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GIS in High School Education: Developing Community Projects

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Abstract

High school EAST students in Eureka Springs, Arkansas, used GIS to serve their community through a 911 mapping project, emergency evacuation landing zone project and city multi-mapping project. The 911-mapping project identified rural roads and streets and created a computer program that displayed them for 911 emergency calls. ArcView 3.3, ArcView Network Analyst, and route analysis were used for this project. The emergency evacuation landing zone project identified and mapped landing zones in 4 Northwest Arkansas counties. ArcGIS 8 and 9, Spatial Analyst, 3D Analyst, slope and population analysis were used for this project. The students mapped the Historic District, created contour maps for a local park, mapped the city's 307 fire hydrants, and mapped an historic cemetery. ArcGIS 9 and elevation data were used for local park project. Future GIS plans include establishing a County Technology Center.

Paper

Eureka Springs is a 125-year-old tourist town in the rural northwest corner of Arkansas. The city's primary industry and the major source of income for most residents is tourism. Many of the 2,278 residents are employed in restaurants and small shops that provide seasonal employment and minimum salaries. In the 2000 census, the city's median household income was $25,547, compared to the national figure of $41,994.

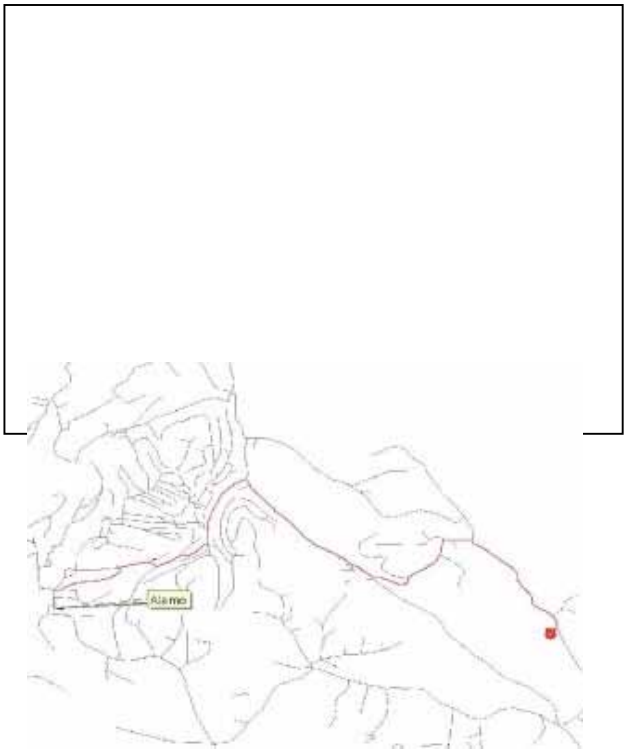
Eureka Springs is one of the towns of Carroll County, where 72% of the county's residents are high school graduates and 14% are college graduates. In the 2000 census, the County's median household income was $27,924 with the state of Arkansas at $49,551. About 15.50% of the County population and 11.00% of families are below the poverty line. Few of the County's residents have access to computers or are technologically proficient.

The County's advantage is that it has 2 EAST Labs, one in Eureka Springs and another in Green Forest. At the 114-year-old Eureka Springs High School, EAST (Environmental and Spatial Technology) is an elective class offered to all high school students. EAST is a unique high school class that emphasizes using advanced technology applications to solve community service projects. In the process of solving community problems, EAST students learn to become creative, intuitive, adaptable learners who can solve unpredictable, real-world problems.

For the last 4 years, the Eureka Springs High School EAST Lab developed and completed several service-based community projects. With each project, EAST students partnered with and learned from various members of the community. The students were

involved in a diverse list of community projects: 911 mapping project (Eureka Springs Police Department), emergency evacuation landing zone mapping project (emergency personnel from Carroll County's 9 towns), Historic District mapping project (Eureka Springs Historic District Commission and the Buildings Department), Harmon Park contour mapping project (Eureka Springs Parks and Recreation Department and city architects), fire hydrant mapping project (Eureka Springs Fire Department), high school butterfly garden (High School faculty and students, local residents and businesses, and the Arkansas Game and Fish Commission), and historic cemetery mapping project (Eureka Springs Cemetery Commission).

The first community project the students worked on was the 911-mapping project in the summer of 2002. As one student commented, "Eureka Springs streets look like a plate of spaghetti". This is a town that doesn't have any traffic lights, has very few "straight" streets, and has streets that eventually land up somewhere else. When the 911 conversion was implemented in the County, all the streets and roads were re-named. Finding them quickly and easily during an emergency call was a difficult task for the Police 911 dispatcher. Using ArcView 3.0 and Network Analyst, the students created maps for each of the city's 599 streets and roads, with written directions from the Police Department to each street and road. Using Visual Basic 6.0, a program was created that had a drop down menu of the streets and their corresponding maps. The Arkansas Department of Education and the Winthrop Rockefeller Foundation funded this 2-year project.



For the 911-mapping project, shown is an example of a map (left) with the route from the Police Department to a specific road, i.e. Alamo. An entire table of written directions (table below) accompanied the maps. This was the first set of maps ever created by the EAST students.

Alamo	Turn left onto Passion Play, Travel on Passion Play for 0.73 mi, Turn left onto Magnetic, Travel on Magnetic for 1.05 mi, Turn left onto Main, Travel on Main for 0.49 mi, Turn right onto Mountain, Travel on Mountain for 0.04 mi, Turn left onto Center, Travel on Center for 0.20 mi, Turn right onto Main,

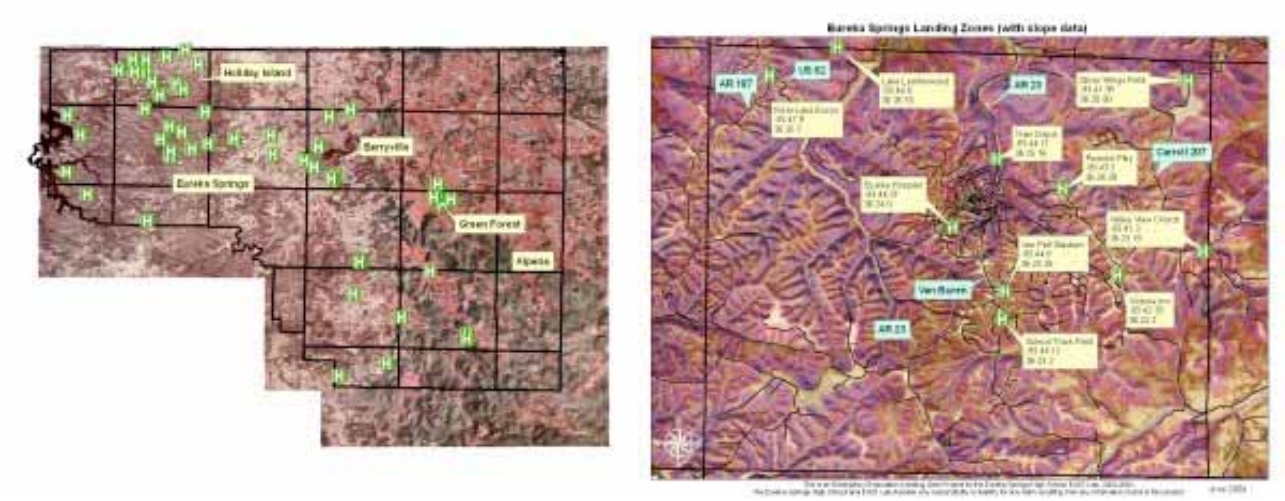
	Travel on Main for 0.11 mi, Turn right onto Trolley, Travel on Trolley for 0.05 mi, Turn left onto Eugenia, Travel on Eugenia for 0.10 mi, Turn left onto Midway, Travel on Midway for 0.31 mi, Turn left onto Van Buren, Travel on Van Buren for 0.08 mi, Continue straight onto Alamo.

Soon after, the EAST students were involved in another mapping project. Most of Northwest Arkansas is rural and difficult to access. It is also one of the fastest growth areas in the country. It is often difficult for emergency personnel to access and evacuate. Funded by a second grant from the Winthrop Rockefeller Foundation and with the help of County firefighters, first responders and emergency services personnel, EAST students from 4 different EAST Labs (Alpena, Eureka Springs, Fayetteville and St. Joe High Schools) worked together to verify existing emergency evacuation landing zones in 4 Northwest Arkansas counties (Boone, Carroll, Searcy and Washington).

The students created slope data, using Spatial Analyst, from .BIL data (obtained from Geostor). From that slope data, they were able to determine which areas would be the best possible sites for potential landing zones (slope 0-5%). The students spent several weekends at "mini-conferences" held in each of the different EAST Labs where they planned strategies, worked out technical problems in ArcGIS 8.0, mapped landing zones, and consolidated the maps in a final uniform layout. Other EAST students didn't have any previous GIS mapping experience. The more experienced students trained them. While mapping the landing zones, landing zone requirements (slope, absence of hazards, 100' x 100' minimum space) were verified and confirmed.

Eureka Springs EAST students completed landing zone maps for the emergency services personnel and firefighters of the Carroll County towns of Berryville, Eureka Springs, Grassy Knob, Green Forest, Holiday Island, Inspiration Point, Oak Grove, South Carroll County, and Southwest Carroll County. Wall maps (2 ft x 3 ft) and a "Book" compilation of area maps were created and distributed.

This was an incredibly comprehensive and difficult project. The students started using the newly introduced ArcGIS 8.0, and learned how to use the software as the project progressed. Coordinating efforts among the EAST students and their respective communities was very challenging. The EAST students were honored by having this project featured in several websites: the ESRI website: http://www.esri.com/news/arcnews/winter0405articles/arkansas-students.html, in the Trimble website: http://trl.trimble.com/docushare/dsweb/Get/Document-184505/13289_Landing_Zone_CS_0904_lr.pdf, and in the Dell website, http://www.dell4k12.com/tpl_case_study.php?ri=861&si=9. The project was also featured in ArcNews, the Winter 2004/2005 issue, and in the Winthrop Rockefeller Foundation 2004 Annual Report.



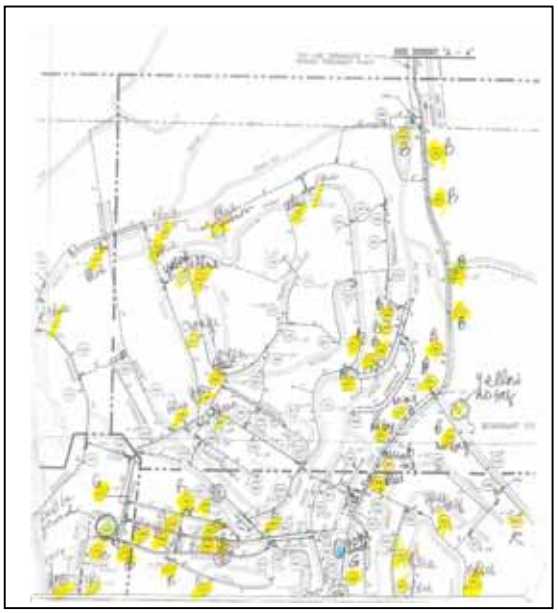
For the Emergency Evacuation Landing Zone project, maps were created to display landing zones for Carroll County (left) and for specific towns, like Eureka Springs (right). Landing zone coordinates and slope data were included in the maps.

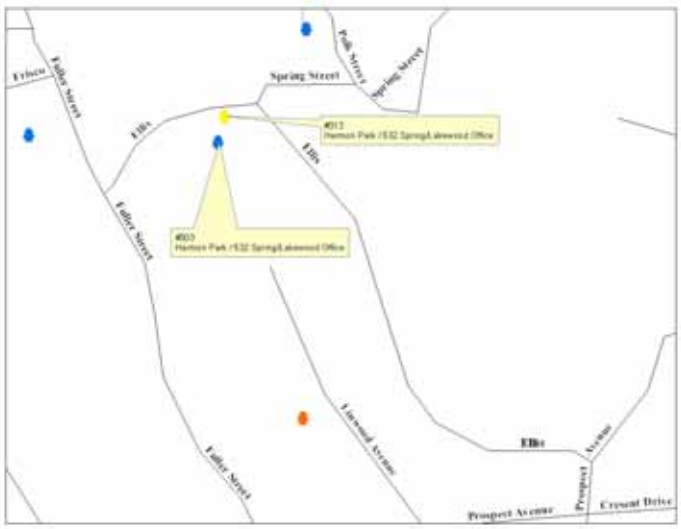
You would think that high school kids would do something else during a perfect weather summer. However, a team of Eureka Springs High School EAST students spent the summer of 2004 working on various projects for the City of Eureka Springs. The students started using and learning ArcGIS 9.0, which they acquired that spring.

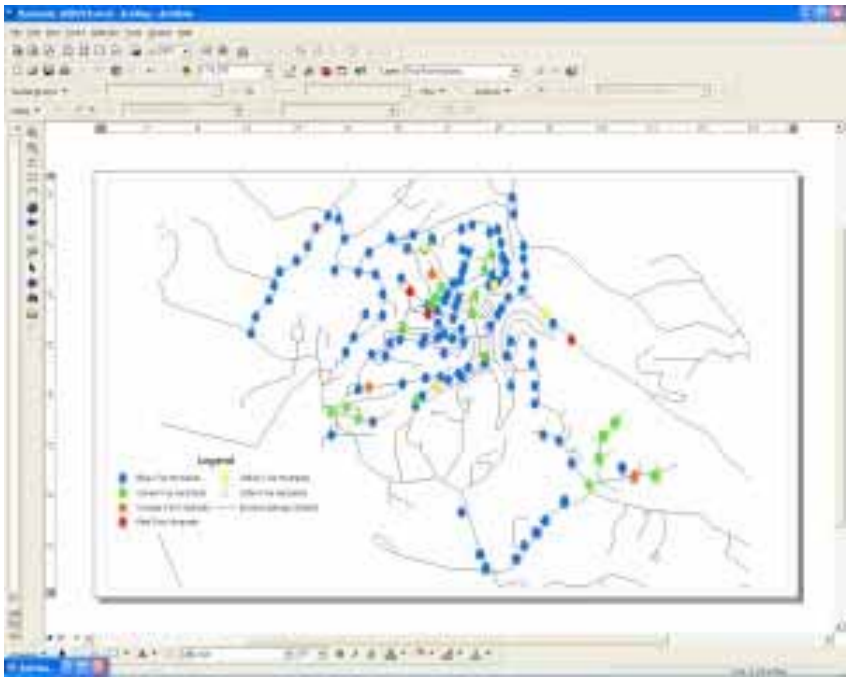
The first city project covered the mapping of the city's Historic District. There are 20 street points that are on the boundaries of the Eureka Springs Historic District. In the past, it was difficult to determine whether a business or residence was located in or out of the Historic District. Historic District building regulations could not be enforced. EAST students took readings of the 20 points as well as the buildings and residences surrounding these points. The students then created maps that included the accumulated data and aerial photos for the City.

For the Historic District project, maps were created to show the businesses and residences in and out of the Historic District. The boundaries of the Historic District are in red.

The second city project involved the mapping of the city's 307 fire hydrants. The Eureka Springs Fire Department's maps of the city's fire hydrants only showed their general location. These maps did not include any other information about the fire hydrants, like color that determines the level of water flow. EAST students completed mapping over 200 fire hydrants within the city limits. They created a consolidated shapefile of each fire hydrant color and added each of those shapefiles to their maps. The maps had street data with the shapefiles labeled by address and fire hydrant tag number. They will complete mapping the rest of the fire hydrant maps during the summer of 2005 and prepare a binder of all street sectors for the Fire Department.

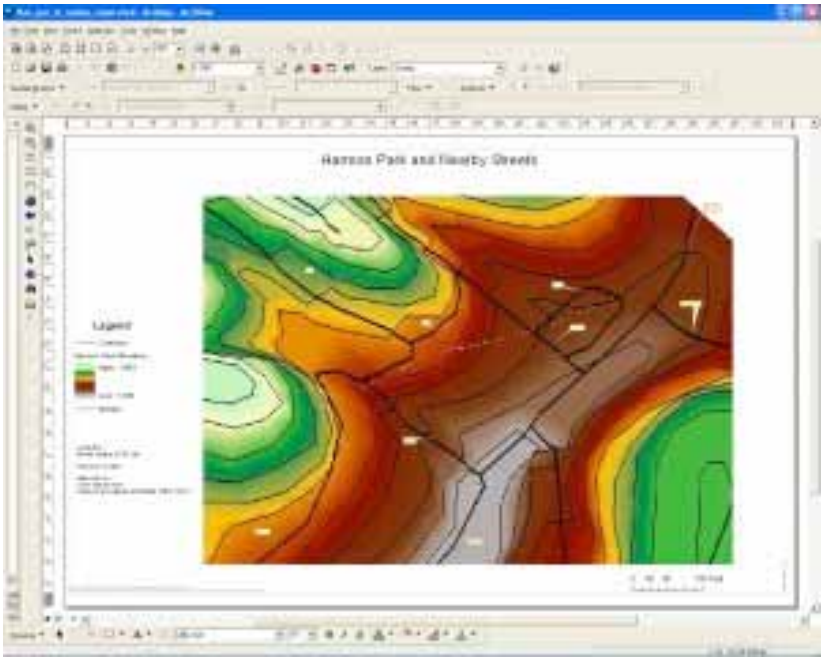






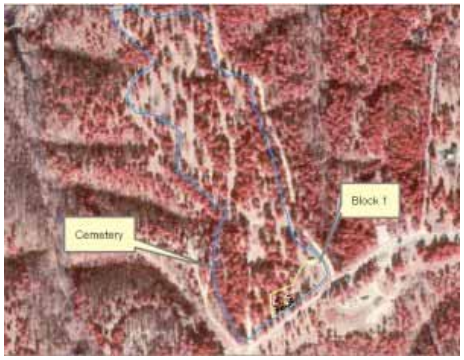
For the Fire Hydrant project, top upper left map shows the type of map the Fire Department currently has. EAST students created the top right map of color-coded fire hydrants for each street sector. The fire hydrant's color determines the level of water flow. Bottom map shows most of the mapped fire hydrants in Eureka Springs.

The third city project was the Harmon Park project, where the students were asked to create contour maps that would enable the planning of recreational facilities at the Park. This was a technically difficult project that the students continued to work on when they returned to school in the fall. The students obtained a topographic map from Geostor, then heads-up digitized the contour lines and assigned elevation data. The contours were opened in ArcView 3.3 and TINs were created from the elevation data. The TINs were converted to raster data in ArcScene where a 3D model of Harmon Park was created by assigning base heights. Street names were added. The city officials and architects reviewed the first set of completed contour maps and changes were requested. Additional mapping at the Park, more comprehensive software analysis and coordination with the staff of CAST at the University of Arkansas (Fayetteville) resulted in more accurate contour maps.



For the Harmon Park project, contour maps were created to help determine where future recreational facilities could be built. This is one of the first maps created.

The new school year brought more mapping opportunities. The Cemetery Commission approached the EAST students to help organize the historic 1850 Eureka Springs Cemetery's records, names and grave locations. For a period of 15 years, grave records were missing, incomplete or inaccurate. There are over 4,000 graves to be mapped and labeled. EAST students started collecting data of the cemetery graves (name, date of birth, date of death, block, lot and plot numbers) and created architectural drawings of the various Cemetery blocks.

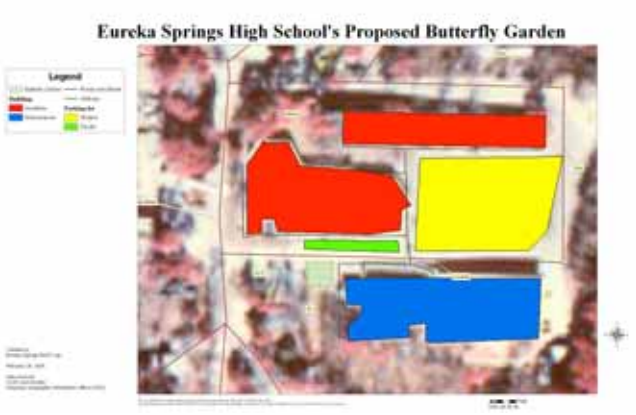


For the Historic Cemetery project, over 4,000 graves have to be mapped to determine who are buried and where they are buried. Map at left shows the completed graves. Right shows the architectural drawing of a cemetery block.

The High School also benefited from the EAST students' technological capabilities. The EAST Lab wrote and received a Wild School Site Grant from the Arkansas Game and Fish Commission to plant a butterfly garden at the high school. The garden was designed to attract various native butterflies and beautify the high school. The Arkansas Game and Fish Commission through its education program Project WILD offers grants to Arkansas

schools to encourage outdoor wildlife and environment education. The Eureka Springs High School was one of 20 Arkansas schools that received a Project WILD grant.

A local nursery helped prepare the original drawings and specifications for the garden. EAST students created a new set of drawings with their architectural drawing software. The students also used ArcGIS 9.0 to create a map of the butterfly garden and the high school. The garden was a great collaborative effort. EAST students used the Shop facilities to build a garden gate, created PowerPoint presentations about butterflies and plants for the Biology students. Volunteers among the students, teachers, staff, school alumni, and from the community planted and will maintain the garden. In addition, the EAST students received donations from local residents and trees from the City Tree Committee.



For the High School Butterfly Garden project, EAST students created a map (left) of the high school and the site of the proposed butterfly garden. Students and community volunteers planted the garden (right).

As to future projects, the Eureka Springs High School EAST Lab is coordinating efforts with the various cities of Carroll County, local banks, Chambers of Commerce, professionals and retired executives to establish a Carroll County Community Technology Center. The Center will offer basic computer training to parents, local skilled and unskilled work force, emergency services providers (fire, police, 911, EMS), city personnel, small business owners and workers, and retirees. Classes will cover Office Suite 2000, Basic Architectural Drawing, Basic Website Design, and Basic Video Production. Advanced computer classes like GPS/GIS Mapping, Video Editing and Animation will also be offered.

Various members of the Eureka Springs High School faculty will conduct sessions that parents need for their children. The EAST Lab, which currently provides technological expertise for its various community projects, will serve as a source of trainers and mentors to the parents and business people expected to use the Technology Center. Local professionals have also volunteered to act as consultants and guest lecturers. An advisory board will help monitor the Technology Center and provide advice and guidance. A grant from the Arkansas Department of Education will allow the EAST students to develop class tutorials and handouts during the summer of 2005. Fund raising efforts for the Center's operating expenses have started. The Center's target opening date is September 2005.

Working with GIS-based community projects has made a difference in the students' lives and in our community. As a 4-year EAST student and my best GPS/GIS mapper recently wrote: "When I joined EAST, I was scared. I didn't have any computer experience. Now I make professional looking maps. I learned how to work with different technologies, how to better relate with others, be a better leader, speak in public, and better serve my community. I have learned how to help my community and it is truly rewarding to be able to really help people around me with the skills that I've developed. EAST has greatly benefited my life and has taught me so much."

Acknowledgments

- Past and present EAST student mappers who sweated in the summer and froze in the winter, who ventured into the wild to get the right coordinates, threatened to beat up slow workstations, mastered the art of map making, learned to appreciate working with others, and eventually realized the value of their community mapping projects: Tesa Clark, Maxine D'Ambrosia, Nathan Drebenstedt, Leah Gould, Travis Graham, Jehnna Gunterman, Christina Henderson, Ashley Hill, Summer Johnson, Anna Lewis, Seth McCormick, Celeste Negrete, Gabe Rodgers, Patrick Ross, Jessica Standley
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- Parents of EAST students who allowed their children to work after school and on weekends
- Eureka Springs School Board, High School Principal David Childers and Superintendent Reck Wallis for their continued support of the EAST program
- My husband, Gordon, for his incredible patience and understanding

References

Additional information on the Emergency Evacuation Landing Zone project can be found in:

The ESRI website: http://www.esri.com/news/arcnews/winter0405articles/arkansas-students.html

The Trimble website: http://trl.trimble.com/docushare/dsweb/Get/Document-184505/13289_Landing_Zone_CS_0904_lr.pdf

The Dell website, http://www.dell4k12.com/tpl_case_study.php?ri=861&si=9.

ArcNews, the Winter 2004/2005 issue

Winthrop Rockefeller Foundation 2004 Annual Report

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