Nine of the 52 respondents reported that they attended a training workshop. There were 2 respondents at the Ft. Myers workshop, 4 respondents at the Tampa workshop, and 3 of the respondents attended both training workshops. The purpose of asking questions about the training workshop was to assess the respondents' level of satisfaction with the training and to evaluate whether the training helped participants to use the Trail Network Update Utility. When asked about their satisfaction with the equipment at the training facility, a majority of the respondents expressed dissatisfaction. Of the 9 participants who responded, 6 (66.7%) reported that they were “Dissatisfied” to “Very Dissatisfied” with the equipment. A project manager who attended the Tampa training stated, “Unfortunately the facility’s computer could not handle all of us either being on-line or accessing the same website. Some people submitted trails that day while the others had to do it later.” Another participant reported a great deal of dissatisfaction with the workshop, “equipment failure, lack of direction, coordination, basically a waste.” A GIS Analyst who attended both meetings commented, “I thought Ft. Myers was good. Tampa was not good due to computer programs.” The results from this question clearly reflect the technical difficulties experienced at the workshop facility in Tampa.

Respondents reported a much higher level of satisfaction with other aspects of the training workshops, such as materials, allocation of meeting time, and the trainers. When asked if the materials provided them with an adequate understanding of how to use the Trail Network Update Utility, 8 out of 10 (80%) reported that they were “Satisfied” to “Very Satisfied”. None of the respondents reported being “Very Dissatisfied” but 1 (10%) reported being “Dissatisfied” and 1 (10%) reported that they were “Neither Satisfied nor Dissatisfied” (Table 6-9).

Table 6-9. User Satisfaction with Materials at Training Workshop

Satisfaction Level	Frequency	Valid Percent
Very Dissatisfied	0.0	0.0
Dissatisfied	1.0	10.0
Neither	1.0	10.0
Satisfied	4.0	40.0
Very Satisfied	4.0	40.0
Total	10.0	100.0

When asked if they were satisfied with the allocation of the meeting time, 7 out of 9 (77.7%) respondents reported that they were “Satisfied” to “Very Satisfied,” while 2 of the 9 (22.2%) respondents reported that they were “Dissatisfied” (Table 6-10).

Table 6-10. User Satisfaction with Allocation of Meeting Time at Training Workshop

Satisfaction Level	Frequency	Valid Percent
Very Dissatisfied	0.0	0.0
Dissatisfied	2.0	22.2
Neither	0.0	0.0
Satisfied	4.0	44.4
Very Satisfied	3.0	33.3
Total	9.0	100.0

Overall, respondents that attended a training workshop reported a high level of satisfaction with the training. Of the 9 respondents, 6 (66.6%) reported that they were "Satisfied" to "Very Satisfied" overall with the training. The remaining 3 (33.3%) respondents were equally divided, with 1 reporting that they were "Very Dissatisfied," 1 "Dissatisfied," and 1 "Neither Satisfied nor Dissatisfied" (Table 6-10).

Table 6-10. Overall User Satisfaction with Training Workshops

Satisfaction Level	Frequency	Valid Percent
Very Dissatisfied	1.0	11.1
Dissatisfied	1.0	11.1
Neither	1.0	11.1
Satisfied	4.0	44.4
Very Satisfied	2.0	22.2
Total	9.0	100.0

As a general indicator of satisfaction with the training and user need for the Trail Network Update Utility, respondents were asked if they used the on-line Trail Network Update Utility to submit a trail after attending the workshop. Eleven respondents answered the question, although only 9 reported attending a workshop. Regardless, all responses were tabulated. A majority of the respondents, 7 out of 11 (63%) reported that they did not use the Trail Network Update Utility again after the training workshop. The remaining 4 (36.4%) respondents reported that they used the tool again to submit a potential trail corridor. Potential explanations for these results could include: the respondent was able to submit their trail at the training workshop, the respondent did not think that the tool was a good method and used another method, or they did not have a trail to submit.

While many respondents expressed satisfaction with the Training Workshops, from these results it is indicated that many aspects of the training could be improved in the future. First and foremost, it would be beneficial if training locations were selected based on the training administrators prior knowledge of the quality of the training facility. Prior to the training workshop in Tampa, there was extensive communication with the training facility and GeoPlan staff. While the training administrators were assured that all computers were functioning properly with the appropriate software, this was not the case and participants expressed a great deal of dissatisfaction, as can be illustrated by one GIS Specialist's comment, "(The training was) too elementary, waste of time, trainers did not appear to know what they were doing, facility was too small, computers bad, easier to submit shapefiles."

Web-Based Tool

One of the primary questions that this study sought to analyze was whether stakeholders involved in planning the statewide Trails Network embraced Web-based GIS as a legitimate planning tool. Of the 52 survey respondents, 27 (62.8%) reported using the Trail Network Update Utility. The predominant explanations for not using the tool were (1) lack of knowledge that the Web-based Trail Network Update Utility existed, (2) a person more skilled in GIS performed this task for the documented participant, or (3) the respondent did not have any potential corridors to add. It appears that in a number of cases, a GIS technician went through the submission procedure, but the supervisor was documented as the participant. Therefore, many of the surveys were sent to individuals who did not participate in the submission process.

Of the 27 respondents who reported using the Web-based Trail Network Update Utility, a majority expressed a high level of satisfaction with all aspects of the process, which include (1) quality of on-line documentation, (2) navigability, (3) ease of use, (4) technical support, (5) time available for submission, and (6) overall satisfaction. Each of the questions about the Trail Network Update Utility were intended to target any specific inadequacies about the Web-based GIS and to get an understanding of respondents acceptance of Web-based GIS as a planning tool. This section will explain how the respondents rated the quality of the Trail Network Update Utility for the update of Florida's statewide Trails Network.

When asked how satisfied they were with the quality of the on-line documentation for the Trail Network Update Utility, 21 of 27 (77.8%) respondents reported that they were "Satisfied" to "Very Satisfied," while 3 of 27 (11.1%) reported that they were "Neither Satisfied nor Dissatisfied," and 3 of 27 (11.1%) reported that they were "Dissatisfied" to "Very Dissatisfied" (Table 6-11). The on-line documentation for the Trail Network Update Utility consisted of an Adobe Portable Document Format (PDF) file that explained how to use the tool in a slide show. The on-line documentation was updated each time a change was made to the Web-based GIS tool.

Table 6-11. Satisfaction Level with On-line Documentation for the TNUU

Satisfaction Level	Frequency	Valid Percent
Very Dissatisfied	1.0	3.7
Dissatisfied	2.0	7.4
Neither	3.0	11.1
Satisfied	14.0	51.9
Very Satisfied	7.0	25.9
Total	27.0	100.0

Next, respondents were asked to rate their satisfaction with the navigability of the Trail Network Update Utility. Again, there was a discrepancy with the number of responses vs. the number of participants that reported using the tool but the data was kept in the spirit of fairness. A majority, 24 out of 29 (82.7%), of the respondents reported being "Satisfied" to "Very Satisfied" with the navigability of the tool, while 2 of the 29 (3.8%) respondents reported that they were "Neither Satisfied nor Dissatisfied," and 3 of the 29 (10.3%) respondents reported being "Dissatisfied" to "Very Dissatisfied" with the navigability of the tool (Table 6-12).

Table 6-12. Satisfaction Level with the Navigability of the TNUU

Satisfaction Level	Frequency	Valid Percent
Very Dissatisfied	1.0	3.4
Dissatisfied	2.0	6.9
Neither	2.0	3.8
Satisfied	17.0	58.6
Very Satisfied	7.0	24.1
Total	29.0	100.0

When asked how satisfied they were with the ease of use of the Trail Network Update Utility, respondents reported a slightly lower level of satisfaction compared with the other aspects of the process. Of the 27 respondents, 21 (77.7%) reported being "Satisfied" to "Very Satisfied," while 4 of the 27 (14.8%) reported that they were "Dissatisfied" to "Very Dissatisfied." The remaining 2 (7.4%) respondents reported that they were, "Neither Satisfied nor Dissatisfied" (Table 6-13). The level of dissatisfaction with the ease of use could possibly be attributed to the newness of the technology and the short length of the project, thus lessening the potential for enhancements. Many collaborative spatial decision-making models are constantly modified over the life-span of the project as users identify needed modifications.

Next, respondents were asked to rate their level of satisfaction with the technical support for the Trail Network Update Utility. Again, respondents reported a lower level of satisfaction for this item in comparison with other aspects of the tool. While a majority of the respondents, 16 out of 21 (76.2%) reported a high level of satisfaction, a significant number, 3 out of 21 (14.3%), indicated that they were dissatisfied with the technical support (Table 6-14). While a number of application bugs were identified and fixed through difficulties reported by users, it is implied that a number of users felt that the technical support did not meet their expectations.

Table 6-13. Satisfaction Level with the Ease of Use of the TNUU

Satisfaction Level	Frequency	Valid Percent
Very Dissatisfied	1.0	3.7
Dissatisfied	3.0	11.1
Neither	2.0	7.4
Satisfied	11.0	40.7
Very Satisfied	10.0	37.0
Total	27.0	100.0

Table 6-14. Satisfaction Level with the Technical Support for the TNUU

Satisfaction Level	Frequency	Valid Percent
Very Dissatisfied	1.0	4.8
Dissatisfied	2.0	9.5
Neither	2.0	9.5
Satisfied	8.0	38.1
Very Satisfied	8.0	38.1
Total	21.0	100.0

Most respondents reported a high level of satisfaction with the time available for data submission. Of the 28 respondents, 23 (82.1%) reported a high level of satisfaction with the time available for submission, while 3 (10.7%) respondents expressed dissatisfaction (Table 6-15). During the final days of the submission period, all requests that were made to the GeoPlan Center for additional time were granted. It is possible that respondents who were dissatisfied with the time available for submission either heard about the Trail Network Update Utility too late or never heard about it at all.

Respondents who used the Trail Network Update Utility reported a high overall level of satisfaction with the tool. Of the 28 respondents, 24 (85.7%) reported that they were “Satisfied” to “Very Satisfied” with their overall experience with the Web-based Trail Network Update Utility. A very low level of dissatisfaction was reported with 2 of the 28 (7.2%) respondents reporting that they were “Dissatisfied” to “Very Dissatisfied” with their overall experience (Table 6-16).

Table 6-15. Satisfaction Level with the Time Available for Submission for the TNUU

Satisfaction Level	Frequency	Valid Percent
Very Dissatisfied	2.0	7.1
Dissatisfied	1.0	3.6
Neither	2.0	7.1
Satisfied	13.0	46.4
Very Satisfied	10.0	35.7
Total	28.0	100.0

Table 6-16. Overall Satisfaction Level with the TNUU

Satisfaction Level	Frequency	Valid Percent
Very Dissatisfied	1.0	3.6
Dissatisfied	1.0	3.6
Neither	2.0	7.1
Satisfied	16.0	57.1
Very Satisfied	8.0	28.6
Total	28.0	100.0

A Bicycle-Pedestrian Planning Coordinator who reported a high level of satisfaction with the tool commented that, “the software was very easy to use and provided an efficient method for updating the Greenways map without unnecessary coordination meetings.” This respondent represents the user group who feels that time and resources can be saved with the implementation of Web-based GIS. Furthermore, this user group expressed a high level of comfort with the software, as one Planning Manager illustrates, “I did not receive any training to use the Web-based system, yet was able to use (it) effectively.” Of the respondents who expressed dissatisfaction with the Trail Network Update Utility, the primary items of contention were access, coordination efforts, and lack of collaboration and networking among colleagues. A Parks Designer commented that, “the opportunity to strengthen relationships, improve communication, and generate ideas over a set of maps was missed.” An Office Manager felt that access to the tool was restricted, “I think that I tried to contribute to this process, but because I am not an official entity such as a city or county, it was not friendly to my input.” A GIS Specialist expressed dissatisfaction with coordination efforts, “This project seems to just languish on forever. If one GIS Specialist handled the project from start to finish – maybe it would get done. Too many students with no continuity.”

Clearly there are aspects of Web-based GIS and the methods implemented to design the statewide trails network that participants feel are lacking. But, it is important to note that very little criticism was actually directed at the Web-based technology, but rather how it was designed and implemented. This provides valuable information regarding the potential restructuring of design and implementation strategies, such as (1) facilitate greater coordination, (2) allow for easier access, and (3) design a framework for collective visioning.

Comparison

Finally, to compare the original process used for the 1994 – 1996 Trail Network Design with the process used for the 2003 – 2004 Trail Network Design, respondents were asked to indicate the degree to which they favored one process over the other on a number of items. The process of drawing on paper maps in the 1994 – 1996 Design was referred to as ‘Manual’ and the on-line digitizing process used in the 2003 – 2004 Design was referred to as ‘ArcIMS.’ ArcIMS is simply a Web-based GIS software program that was used for this project and is analogous to the term Web-based GIS. Participants were asked to rate one process over the other on issues such as, (1) ease of submission, (2) quality of final product, (3) travel time, (4) access to geographic data, and (5) potential for more users. The criteria used to rate the two trail design processes were, “Manual Strong” indicating that a respondent strongly favored the manual process, “Manual Moderate” meaning that a respondent moderately favored the manual process, “Neutral” indicating that neither procedure outweighed the other, “ArcIMS Moderate” meaning that a respondent moderately favored the ArcIMS process, and “ArcIMS Strong” indicating that a respondent strongly favored the ArcIMS process. Participants were also given the option to select “N/A” which meant that they did not have enough information to answer the question. All N/A responses were recalculated as “No Data.”

A very small sample of the survey population, 7 of 52 respondents, participated in the 1994 – 1996 Trail Network Design. Even though the sample is small, the respondents were able to contribute valuable information to compare the two Design processes. Among respondents, there was an overwhelmingly strong preference for ArcIMS as a design tool for the statewide Trails Network. In fact, all respondents reported that they had a “Moderate” to “Strong” preference for ArcIMS on every comparison item. There was no preference at all for the Manual method and no one reported being neutral on any comparison items.

When asked which process made it easier to submit potential trail corridors, all (100%) respondents reported that they strongly favored the ArcIMS process. Respondents equally favored the ArcIMS process when asked which process required the least amount of travel time for them (Table 6-17). Respondents also reported that the ArcIMS process resulted in a more complete statewide Trails Network. Only 6 participants responded to this question, but 5 of the 6 (83.3%) reported that they strongly favored the ArcIMS process in the ability to produce a more complete statewide Trail Network. The remaining participant reported that they moderately favored ArcIMS (Table 6-18).

Table 6-17. Ease of Submission and the Least Travel Time

Preference	Frequency	Valid Percent
Manual Strong	0.0	0.0
Manual Moderate	0.0	0.0
Neutral	0.0	0.0
ArcIMS Moderate	0.0	0.0
ArcIMS Strong	7.0	100.0
Total	7.0	100.0

Table 6-18. More Complete Statewide Trail Network

Preference	Frequency	Valid Percent
Manual Strong	0.0	0.0
Manual Moderate	0.0	0.0
Neutral	0.0	0.0
ArcIMS Moderate	1.0	16.7
ArcIMS Strong	5.0	83.3
Total	6.0	100.0

When asked which process gave participants more access to geographic data and which process was easier, 6 of 7 (85.7%) respondents reported that they strongly favored the ArcIMS process (Table 6-19). These results show an overwhelming preference for Web-based GIS as an effective tool for the design of a statewide Trail Network.

Table 6-19. Access to Spatial Data and was Ease of Use

Preference	Frequency	Valid Percent
Manual Strong	0.0	0.0
Manual Moderate	0.0	0.0
Neutral	0.0	0.0
ArcIMS Moderate	1.0	14.3
ArcIMS Strong	6.0	85.7
Total	7.0	100.0

The last comparison item asked which process allowed more people to submit potential trail corridors. Of the 7 respondents, 5 (71.4%) strongly favored the ArcIMS process and 2 (28.6%) moderately favored the ArcIMS process (Table 6-20).

Unfortunately, there is no historic data documenting the number of participants that submitted potential trail corridors during the 1994 – 1996 Trail Network Design.

Table 6-20. Submission of Trail Corridors

Preference	Frequency	Valid Percent
Manual Strong	0.0	0.0
Manual Moderate	0.0	0.0
Neutral	0.0	0.0
ArcIMS Moderate	2.0	28.6
ArcIMS Strong	5.0	71.4
Total	7.0	100.0

To wrap up the comparison of the original process used for the 1994 – 1996 Trail Network Design with the process used for the 2003 – 2004 Trail Network Design, participants were asked if they felt that the benefits provided with the 2004 Trail Network Update Utility made changing the process used in 1996 worthwhile. All of the respondents (100%) reported that they thought it was worthwhile to change the process.

The overwhelming support for the Web-based method for updating the Trail Network Opportunity Maps was well articulated by the President of an environmental planning firm, "Although I didn't review your trails the old way, there is no comparison for what you currently use. Perhaps the reason I cannot comment as an actual user of the old hand-drawn method is because this method is limited in being able to reach all persons who may have valuable information." A planner who also favored the ArcIMS process commented, "My experience with on-line mapping has been good and getting better all the time. I feel using GIS for getting and giving trail data is the way to go."

Analysis of Research Questions

There are five primary questions that this study sought to answer regarding the implementation of Web-based GIS in the design of a statewide trails network as part of Florida's Greenways and Trails System. Due to the small survey population, the questions will be explored using descriptive statistics and cross-tabulation. The answers to the research questions are meant to apply exclusively to this project and do not imply that similar results would be incurred in similar studies.

Public Involvement. Can Web-based GIS improve the opportunity for public involvement in designing of a statewide trails network?

The purpose of this question was to evaluate whether Web-based GIS gave the public a greater opportunity to participate in the 2003 – 2004 Design of the Statewide Trails Network. Given the results of the survey, it can be shown that the implementation of Web-based GIS helped the public to better prepare for the public meetings and allowed more people to participate. Of the respondents who utilized Web-based GIS to prepare for the public meeting, 78.6% reported that it helped them to better prepare for the meeting. Other respondents reported that although they were active in greenways and trails planning during the original design of the Trail Network in 1996, they were not involved because access was limited. A Senior Planner commented, “Web-based technologies are a great way to enhance public input. This is a great application.”

Training. Do training workshops improve a participant’s satisfaction with Web-based GIS as a planning tool for the design of a statewide trails network?

The purpose of this question was to explore any potential relationships between training attendance and satisfaction with the Trail Network Update Utility. By conducting a Crosstabs procedure, which provides a measure of association for two-way tables, it was found that the respondents who attended training reported a higher level of satisfaction with the Web-based tool than those who did not attend training. As illustrated below (Table 6-21), none of the respondents who attended training reported being “Very Dissatisfied” or “Dissatisfied” with the Trail Network Update Utility.

Table 6-21. Satisfaction Level with TNUU Based on Training Attendance

Training Attendance	Very Dis-satisfied	Dis-satisfied	Neither	Satisfied	Very Satisfied	Total
Attended Training	0.0	0.0	0.0	1.0	3.0	4.0
No Training	1.0	1.0	1.0	6.0	2.0	11.0
Total	1.0	1.0	1.0	7.0	5.0	15.0

These results imply that some level of training is beneficial when introducing advanced technologies to the public. Although one respondent commented that the tool was easy to use without any training, many potential users are less comfortable with new technology, as one participant pointed out, "Technophobia is probably still a limit to the number of users for Web-based participation – but I think it is inevitable that the process goes that direction. Manual management of public data inputs borders on unfeasible." Given the high level of dissatisfaction with the training workshops, a recommendation for future enhancements would include better methods of training that more closely resemble the needs of the users.

Potential Users. Is there potential for reaching a broader audience for the design of a statewide trails network with the implementation of Web-based GIS?

Although there was no framework in place to collect data regarding the number of participants in the original Trail Network Design, we were able to ask individuals who participated in both the 1994 – 1996 Trail Network Design and the 2003 – 2004 Trail Network Update which process they thought allowed more people to submit potential trail corridors. Of the 7 respondents who were involved in both processes, 100% reported a moderate to strong preference for the Web-based methodology as the best means to reach a broader audience. The potential of Web-based GIS to facilitate greater involvement in the decision-making process is supported by other research as well (Schuler, 1994; Armstrong and Densham, 1995; Banger, 2001).

Design. Does using Web-based GIS enhance the design of a statewide trails network?

There was overwhelming agreement among participants that Web-based GIS provided enhancements to the design of the statewide trails network in the following ways:

- The Web-based GIS method made it easier to submit potential trail corridors to the Office of Greenways and trails.
- The Web-based GIS method resulted in a more complete statewide Trail Network.
- The Web-based GIS method required the least amount of travel time.
- The Web-based GIS method gave users more access to geographic data on which to base their trail recommendations.
- The Web-based GIS method was easier.
- The Web-based GIS method allowed more people to submit potential trail corridors.

Based on the overwhelming consensus among participants, we can conclude that Web-based GIS is a more effective method for designing a Florida's statewide Trail Network.

Collaborative Spatial Decision Making. Is Web-based GIS sufficient in providing a forum for collaborative group decision-making about the design of a statewide trails network or are supplemental activities needed?

While participants felt that the benefits provided with the 2004 Trail Network Update Utility made changing the process used in 1996 worthwhile, they did have concerns about its ability to provide interaction and learning amongst participants. A Program Manager commented that the manual method used in 1996 enabled, "greater personal interaction, learning amongst participants, (and) allowed collective vision to form." This participant felt that ArcIMS allowed for greater access at the loss of interaction and learning amongst participants, therefore less collective vision was created.

The Trail Network Update Utility was not designed to support on-line chat rooms or forums for users to collaborate and share information. In the future, it would be desirable to provide these utilities in order for collaboration among participants. While some participants felt that the Web-based tool eliminated unnecessary coordination meetings, others stated that they still prefer direct contact if it is available. This study proposes that enhancements to the Trail Network Update Utility would be necessary to provide a forum for collaborative group decision-making, but supplemental activities such as meetings that provide direct contact are still an essential element of the group decision-making process.

CHAPTER 7
SUMMARY AND CONCLUSIONS

At the beginning of this paper we discussed the background of greenways planning and the need to update the statewide trails network in Florida. We then discussed the issue of how the public involvement approach grew from social and political demand, and the challenges it posed on communication channels (Sarjakoski, 1998). Spatial Decision Support Systems emerged as a powerful model in the 1990s to develop customized and flexible decision-making tools (Densham, 1991; Armstrong, 1994). Later, Collaborative Decision-Making (Armstrong and Densham, 1995; Coleman and Brooks, 1995; Schuler, 1994) was designed to overcome the limitations of a single user GIS. The widespread availability of Internet connections has further enabled decision-makers to communicate complex spatial information to a wider audience (Kangas and Store, 2003). Today, the future of Web-based GIS is brimming with opportunities. Research has shown that there will be opportunities to increase productivity and opportunities for public involvement by placing friendly GIS interfaces at the disposal of novice users.

The objective of our study was to determine whether using Web-based GIS technology enhanced the update of the statewide trails network. Our study looked at various aspects of using Web-based GIS, such as the opportunity for public involvement, difficulty of technology for users, potential for reaching a broader audience, the impact on collaborative group decision-making, and quality of the final product. The results of our study could help in the design and implementation of future Web-based GIS utilities for statewide greenways planning and other spatial planning activities as well.

Individuals who were involved in both the 1994 – 1996 Trail Network Design and the 2003 – 2004 Trail Network Update felt that the implementation of Web-based GIS enhanced the planning process in the following ways: (1) it made it easier to submit potential trail corridors, (2) it resulted in a more complete statewide Trail Network, (3) it required the least amount of travel time, (4) it gave more access to geographic data, (5) it was easier, and (6) it allowed more people to submit potential trail corridors. But, the implementation of Web-based GIS for public involvement in greenways and trails planning need not compete or do away with direct participation. Instead, we propose that it can be used to support and supplement traditional participatory methods. Web-based GIS at best supplements other participation forms, it does not replace them. Yet, Web-based GIS is well suited to the planning of a statewide Trails Network because stakeholders are willing to participate and they feel that it is a more efficient method, but there is still a reasonable need for direct contact and meetings to allow for a collective vision to form.

While technophobia is probably still a limit to the number of users for Web-based participation, this study found that training can enhance a participant's satisfaction with their overall experience using Web-based GIS. This study also found that Web-based GIS increases the potential for reaching a broader audience but the design of the Trail Network Update Utility did not provide the framework to support collaborative group decision-making.

Recommendations for Future Study

Many enhancements could be made to the design and implementation of the Trail Network Update Utility to increase the potential for public involvement and collaboration among participants. The most important area of future research is testing the fit of different decision support methods with the needs faced by stakeholders in the greenways and trails planning process. The Trail Network Update Utility could also be enhanced to provide a more user-friendly and intuitive Graphical User Interface (GUI) and training methods could also be more fine-tuned to provide users that are less comfortable with new technology with a way to use Web-based GIS.

Trail Network Update Utility Enhancements

Comments received from the survey showed that there were aspects of the Web-based GIS that participants felt were lacking. Most of the criticism was directed at how the Trail Network Update Utility was designed and implemented. This section looks at specific design and implementation strategies that could be improved to provide users with a more user-friendly Web-based GIS.

Design

The Trail Network Update Utility could be modified to give users greater opportunity to collaborate amongst themselves, be more informed, and have access to more GIS tools. Some recommendations to accomplish these goals include:

- A strategy to enable greater collaborative decision-making could include a framework for on-line forums that allow for greater communication amongst participants.
- To give users greater involvement in the decision-making process, a dynamic spatial analysis tool that prioritizes their recommended trail corridor using FGTC approved criteria could be provided. These criteria would include: regional significance, ecological connectivity, local connectivity, suitability for specific

users, access/proximity, interpretive potential, scenic character, management, and continuity for potential trail corridors.

- An improvement that would give participant's greater control and flexibility would be to allow the user to amend submitted information rather than having to delete and start over.

- The ability to print maps of varying sizes would provide a more robust Web-based GIS for users, thus eliminating the need to recreate all of the maps in a single user GIS for printing purposes.

- To make the Web-based GIS interface more user-friendly, it would be beneficial to give users the ability to save preferences, such as, geographic extent, datalayers which are displayed, and a history of segments that they have submitted.

Implementation

Greater administrative efforts could be made to encourage the participation of more individuals and assure that the project runs more smoothly:

- To make the Web-based GIS utility available to a broader and more diverse audience, it could be advertised more aggressively.

- To accommodate the two types of potential participants, (1) the planner and (2) the GIS technician, the Utility should allow for two user profiles for each trail segment. Therefore, pertinent follow-up questions can be directed to the appropriate user.

- Based on comments collected during the survey, it appears that there is a need to equally integrate all participants regardless of organizational affiliation or geographic location.

Training

Improved methods of training that more closely resemble the needs of the users could include:

- The provision of on-line classes for remote training could allow more individuals to experience some training for the Web-based GIS tool.

- Better equipped training facilities would improve participants overall experience and make them better prepared to use the Web-based GIS tool.

- Training workshops could be held in more locations, especially in northwest Florida to accommodate more potential users.

APPENDIX A
IRB APPROVED RESEARCH PROPOSAL

1. Title of Project:
   Web-Based GIS to Enhance the Design of a Statewide Trails Network as Part of Florida's Greenways and Trails System

2. Principle Investigator:
   Name: Lila M. Schaller
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3. Supervisor:
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   MAURP, University of Florida, 1981
   BS, University of Central Florida, 1979
   Title: Associate Professor and Chairman, Department of Urban and Regional Planning; Director GeoPlan Center
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4. Dates of Proposed Research:
   Begin date: February 10th, 2005
   End date: April 2nd, 2005

5. Source of Funding for the Protocol:
   Unfunded

6. Scientific Purpose of the Investigation:
   The purpose of this study is to evaluate the effectiveness of a web-based GIS approach to the design of a state-wide trail network and compare it with the

previous method of data collection which involved drawing trails by hand on paper maps.

The scientific reason to conduct this survey would be to determine if a new approach using web-based technology to collect and store data improves the planning process and the desired product.

7. Research Methodology:
   A survey will be mailed to individuals who were involved in the 2004 design of the state-wide Recreational Trails Network for the Office of Greenways and Trails.

   Individuals will be asked to evaluate the utilities that were provided and give input on whether the web-based GIS approach was more effective in terms of time, data, and the final product.

8. Potential Benefits and Anticipated Risks:
   The potential benefit of information that will be collected from this survey will
   - Help the Office of Greenways and Trails and the GeoPlan Center at the University of Florida understand the needs of the people involved in greenways planning.
   - Help in the design and implementation of future web-based GIS utilities for state-wide planning.

   There will be no more than minimal risk for participants.

9. Describe How Participants Will Be Recruited, the Number and Age of Participants, and Proposed Compensation:
   Participants will be recruited based on their previous participation in greenways planning in Florida. All participants that will be selected must have been directly or indirectly involved in the design of the state-wide trails network over the last ten years.

   Surveys will be mailed to approximately 60+ participants who are all above the age of 18. Age is not a variable in this study, but all professionals in the field of greenway planning happen to be older than 18 years of age. There is no proposed compensation for participants who complete and return the survey.

10. Describe the Informed Consent Process:
    An Informed Consent cover page will accompany all surveys, which will provide potential research participants all the information reasonably needed for them to decide whether or not to participate. The informed consent letter states that participation is voluntary and completely confidential (see attached informed consent letter).

11. Signatures:

Lila M. Schaller	Paul Zwick, PhD
Principal Investigator	Supervisor

APPENDIX B
IRB APPROVED INFORMED CONSENT LETTER

Dear Participant,
I am a graduate student in the Department of Urban and Regional Planning at the University of Florida. As part of my coursework I am conducting a survey, the purpose of which is to learn about the effectiveness of web-based GIS for greenways planning. I am asking you to participate in this survey because you have been identified as an expert in my area of research. You will be asked to fill out a survey, which should take no longer than 15 minutes. The survey is enclosed with this letter. You do not have to answer any question you do not wish to answer. You can complete the survey at your leisure and mail it by March 10th 2005 in the return envelope enclosed.

There are no anticipated risks, compensation or other direct benefits to you as a participant in this survey. You are free to withdraw your consent to participate and may discontinue your participation in the study at any time without consequence.

The title of my research is, *Web-based GIS to enhance the design of a state-wide trails network as part of Florida's Greenways and Trails System.* The purpose of this study is to evaluate the effectiveness of a web-based GIS approach to the design of a state-wide trail network and compare it with the previous method of data collection which involved drawing trails by hand on paper maps. Geographic Information System (GIS) is a system of computer software, hardware and data, and personnel to help manipulate, analyze and present information that is tied to a spatial location. The core product of a GIS is a geographic database with attributes that describe spatial data, but other important functionalities are, geographic data acquisition, spatial analysis, cartographic presentation, and data management.

Information collected from this survey will potentially:

- Help the Office of Greenways and Trails and the GeoPlan Center at the University of Florida understand the needs of the people involved in greenways planning.
- Help in the design and implementation of future web-based GIS utilities for state-wide planning.

Your identity will be kept confidential to the extent provided by law and your participation in this study is completely voluntary.

If you have any questions about this research protocol, please contact me or my faculty supervisor.

Lila M. Schaller, Graduate Student, Department of Urban and Regional Planning, 431 Arch Building, Gainesville, FL 32611. (352) 392-3508, lila@geoplan.ufl.edu

Paul Zwick, PhD. Chair, Department of Urban and Regional Planning, 431 Arch Building, Gainesville, FL 32611 (352) 392-0997 x421, paul@geoplan.ufl.edu.

If you have any questions about your rights as a research participant in the study please contact:

UFIRB Office, Box 112250, University of Florida, Gainesville, FL 32611-2250; ph 392-0433.

Agreement:
I have read the procedure described above. I voluntarily agree to participate in the procedure and I have received a copy of this description.
Participant: ____ Date: _________________
Principal Investigator: ________________________________Date: _________________

APPENDIX C
SURVEY INSTRUMENT

TRAIL NETWORK UPDATE SURVEY
GENERAL INFORMATION

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This survey is broken into four parts, to represent the different stages of the process used to design the statewide Trail Network. The parts of this survey include Part 1: Public Meetings, Part 2: Training Seminars, Part 3: Web-based Trail Network Update Utility, and Part 4: Comparison of the original design of the Trail Network from 1994-1996 with the recent design from 2003-2004. Please begin by answering the questions on page 1, then follow the directions to the parts of the survey that match your experience.

1. How many years have you been involved in greenways and trails planning?_____

2. Job Title: ____

3. Please rank your level of comfort with Geographic Information Systems (GIS) on a scale of 1 to 5, with 1 being the least comfortable and 5 being the most comfortable.
(circle one number that applies)

1 2 3 4 5

4. Please rank your level of comfort with the Internet on a scale of 1 to 5, with 1 being the least comfortable and 5 being the most comfortable. *(circle one number that applies)*

1 2 3 4 5

5. Did you attend a public meeting during the Public Comment Period?

☐ YES ☐ NO

If you answered **YES**, please skip to page 2. If you answered **NO**, please continue to question 6.

6. Did you participate in a training seminar for the Trail Network Update Utility?

☐ YES ☐ NO

If you answered **YES**, please skip to page 3. If you answered **NO**, please skip to page 4.

Figure C-1. General Information Section of Survey

TRAIL NETWORK UPDATE SURVEY
PUBLIC MEETINGS

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7. Which public meeting did you attend? ☐ Ft. Myers ☐ Orlando ☐ Tallahassee

8. Did you chose to attend a public meeting to submit trails rather than use the web-based Trail Network Input Utility?
☐ YES ☐ NO

If YES, why?

____

____

9. Did you view the proposed Trail Network prior to attending the public meeting?
☐ YES ☐ NO

If YES, which method did you use to view the data?

☐ Downloaded the shapefile ☐ Paper Map ☐ On-line ArcIMS site ☐ Other

If you used the ArcIMS site, please continue to questions 10 – 12. If you used another method or answered **NO**, please skip to question 13.

Please indicate how much you agree or disagree with the following statements concerning the web-based Trail Network Update Utility (ArcIMS site).

	Strongly Disagree	*Disagree*	*Neither*	*Agree*	*Strongly Agree*	*N/A*
10. The on-line viewer was easy to access.	1	2	3	4	5	0
11. The on-line viewer was easy to use.	1	2	3	4	5	0
12. The on-line viewer helped me to better prepare for the public meeting.	1	2	3	4	5	0

13. Did you participate in a training seminar for the Trail Network Update Utility?
☐ YES ☐ NO

If you answered **YES**, please skip to page 3. If you answered **NO**, please continue to question 14.

14. Did get a username and password to logon to the web-based Trail Network Update Utility?
☐ YES ☐ NO

If you answered **YES**, please skip to page 4. If you answered **NO**, please stop here.

Figure C-2. Public Meeting Section of Survey

TRAIL NETWORK UPDATE SURVEY
TRAINING SEMINARS

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15. Which training seminar did you attend?

☐ Ft. Myers ☐ Tampa

16. Did you use the on-line Trail Network Update Utility to submit a trail after attending the seminar?

☐ YES ☐ NO

Please rate the training seminar that you attended on each of the following items on a scale of 1 to 5, with *1 = Very Dissatisfied, 2 = Dissatisfied, 3 = Neither, 4 = Satisfied, and 5 = Very Satisfied. If you do not feel like you have enough information to answer the question, circle (0) in the 'N/A' category.*

	Very Dissatisfied	*Dissatisfied*	*Neither*	*Satisfied*	*Very Satisfied*	*N/A*
17. Were you satisfied with the equipment at the training facility?	1	2	3	4	5	0
18. Were you satisfied that the materials provided you with an adequate understanding of how to use the Trail Network Update Utility?	1	2	3	4	5	0
19. Were you satisfied with the allocation of the meeting time?	1	2	3	4	5	0
20. Were you satisfied with the trainers?	1	2	3	4	5	0
21. Overall how satisfied were you with the training?	1	2	3	4	5	0

Please provide us with any comments that you have about the training seminar or recommendations for future enhancements.

Please continue to page 4, to answer questions about the web-based Trail Network Update Utility

Figure C-3. Training Section of Survey

TRAIL NETWORK UPDATE SURVEY
Web-Based Tool

Table of Contents

22. Did you use the Web-based Trail Network Update Utility? ☐ Yes ☐ No

If NO, why?

____

____

If you answered **YES**, please continue to question 23. If **NO**, you can stop here. Thank you for completing this survey.

Please help us to evaluate the effectiveness of the on-line Trail Network Update Utility that was used to collect data about potential trail corridors for the 2004 Trail Network Update. We are referring to the ArcIMS site that was used to digitize potential trails and upload shapefiles.

Rate the Trail Network Update Utility on each of the following items on a scale of 1 to 5, with 1 = Very Dissatisfied, 2 = Dissatisfied, 3 = Neither, 4 = Satisfied, and 5 = Very Satisfied. If you do not feel like you have enough information to answer the question, circle (0) in the 'N/A' category.

	Very Dissatisfied	*Dissatisfied*	*Neither*	*Satisfied*	*Very Satisfied*	*N/A*
23. How satisfied were you with the quality of the on-line documentation for the Trail Network Update Utility.	1	2	3	4	5	0
24. How satisfied were with with the navigability of the Trail Network Update Utility?	1	2	3	4	5	0
25. How satisfied were you with the ease of use of the Trail Network Update Utility?	1	2	3	4	5	0
26. How satisfied were you with the technical support for the Trail Network Update Utility.	1	2	3	4	5	0
27. How satisfied were you with the time available for data submission?	1	2	3	4	5	0
28. How satisfied were you with your overall experience with the web-based Trail Network Update Utility?	1	2	3	4	5	0

29. Were you involved in the original design of the statewide trail network in 1996?
☐ YES ☐ NO

If you answered **YES**, please continue to page 5. If you answered **NO**, please stop here.

Figure C-4. Web-Based Tool Section of Survey

TRAIL NETWORK UPDATE SURVEY
Comparison

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Please help us to compare the original process used for the 1994 – 1996 Trail Network Design with the process used for the 2003 - 2004 Trail Network Design. The process of drawing on paper maps in the 1994 – 1996 Design is referred to as 'Manual' and the on-line digitizing process used in the 2003 – 2004 Design is referred to as ArcIMS.

Please indicate the degree to which you favor one process over the other.
Manual Strong *– Strongly favor the manual process,*
Manual Moderate *– Moderately favor the manual process,*
Neutral *– Neither procedure outweighed the other,*
ArcIMS Moderate *– Moderately favor the ArcIMS process, and*
ArcIMS Strong *– Strongly favor the ArcIMS process.*
N/A – If you do not feel like you have enough information to answer the question

	Manual Strong	*Manual Moderate*	*Neutral*	*ArcIMS Moderate*	*ArcIMS Strong*	*N/A*
30. Which process made it easier to submit potential trail corridors to the Office of Greenways and Trails?	1	2	3	4	5	0
31. Which process resulted in a more complete statewide Trail Network?	1	2	3	4	5	0
32. Which process required the least amount of travel time for you?	1	2	3	4	5	0
33. Which process gave you more access to geographic data on which to base your trail recommendation? (i.e. roads datasets, water resources, conservation lands, etc.)	1	2	3	4	5	0
34. Which process was easier for you?	1	2	3	4	5	0
35. Which process do you think allowed more people to submit possible trail corridors?	1	2	3	4	5	0

36. Do you feel that the benefits provided with the 2004 Trail Network Update Utility made changing the process used in 1996 worthwhile?
☐ YES ☐ NO

In your own words, what do you think about the two different methods that were used for the design of the Trail Network?

____

____

____

____

____

Thank you for completing this survey. Please send it back in the return envelope that was included in your packet.

Figure C-5. Comparison Section of Survey

TRAIL NETWORK UPDATE SURVEY
APPENDIX A: Web-Based Tool for viewing Data

This is a screen shot of the web-based Trail Network Update Utility used for viewing data.

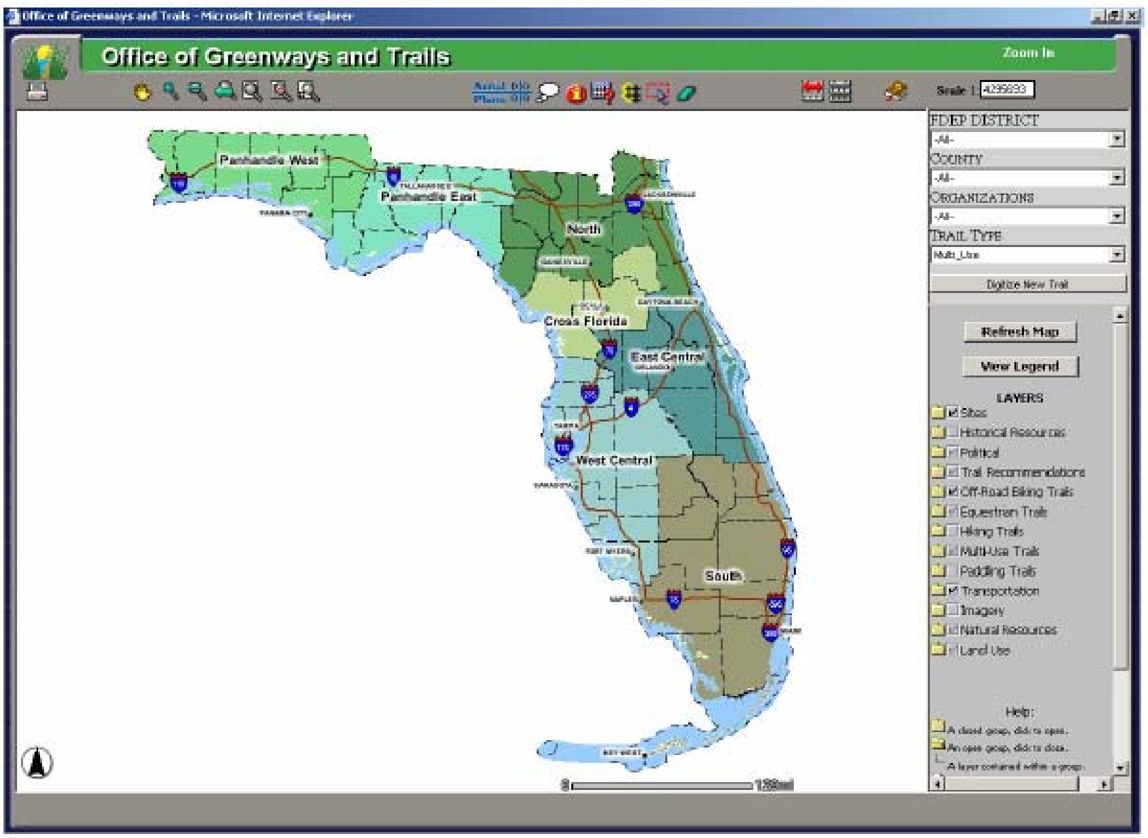

Figure C-6. Graphical Representation of Web-Based Tool in Survey

TRAIL NETWORK UPDATE SURVEY
APPENDIX B: Web-Based Tool for Digitizing

This is a screen shot of the digitize portion of the web-based Trail Network Update Utility.

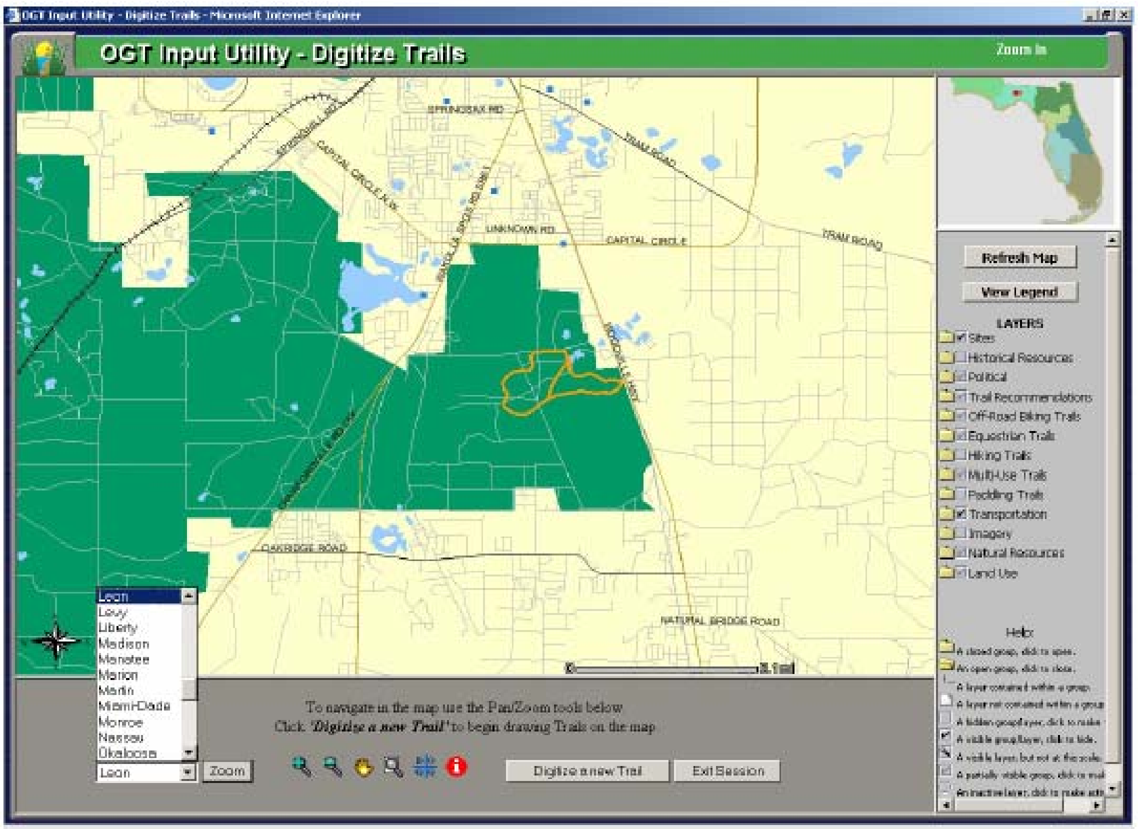

Figure C-7. Graphical Representation of Input Utility in Survey

Please use this space to add any additional comments.

Figure C-8. Blank Page for Additional Comments in Survey

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BIOGRAPHICAL SKETCH

Lila Schaller was raised in a small intentional community (called Spiral Garden) outside of Tallahassee, Florida. She attended a number of alternative schools throughout her childhood, including the Montessori Cooperative Early School, Grassroots Free School, Full Flower Education Center, and School for Applied Individualized Learning (SAIL). Lila received her undergraduate degree in Geography from the University of Florida in 2002. During her undergraduate education, Lila worked as a GIS Technician at the USDA Natural Resource Conservation Service. Upon graduation, Lila worked as a GIS Analyst at 3001, Inc., in Gainesville, Florida. In the fall of 2003, Lila began pursuing her master’s degree in Urban and Regional Planning at the University of Florida and began working at the GeoPlan Center.