Streamlines

A Newsletter for North Carolina Water Supply Watershed Administrators

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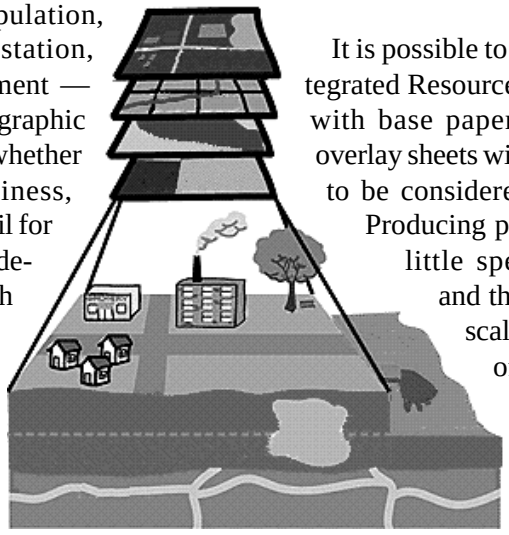
Integrated Resource Mapping

Many of us perform studies and make decisions pertaining to land use on a regular basis; wouldn't it be nice to have a tool to help make these tasks easier? Integrated Resource Mapping (IRM) has the potential to allow us to deal with spatial decision-making in a more logical and orderly fashion. The major challenges we face in the world today — overpopulation, pollution, deforestation, resource management — have a critical geographic dimension. And whether siting a new business, finding the best soil for growing crops, or determining which lands should be set aside for parks or open space, local problems also have a spatial component.



In his ground-breaking book *Design with Nature*, Ian McHarg formulated a methodology for analyzing various factors pertaining to the landscape in an integrated, spatial format. The general idea was to map each resource separately and then to combine aspects in a "layered" format to gain broader insight into the geographic area under consideration. McHarg developed a technique of overlaying various resources, uses, and constraints to produce an integrated picture for easier analysis. Using an appropriate map with the desired attributes made visible, planners, engineers, and local government officials should be better able to make a variety of land use decisions. Due to broad expertise in a variety of fields, planners may be uniquely trained and qualified to use these methods to synthesize information from various disciplines into a comprehensive analysis.

It is possible to perform simple Integrated Resource Mapping analysis with base paper maps and mylar overlay sheets with different features to be considered in combination. Producing paper maps requires little specialized training, and the USGS 1 : 24,000 scale topographic maps often make excellent base maps. Features such as water boundaries, steep slopes, vegetation, and land cover can be directly or indirectly read off of the base map and transferred to a transparent (mylar) overlay where it is depicted in different colors or shading. When the map "sandwich" is put together, it becomes simple to make siting decisions such as to which areas development should be targeted, and which areas should be preserved and set aside for conservation.

Integrated Resource Mapping techniques have been used for many years, but it has never been easier to make these analyses than now, thanks to advances in computer technology and the advent of Geographic Information Systems (GIS). GIS is an outstanding tool for performing analysis using multiple layers of information, but is not required for IRM. It is possible to perform similar analyses using transparent overlays to achieve the same "layered" effect. The elegance of GIS is in the ease of changing views, mixing and matching layers, and creating beautiful maps at any scale.

WHAT IS GIS?

One of the most powerful ways to perform Integrated Resource Mapping is through the use of Geographic Information Systems (GIS). GIS is a computer-based tool for mapping and analyzing features that exist and events that happen on the landscape. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic benefits offered by maps. These abilities distinguish GIS from

(continued on page 2)

IN THIS ISSUE

I. R. M. *(from page 1)*

other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies. Map making and geographic analysis are not new, but GIS performs these tasks better and faster than do the old manual methods. And, before GIS technology, only a few people had the skills necessary to use geographic information to help with decision making and problem solving.

SPATIAL ANALYSIS

Integrated Resource Mapping is ideal for geographical analysis of features on the landscape. An overlay, or spatial join, can integrate data on soils, slope, vegetation, water bodies, tax assessment, or land ownership with a variety of other features of the user's choosing. Once you have map overlays containing your geographic information, you can begin to ask analytical questions such as:

- Where are all the sites suitable for building a new shopping center?
- Where do steep slopes, floodplains, sensitive habitat, or other environmental constraints combine to make development difficult or impossible?
- Where is the best place to put the new park, the new school, or the new residential subdivision?

IRM provides the framework to make these determinations in a logical manner based on existing and future conditions on the ground. Two analytical tools are frequently used in IRM decision-making: proximity analysis (e.g., how many houses lie within one-half mile of this water body?) and overlay analysis (i.e.: integration of different layers joined visually or physically). GIS, in particular, is very powerful when used for IRM to analyze geographic data, to look for patterns and trends, and to undertake "what if" scenarios.

MAKE BETTER DECISIONS

The old adage "better information leads to better decisions" is as true for Integrated Resource Mapping and GIS as it is for other methods. IRM, however, is not an automated decision making system but a tool to compile, analyze, and map information in support of the decision making process. For example, IRM can be used to help reach a determination about the appropriate location for a new development so that it has minimal environmental impact, is located convenient to an existing transportation network, and is within local government service provision areas. IRM is frequently used to assist in tasks such as presenting information at public hearings or at local government board meetings since information can be presented succinctly and clearly in the form of a map and accompanying report, allowing decision makers to focus on the real issues rather than trying to understand the data. Again, GIS stands out in this area since its maps can be produced so quickly that multiple scenarios can be evaluated efficiently and effectively.

Watershed and wellhead protection are excellent applications for IRM to understand geographically the development restrictions in place for watershed protection. IRM can be used in a regional water supply protection study to assess the supply, delineate areas to be protected, and identify potential hazards and proposed projects or activities in the area that would be detrimental to water quality. After protection zones are established for each water source, potential sources of contamination can be identified and classified in order of concern based on their potential to adversely affect water quality. In a sense, this is what the State of North Carolina has done in implementing the water supply watershed protection (WSWP) program. It is left to the local governments to implement the WSWP program in a comprehensive and logical manner to protect resources while encouraging environmentally responsible growth.

TO GIS, OR NOT TO GIS . . .

Deciding between paper maps and GIS is like deciding between a Rolodex and a computer database to store phone numbers. While a Rolodex is initially cheaper than a computer, and requires less skill, the database can be used for more purposes, such as sorting out all of the people within a certain area code or municipality. The decision regard-

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C G I A

The Center for Geographic Information and Analysis (CGIA) is a state agency in the Governor's Office of State Planning with offices in Raleigh and Asheville. CGIA operates a service center to provide GIS products and analyses to other government agencies, organizations, utilities, and private companies throughout North Carolina. CGIA also oversees a statewide effort to coordinate geographic information resources. For more information, contact CGIA at (919) 733-2090, or point your web browser to URL: http://cgia.cgia.state.nc.us

Look for *Streamlines* on the World Wide Web at URL:
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ing GIS should be based on the preferences and resources at the local government's disposal. If one does not own a computer, or know how to operate it, then the Rolodex is probably the better choice. The decision, of course, is more pronounced when deciding between mapping techniques because the equipment is more expensive and difficult to operate than a simple database, and using paper maps is much more cumbersome than flipping through a Rolodex.

A local government with the resources and/or staff available to take the GIS plunge has a variety of options and can choose from an inexpensive PC running desktop GIS to a full blown workstation with digitizing pads and full color plotters. In comparison to full-scale GIS systems, software continues to be developed which is relatively low cost, easy to use without extensive training, and can run on computers with the 486 or Pentium processors found in many office computers. There are, of course, costs and benefits associated with each option. The desktop version will lose some functionality (customizability, data availability), but may still enable local planners to access and view extensive resource databases and perform sophisticated analyses with a relatively minimal investment in equipment and staff time. If a community cannot afford to obtain the computer equipment or the specialized staff which may be necessary for GIS, contracting out for these services is an option as well.

When contemplating GIS, don't forget to budget for information acquisition, since possibly the most important component of GIS is the data and map layers. Geographic data and digital maps can be generated in-house or purchased from a commercial data provider. The Center for Geographic Information and Analysis (CGIA, see page 2) is a state clearing house for geographic data. They do, however, charge a fee for providing this information. The GIS investment, while initially expensive, may continue to pay off years later as data accumulates and analysis becomes more sophisticated. The ability to leverage the information collected in a study to real accomplishments is key to the success of the system.

"Environmental protection is inherently spatial"
- Andrew Battin, National GIS program manager, EPA

THE NEXT STEP

Land use management may be the key to improving water quality, especially considering non-point source pollution which cannot be controlled with standard regulatory permitting and enforcement techniques alone. In many areas in North Carolina, land use decisions are made at the local level by a combination of elected, professional, and volunteer municipal officials. Because the cumulative water quality impact of these local decisions can be great, educating municipal officials about the relationship of land use to water quality and presenting complex geographical information in an understandable manner are critical steps to effective watershed management. Using spatial analysis tools such as IRM and/or GIS enables more effective analysis of the complex relationships between demography, land use, wetlands, water quality, pollutant loading, and other factors. We can then focus our efforts in an integrated manner rather than in piecemeal fashion.

Watershed assessment and protection efforts have generally been driven by more "reactive" approaches in which wetlands and waters that show signs of degradation are examined and the resulting diagnostics are used to mitigate the damage. North Carolina's WSWP program, however, uses a proactive approach to attempt to keep the state's drinking waters in good condition. Since the program is administered locally, it is important for local decision-makers to understand the connection between land use activities and watershed resources. Combined with a comprehensive mapping inventory of local resources and constraints on the ground using IRM, the WSWP rules give local governments the flexibility to plan for orderly and responsible development in their communities and their drinking water supply watersheds.

URISA

The Urban and Regional Information Systems Association (URISA) is a national organization whose goal is to encourage a multi-disciplinary, professional approach to the planning, design, and operation of information systems. In recent years, the focus of the Association has been on geographic information systems and spatial data. The North Carolina chapter encourages professional and educational development by sponsoring workshops, by encouraging members to provide instructional or technical support to schools or other organizations, and by holding semi-annual meetings. For more information, contact NC URISA at (704) 336-6629, or point your web browser to URL: http://www.urisa.org

Resources

Arnold, C.L. "The Use of Geographic Information System Images as a Tool to Educate Local Officials about the Land Use / Water Quality Connection." Proceedings of the Watershed '93 Conference. VA, 1993.

ESRI. ArcView GIS -- promotional literature. Redlands, CA, 1997.

Griffin, C.B. *Introduction to GIS for Public Agencies*. Conservation Technology Information Center, 1995.

McHarg, Ian. *Design with Nature*. Doubleday (Natural History Press). NY, 1971.

What's Happening ?

January 23 & 24, 1998 – "Management Course for Planning Directors." American Planning Association (APA). Charlotte, NC. For more information, call (800) 870-6306.

February 11 & 12, 1998 – Water Quality Committee (WQC) and Environmental Management Commission (EMC) meetings - Raleigh, Archdale Building, 512 North Salisbury Street, Ground Floor Hearing Room, Noon (WQC) / 9am (EMC).

February 13, 1998 – Deadline for proposals for funding from the Drinking Water State Revolving Fund. Contact Sid Harrell of DEH's Public Water Supply section at (919) 715-3216 for more information.

February 27, 1998 – Deadline for proposals for Clean Water Act Section 319 Grants for the fiscal year 1999 funding cycle. For more information, contact Linda Hargrove of DWQ at (919) 733-5083, extension 352.

March 11 & 12, 1998 – Water Quality Committee (WQC) and Environmental Management Commission (EMC) meetings - Raleigh, Archdale Building, 512 North Salisbury Street, Ground Floor Hearing Room, Noon (WQC) / 9am (EMC).

April 8 & 9, 1998 – Water Quality Committee (WQC) and Environmental Management Commission (EMC) meetings - Raleigh, Archdale Building, 512 North Salisbury Street, Ground Floor Hearing Room, Noon (WQC) / 9am (EMC).

May 3-6, 1998 – "Watershed '98 -- Watershed Management: Moving From Theory to Implementation." Denver, CO. For more information, contact the Water Environment Federation at (703) 684-2400.

May 17-22, 1998 – Conference of the Association of State Floodplain Managers. Flood hazard mitigation, watershed planning, etc. Milwaukee, WI. For more information, contact Diane Watson at (608) 274-0123.

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