The Environmental Screening Tool: Efficient Transportation Decision Making with ArcIMS

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The Florida Department of Transportation has developed a new, more efficient process for conducting environmental reviews of transportation projects. A key component of Florida's Efficient Transportation Decision Making process is the Environmental Screening Tool, an interactive database and mapping application available on the Internet. The application provides transportation planners with the ability to digitize proposed projects, and enables participating agencies to review the effects of those projects on the human and natural environment. This paper discusses the implementation of the tool using ArcIMS, ArcSDE, Oracle, ArcObjects, JSP, and Perl with an emphasis on overcoming the technical challenges that were encountered. The paper provides background information about the requirements and how these were identified; techniques for on-line data entry and GIS analysis, customizing and optimizing the ArcIMS map viewers; and the challenges that the FDOT has met in implementing a statewide information system to support the new process.

INTRODUCTION

The Transportation Equity Act for the 21st Century (TEA-21) called for a streamlined approach for conducting National Environmental Policy Act (NEPA) reviews of transportation projects. In response, the State of Florida Department of Transportation (FDOT), working with the Federal Highway Administration (FHWA), Federal Transit Administration (FTA) and other federal, state, and local agencies, has developed a refined and improved methodology for better transportation decision-making while complying with all Federal and State environmental regulations. FDOT's Efficient Transportation Decision Making (ETDM) process redefines how the State of Florida accomplishes transportation planning and project development within its current statutes and regulations.

Some problems with the previous process that have been addressed by ETDM are:

- Sequential, dependent actions that result in long project timelines
- Long timelines can include gaps during which institutional memory may lapse
- Planning project inputs are not always carried into the project Design phase
- Late environmental resource agency involvement
- Risk of late project changes in response to unforeseen environmental effects

The new process brings environmental concerns into focus early in the transportation planning process, before time and resources are committed to projects that may be fatally flawed. Transportation planners receive feedback from environmental resource agencies and the public on projects as part of the new process. Potential effects of the project on the community and natural environment are communicated to the planners, allowing their organizations to identify potential problems and avoid, minimize, or mitigate those effects. The ability to influence transportation decisions and the availability of meaningful dispute resolution mechanisms are elements that give environmental resource agencies a real stake in participating in the process. In addition, the transportation planning process benefits from advance knowledge of potential effects, or lack thereof. This knowledge helps FDOT to better scope NEPA documentation, focusing on significant environmental issues while spending less effort on non-issues.

Key ETDM Process features include:

- Concurrent actions, resulting in time savings
- Early identification of critical issues, so there are fewer late surprises
- Interactive, cooperative transportation planning
- Shortened project timelines
- Efficiency gained from use of technology
- Early approvals linked to NEPA reviews of well-studied projects

The Environmental Screening Tool (EST) is an innovative ArcIMS application that 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 provides access to a repository of 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 [1]:

- 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 next section gives an overview of the modules that comprise the EST application and how those modules interact to support the ETDM process.

EST MODULES

The EST is an integral part of the functional implementation of the ETDM process. It is structured as a collection of modules that support the work of the various user roles, from transportation planner to environmental resource specialist. Each module consists of a set of web-based tools and server-side processes that handle the client web page requests. Each of the modules is described briefly below.

Project Input Utility**:** The Project Input Utility is used by FDOT and Metropolitan Planning Organization (MPO) transportation planners to input project data and line-work into the ETDM database. There are several methods for inputting project data, including:

- Batch upload of GIS files utilizing the ETDM project data specification
- Online digitization of project line-work
- Extraction of project line-work from the FDOT Basemap

Project planners can initiate GIS analysis routines that execute pre-defined buffer queries of community and environmental data. The results of these analyses are then stored in the database for reporting purposes. Project attributes and features can also be modified with the on-line utilities, while a history of project changes is recorded in the database.

Project Management Tools**:** These tools offer search routines for locating projects, and a variety of reports, tools, and reminders that assist ETDM Coordinators with administrative functions. Examples include the Generate Summary Report tool, a web form that allows coordinators to complete their summary reports; the Assign Project Manager tool, which allows some administrative functions to be delegated to other users; and the ETAT Review Status Report, which tracks the progress of ETAT reviewers in submitting commentary on selected projects.

ETAT Review Tools**:** A set of modules that give ETAT members the ability to view project attribute data in reports; display project line-work in an interactive map viewer; view GIS analysis results; perform interactive buffer analysis; review the project purpose and need statements; and enter the official position of their agency on projects being reviewed.

Sociocultural Effects Module**:** A set of modules for FDOT and MPO Community Liaison Coordinators (CLCs) that includes all of the ETAT Review Tools functionality, along with some additional tools to support Sociocultural Effects Evaluations (SCEs). For example, CLCs have the ability to digitize and describe community boundaries and focal points with the Community Characteristics Inventory tool; and CLCs can input desired project features, such as sidewalks or bike lanes, that have been expressed by the public.

Public Access Site**:** A publicly available website that provides access to the results of ETAT review screens, summary reports, project data, GIS analysis results, and an interactive mapping application similar to the one used by the ETAT members, CLCs, planners, and ETDM coordinators. All of the project data and project maps include only those projects that have been through a formal ETAT review, while some sensitive data is excluded from public access.

Other modules include the Discussion Forum, an online message board for informal discussion of the ETDM process, the EST, or any related topics. The website continues to grow in flexible manner as feedback is gathered from users during workshops, training sessions, and help desk calls.

PROCESS AND DATA FLOW

The various modules of the EST work in concert to manage the flow of data within the ETDM process. Figure 1 illustrates how each piece fits into the overall flow of information. The steps shown in the diagram for moving projects through the EST modules are described below.

1) MPO and FDOT planners load the database with information about proposed transportation projects, including purpose and need statements, project description summaries, and segment-level details. In parallel, community liaison coordinators load community characteristic information, and environmental resource agencies provide datasets of their priority resources to the Florida Geographic Data Library (FGDL).

2) Once project data and line-work is loaded, planners initiate the execution of GIS analysis routines. Datasets are organized into logical "Issues" such as Wetlands or Aesthetics, and the corresponding analyses of those datasets produce lists or summaries of the features in proximity to the proposed projects. The results of the analyses are stored in the database for fast search and retrieval.

3) ETDM coordinators select one or more analyzed projects for screening by ETAT members and the public. ETAT commentary is collected directly through the EST during a 45-day review period. ETAT members assign a Degree of Effect of the project on the issue being reviewed, and provide commentary on affected resources. Public comments are gathered via existing public involvement channels such as community outreach events and public hearings. CLCs then summarize these comments and input them to the ETDM database through the EST.

4) At the end of the review period, ETDM coordinators generate a summary report of the information collected during the ETAT review. The coordinators respond to individual ETAT comments; assign a summary degree of effect for each project and issue; coordinate with ETAT members to attempt to resolve any conflicts; and make commitments on behalf of the planning organization, such as agreeing to perform technical studies. Once complete, the summary report is made available to ETAT members and the public.

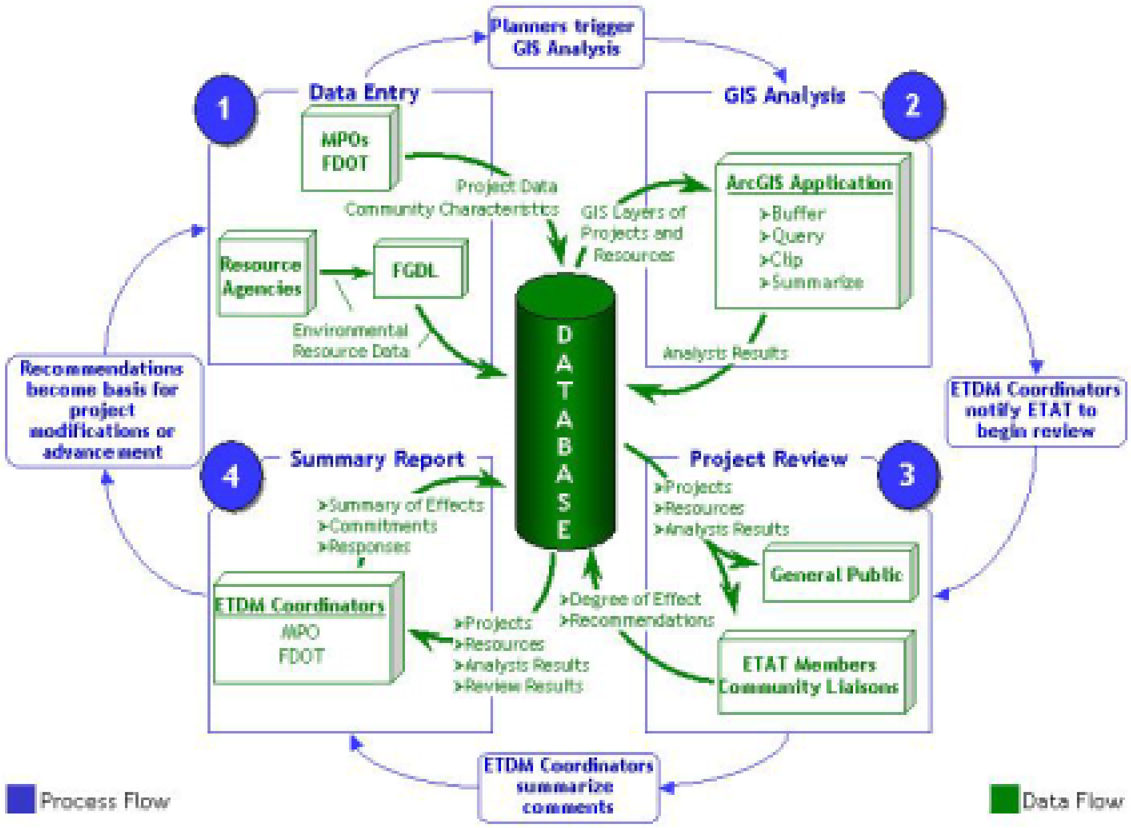

Figure 1. EST Process and Data Flow Diagram

Projects undergo multiple screening events, allowing project data and knowledge to accumulate over time. Project modes, alternatives, and configurations may change in response to the ETAT and SCE review processes.

TECHNOLOGY FOUNDATIONS

The EST, ETDM database, and related processes provide real-time multi-user access to maps and query capabilities; allow creation and modification of project line-work; perform GIS analysis routines and on-the-fly analysis; track time-dependent actions; and enforce user roles and privileges. Some of these functions are handled in application code, but the foundation for the dynamic applications and processes is the database. The Oracle database management system is used to manage tabular data from an array of interrelated entities:

- Projects, alternative corridors, segment attributes, and documents
- Analysis definitions and results
- ETAT reviews and SCEs
- Planning organization commitments, responses, summaries, and EST generated e-mail correspondence with ETATs
- Organizations, users, roles, and jurisdictions
- Association tables
- Lookup tables

- History
- Help Desk call tracking
- Development team task management

Other Oracle objects are employed to carry out some administrative tasks, for example:

- Oracle process for automatically closing the ETAT review period
- Stored procedures providing e-mail functionality to web forms
- Sequences and triggers for generating primary keys
- Update triggers for updating time stamps and writing history tables on update
- Views of commonly joined tables
- Indexes

Along with Oracle, the ArcSDE technology is used to manage spatial data including:

- Projects segments
- Community boundaries and focal points
- Spatial views joining tabular and spatial data for projects, segments, and community data
- Spatial indexes
- ETAT agency data
- FGDL data

The applications and data are housed at the University of Florida GeoPlan center. The center is also responsible for storing and maintaining the Florida Geographic Data Library, a repository of satellite imagery, aerial photographs and spatial (GIS) data from throughout the state of Florida. 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. FGDL's standardized structure lends itself to easily loading data into the ETDM architecture (ArcSDE), and performing analyses against the data, without requiring extra computer processing time for data standardization. [1]

The GeoPlan center houses and maintains all of the server hardware and software used by the EST. A brief overview of the system specifications is presented here.

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

Customization of the ArcIMS HTML viewer

The ArcIMS HTML viewer was selected as the basis for the EST because of its flexibility and ease of customization. The customizations to the EST include the addition of several tools to the viewer's toolbar, such as the "Show/Hide Aerials" tool; customized look-and-feel, using HTML framesets, div tags, and style sheets; and the integration of code from other sample viewers as needed, such as the MultiService sample, which is used to switch between map services. Using client-side scripting with JavaScript and server-side scripting with Java Server Pages (JSP) or PERL, the EST is a dynamic application that changes content served based on the role of the client user. Specific examples of these techniques appear in the following sections.

PROJECT ENTRY AND ANALYSIS

There are several methods for loading project data into the ETDM database. The methods are described in this section, along with details on the functional implementation.

Transfer GIS files

The data format specification published on the EST is used by planning organizations with existing project data in a GIS format to map data elements in their system to ETDM elements. Data that conforms to the standard is exported to ESRI shapefiles, or to ArcSDE or ARC/INFO coverage export files. These exported files are then sent for batch project uploading into the ETDM database. Project features, attributes, and supporting documents are compressed, archived, and submitted through a web form in the EST. A combination of JSP and PERL scripts are used to load the files and copy them to the appropriate location, where GeoPlan staff can verify if the data meets the specified requirements and then either load data that conforms to the standard into the database, or work with the planning organization to resolve any problems.

On-Line Data Entry

For users that don't have their project data in a GIS format, the EST provides tools for on-line entry of project data. Planners can digitize proposed projects on screen, edit the line-work, and enter attribute information through web forms. In addition, the line-work and some attribute information can be extracted from existing road segments on the state highway system (SHS).

On-screen digitizing: Transportation planners can use the EST to digitize projects under consideration. First, planners create a project record using an on-line form (Figure 3). The primary key of the project record ties all project information together, including segments, alternatives, modifications, GIS analysis results, and so on. The form is implemented with PERL and has a robust privilege checking function that ensures users only create projects within their database-defined jurisdictions.

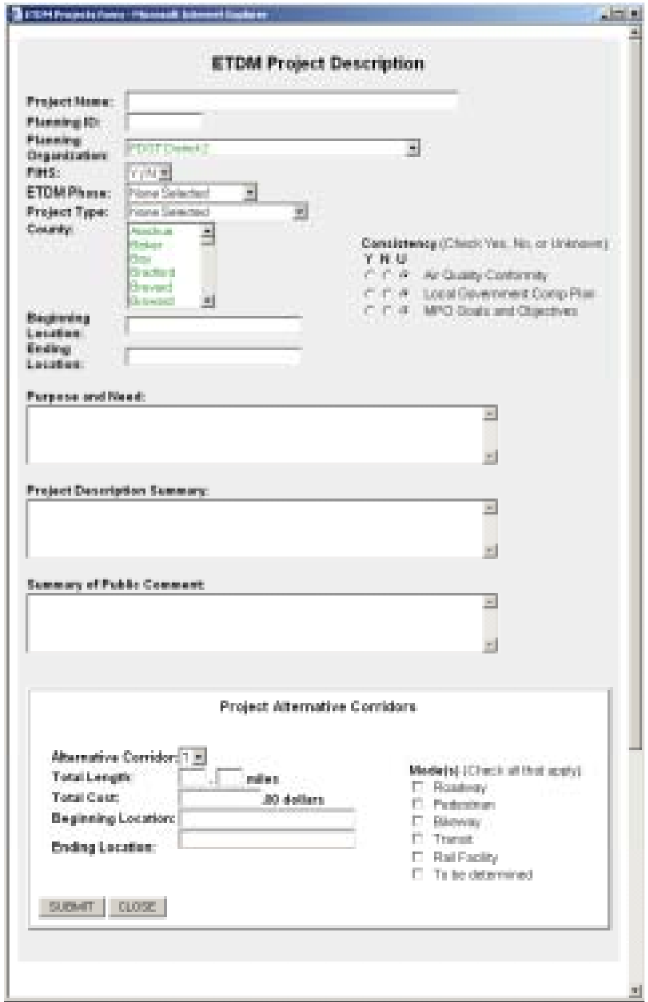

Figure 3. Input project description and segments

Users can search for projects created previously, edit descriptive information, add alternatives, update segments, and run GIS analysis using the project management page shown in Figure 4. The search filters are used to quickly find desired projects for further update and analysis. Projects appear in the list after the project creation form has been submitted. Once the tabular project record is created, users can add segments to the project using a customized HTML viewer interface, called the Project Input Utility. A screen capture of the on-line project input utility is shown in Figure 5.

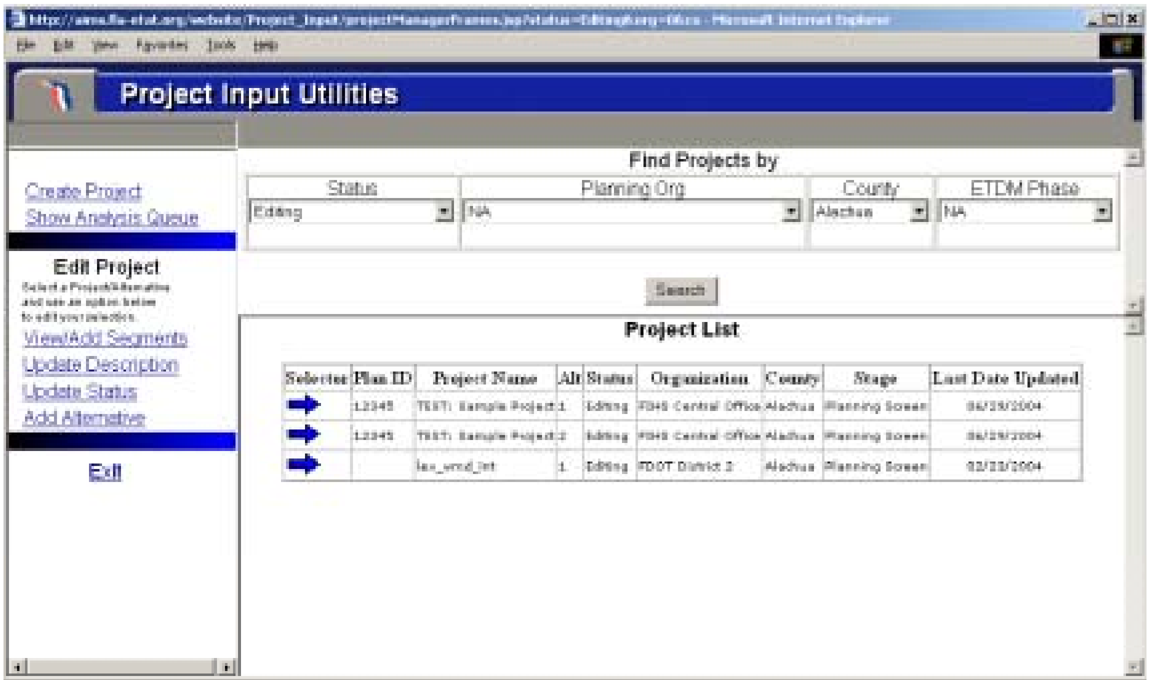

Figure 4. Project manager interface showing projection selection and project modification functions

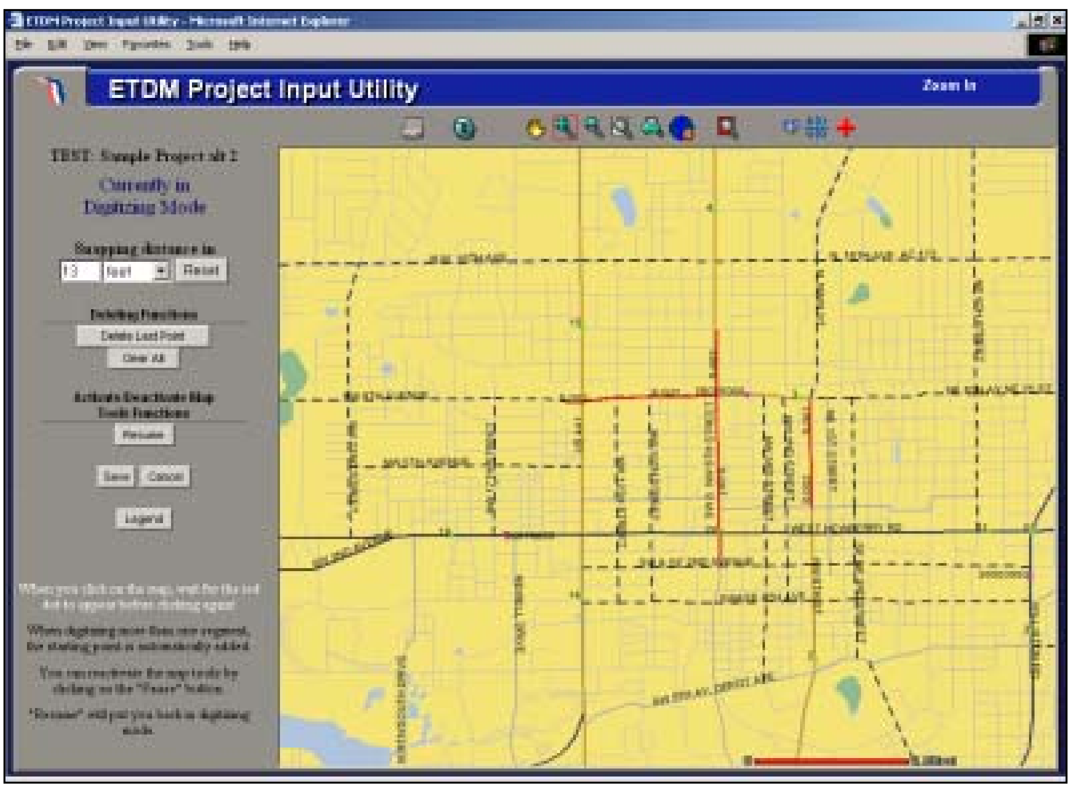

Figure 5. On-Line segment digitizing interface

Using a modified version of the built-in ArcIMS Measure tool, users can digitize lines on screen. The coordinates of the vertices they produce are stored in the browser's memory using JavaScript data structures. Any edits to the line-work at this point happen in much the same way that measurement lines are edited: delete last point and clear all points merely update JavaScript objects and update the map's acetate layer. When the "Save" button is clicked, however, several complex events occur:

- The coordinates of the polyline vertices are posted to a JSP page that loads them into a database table.
- An entry is inserted into a queue of requests for shape creation.
- A JavaScript setInterval function is used to periodically load a hidden JSP that checks the queue record for a success or failure flag.

Meanwhile, a server-side database process continually checks the queue, and when it finds a new entry, calls an ArcObjects/Visual Basic process to create the requested features. The queue is served on a first-come, first-served (FCFS) basis. If the features are successfully created, the record in the queue table is flagged as successfully executed. Otherwise, a failure flag is set on the queue record. In either case, e-mail with success or failure information is automatically generated and sent to a distribution list, for archiving and debugging purposes. Finally, the browser process that periodically checks for completion of the "Save" request will find a success or failure flag, update the map, and notify the user accordingly.

The on-screen digitization process continues in this manner, allowing the user to create as many connected or disconnected segments as they like. Snapping tools are provided to help with connecting segments, and Pause/Resume tools are available to allow panning and zooming during digitization. Individual segments can be deleted from the project, and existing segments can be modified. The user can exit the system at any time, and any saved segments are recalled from the database the next time the project is loaded in the utility.

Extraction from FDOT State Highway System (SHS)

An alternative to free-hand digitization of project line-work is extraction from the SHS Basemap. The advantage to using the extraction utilities include the ability to extract some attribute information from the underlying SHS segment, and to easily create complex segment shapes that would require time-consuming free-hand drawing of segment vertices.

The SHS segment extraction is based on the roadway identifier attribute, and the beginning and ending mileposts (BMP/EMP) of the extracted segment. The milepost layer, created offline using dynamic segmentation techniques, relates milepost point features to the SHS roadways where they occur via the roadway id information. To aid in extracting segments or even partial segments, the project input utility provides a milepost-helper tool. By enabling the tool and clicking anywhere on an SHS roadway, the user can obtain the roadway ID and fractional milepost of the point at which he/she clicked. The roadway ID attribute is obtained by a simple GetFeatures ArcXML request. The fractional milepost is calculated in JavaScript using a retrieved set of ordered vertices and coordinates that define the underlying SHS segment.

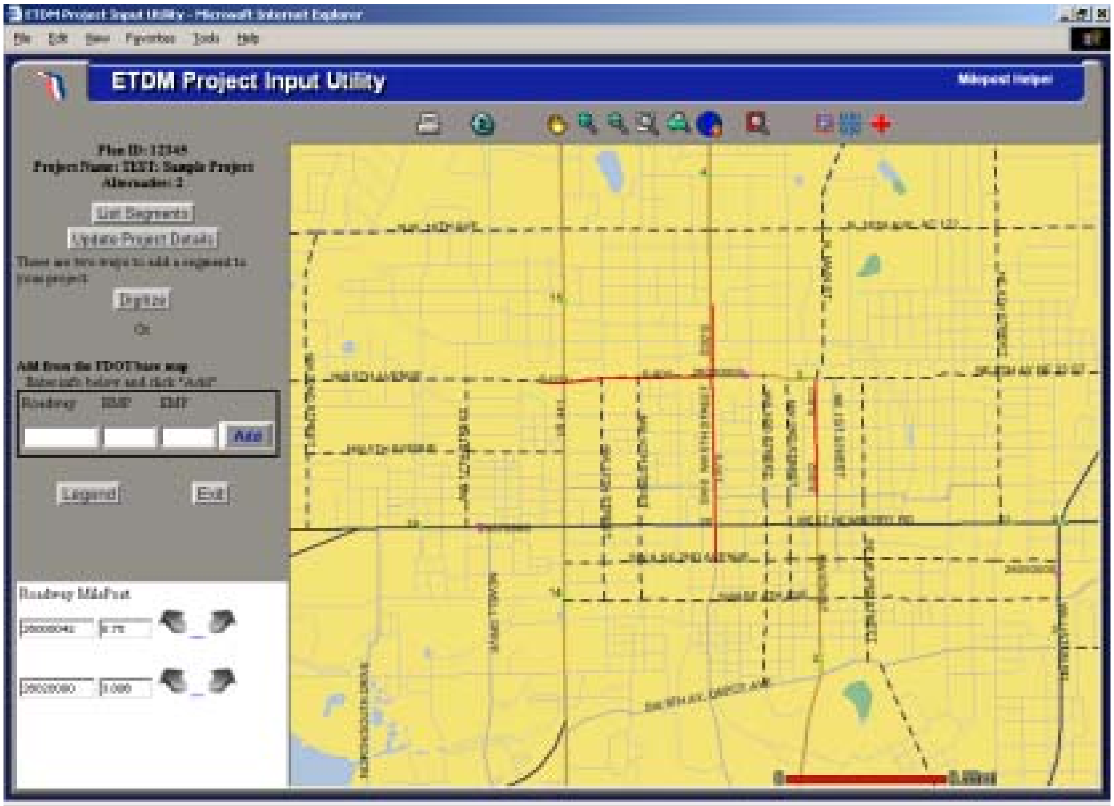

Figure 5. Extraction from State Highway System

GIS ANALYSIS

Any projects with existing line-work can be submitted for GIS analysis. Through collaboration with environmental agencies and planning organizations, the set of analyses were selected for the purpose of aiding the Sociocultural and environmental review process. In general, the inputs to the analysis routine are the project geometry and the resource datasets. The outputs are lists or summaries of features that occur in proximity to the project lines. For example, the Agricultural Lands analysis shows the total acreage of landuse polygons with an agricultural designation that intersect a set of buffers around the project line. The results of the GIS analysis are presented in a report, as shown in Figure 7. The report contains a name and description of each analysis, the results for each buffer area, lists or summaries of features found, dates when analysis was run, and links to metadata.

When planners are ready to initiate GIS analysis, they simply change the project status to “Ready for GIS Analysis” through a web form. This creates a record in a queue of projects awaiting GIS Analysis. At this time, projects less than ten miles in length are queued for real time analysis on a first-come, first-served basis. Projects over ten miles in length are queued for batch analysis jobs that occur overnight. As needs change or new datasets become available, the list of analyses continues to adapt and grow.

The following three sections (Analysis Criteria and Data, Analysis Area, and Analysis Functions) provide more details about the GIS analysis routines. Aside from minor updates they are from [1] and have been included for reference.

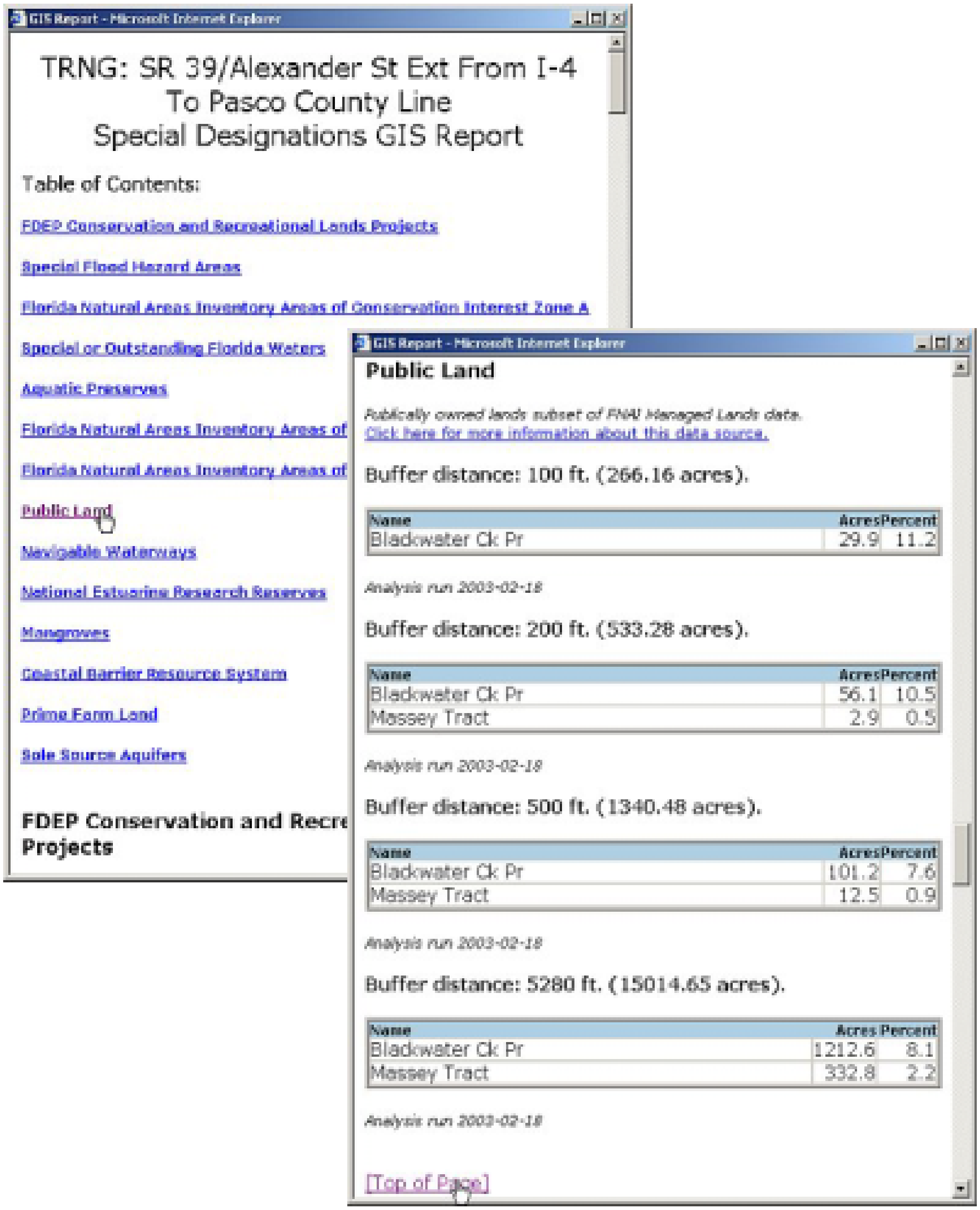

Figure 7. Results of the GIS analysis

Analysis Criteria and Data: The ETAT task work groups have 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, recreation areas, wetlands, wildlife and habitat, historic and archeological sites, socio-cultural effects (including aesthetic effects, potential relocation effects, economic effects), mobility, air quality, water quality and quantity, contaminated sites, flood plains, safety etc. Each issue is associated with one or more GIS data layers that provide information to be analyzed. For example, to assess the impact on wetlands several GIS data layers are analyzed, including: 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 >= 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: Much of the analysis definition is stored in a set of database tables that relate the analysis types to datasets, fields, and query conditions. This analysis executable itself is coded with Visual Basic and ArcObjects, and is able to read the analysis definitions from the database to perform its work. This allows new analyses to be added in a flexible manner that doesn't involve re-compilation of the executable. The database tables also relate analyses to issues, so that if an agency representative requests that an existing analysis be added to the report of GIS analysis results for a particular issue, it is a matter of simply adding a record to the analysis-issue association table.

REVIEW OF PROJECT EFFECTS

Once the project descriptive information and GIS analysis results have been recorded in the database, ETDM coordinators at the FDOT districts or local MPOs can initiate a review of the proposed transportation projects by environmental resource agencies and the public. This review takes place via the ETAT Review Module, Sociocultural Effects Module, and Public Access Site Module of the Environmental Screening Tool. These modules are collections of tools and functions available through a web interface that allow ETAT members to review the effects of proposed transportation projects on the human and natural environment.

ETAT Review Module

The starting point for ETAT reviews is the Projects Needing Review report, which displays a dynamically generated list of projects that are currently in an active screening event. The list is based on the user's jurisdiction and the status of projects within that area, a time-dependent value that is automatically updated by the database when the project review period ends. The project records are linked to the EST map viewer through anchor tags that have parameters appended to the URL. For example, when the project extent coordinates are passed to the map viewer via the URL, the map viewer will load a map bounded by those coordinates. The viewer itself is an ArcIMS HTML viewer that incorporates customized JavaScript and JSP components.

The EST map viewer has evolved in response to user feedback, new technology, and refined techniques for improving application performance. Standard techniques for performance improvement have been employed, such as pre-loading images for rollover effects; replacing deprecated HTML formatting attributes with cascading style sheets; and removing un-used code to reduce file size. ArcScripts, customized web-application code supplied by the ESRI user community, have also been incorporated into the application. The use of ArcScripts leverages the expertise within the vast ArcIMS user community and leads to valuable enhancements with reduced development time. Some of the customizations that have been applied to the EST map viewer are:

- A dynamic menu frame for map navigation and loading forms and reports
- Time-saving tools in the toolbar, such as the Show/Hide Aerials button
- Collapsible folders in the Table of Contents, from ESRI user downloads
- Look-and-feel of frames, borders, and message areas

Sociocultural Effects Module

The Sociocultural Effects (SCE) Module of the EST provides mechanisms for Community Liaison Coordinators (CLC) from the FDOT districts and MPOs to digitize and describe community boundaries and focal points, using tools similar to the Project Input utilities. The CLCs can also review the potential effects on the human environment through the same dynamic forms and reports found in the ETAT Review Module. This is accomplished by using Access Control Lists (ACLs), which are the means by which remote Internet users can be identified by the web server software. The menus, options and reports presented to the CLCs are dynamically generated using JSP forms executed by the Tomcat servlet engine. This allows variations in the requirements for SCE reviews to be embedded in the business logic of the JSPs, all by checking the role of the client user.

Public Access Site

The public has access to the results of ETAT and SCE review screens through the Public Access Site. Many of the same reports are provided in the public site, with logic in the

JSP that ensures only information that meets the criteria defined by the ETDM process is available through the public interface. For example, sensitive information about threatened and endangered species or certain historic and archaeological sites can be excluded from the public site through the use of database-driven server-side logic. This means that certain sensitive project reviews that mention sensitive can be flagged and excluded from the public site.

APPLICATION DEVELOPMENT PROCESS

Systems Engineering Approach

The project uses a Systems Engineering Approach to applications development. The Systems Engineering Approach includes needs assessment, design, development, testing, and implementation phases that occur iteratively to allow for frequent user input, timely delivery of the products, and the flexibility to adjust with not only shifting requirements, but also adjustments to a newly developed process. This methodology provides the basis for high quality application design in a flexible environment tailored to meet the latest needs of the users.

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.

User Requirements

The preliminary user needs assessment were provided through the Streamlining Working Group, executive leadership among DOT, the agencies, and the MPO's, guiding and supplying the goals and objectives of the Project. Beginning in July 2001, requirements analysis began on the Environmental Screening Tool. Leveraging of the existing process development meetings, system stakeholders were identified and several techniques were used over the next few years to extract and refine requirements. Techniques included joint application development meetings, one-on-meetings with users, surveys; web based online forums, net meetings, and prototyping. The design was and continues to be refined as both the application and process mature through implementation. Rapid application development techniques ensure that users' needs are met.

Spiral Development

Application development used a phased approach, using the following general methodology [1]:

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 technology and design 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 with an emphasis on optimizations for performance and data integrity
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 and prioritization of tasks from the steering committee

Challenges & Solutions

The ETDM Process and the Environmental Screening Tool represent a paradigm shift in how all of 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 as new means of cooperation are forged. Functional lines within organizations are crossed as new roles become defined to support the process. To over come 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 encountered is overcoming inertia to institutional and cultural changes needed to accommodate the ETDM process. Not only has FDOT undergone several noticeable changes within its own organization to lead the way for development, but also most of the resource agencies and MPOs have repositioned workload and shifted responsibilities to accommodate the changing environment. In many cases, new positions were created within the organizations, thus giving a certain amount of creditability to the process and the application. From reworking job descriptions, revising business rules, developing agency operating agreements, and restructuring internal business rules to incorporate ETDM into the existing workflow, the stakeholders have made significant adjustments to accommodate the new process and supporting technology. This malleability is motivated by the identifiable benefits of participation in ETDM and has fostered growth and opportunities to fundamentally "change how we do business" in the state of Florida.

A particularly complex challenge for the Department was the technical feasibility of a web-based GIS system with hundreds of external MPO and agency users. Given the structure of the DOT Network, it was positioned well for secure access controls from the intranet; however, it was not prepared to handle a large number of external users coming into their secure network through existing means, such as VPN. Moreover, the department did not have the IT resources in place to manage public access to Internet map services. To meet these needs, the GeoPlan Center at the University of Florida was selected as the location to house and provide access to the EST. The GeoPlan Center possessed not only the Florida Geographic Data Library, a digital inventory of Florida's GIS Assets which serves as the backbone to the EST, but it also has the computing, networking, and information technology resources and experience to support and maintain the system.

With such a large numbers of users, distributed within agencies, across agencies, and through out the state and county, training the user community and keeping everyone up-to-date on changes has been one of the largest challenges facing the overall implementation of the EST. The EST training program consists of two delivery methods:

- Hands-on training presented in a lab setting where the participants actively use the module and work through examples
- Web-based training classes through eCONNEX and Lotus Sametime software

Given the number of users and their organizational, functional, and geographical disbursement, it is imperative to supplement the hands-on training with numerous engaging training opportunities. There are several avenues available to handle the support-based requests of the EST user community. The first is a comprehensive online self-help center. The center provides the following services:

- Access to the EST manuals and user guides
- Access to PowerPoint presentations describing the ETDM process and EST modules, along with short movie clips demonstrating each module
- Answers to frequently asked questions
- A How-To section
- A discussion forum for all federal, state, and local agency participants
- Mail groups for reporting application problems and suggesting enhancements
- An FDOT Central Environmental Management Office Help desk for fielding 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. Lastly, to keep all users up-to-date with changes to the EST or upcoming events, a mass e-mail program was created to notify the user community about any important information.

Over all, providing browser-based delivery methods has helped eliminate other challenges, including the perception that you need to be a GIS specialist with a high-end computer and potentially expensive software in order to effectively use a GIS. The EST leverages the existing technological infrastructure, provides a central entry point to a variety of resource and project data, and maintains the institutional memory of long-term planning efforts. It uses the power and performance of the Web to present the information in an easy to use interface with many standard point-and-click functions. EST ease of use, phased implementation, frequent training opportunities, and system support structure help to minimize potential difficulties experienced by ETDM participants.

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.

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