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USE OF A GEOGRAPHIC INFORMATION SYSTEM TO IDENTIFY ENVIRONMENTAL CONSTRAINTS FOR LARGE-SCALE PROJECTS: INTERSTATE 70 TRANSPORTATION CORRIDOR

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Abstract: The Missouri Department of Transportation (MoDOT) employed ArcView 3.1 software from ESRI through an enterprise-wide Geographic Information System (GIS) to identify environmental constraints to expanding I-70. Geographic information on historic buildings and bridges, archaeological sites, cemeteries, roads, wetlands and streams, floodplains, public lands, and sensitive biological resources was used to produce a series of coverages along I-70 from Kansas City to St. Louis. While documenting the feasibility of improving I-70, MoDOT considered the following issues: the availability of resources for geographic data, the level of detail and extent of coverage needed for the project study area, and the techniques for updating topographic map information. MoDOT produced a map in 36 plates to cover the project study area and found two areas along the facility with a concentration of environmental constraints. GIS and the resulting feasibility study were used to help MoDOT determine that a tiered environmental document was needed to evaluate alternatives to expanding I-70.

Introduction
The Missouri Department of Transportation (MoDOT) conducted a feasibility study of Interstate 70 (I-70) to investigate and evaluate the deficiencies in the existing interstate facility and to recommend strategies for eliminating those deficiencies. Comments from the traveling public about congestion and pavement conditions on I-70 made it apparent that the facility is not adequate as it exists today. MoDOT studied and assessed the conditions of the pavement, bridges, and interchanges; traffic patterns and projections; and the socioeconomic conditions and cultural and environmental resources. The goals of the study were to 1) project the future needs of I-70, 2) analyze a range of possible solutions to deficiencies, and 3) make recommendations on viable alternatives that provide transportation service commensurate with social, economic, and environmental impacts. MoDOT is reporting on the portion of the study involving the use of an enterprise-wide Geographic Information System (GIS) to identify environmental and cultural constraints for this large-scale project.

I-70 Background
I-70 crosses ten states, beginning in Maryland and ending in Utah. One of the longest interstate routes in the country, the facility connects St. Louis with Kansas City. The Missouri portion of I-70 is 251 miles long. Missouri began work on I-70 in August 1956 (completing it in 1965) as the first state to start construction on the interstate system. I-70 carries more traffic daily than any other roadway in the state and has far exceeded the expectations of a twenty-year design life. Excepting the reconstructed portions, the Missouri section of I-70 is between 34 and 43 years old.

Methods
MoDOT studied a 194-mile corridor extending from the eastern boundary of Kansas City to the western boundary of St. Louis. For the through lanes on the majority of the facility, MoDOT's environmental and cultural teams looked at a study area extending 100 feet from the outer edge of the pavement. This distance was believed to be adequate to expand I-70. The teams extended the study area width to accommodate the latest design safety standards for reconstructing the interchanges. MoDOT identified standard environmental and cultural resources typically considered for National Environmental Policy Act (NEPA) documents and environmental permits. These included historic bridges and buildings, cemeteries, archaeological sites, hazardous waste sites, wetlands and streams, sensitive biological species, floodplains, public lands, and socioeconomic conditions.

MoDOT used ArcView 3.1 software, a product of ESRI, to produce a map in 36 plates. MoDOT selected a GIS-based project for the savings in time and the ability to use the final product as a base for future environmental
documents for I-70. In addition, the GIS product can be queried during the permitting and design phases of the project.

Geographic data sets and digital information were verified and customized to meet specific applications required for the project. The final map was projected in Universal Transverse Mercator (UTM) North America Datum (NAD) of 1983.

MoDOT used a 1:24,000 scale (24K) digital raster graphic (DRG) files created by the U.S. Geological Survey (USGS) as backgrounds for the plates. Originally created in NAD 27 by the USGS, the DRG were projected in NAD 83 in 1998 by the Transportation Management System at MoDOT. DRG maps are used as the source image during digitizing for spatial accuracy and control. Digitizing is a process whereby features from a paper map are converted into a digital format.

For cultural resource sites, GIS themes were created from point-source resources for archaeological sites, historic buildings and bridges, and other cultural sites. MoDOT used heads-up digitizing techniques on 24K DRG maps. Cemeteries were partially derived from Geographic Names Information System (GNIS), a 24K geodata set describing specific places of Missouri. The original information data set consisted of USGS Level 1 GNIS that was converted to NAD 83 by the Missouri Spatial Data Information Service (MSDIS). Cemeteries indicated on the DRG maps but not included in the GNIS coverage were added to the original GNIS data set using heads-up digitizing techniques.

MoDOT derived the water body data for this project from a 100K digital line graph (DLG) containing hydrography of Missouri counties. The original data were converted to ARC/INFO using the Spatial Data Transfer Standard and from NAD 27 to NAD 83 by MSDIS. The roadway data set was derived from TIGER/Line Files and modified by MoDOT in 1995.

MoDOT created the wetland layer from a 24K data set, National Wetland Inventory, available from the U.S. Fish and Wildlife Service. Data were available as 7.5ft by 7.5ft blocks containing ground planimetric coordinates of wetland point, line, and area features and wetland attributes. Original data were available in NAD 27 and converted to NAD 83 by MoDOT in 1999. Floodplain information, in a 24K data set known as Q3 flood data, was created from Flood Insurance Rate Maps published by the Federal Emergency Management Agency 1996 to present.

MoDOT uses a 100K data layer first published by the Missouri Resource Assessment Partnership (MoRAP) to identify lands owned and leased by federal and state governments. MoDOT used a 24K data set containing point locations for threatened, endangered, or otherwise sensitive species and their habitats. This information, known as Heritage Database Information, is provided to MoDOT through a Memorandum of Agreement with the Missouri Department of Conservation.

MoDOT Tools
MoDOT uses a high-end GIS workstation, GPS receiver and data logger, and plotter on these types of projects. In addition, digital cameras, scanner, CD writer, and laptop computers are used for GIS projects. MoDOT uses ESRI's ARC/Info and ArcView 3.1 for GIS development and Pathfinder Office for field data processing. Microstation of Bentley Systems, Inc., and a photo editing software are also employed for map development.

MoDOT uses a variety of data sets, which can be classified as “canned,” “fresh,” or “reconstituted.” Canned or existing data sets are good screening tools over large areas. These are widely available from universities, government agencies, and businesses. The drawbacks to canned data sets are that the data are static and the accuracy must be verified by other means.

Fresh data are collected with GPS when no existing data are available for a location. This affords up-to-date accuracy and allows precise delineation of features. Since fresh data sets may require field collection, creating them can be very time consuming.

Reconstituted data are created from existing data sets and updated for specific locations or features. Reconstituting data allows for up-to-date accuracy, allows precise delineation of individual features, and
requires less time than fresh data collection. Producing reconstituted data may limit the use of a data set to only a specific project.

**Results**

MoDOT’s use of GIS provided information on cultural and environmental parameters identified as important in assessing the feasibility of I-70 improvements. Thirty previously recorded archaeological sites were identified within the study area. A record search of the National Register of Historic Places revealed two architectural resources. A record search and field survey revealed 21 bridges 50 years or older. These bridges were generally part of the old Route 40, portions of which were incorporated into the “new” interstate as outer roadways. Three species listed as federally protected and two candidate species were identified. Two locations within the project corridor have a concentration of environmental constraints and are described next.

**I-70 Crossing of Missouri River at Overton Bottoms**

Overton Bottoms is in the Missouri River floodplain 10 miles west of Columbia, Missouri, where I-70 crosses the river on two, two-lane bridges. The remaining I-70 crossing within the floodplain at Overton Bottoms is on a fill section. During the floods of 1993 and 1995, considerable sand deposits and scour holes formed within the floodplain near the river crossing. The U.S. Army Corps of Engineers (USACE) subsequently purchased land in this floodplain and adjacent to the I-70 crossing with the intent of establishing wetlands and a wildlife refuge.

MoDOT has had formal contact with the USACE and the land-managing agencies, the U.S. Fish and Wildlife Service and the Missouri Department of Conservation. These agencies are aware of the potential expansion of I-70 through the floodplain and indicate that this action could be acceptable. However, acquiring right-of-way at this location will involve compensatory wetland mitigation, public land purchase, and compliance with Section 4(f) of the Department of Transportation Act.

One federally protected and two candidate fish species are potentially found at the I-70 crossing (MDC 1999). The pallid sturgeon (Scaphirhynchus albus) is listed as endangered, and the sturgeon chub (Macrhybopsis gelida) and sicklefin chub (Macrhybopsis meeki) are candidate species. Informal consultation with the U.S. Fish and Wildlife Service will be required to determine whether any of these listed species could likely be affected by any proposed actions.

MoDOT identified one historic building in the area of the Missouri River crossing that is potentially eligible for listing on the National Register of Historic Places (NRHP). Although probably not yet 50 years old, the Les Bourgeois Winery may be culturally significant to the area and will require further investigation in subsequent studies.

The KATY Trail State Park, a rails-to-trails project developed by the Missouri Department of Natural Resources, will extend from Kansas City to St. Louis when it is finished. The trail is protected by Section 4(f) of the Department of Transportation Act. However, the trail is located under the bridge near the high bluff and the impact resulting from the expansion of I-70 would likely be minimal.

**I-70 at Graham Cave State Park**

The Graham Cave State Park area in Montgomery County, approximately 40 miles east of Columbia, Missouri, is also of concern to the expansion of I-70. A large rock commonly referred to as “slave rock” is located in the median of I-70. It is a widely held belief that the rock was once the site of slave auctions. Extensive research (MoDOT 1998) on the subject revealed no written evidence for this belief. The rock was used for picnics and social gatherings beginning in the late nineteenth century and continuing through the mid-twentieth century. During that time, it was known as “picnic rock” or “Graham Rock.” In 1951, U.S. Route 40 was constructed through the area and the land surrounding the rock was designated as a roadside park. In 1963, additional lanes were added to Route 40 to create Interstate 70 and the roadside park became inaccessible. At present, it is unknown what implication there might be to an interstate project that has impacts on this rock. Although there is no documentary evidence for slave sales at the rock, there is a consistent body of folklore that has evolved since the mid-twentieth century saying sales did occur there.
The Graham family, after whom Graham Cave State Park is named, settled south of the slave rock area in 1816. Their house, constructed in 1828, is located within sight of the rock and is still occupied by descendants of the Grahams. This farmstead, located adjacent to I-70, should be considered potentially eligible for the NRHP. Graham Cave State Park lies adjacent to and just north of I-70. Within this 82-acre park is a natural resource designated by the Missouri Natural Areas Committee as the Graham Cave Glades Natural Area. The natural area is a complex of sandstone- and limestone-glade community types, with dry sandstone forest and dry sandstone cliffs. The close proximity of some of the sandstone and limestone glades allows some dolomite glade species to occur alongside sandstone glade species (Reese 1986).

Graham Cave State Park has been invested with improvements made possible through funding from the Land and Water Conservation Fund Act. Permanent taking from properties improved or acquired with these funds must be replaced with land of at least equal monetary value and recreational utility, as determined by the U.S. Department of the Interior.

Conclusions
The use of GIS is often discussed in terms of its power to analyze spatial data. GIS is also used as a production tool for visual point and area locations. With this project, MoDOT used GIS to analyze spatial data and integrate non-spatial data to produce a map showing environmental point and area locations. GIS cannot be discounted for mapping when previously collected data are available or are easily converted into digital format. In this case, GIS is a powerful tool that considerably reduced the number of hours needed to produce information in a visual format. Using GIS also produced project-specific information that has been subsequently used and expanded upon during the data collection for a tiered Environmental Impact Statement (EIS). MoDOT used its GIS system to identify cultural and environmental constraints and used the feasibility study to investigate and evaluate the deficiencies in the existing interstate facility. As a result of the completed work, two strategies appeared to be the most feasible solutions for the capacity problems for I-70. Adding capacity to the existing interstate facility is one of the strategies. Adding capacity in the median, with future widening capability on the outside, is one alternative to this strategy. Another alternative would be to add capacity on the outside leaving the median for any future widening. The second strategy for the I-70 corridor is to construct a new, parallel interstate facility or provide a public transportation alternative such as high-speed rail. MoDOT concluded that a tiered environmental document would be the appropriate tool to achieve the extensive public, community, and agency involvement needed before a preferred strategy for the improvement of I-70 can be developed. At this time, the first tier draft EIS has been completed and is available for viewing at http://www.i70study.org. Selecting a preferred alignment and determining logical termini for construction staging will be the foci for the second tier EIS.

Biographical Sketch: Gayle A. Unruh is the Wetland Coordinator for the Missouri Department of Transportation's (MoDOT) wetland specialists team. Employed with MoDOT for eight years, she does wetland delineation, Section 404 permitting, and wetland mitigation and banking development. Gayle works on wetland mitigation development teams with the U.S. Army Corps of Engineers and Missouri Department of Conservation to provide compensatory mitigation projects under the management of those agencies. Ms. Unruh was an author of a Memorandum of Understanding (MOU) between MoDOT and the Section 401 Water Quality Certification issuing agency, Missouri Department of Natural Resources. Under recent legislation and this MOU, Missouri has streamlined the process of water quality certification and conditioning for all MoDOT projects authorized by Nationwide permit. Prior to her work with MoDOT, Gayle worked for consulting companies as an avian toxicology researcher, wildlife specialist, and technical writer. She received a Masters of Science in biology with an emphasis in avian ecology from Western Illinois University, Macomb, Illinois, and a Bachelors of Arts in environmental science from McPherson College, McPherson, Kansas.

References