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UTILIZING GEOGRAPHIC INFORMATION SYSTEMS THROUGHOUT THE DESIGN AND PERMITTING PROCESS

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Abstract: While geographic information systems (GIS), including data collected through global positioning systems (GPS), are not new to the transportation design industry, coordinated utilization of these technologies does not often occur throughout the course of a project. This may result in the duplication of efforts by the design and environmental analysis teams, or may necessitate analysis done by less efficient means, possibly incurring project delays. By integrating GIS into the project development process as early as possible, these issues can often be minimized or eliminated. The following four projects, widely varied in both scope and budget, show how the incorporation of GIS have enhanced projects' progress at various stages of completion. Implementation of such techniques should become a standard step in project development to ensure the most timely and accurate results possible.

Route 41 Land Use Study, Chester County, PA

The Route 41 Corridor Land Use Study presented the opportunity to integrate GIS at the inception of the project. Data sets were obtained from a number of sources, and were then combined and corrected to match as necessary, in order to gather an inventory of the area's natural, cultural and demographic assets and liabilities for development. An accessibility map was created by determining accessibility distances from major built-up areas and major roads. For example, major roads were given a 3000-foot buffer of accessibility. This means that based on experience, a 3000-foot frontage on a major road was an area close enough to be easily accessible. Natural features including floodplains, wetlands, slope, wooded areas, prime agricultural soils and seasonal high water tables were mapped, ranked in order of desire of avoidance, and then integrated into a Natural Features Composite Constraint map. For example, a level 5 constraint (land that does not include any of the above features) is the most desirable for development while a level 1 constraint (floodplains) is the least desirable. This resultant map is shown below.

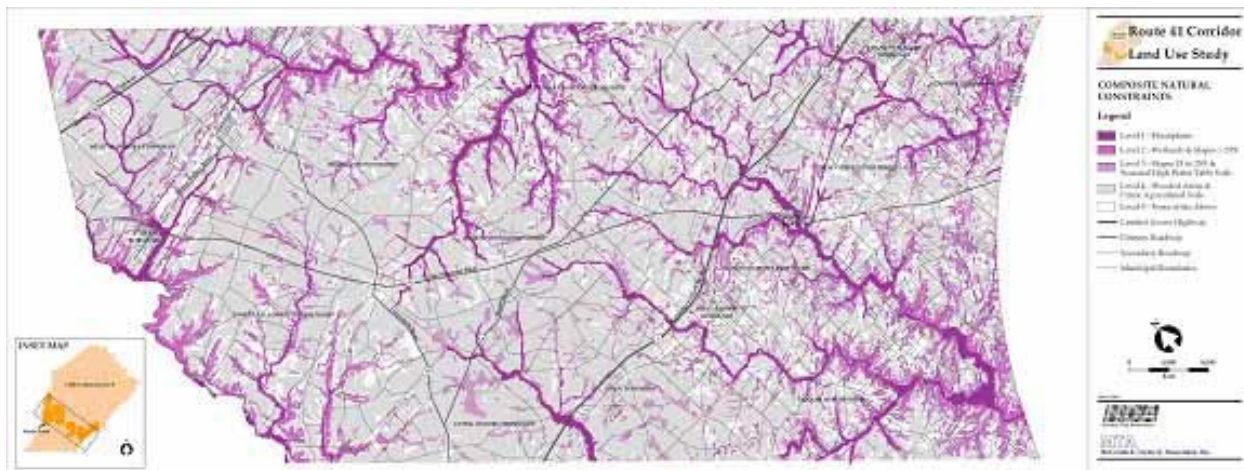


Fig. 1. Natural Features Composite Constraint map

The data that resulted from these two maps was then combined to create a potential suitability map for land use development. The land use suitability resulting from this map will be used to help identify potential corridors for future transportation improvements. GIS analysis integrated a large number of features over an extensive (nearly 20-mile long) corridor, which would have been unmanageable through conventional analytical techniques.

DuBois-Jefferson County Airport Access Project, PA

A 4,000-acre study area around the existing airport was examined for a roadway network improvement project. A number of ecological features such as cropland, pasture land, forest and wetlands were surveyed and then digitized into GIS layers. Ten different potential road alignments were initially analyzed. GIS was used to calculate the impacts of each alignment on each ecological layer. These ten alignments were then reduced to the two alignments with the least impacts. Modifications were then made to the two remaining alignments to further reduce their impacts on exceptional value wetlands.

The impact calculations were initially done one alternative and one ecological layer at a time. This proved to be very time consuming and prone to error. To solve these problems, an iterative program was written in Visual Basic for Applications to automatically calculate impacts and write the results to a database spreadsheet file for any combination of alternatives and ecological layers. Use of GIS allowed for a far more extensive range of alternatives and features to be examined than could have been accomplished by traditional methods, and in a much shorter time frame. Additional information on this project can be found at: <http://www.dujairportaccess.com>

Blue Ball Properties Project Waters and Wetlands Permitting, New Castle County, DE

Permitting often falls within a project's critical path as final design approaches completion. The Blue Ball Properties Transportation Improvements Project was under a very aggressive schedule resulting in the need to begin the permitting process at the onset of final design. This required a need to coordinate design changes mandated by both engineering and environmental constraints simultaneously. GIS was the only practicable way to achieve this.

Without the flexibility afforded by GIS, it would have been extremely difficult to keep the impact information in the application current and meet the project's permitting schedule. As the project design evolved, the GIS database, and hence project impact tallies, were regularly updated. This ensured delays due to impact and permit issues would be avoided. Ultimately, GIS was used to generate a set of impact sheets that depicted the regulated resources, project design, and areas of impact. These sheets were the final piece of the permit application and are being used by the regulatory agencies to inspect construction activities. Additional information on this project can be found at: <http://www.blueball.net/>

U.S. 222 Relocation and Reconstruction, Berks County, PA

GIS analysis, and particularly the integration of GPS data, has become a critical element of the southern two miles of the eight-mile U.S. 222 realignment and widening in Berks County, PA. The discovery of populations of the threatened bog turtle (*clemmys muhlenbergii*) led to the issuance of a biological opinion with a finding of no likely jeopardy for the species by the U.S. Fish and Wildlife Service (USFWS). This included several measures necessary to help protect the species and/or enhance habitat.

In order to institute those measures, and also to adapt the project's final design to changing conditions, such as a better understanding of species behaviors and newly discovered populations, GPS was utilized to provide precise data which could be integrated into the GIS project database, which included design and environmental features. Without this tool, it would have been extremely difficult to ensure the project was avoiding known and newly discovered habitat, which may have resulted in project delays. Likewise, GPS ensured that the proper easements were in place to allow for the necessary control measures during and after construction. Additional information on this project can be found at: <http://www.222connections.com/berks/berks.html>.

Biographical Sketch: Christopher C. Salvatico has extensive experience as a GIS specialist/cartographer. Salvatico is responsible for the creation, updating, and maintenance of cartographic resources for various projects in the firm of McCormick Taylor & Associates, Inc. Salvatico has 10 years of experience as a cartographer and has knowledge in GIS, physical geography, cartography, air photo interpretation, and is also certified for advanced web design. Before arriving at McCormick Taylor, Salvatico helped create master plan mapping for St. Thomas, Virgin Islands, and has been chief cartographer for over seven books and atlases. He has an extensive background in many software programs including ESRI and Adobe products. He also has a certificate for advanced web design and is the webmaster for McCormick Taylor's company website as well as for many project Web sites.