Title: Planning Support tools for Northwest Arkansas Communities - Paper #2005

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Abstract

The RGIS Mid-South office (www.ruralgis.org) has completed several "technical demonstrations" using one of the latest decision-support products, CommunityVIZ 1.3. An overview of our techniques and lessons learned during our pilot project will be discussed. The tasks identified by the community for the original demonstration were the estimation of the community's potable water usage in the future, the measure of the increase in total impervious surface area and the loss of prime farmland soil due to estimated development trends. A desktop, GIS application was developed with CommunityVIZ to assist the City Administrators with Open Space planning and our experiences with this process will also be discussed. The discussion of these pilot products should be of interest to anyone considering the implementation of similar planning support technologies into any moderately-sized rural community within the United States.

Introduction

During the past eighteen months, the RGIS Mid-South office developed several decision support prototypes for the city of Fayetteville, Arkansas. This rapidly expanding community of 59,000 citizens was identified as a logical choice for this demonstration due to its incredible growth rate and proactive planning department. The requested deliverables for this effort included the completion of a "Build Out" analysis for the study area and the calculation of impact estimates on residential water use, projected wastewater output, impacts to school age populations, as well as, impacts to the prime soil resources within the study area. Fayetteville's planning office defined the estimation of these impacts as their primary interests for this decision support demonstration. A prototype Open Space Planning Scenario was also developed within CommunityVIZ for the study area. The result from this technical demonstration sparked considerable interest in the application of decision support technologies within our local planning community and the Fayetteville Public School District.

Our Target Audience for the Demonstration Project

Our primary audience was initially determined to be the complete staff of the City of Fayetteville's Planning and Engineering office as well as the NWARPC staff members. Throughout this project we introduced a broader audience to the CommunityVIZ software applications and therefore, our audience grew to include the Fayetteville School District staff, the City of Springdale's Planning and Development office. The members of these offices also provided contact points and recommendations for other local municipalities that should be introduced to these results.

Several informal presentations to the project team members led to requests for additional assistance with the migration of these tools into their daily operations. Hugh Ernest with the City of Fayetteville suggested the introduction of these technologies into the Parks and Trails subcommittee prior to a formal presentation to the full City Council.

Summary of our Demonstration Goals and Objectives:

We determined during our initial project planning meetings to use the CommunityViz Software Suite conduct a "build out" analysis within a high growth area of Fayetteville, Arkansas and to use the Scenario Constructor module to quantify the impacts from development on the following:

- Estimated future water use by residential customers
- School age children projections/estimates within the Study Area
- Estimated sewer treatment plant impacts due to growth
- Calculate impacts to prime soils within the development zones
- Estimated changes to Impervious Surfaces due to estimated growth

We were also asked to develop open space suitability scenario that could be used in "real time" during planning committee meetings.

Pre-Existing Decision Support Capabilities of Project Team

Prior to beginning this project both the City of Fayetteville and the Northwest Arkansas Regional Planning Commission (NWARPC) were using Geographic Information Systems on a daily basis. Fayetteville has an existing three person staff within their GIS department, headed by John Goddard, and is equipped with ESRI, Inc. GIS software. The NWARPC office had two staff members fluent in GIS and also uses ESRI software for their daily transportation planning related tasks. Prior to this pilot demonstration project, neither of these offices were using "decision support" products that would be considered equivalent to the capabilities of the CommunityVIZ software.

The city had purchased several additional ESRI software licenses for other departments, but the primary use of any of their GIS software products occurs within their GIS program office. The city has had extensive, engineering level, planimetric data products developed within a Computer Aided Drafting (CAD) environment and much of the GIS staff's effort is in support of other departments for specific GIS analysis. Roughly eighty percent of their time is devoted to maintaining accurate, up-to-date datasets while coordinating with data partners within the community and providing access to these data via their award winning, ArcIMS web mapping system (www.faygis.org).

The NWARPC GIS users continue to updated and develop GIS data that supports their primary responsibilities within the region, which are related to transportation planning and analysis. Most of their traditional planning research and analysis is conducted by two staff planners that are knowledgeable ArcView software users.

Study Area Description

The study area for these prototypes covered 40 square miles of the western edge of the city of Fayetteville, Arkansas with an approximate 2003 population of 59,000 citizens. This community is located within the 3rd U.S. Congressional District of Arkansas and completely within the boundaries of Washington County Arkansas and according to the 2000 census, the 6th fastest growing Metropolitan Statistical Area (MSA) within the United States, the Fayetteville-Springdale-Rogers MSA.

This region has been considered one of the fastest growing areas within the Mid-South region and was recently ranked as the top-rated local economies within the United States by the Milken Institute (www.milkeninstitute.org). Local planning regulations vary between incorporated cities and land use regulations are basically non-existent within the rural areas of Washington County. Similar regulatory conditions are found throughout the region, and concerns over unplanned, rampant growth have not risen to the point where the general citizenry has requested the desire for strengthening of rural land use regulations. Poultry and cattle farming are still a significant portion of the areas local economy, while the corporate headquarters of Wal-Mart Stores Inc., J.B. Hunt, and Tyson Inc. have definitely fueled the influx of a well-educated, profession workforce seeking the relatively high quality-of-life associated with this fast growing rural community. The population growth rate over the entire MSA has averaged 47% since the 1990 census.

Summary of Project Deliverables

Build-Out Analysis

The calculation of the Build-Out Analysis required the use of the CommunityVIZ software product, collection of supporting GIS data layers from the local GIS department (www.faygis.org), and an extensive review of local zoning ordinances. The "Scenario Set-up Wizards" within CommunityVIZ enabled us to use the existing Fayetteville zoning map (GIS dataset) to determine how many commercial, residential and/or industrial structures would be built within the available (undeveloped) land. The GIS data layers required for this analysis included: Zoning Map, Street centerlines, Streams (non-navigavible), existing building locations, digital elevation data, and a percent slope map was calculated from the digital elevation model.

After consulting with Fayetteville's planner, we confined future development to areas where slope was less than 15% and beyond an 80 foot buffer from the local streams. These physical constraints were defined within the zoning ordinances and are often hotly debated between developers, citizens and city officials.
Our next step was to set-up the Build-Out scenario within CommunityVIZ 1.3 using the appropriate housing densities for each zoning classification. This task was accomplished with the assistance of a wizard driven menu, but required interpreting the Fayetteville zoning ordinances for each residential and commercial zoning category. By defining the allowable density for structures within each zoning category, the Build-Out application

can accurately place "estimated' building centroids within the undeveloped regions of the study area. The software considers the locations of any existing housing/commericial structures during the placement process while avoiding any predetermined constraints to development, such as our steep slopes and riparian corridors. The Build-Out process resulted in the allocation of estimated, future structure (point) locations within the developable land areas defined by the (polygons) zoning dataset. Structure densities (by type) and resulting counts of estimated structures within each individual polygon varied depending upon the local regulations and natural constraints defined for each unique category within our study area.

The results of the Build-Out process were an essential component of our demonstration, and especially since each of our resulting "indicators" of impact would reference these results/estimates (the estimated new building locations).

Several iterations of the "Build-Out" process were conducted so that the set-up parameters could be adjusted to more closely reflect reality within the study area. For instance, the future structure locations cannot consider future road centerlines of the planned residential subdivisions. However, an *efficiency factor* can be adjusted so that if 30% of the land areas of new subdivisions are typically used for utility easements, street right-of-ways, etc., then these "inefficiencies" can be factored into the output during the "Build-Out" allocation process. We experimented with these settings and compared our preliminary results within a few sample areas until satisfied with the results for this demonstration. The good news is that new building allocations can be manually placed or distributed across the available land so that those impacts can be included within the context of a Build-Out scenario.

The real value of this demonstration was the realization that the **future impacts** of our current ordinances and legal limitations placed upon development within the study area could be replicated within CommunityVIZ. The results could also be visualized in two or three dimensions with Sitebuilder3d to increase the comprehension of the forthcoming results of today's development regulations and practices.

Development Impact Indicators

After an acceptable and/or representative "build out" analysis was performed, we demonstrated some additional capabilities of the CommunityVIZ software suite. To accomplish this task we began reviewing the recently adopted "impact fees" within Fayetteville's city ordinances and quickly realized how the estimated city services (per single family households) could be incorporated into a scenario to instantly report the "resource drain" within the study area. This CommunityVIZ demonstration enabled the city officials to review these proposed impact fees and the resulting fee recovery from a different (visual) perspective. The real-time reporting via charts and graphs made for an easy to understand assessment and demonstration of how and where these impact fees would be collected and/or applied in order to sustain the current level of service to their citizens.

We also developed an indicator for *"Residential Water Consumption"* and compared the existing daily water consumption to the future water consumption, which was also based upon our estimated (future) residential structures calculated during the "Build-Out" analysis. The results indicate the need to nearly **double** the current potable water and waste water capacity (i.e.infrastructure} within the study area.

While demonstrating the capabilities of the CommunityVIZ software to Robert Gaudagnini, the GIS analyst for the Fayetteville School District, he determined that the product would be beneficial to their upcoming facility planning project. Robert also provided valuable assistance during this project by calculating the appropriate variables to use within our "estimated school age population" indicator chart. The results of his GIS research and analysis within the Fayetteville school district enabled us to accurately determine the local ratio of school aged children per single and multi-family households. His student population estimates were based on the best available data, and are almost entirely dependent upon accurate estimates of available housing, such as those developed by the "Build-Out" analysis developed within this demonstration. The following summary of Robert's GIS analysis of school aged population per dwelling unit was provided in his draft report written in March of 2003:

> ***Housing Model= 1) Single Family Dwellings-derive ratio of 1 student per 2 house holds (based on GIS patterns of existing housing).; 2) Apartment (multi-family dwellings)-derived ratio of 1 student per 5 apartments (based on GIS patterns of existing housing); 3) Compute plat single family housing within district-1223; 4) Compute plat multi-dwelling housing-1880. Add characteristics such as proximity to a school, 2 bedrooms vs 1 bedroom apartments and adjust numbers for potential student growth. The estimated growth of students (assuming all the units are built and inhabited within a 2-5 year period) would be 987 students. – Robert Guadagnini, Fayetteville Public Schools 3/17/03***

Work with the Fayetteville School District has continued and they have purchased the CommunityVIZ software.

Our demonstration of future development impacts also included an estimate of "Impervious Surfaces" within the study area. A sample scenario is included with the CommunityVIZ Suite that had been developed by the University of Connecticut's Cooperative Extension Service during their Non-point Education for Municipal Officials (NEMO) Project. We thought this would also be a useful demonstration for our RGIS outreach effort. By using the estimated structure locations calculated during our "Build-Out" analysis; the existing street centerlines, and the existing buildings from Fayetteville's GIS department, we were able to replicate this scenario using data within our study area (Figure 1). The resulting estimates of percentage of impervious surface within the study area sparked much interest from our project team; especially those from the city of Fayetteville. Our preliminary results were interesting, and thought to be very useful for quickly evaluating future subdivision schematics when only limited data are available, but there were some limitations identified. Existing parking lots and sidewalk inventories had not been completed within the study area, and therefore those impervious areas were not included within our estimates. Possible alternatives were discussed, which included the manual data creation via digitizing over recent aerial photography, but those methods may prove to be too time consuming for extensive project areas and would need

to be balanced against the city staffing limitations. The use of CommunityVIZ for impervious estimates for proposed projects was considered technically feasible.

Figure 1: An example of the Impervious Surface Scenario that includes the actual Indicator Chart of impervious surface summary.

Open Space Planning Scenario

Upon our initial meeting and definition of our goals for this demonstration project, Hugh Ernest of the City of Fayetteville requested the development of a decision support application specifically aimed at evaluating land parcels for public open space. Hugh defined his criteria and we developed a prototype that he'd prefer to deploy into the Parks and Trails Subcommittee meetings. The subcommittee has just recently published their master planning document and we are preparing to move this technology into the subcommittee meetings. Mr. Ernest has expressed much interest in the software and these demonstration products but he's also pointed out the many challenges associated with technological change within local government and his experience in county and local government has been most valuable during this project. The political changes that must take place during technological adoption are often the greatest challenge these early adopters face.

The Open Space scenario allows open space planners to draw a rectangles or polygons over a local aerial image and immediately receive updated charts or reports regarding the soil conditions found within the proposed parkland, the estimated school age population within walking distance to the proposed parkland, whether the prime farmland soils will

be protected, and a "warning message" if a portion of the proposed parcel contains poor soils or crosses into the 100 year flood zone.

The indicators and calculations performed within this scenario will most likely change as it's used, but Fayetteville's GIS manager, John Goddard, is fluent in the avenue programming language and perfectly capable of making minor adjustments to the scenario as changes are requested.

Spatial Data Requirements of these Scenarios

Most of the data used during this demonstration project was originally produced at map scales of 1:24000 with the exception of the data obtained from the City of Fayetteville's GIS department (*).

Vector GIS Data:

- Existing Building Centroids* (1998)
- Street Centerlines* (2002)
- Zoning Map* (2003, zoning category attributes)
- Streams/Creeks* (2001)
- Incorporated City Boundary* (2002)
- Fayetteville School Districts* (2001)
- Floodways, 100yr* (2001)
- SSURGO Soils (prime soil attributes)

Raster GIS Data:

- Color Infrared Photography (2001- 1m. DOQQ)
- Digital Elevation Model (30m. USGS DEM)
- Slope (percent, derived within GIS from DEM)

Software Required:

- CommunityViz 1.3
- ArcView 3.3
- ArcGIS 8.3 (used for slope calculation, reprojection, final maps)
- MS Office products

Final Discussion

I believe these product demonstrations will make a significant impact on the way our local planners conduct their business in the future. Adoption of these technologies has not been instantaneous, but both the city and the school district have expressed an interest in adoption of these techniques. We have not seen these applications into the day to day operations within the city, county or school district offices, but there has been a solid interest from the city with regards to accurately calculating the impervious surfaces throughout the city's planning area. We are definitely excited about the upcoming opportunities to demonstrate, apply and build confidence in these cutting-edge decision support tools within other local communities.

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