

Florida's Environmental Screening Tool: Taking ArcIMS to the Edge

Ruth Roaza, Ilir Bejleri, Ph.D., Alexis Thomas, Peter McGilvray

The Florida Department of Transportation has developed a new, more efficient process for conducting environmental reviews of transportation projects. A key component of the process is Florida's Environmental Screening Tool, an interactive database and mapping application available on the Internet. Planners use the tool to digitize projects directly on-line or upload existing GIS files. GIS analyses are automatically run to locate environmental resources in the project vicinity. Environmental resource agencies review project information, view maps, query results of GIS analyses, and record comments about project impacts on priority resources. The application uses ArcIMS, ArcSDE, Oracle, ArcObjects, JSP, XML, HTML, PERL, and JavaScript.

INTRODUCTION

In response to the "Environmental Streamlining" legislation passed by the Congress as part of the Transportation Equity Act for the 21st Century, Florida has undertaken efforts to implement a more efficient transportation planning and environmental review process. These efforts led to the development of Efficient Transportation Decision Making (ETDM) process, which redefines how the State of Florida accomplishes transportation planning and project development. The overall intent of the ETDM process is to improve transportation decision-making in a way that protects the human and the natural environments. The approach includes active participation of federal, state, and local agencies, and the public. Early in the transportation planning process, resource agencies and the public interact with transportation planners to identify potential effects that the project may have on the community and the natural resources. Agencies also identify avoidance and mitigation opportunities and prescribe technical studies to be accomplished by the Florida Department of Transportation (FDOT) when the project proceeds.

An innovative technology application, the Environmental Screening Tool (EST), provides a vital foundation to the new process, supporting agency participation and community involvement throughout the project life cycle. The EST is an Internet-accessible application that provides tools to input and update information about transportation projects, perform standardized analyses, gather and report comments about potential project effects, and provide information to the public. The EST brings together information about a project and provides analytical and visualization tools that help synthesize and communicate that information. The user community includes staff from 7 FDOT district offices, 26 Metropolitan Planning Organizations (MPOs), 24 resource agencies, and the general public. The

application is used throughout the ETDM process to:

- Integrate data from multiple sources into an easy to use, standard format
- Analyze the effects of proposed projects on the human and natural environment
- Communicate information effectively among agency representatives and to the public
- Store and report results of the environmental review effectively and efficiently
- Maintain project records, including commitments and responses, throughout the project life cycle

The EST integrates ESRI's Internet mapping service (Arc IMS), Oracle relational database management systems and traditional geographic information system (GIS) techniques. This integration was implemented using industry-standard platform-independent development tools such as Hyper Text Markup Language (HTML), Java Script, Java Server Pages (JSP), ArcObjects, and Extensible Markup Language (XML). The application is deployed at the University of Florida in conjunction with the Florida Geographic Data Library (FGDL), a repository of GIS data gathered from federal, state, and local governments.

This paper describes the Environmental Screening Tool, with an emphasis on the technical challenges and how these were overcome. The Technology Foundations section provides an overview of the application functionality, data flow, system configuration, and database design. The next section describes the mechanisms for project data entry and standardized GIS analyses. The Review of Project Effects section describes the application components that are used to identify potential project effects to the human and natural environments. Finally, the paper concludes with a summary of the challenges that the FDOT has met in implementing a statewide information system to support the new process.

TECHNOLOGY FOUNDATIONS

The EST is a fundamental component of the new ETDM process. As such, its development occurred in conjunction with process refinements. This created a very flexible environment in which the process could be refined to take advantage of technology, and the technology could be easily adjusted as process details were defined. It also presented the team with the challenge of developing a complex application while the work process requirements were still evolving. The team addressed this challenge by designing for change and developing the application incrementally in a series of modules. The database design emphasizes flexibility so that the application can be easily adapted as the process is adjusted. Each module was developed by starting with the basic requirements and adding complexity as the process was refined. This allowed frequent opportunities for the steering committee and potential users to review and respond to the application as it was being developed. The end result is a toolbox of customized applications that supports the ETDM process. These are organized in the following modules:

Project Input Utility: Used by the FDOT and MPOs to add new transportation projects to the database and update the database as the project progresses through the ETDM process. The EST provides three ways for new projects to be entered into the system. MPOs with existing GIS databases may upload their existing files using the "Transfer GIS Files" option. Alternatively,

FDOT planners submitting plans for existing state roads can use an extraction utility to transfer information from the State Highway System (SHS) database into the ETDM database. In addition, projects that are not already available digitally can be entered on-line using a digitizing utility. When projects are added or modified, the application automatically analyzes the proposed projects using prescribed criteria developed by the ETAT; for example, calculating the acreage of wetlands within the impacted area, and counting the number of known historical and archaeological sites in proximity to the candidate project.

Project Management Tools: Provide functions for ETDM Coordinators and their project management teams to review project entries for completeness, notify ETAT representatives to review projects, and create summary reports.

ETAT Review Tools: Include forms and maps for agency representatives on the Environmental Technical Advisory Teams (ETAT) to view and query the database, review results of the GIS Analysis, and enter comments about the project into the database.

Sociocultural Effects Module: Used by the FDOT and MPOs to enter community characteristics into the database and review the sociocultural effects of the projects.

Public Information Site: Enables read-only access to the ETDM database.

While each of these modules provides unique functionality to various users in the ETDM process, they all access a single integrated database. Figure 1 illustrates the flow of information through the Environmental Screening Tool. MPO and FDOT planners enter information into the database about proposed transportation projects. These organizations also provide community characteristic information for their areas of jurisdiction. Resource agencies provide information describing their priority resources to the FGDL. This information is loaded into the ETDM database and is accessed through Internet map services. After projects are loaded in the database, standard GIS analyses are automatically performed to identify potential environmental effects. These analyses were prescribed by the resource agencies during the needs assessment and include concerns such as, identifying National Register Sites within a mile of proposed projects, describing wetland characteristics within the potential right of way, or locating critical species habitat within a half mile of the project. The results are stored in the database along with the project information. Agency representatives and the public review project details, resource maps of the project location, and the results of the GIS analyses. They supplement their review with additional information and local knowledge of the area. Agency representatives coordinate internally to resolve agency positions. When the internal position is formulated, they enter the agency comments into the database. The public provides input directly to the MPOs and FDOT through existing public involvement techniques such as workshops and surveys. After the review period, coordinators in the MPOs and FDOT summarize the information and it becomes available for public review and comment.

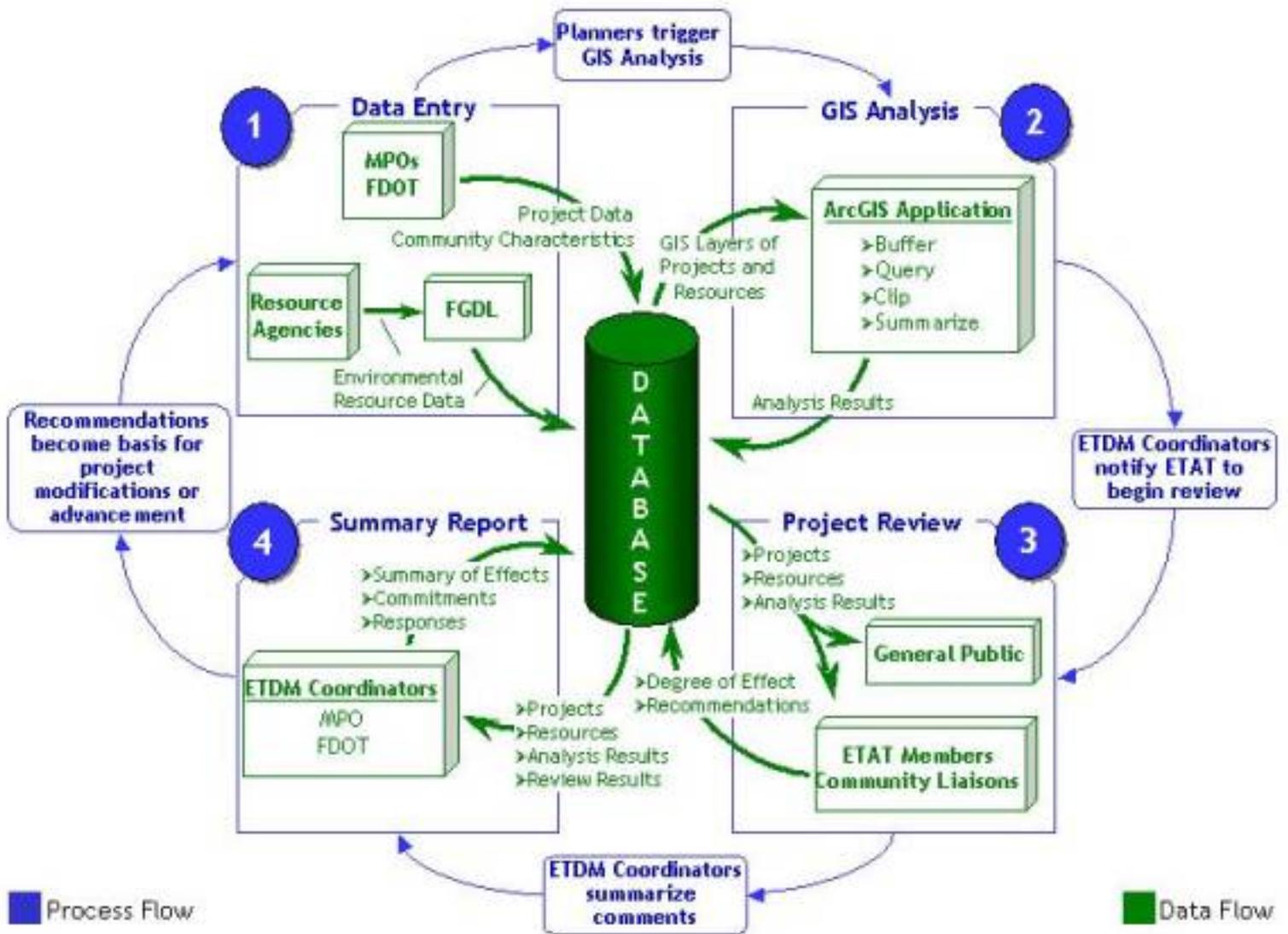


Figure 1. EST Process and Data Flow Diagram

The ETDM database is currently built on Oracle 8i technology. It is comprised of no fewer than 75 tables that store schema specific attributes. These include the location and orientation of transportation projects currently undergoing the planning and review process, the location of designated communities and community focal points, and the results of all GIS analyses. The database also stores attribute information for all projects including project descriptions, purpose and need statements, project reviews and comments, and summary reports. Thirty-four database triggers are employed to update history tables, which archive the changes made to each project; to track significant modifications made to projects (including changes to linework and segment configuration); and to automatically increment ID codes. Stored procedures are used to keep track and limit the ETAT review period. Oracle views and SDE spatial views are utilized for complex joins of tables and efficient display of spatial layers.

The ETDM spatial database is built from the Florida Geographic Data Library (FGDL). FGDL is a mechanism for distributing satellite imagery, aerial photographs and spatial (GIS) data throughout the state of Florida to the general public. FGDL is stored and maintained at the University of Florida's

GeoPlan Center. Data is collected from various sources, including state, federal and local agencies, nonprofit organizations, and private companies. All data is subject to a QA/QC (quality assurance/quality control) procedure, which organizes the data into a standard format and projection, with complete documentation (metadata) for each data layer. Hence, many FGDL users will not have to do any additional data processing in order to begin analyses. FGDL's standardized structure lends itself to be a symbiotic component of ETDM. The data merely needs to be loaded into the ETDM architecture (ArcSDE), and analyses can be performed against the data without affording extra computer processing time for data standardization. Spatial data currently used in the EST contain over 200 statewide vector layers and 10000 images. Examples of vector layers include: National Wetlands Inventory (line and polygon), USGS 1:24000 Hydrography (line and polygon), parcels, Specific soils, landuse, future landuse, and various layers describing Florida's social, natural, and physical environment. SDE image layers include mosaics for 3885 Digital Orthophoto Quarter Quads, over 7000 black & white aerial photographs, and statewide LANDSAT imagery.

The system configuration was designed to allow maximum flexibility in development of any given module while supporting an initial capacity assumption of approximately 200 users. The Oracle DBMS and SDE installation were selected to run in a Unix environment for purposes of scripting and overall robustness. The choice of Windows for the ArcIMS server was based on early phases in the development process (i.e.: initial deployment with Microsoft IIS and Active Server Pages (asp), versus current Apache and jsp configuration). The applications developed in VBA have been turned into Windows services distributed across application servers, with individual services tied to specific CPUs. This model allows for easier application development and implementation, as well as identification of individual application resource use and needs.

System configuration

DBMS server:

- Oracle 8i (version 8.1.7)
- SunFire 280R with 2 900 MHz processors
- Solaris 8
- ArcSDE 8.2

ArcIMS server:

- Dell Poweredge 6450 with dual 1 GHz processors
- Windows 2000 Server
- Apache 1.3.27
- Tomcat 3.2.3
- ArcIMS 4.0.1

Application servers:

- Dell Poweredge 6450 with dual 1 GHz processors
- Dell Precision 410 with dual 500 MHz processors

PROJECT DATA ENTRY

The project data are entered in the ETDM database by using the Project Input Utility. This utility enables FDOT District staff and MPOs to add new projects to the database, review analysis results, and update the database as the project progresses through the ETDM process. The EST provides three mechanisms for new projects to be entered into the system:

- Transfer GIS Files
- On-line Data Entry
- Extraction from FDOT State Highway System

Each method is designed for specific user needs, has its own functions and interfaces and present advantages and limitations that are discussed in the following sections.

Transfer GIS Files

This mechanism is designed to allow existing GIS data to be readily translated and transferred to the ETDM database. This option is intended for planning organizations that already have their project data in GIS format or in a format that is easily converted to GIS.

File Format: At this time, the only accepted formats for uploading are ESRI Shapefiles, ArcSDE export, or ARC/INFO coverage export files. The spatial features should represent line segments that make up project corridor alternatives. Each transportation project may contain one or more alternative corridor lines made up of one or more segments. Attribute data describing the projects, alternative corridor lines, and segments if not already part of the GIS attribute tables may be submitted in a separate dBASE IV, Excel, or Oracle table; but if so, a unique segment identifier, alternative identifier and project identifier must be included for each record of both the external attribute table and the feature attribute table to enable the tables to be linked. Supplemental attribute project information such as Purpose and Need Statement, Summary of Public Comments, Project Description Summary etc. is stored in the ETDM Oracle database in fields of type "CLOB". These fields are too large and the required information that gets stored in these fields is unsuitable to be transferred using dBASE IV or Excel. For this reasons this information is simply transferred using text files. Last, the GIS files must include an up-to-date projection file and a metadata file that contains information about the source and accuracy of the project data.

Transfer: All relevant project files must be compressed into one single zip file. This file is uploaded in the server using a file upload custom utility. The user information is collected using an input web form (Figure 2).

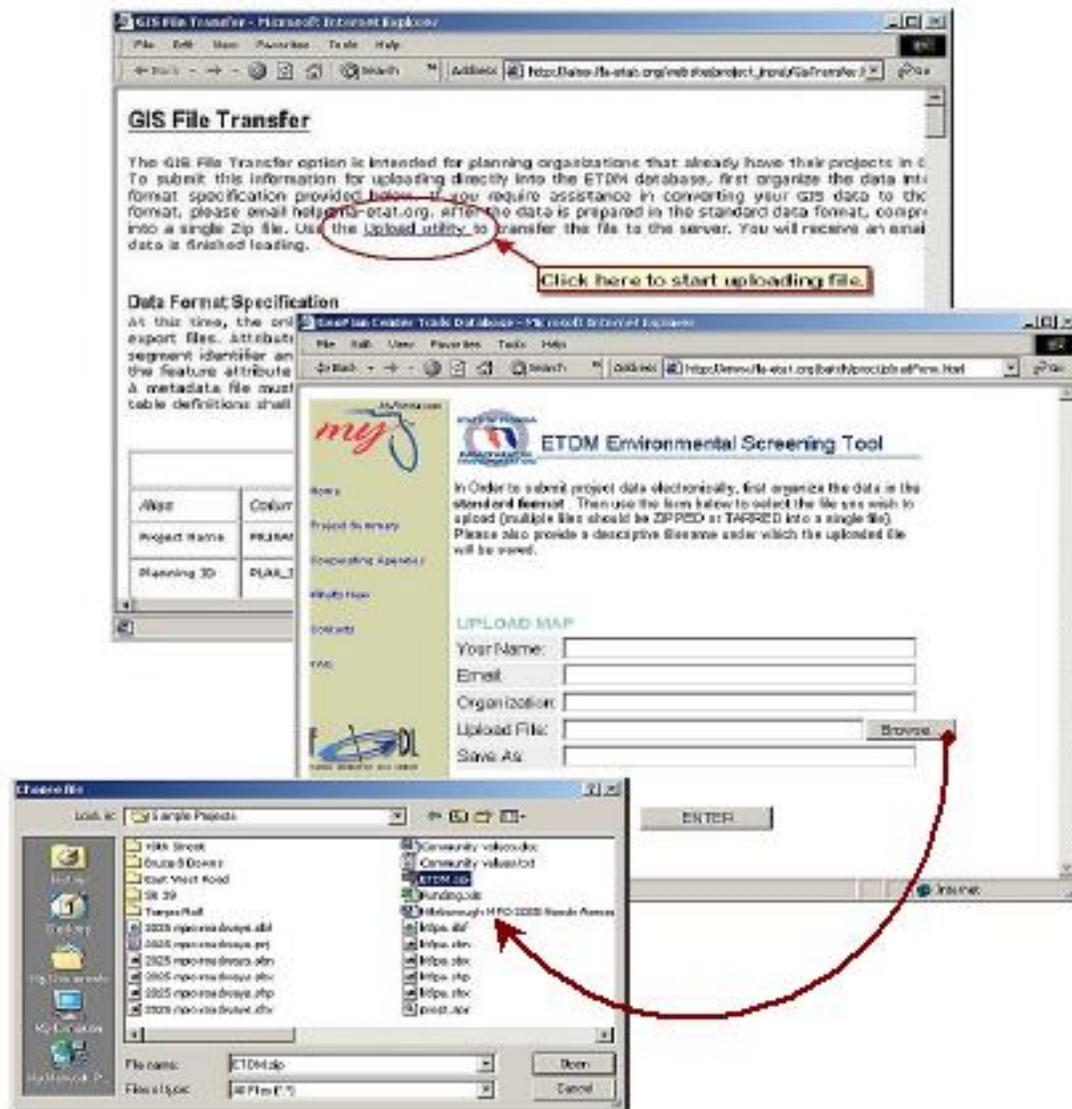


Figure 2. Web interface to transfer GIS files

Processing: The submitted data is then processed and converted to a format compatible to be entered in the ETDM Oracle database. Most of the processing is semi-automatic and is done using GIS and database software tools.

Transfer GIS files mechanism has the benefit of minimizing redundant data entry. However it has the limitation of not being fully automated. In addition potential problems may arise with data projections and especially with missing or incorrect unique ID values used to joint attribute data to segments. At present all problems are corrected manually. Future plans include developing tools to automate routine steps as the input data become more standard.

On-Line Data Entry

This is a mechanism designed to allow users to create project data in GIS format and store them in the ETDM database. This option is useful for planning organizations that don't have their project data in

GIS format. On-line data entry allows users to digitize street segments on-screen and enter corresponding attributes using input web forms. Both spatial and non-spatial information is integrated and stored in the ETDM database.

On-screen digitizing: It is used to draw new segments. The base for digitization is an ArcIMS image service. The client places points on the screen to designate segment beginning and end points. The segments are generated on the server and the client screen is refreshed to show the new segments. The service contains several GIS reference data layers such as streets, water bodies, political boundaries and aerial photography. Segments are drawn using different colors and are labeled automatically. The module offers some basic online editing capabilities such as snapping to segment endpoints, adjustable snapping tolerance, automatic connection of new segments to the end point of previous segments, deletion of last point drawn, deletion of the entire segment and zoom and pan during digitizing (Figure 3).

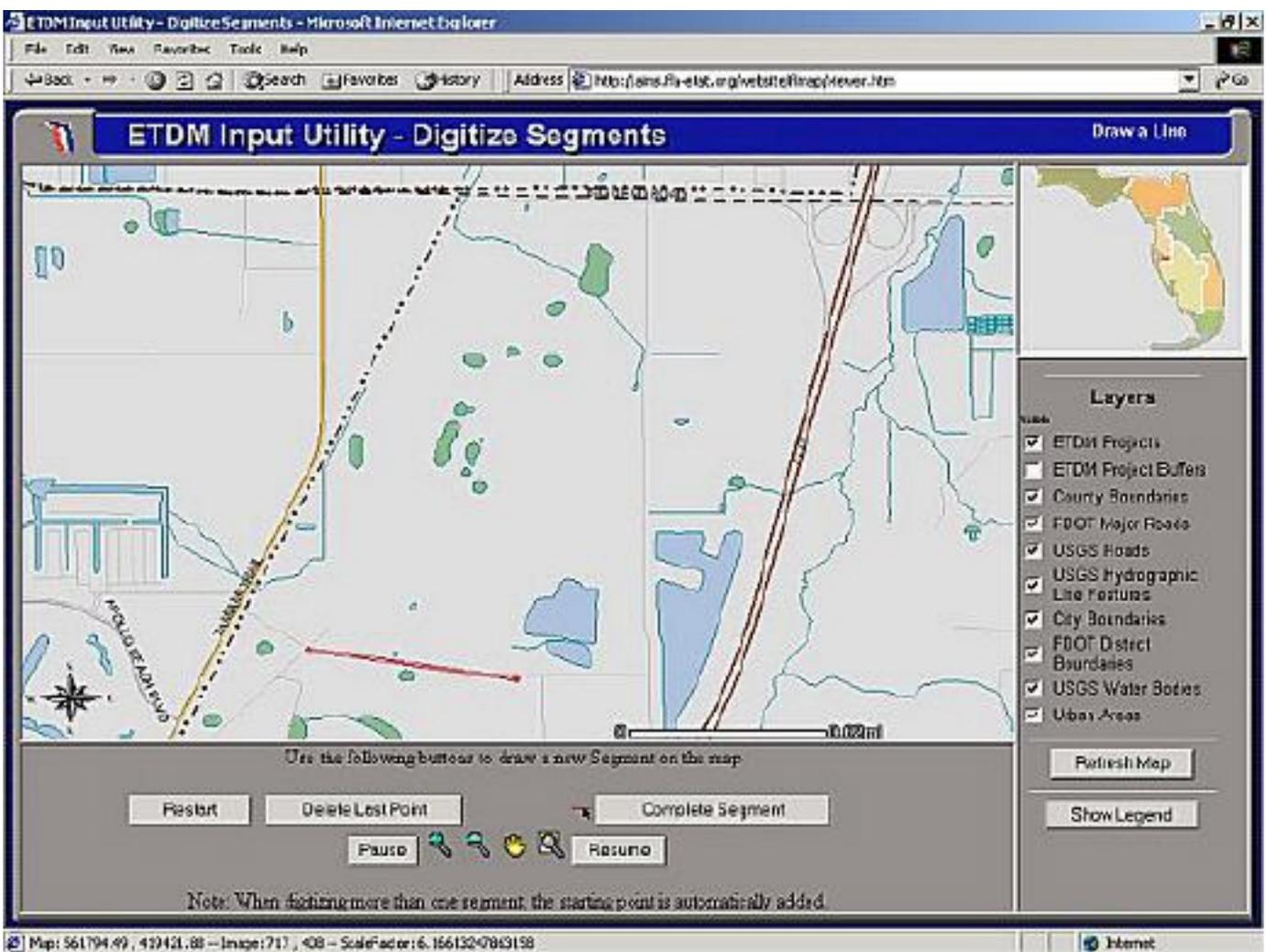


Figure 3. On-Line segment digitizing interface

Attribute entry: Project description information and individual information for each segment is entered in web forms (Figure 4). This module has the capabilities to enter more than one alternative for each

project. Once the data entry is completed the Project Input Utility, writes the project data to the ETDM database.

ETDM Project Description

Project Name:
Planning ID:
Planning Organization:
FHS:
ETDM Stage:
Project Type:
County:
Beginning Location:
Ending Location:

Consistency (Check Yes, No, or Unknown)
Y N U
 Air Quality Conformity
 Local Government Comp Plan
 MPO Goals and Objectives

Purpose and Need:

Project Description Summary:

Summary of Public Comment:

Project Alternative

Alternative:
Total Length: . miles
Total Cost: .00 dollars
Beginning Location:
Ending Location:

Mode(s) (Check all that apply)
 Roadway
 Pedestrian
 Bikeway
 Transit

SUBMIT CLOSE

Figure 4. Input project description and segments

The On-Line Data Input mechanism has the advantage of being fully automated. In addition there are no issues of incompatible data projections since digitizing is done on top of reference data that are already in the ETDM GIS projection, so the new data created is automatically stored in the same projection. Use of forms to capture the project information and segment attributes minimizes errors especially when attributes are selected from pick lists. Despite its advantages this method does have its problems in a multi-user environment.

Extraction from FDOT State Highway System(SHS)

This method is used by FDOT planners to submit plans for existing state roads. Segments are extracted from the SHS and transferred to the ETDM database. Segment extraction is based on segment Roadway ID, beginning milepost (BMP) and ending milepost (EMP). The interface provides tools to assist FDOT planner to determine the Roadway ID and milepost by placing the cursor along any state road (Figure 5). This module is integrated with the on-line data entry system to digitize new proposed SHS segments.

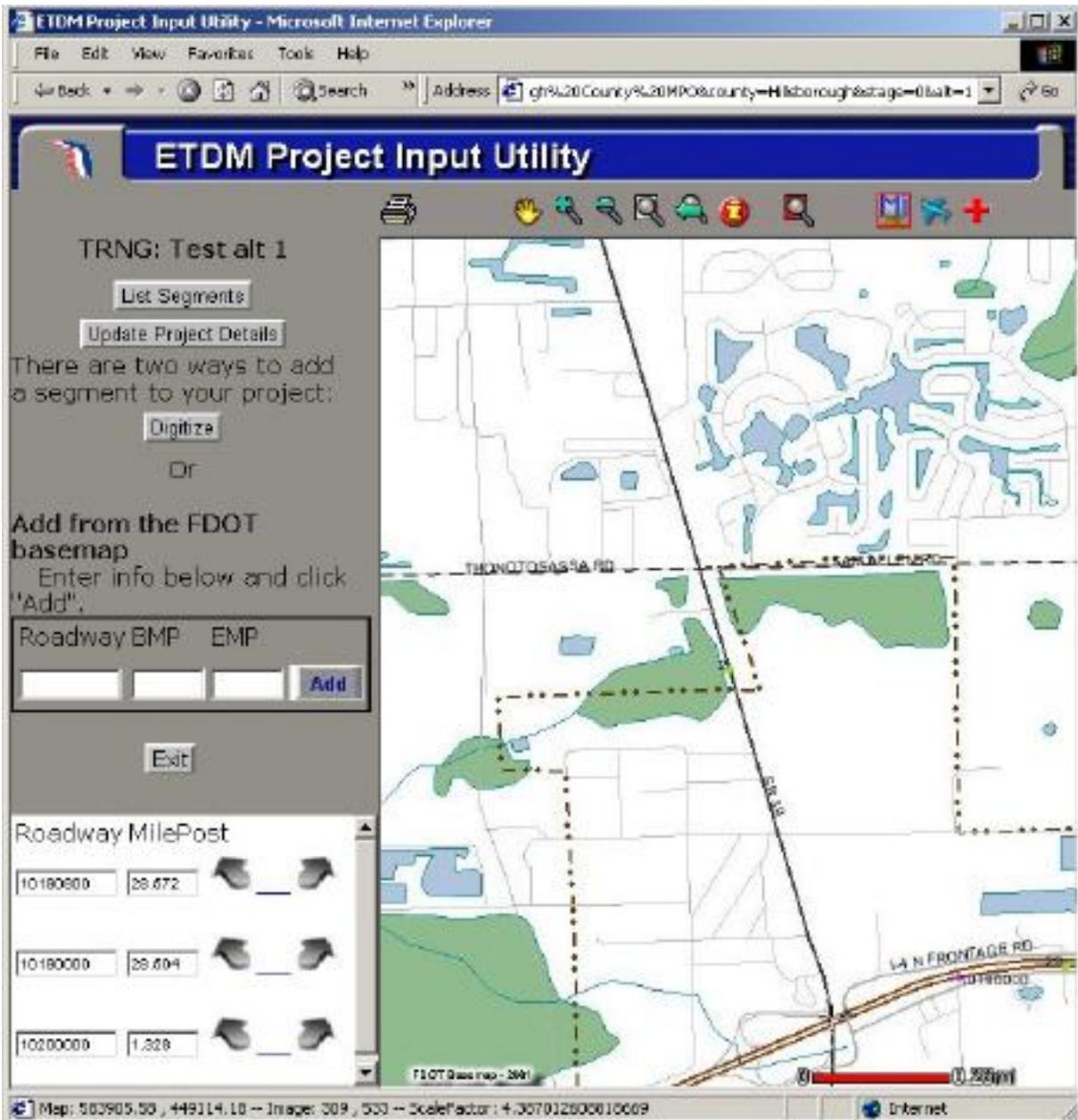


Figure 5. Extraction from State Highway System

Project Modification

The input utility along with project input provides functions that allow project modification for projects

entered online or those extracted from the SHS. The project modification interface allows for selection of a project by searching based on various criteria such as Project Status, County, Planning Organization and ETDM stage (Figure 6).

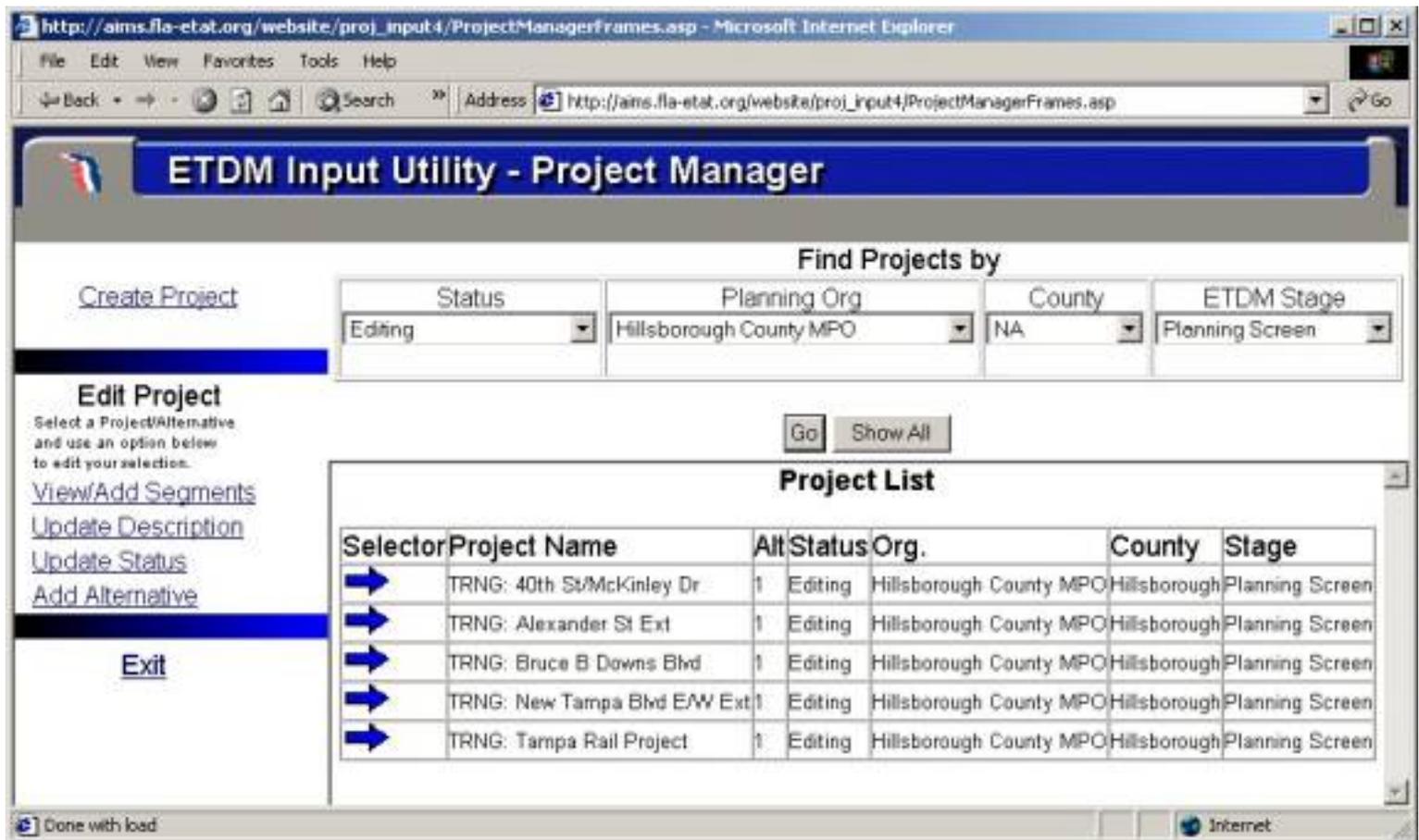


Figure 6. Project manager interface showing projection selection and project modification functions

This interface allows for the update of project information using web forms, changing the geometry and attributes of segments and the ability to add new segments and new alternatives.

GIS ANALYSIS

After projects have been entered into the database, automated GIS analyses are conducted to determine environmental and socio-cultural resources that may be impacted by the proposed project. The analysis compares the location of the project area with the location of various environmental and cultural resources (stored in GIS format) and produces numbers as quantitative measurement of the impacts. For example one of the analysis criteria is to determine the impact of the proposed projects on the wetlands. The analysis performs an intersect operation between the wetlands GIS data layer and the project area and produces a list of wetlands affected, the area in acres for each wetland in the study area and the total acres of wetlands affected. These results are stored in the ETDM database to be reviewed later by the ETAT review team (Figure 7). The following sections provide more details about the GIS analysis

routine.

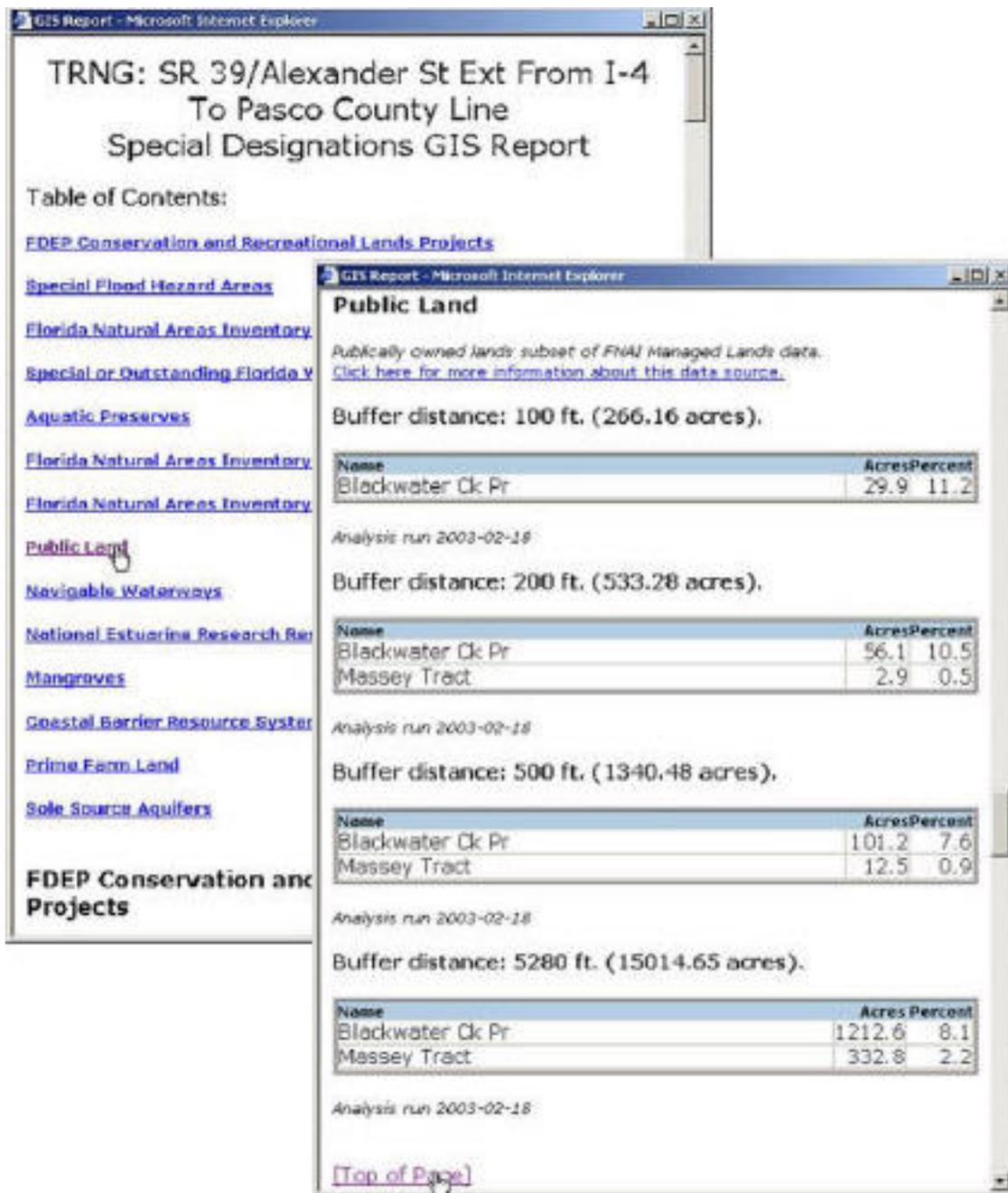


Figure 7. Results of the GIS analysis

Analysis Criteria and Data: ETAT has developed a number of prescribed standard criteria or issues that need to be considered for each proposed project. These issues reflect the need of all resource agencies involved in the project. Issues include land use, farmlands, recreational areas, wetlands, wildlife and habitat, historical and archeological sites, socio-cultural effects, mobility, noise, air quality, water quality and quantity, contaminated sites, flood plains, safety etc. Each issue is associated with one more GIS data layers that provide information to be analyzed. For example, to assess the impact on wetlands several GIS data layers are analyzed: National Wetlands Inventory, Priority Wetlands Habitat, Hydric Soils, Sinkholes, Seagrass Beds and Mitigation Banks.

Analysis Area: ETAT has defined three standard analysis areas: 100 feet, 500 feet and 1 mile buffers around the proposed project centerline. All the analyses are performed for each buffer area. The three buffer areas are chosen in order to determine the impact on the areas that are in close proximity to the proposed project but also to see the potential impact of the project to a larger extent.

GIS Functions: The GIS functions employed to perform the analysis include:

- **Buffer:** Used to create the analysis area polygons
- **Attribute queries:** Used to select for analysis only relevant features, e.g. the query expression $FLUCCS \geq 2000$ and $FLUCCS < 3000$ is performed on the land use layer in order to select only the agricultural lands needed to be analyzed for a given issue. FLUCCS is the field in the landuse layer that stores the Florida Land Use Codes.
- **Spatial queries:** Used to select the features that are completely within or intersect the study areas. This operation narrows further down the feature selection to a subset that spatially coincides with the study area.
- **Clip:** Used to determine the area of polygons and the length of the lines that cross the study area.
- **Summarize:** Used to calculate the total acres of polygons in the study area. Analysis Results: The results of the analysis are stored in the Oracle tables as a string in HTML format. This information is retrieved later and is used by the review module to show the results in web pages that are generated dynamically.

GIS Application Structure: All the GIS operations and compilation of results are done automatically. They are performed by a custom ArcGIS application written in Visual Basic for Applications (VBA). The application is packed using Visual Basic (VB) into an executable that resides on the server and runs every time an analysis is required. The variables used by the application include project ID, segment IDs, GIS data layers, GIS operations to name a few. All this information is stored in the ETDM database (Oracle tables) that is external to the application. This solution allows flexibility to add more issues and data layers to be analyzed without recompiling the executable.

REVIEW OF PROJECT EFFECTS

After project information has been entered into the database and the standard GIS analyses run, agencies and the public review the projects for potential effects to the human and natural environments. These functions are performed through three of the EST modules: the ETAT Review Module, Sociocultural Effects Module, and Public Access Site.

ETAT Review Module

The ETAT Review module provides easy access to information about transportation projects currently submitted to the cooperating agencies on the ETAT. The information is organized by project and by resource issue. Each ETAT representative is responsible for reviewing the projects and recording

comments regarding the resource issue(s) for which their agency has jurisdiction. Two options are available for the ETAT Review tools. The "Database Only" link provides access to the forms and reports, but does not include maps. This option has faster response time over the network, but does not enable the user to view and query the GIS data layers. Federal agency field offices that access the Internet through telephone modems use this option to enter their comments about projects after reviewing GIS data from the FGDL on their local computers. For full access to the ETAT Review module, including the interactive GIS map service, ETAT members use the option "Database with On-line Map."

ETAT Review tools and functions help ETAT representatives to view, query, and comment on the projects and resources in the project area. The main portion of the module is an HTML Map Viewer (see Figure xx). The map viewer is an interactive GIS map with tools that enable users to navigate around the map, select features on the map, view metadata describing each data layer, and perform simple ad hoc analyses of the data. To the right of the map, are a series of pull down menus that have been customized for the ETDM process. These menus enable the user to quickly zoom to the county and the project extent, switch maps among the various environment issues that need to be reviewed, access reports of project information and GIS analysis results, and open forms to enter their agency comments. The Table of Contents (TOC) is located on the lower right side of the Map View. The TOC displays the list of data layers available in the Map View, allows the user to choose the layers to view and query on the map, and provides access to the map legend. Due to the large number of data layers available in each map, the listing of data layer names is organized in categories.

Each issue map is implemented as a separate image map service in ArcIMS. The forms and tools are written in JSP, PERL, JavaScript, and HTML along with some procedures to parse XML. The data layers served through the map servers are stored in Oracle using ArcSDE. The original prototype of the module was built using a Java version of the Map Viewer pulling data from shape files and using ASP as the primary programming language for the forms and tools. This platform proved to be extremely unstable and not suited for an inter-agency, multi-user application. The Java objects caused problems among the various agency firewalls and the combined use of ASP and shape files caused the map server to overload and freeze when more than 5 users accessed the system. Customization and optimization of this viewer was problematic because the source code for the Java viewer is not open source. These problems were resolved when the application was implemented in the current environment.

Sociocultural Effects Module

The Sociocultural Effects module enables FDOT district staff and MPOs to enter community characteristics into the database and record the sociocultural effects of projects.

Community Characteristics are added to the database through a Community Characteristics Inventory tool. This tool is comprised of an HTML Map Viewer with functions to digitize community extents, update information to describe those communities, and add community focal points. Community boundaries and focal points are digitized directly on screen and appended to SDE layers. These

programs are written in JSP, JavaScript, and HTML. Attributes are added to the database via forms written in PERL.

Sociocultural effects of projects are recorded in the EST through a tool that is very similar to the ETAT Review option with the on-line mapping. Tools in this application enable users to review project information, data layers, and results of GIS analyses pertaining to the human environment, such as demographics, community characteristics, and cultural and historic resources. They record project effects by answering a series of questions to help identify significant issues that may cause concern in the community. The application is deployed as an HTML Map Viewer with forms, tools, and reports written in JSP, JavaScript, and HTML.

Public Access Site

Through the public access site, the general public can query the ETDM database to retrieve reports about project characteristics, agency comments, and GIS analysis results. This module is written in JSP, JavaScript, HTML and XML. A light version of a Map Viewer is currently under development to provide access to the project location maps and environmental resource maps. At this time, the public cannot submit comments through this website. The FDOT and MPOs have existing mechanisms that successfully collect information from the public and make sure that the appropriate personnel receive it. The public will continue to use these mechanisms to provide comments about the projects.

CONCLUSION

The Environmental Screening Tool is an essential element of Florida's ETDM Process. It provides the mechanism to support project analysis, visualization, communicating information, facilitating agency participation and community involvement throughout the project life cycle. It provides the toolbox of modules that efficiently load data, store results of environmental reviews, and provide that information to the public. The EST development process and implementation strategy uses a phased approach, designed with flexibility and existing participant workflow processes in mind. This methodology allows continued refinement of the process and the application, gain user acceptance, ensure a continuous feedback loop, effectively manage expectations, and minimize change. Application Development Process

Because the EST is fundamental to the success of the new ETDM process, application development occurred simultaneously with process engineering. The application development team participated in the meetings when the new process was being developed to enable continual feedback about technology capabilities, process refinements, and development activities. After the process was developed at the conceptual level, application development began, using the following general methodology:

1. Determine general system requirements

- Identify key objectives of the ETDM process to provide a focus for technology solutions
- Review existing information systems that users have found helpful in other environmental

- processes and projects
- Evaluate options

2. Build the database foundation

- Conduct a needs assessment with the cooperating agencies to identify data needs and GIS analysis requirements
- Acquire existing sources of environmental resource data
- Design the database

3. Develop the user interface in independent modules

- Develop functional prototypes
- Present prototypes to the project directors and potential users
- Modify modules based on feedback

4. Enhance the application as the process details are further developed

- Participate in meetings to help refine the process
- Develop system specifications and costs for modifications
- Implement modifications after receiving authorization from the steering committee

Implementation Strategy and Status

The FDOT is using a phased approach to implement the new ETDM process. EST training, user support, and maintenance are an integral part of that implementation and coincide with the deployment of the ETDM process. EST, version 1, production release occurred in March of 2003 with the beginning of statewide training on the ETDM process. The incremental release, training, and support of the Environmental Screening Tool modules take place concurrently with each scheduled ETDM event.

Training: The EST training program consists of two delivery methods; 1) Hands-on training presented in a lab setting where the participants actively use the module and work through examples and 2) Web-based training classes through eCONNEX and Lotus Sametime software. Given not only the number of users but their organizational, functional, and geographical disbursement, it is imperative to supplement the hands-on training to provide numerous engaging training opportunities. The web-based classes consist of a set of users logging on to a web site and calling into a teleconference line. Once there, class is conducted as if it were in a lab setting with the ability to see the instructor's presentation from their office computer, as well as interact with the instructor and work through examples.

Initial statewide training about the ETDM process finished in May 2003. These workshops included an overview of the Environmental Screening Tool. Following these training sessions, the first round of hands-on training for the Input Utilities and ETDM Project Manager modules was scheduled to begin

the initial upload, update, and management of the proposed projects found in the MPO Long Range Transportation Plans and FDOT Cost feasible Plans. Training for the Sociocultural Effects EST Modules training will coincide with supplemental training on the Sociocultural Effects process, scheduled from September 2003 - November 2003. The initial event to review projects for environmental effects is scheduled for December 03 - March 04. Agency ETAT members and support staff will be trained on the ETAT Review Modules between October 2003 - December 2003.

User Support: Support of the EST is available to the user community in several formats. The first is a comprehensive online self-help center. The center provides access to the EST manuals and user guides, PowerPoint presentations describing the ETDM process and EST modules, frequently asked questions, a how-to section, and a discussion forum where the user can engage other users in conversations to work through any issues. The center also provides a mechanism to report application problems and suggest enhancements. It also offers access to short movie clips demonstrating each module to reacquaint the user and reintroduce the modules navigation and intended functions. Secondly, at FDOT, a central office Help desk has been established to field user support calls. Using either eCONNEX or the Lotus Sametime software, the Help Desk can visibly demonstrate to the user how a task is accomplished with the EST. A user can log onto a website and see the shared Help Desk support desktop as the support specialist talks the user through the steps over the phone. If the problem requires local support on the users computer, the Help Desk can use the remote access technologies within eCONNEX and Sametime to reach out and make any necessary local configuration changes.

Maintenance: The EST system maintenance is handled through formal version releases. Maintenance can include new functions and modules or access to new data and the supporting GIS analysis, as well as change requests. A change request can be either a defect correction or an enhancement to the system. Given the plasticity of the new ETDM process the development team has prepared itself for new and refined requirements. Contents of the change requests are reviewed to ensure clarity, completeness, feasibility, and consistency and then provided to the executive steering committee for implementation prioritization.

Environmental Screening Tool data set maintenance is handled through formal agency operating agreements in which participants agree to review and refresh the data at a defined interval. Depending on the data and the agency, this process can be weekly, annually, or longer. Other resource data sets that are housed at the FGDL and used by the EST but do not have an ETAT agency representative are reviewed and refreshed by the GeoPlan Center as they become available.

The single largest data set maintenance related task remains the collection, integration, and management of local government data into the EST database. These data sets and supporting GIS analysis represent the greatest resource expenditure because of the volume of disparate data. The GeoPlan has been tasked with approaching each MPO to identify their data and assess the feasibility of integration. The results of this effort are presented to the executive steering committee for review and prioritization.

Challenges & Solutions

The ETDM Process itself and therefore the Environmental Screening Tool represent a paradigm shift in how all the stakeholders collectively communicate, interact, plan and manage transportation improvement projects. For a statewide application of this magnitude, there were many challenges to rise above. Organizational lines are crossed. Functional lines within organizations are crossed. To overcome this enormous challenge in the development of the EST, FDOT used several consensus building strategies like Joint Application Development meetings, Memorandums of Understanding, interviews, surveys, and on-line discussion forums and team rooms. These techniques were used to identify and refine requirements, generate user support, and develop a communal sense of ownership.

Another challenge FDOT has been specifically dealing with has been institutional and cultural changes to accommodate the ETDM process. The FDOT has undergone several changes in its organization to lead the way for development. From creating new-dedicated positions, reworking job descriptions, revising business rules, developing agency operating agreements, and the restructuring of the organization to incorporate ETDM into the existing workflow, the Department has evolved to embrace the new process and supporting technology. This malleability to change as needs dictate has allowed the Department to take a very pivotal stance in the face of future technological developments, a challenge that every organization must strive to overcome.

Web technologies and browser based delivery methods have helped eliminate other challenges including the perception that you need to be a GIS specialist in order to effectively use a GIS based system and that you need a high-end computer and software to use this type of system. The EST leverages the existing technological infrastructure, provides a central entry point to a variety of resource and project data, and uses the power and performance of the Web to present the information to the community of users. The EST as a web-accessible system helps eliminate both challenges. The EST ease of use, phased implementation, frequent training opportunities, and system support structure help to alleviate most user concerns.

The ETDM process is still in phased implementation and not yet fully operational. However, the EST is in production and users are beginning to use it to process real projects. Based on feedback from testing, training, and initial use, user acceptance has been very positive so far. As with any application, enhancements will be needed as more people begin using it, but the foundation is solid. In the words of one transportation planner, after receiving EST hands-on training, one of the things that worked well in developing the ETDM process was *"the thought that went into the Environmental Screening Tool: easy and intuitive so that even people who are not GIS experts can use it!"* (Richard Clarendon, May 2003 email correspondence).

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AUTHOR INFORMATION

Ruth Roaza
Senior GIS Project Manager
URS Corporation Southern
3676 Hartsfield Road
Tallahassee, FL 32303
Tel.: (850)574-3197
Fax: (850)576-3676
ruth_roaza@urscorp.com

Iilir Bejleri, Ph.D.
Assistant Professor
University of Florida
Department of Urban and Regional Planning
431 Architecture Building
PO Box 115706
Gainesville, FL 32611-5706
Tel.:(352)392-0997
Fax: (352)392-3308
ilir@geoplan.ufl.edu

Alexis Thomas
Project Manager
GeoPlan Center
University of Florida
Department of Urban and Regional Planning
431 Architecture Building
PO Box 115706
Gainesville, FL 32611-5706

(352) 392-1379
Fax: (352)392-3308
alexis@geoplan.ufl.edu

Peter McGilvray
Information Technology Manager
Florida Department of Transportation
Environmental Management Office
605 Suwannee Street MS 37
Tallahassee, FL 32399-0450
Tel.: (850)410-5885
Fax: (850)410-5808
peter.mcgilvray@dot.state.fl.us