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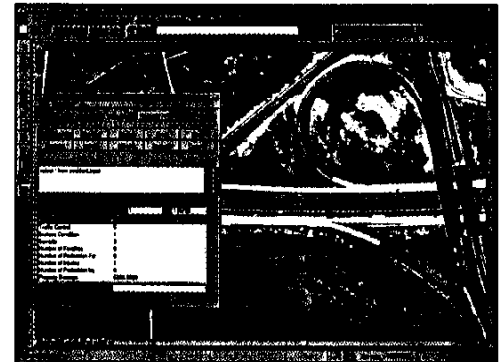
**GEOGRAPHIC, MAPPING, EARTH INFORMATION**

**June 1997**  
6 Dollars  
*EARTH OBSERVATION MAGAZINE*

**Two Foot Contours from  
1"=800' Photography:  
Are We Fooling  
Ourselves? page 30**

## **Civil Engineering Special**

**Improving Road Management  
with GIS, GPS and Aerial  
Photography**

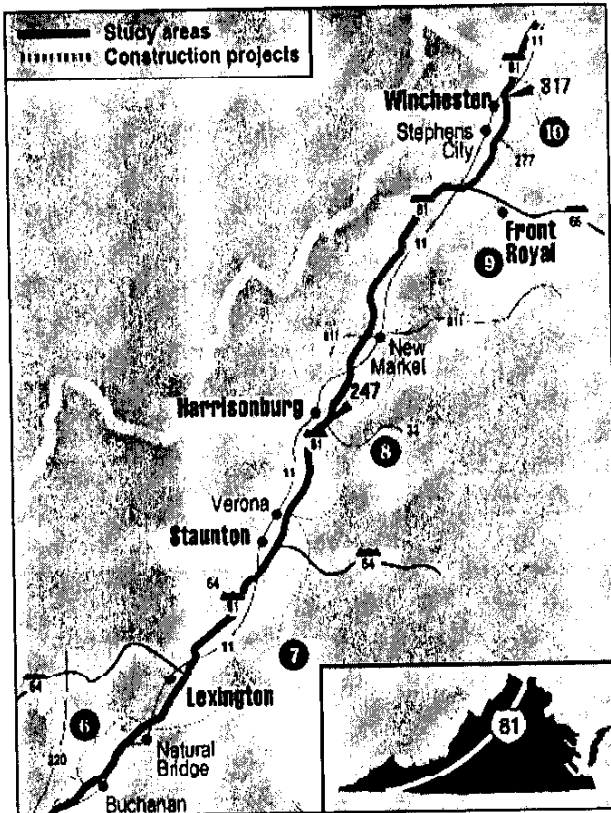


**page 24**



**The  
Commoditization  
of GIS Data: A Whole New  
Market Emerges page 16**

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The VDOT's GIS is being used to look at the status of I-81 projects from Roanoke to Winchester

# The Road Most Traveled

The Virginia Department of Transportation prepares an extensive \$2 billion, 20-year expansion plan to improve Interstate efficiencies.

By Lisa Smith

The state of Virginia, one of the East Coast's most popular vacation areas, contains some of the most scenic and historically important locales on the eastern seaboard of North America. Interstate 81 is one of the main roadways through the western part of the state. The highway extends from Dandridge, Tenn. to the U.S./Canada border, and 325 miles of it stretches through some of the most beautiful areas of Virginia. Rolling past the Appalachian Mountains, Blue Ridge Mountains and the Shenandoah Valley, the highway was voted one of 10 most scenic interstates in the U.S. by the American Automobile Association.

While travelers through Virginia can expect to see some spectacular views and historic Civil War landmarks during their journey along the four lane highway, they can also expect some traffic delays due to congestion. Very soon, they will also begin seeing signs of major road construction as the Virginia Department of Transportation (VDOT) gets ready to undertake improvements to the road. Plans to alleviate the problems of a road already at its carrying capacity of

between 20,000 to 50,000 vehicles per day are currently being developed. Traffic on the interstate has literally tripled in the 30 years since its original construction, and the ever increasing number of recreational vehicles, cars and, most significantly, trucks, is causing growing inconvenience and safety concerns. Designed to carry only 15 percent truck traffic, it is now handling as much as 40 percent in some areas and, according to VDOT that number will only continue growing.

To make the interstate more efficient, VDOT is currently preparing an extensive \$2 billion, 20-year expansion plan. The first step of this plan is a series of "conceptual studies," some of which began in early 1996, detailing the best way to proceed with widening the highway. VDOT's Location and Design Division has broken the 325 mile stretch into 10 sections, and has hired several engineering consultants to study each section and make recommendations for improvements. Each study will take approximately 18 months to complete and will establish plans to be completed by the year 2010 and the year 2020.

The consultants involved on these studies analyze traffic flow and accident statistics, environmental and historical studies, and right of way data detailing land ownership of road fronted property. Other divisions within VDOT are studying the use of Intelligent Transportation Systems (ITS): new technologies for ensuring steady traffic movement. VDOT is also soliciting private enterprise to build more rest stops and truck parking areas on the interstate, and, since its goal is to encourage public involvement as much as possible, held a series of public meetings in early 1996 to hear suggestions for the improvements. Members of the trucking industry and local government pointed out the need for wider interchanges and more climbing lanes, goals VDOT plans to

**Summary:**

The VDOT improves its road management capabilities by implementing a geoenvironmental system.

**GeoTechnologies Used:**

- Digital ortho
- CAD
- GIS

**Benefits:**

- Converting to GIS provides the VDOT with faster, more accurate data.
- GIS proves more cost-effective
- Use of GIS saves time

address in its final construction plans.

Anderson & Associates, Inc. is one of the consultants hired by VDOT to complete three of the 10 conceptual studies. The 19 year old company, which specializes in civil, environmental and transportation engineering and planning, is about halfway through its first study area, a 49 mile stretch extending from the Natural Bridge to Verona. The study area will be completed in the fall of 1997.

To make the task of processing the enormous amount of graphical and textual data involved in such a large scale project manageable, the company is inputting all information into MicroStation GeoGraphics, the geoenvironmental system from Bentley Systems Inc., which will enable the team to instantaneously access their gathered data based on geographic location. To accomplish this, engineers began with base planimetric maps and orthorectified photography, from which they reconstructed road centerlines from the original 1960s era roadway plans. Necessary adjustments to the roadway centerlines discovered by ground control surveys were easily made. In order to manipulate the digital orthorectified photography into files that can be viewed, correlated and plotted using MicroStation, Anderson & Associates is using MicroStation Descartes, which allows the dozens of side by side images of the highway corridor to be combined and trimmed into several strips that can be viewed simultaneously.

With a solid map base, the project team began work on inputting traffic data and right of way information. By taking actual traffic counts on the interstate, ramps and cross streets, and comparing present data to historic traffic count information, Anderson & Associates is able to forecast future traffic volumes. They also look at traffic accident data gathered by state police over a three-year period. This was supplied in text format only, so mappers placed a data point at each accident site on their map. "We tied all our traffic data back to the GIS," said Mike Russell, Anderson & Associates' project manager for the I-81 project. "It gave us the flexibility to ask, for example, how many accidents between point A and point B involved trucks. We can get an immediate answer to queries like that. Certain areas really pop out as problem areas, and that's not something you can see just by looking at the data."

With the traffic data clearly depicted in the system, and associated data such as the cause and date of each accident referenced within the system, finding key problem areas became as simple as looking at the map. Anderson & Associates discovered that most accidents occur randomly along the interstate, and are a result of automobile driver inattention. However, there are higher concentrations of accidents in places where the road narrows for a bridge and goes into a steep grade, or where ramps leading to and from truck stops become backed up and cause right lane traffic to slow or stop. In mountainous terrain, grades can reach four percent, which can slow down a large truck significantly. While at least one additional lane in each direction is being planned for the entire length of the Virginia road, additional truck climbing lanes will have to be placed in steep grade areas like these, and longer ramps will have to be created for the rest stops.

Because land for the additional lanes will have to be purchased from individual land owners, getting right of way information into the geoenvironmental system is vital to the consultants' plans. Anderson &



Traffic reports showing the accident history of a particular location reveal problem areas that are easily pinpointed on Anderson and Associates' base map. (top right)

Tim Stowe and Mike Russel on site at the I-81 and I-77 interchange in Virginia. (lower left) Photography by Glen Blackeburg, Virginia.

Associates digitized county tax maps of Rockbridge and Augusta counties showing all of the property along the highway corridor. The property polygons on these maps were georeferenced into MicroStation GeoGraphics then linked to a property

owner listing, so that engineers could see exactly where proposed right of ways would fall. Their goal is to create a complete listing of all property parcels, their owners and the taking area within the GIS, which will make planning the rights of way for the additional lanes a simple matter of tapping into the database.

"We'll be able to print a listing from GeoGraphics showing the names of property owners from whom we'll need to acquire right of way, how much land we will be taking and how much remaining property that landowner will have," said Tim Stowe, Anderson & Associates' principal in charge of the I-81 project. "Having this information in a geoenvironmental system will save us a lot of valuable time." Anderson & Associates will also tie information regarding bridges, drainage structures and pavement areas into MicroStation GeoGraphics. Details regarding specific structures will be attached to the feature itself as a reference file, which will help the consultants evaluate whether or not a bridge can be widened or if a section of pavement has to be replaced. "By attaching information and even pictures to a file, we'll be able to click on a bridge and it will pull up all available data," said Russell. "We like to keep as much data in digital form as we can."

At the end of the study in the fall of 1997, the company will provide a bound report containing all its recommendations for road widening to the Commonwealth Transportation Board for review. This will be composed of the 11 x 17 plotted images that were created by using MicroStation Descartes to pull the multiple orthorectified photos together into usable images, and then putting those images into MicroStation 95. The final report will show the proposed

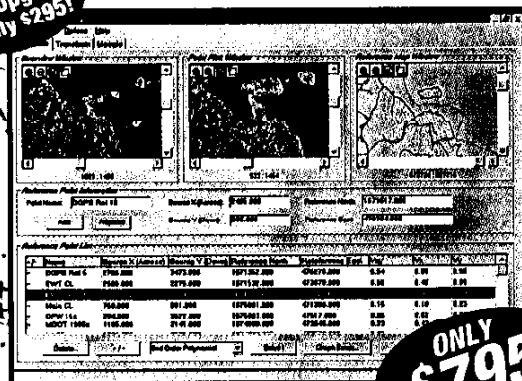
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improvements in color overlaid on the black and white orthorectified photos, which will also be used in future public meetings held to inform public and civic groups of the improvement plans. VDOT will hold two more public meetings in each of the 10 study areas. Anderson & Associates is using a Hewlett Packard Design Jet plotter and a Canon color copier to produce their plotted images for their reports.

The reports created by the consultants will help establish priorities for roadway work. The company's findings must first be reviewed by the Commonwealth Transportation Board, then used to set priorities for construction projects. The projects will be added to VDOT's Six-Year Improvement Program, the final schedule for completing road and bridge projects. The actual road widening construction of the entire 325 mile stretch will take place in sections over the next 20 years, according to the priorities determined by the results of the study groups. Anderson & Associates' first section includes one of the interstate's most congested areas, near the town of Wytheville, where another interstate, I-77, overlaps it. The area is now the only six-lane stretch of the highway in Virginia, and it may be necessary to widen it to eight. Difficult areas such as this will take higher priority in VDOT's schedule.

Thus far, Anderson & Associates is a little more than halfway finished with their first study area, a stretch of highway between Virginia's famous Natural Bridge rock formation and the town of Verona. “We're about 70 percent finished with the work as far as developing alternatives and presenting them. We have one person doing the mapping,” said Stowe. “MicroStation products have made it very easy for him. We also have about six engineers doing the design work and developing roadway concepts. We've split the roadway into pieces so each individual can work concurrently.” The company has found that MicroStation products provided greater efficiency and productivity than other software packages.

According to Fred Kiiffner, of VDOT's Location and Design Office, the construction schedule for each project will be staggered and at least two lanes of traffic will be kept moving past work areas. This will keep traffic interruption to a minimum and provide the most effective work-zone safety for workers and drivers. VDOT will also provide traffic updates for motorists throughout construction.

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