Mapping and Land Records Modernization

Strategies for Arkansas

A Report to Governor Jim Guy Tucker

Prepared by the

State Mapping and Land Records Modernization Advisory Board

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EXECUTIVE SUMMARY

In Arkansas a major portion of the information on paper and stored in digital form is referred to as geo-referenced data (information connected to an identifiable point or area on earth). Economic, natural resource, agricultural, political, and demographic activities and trends share the common attribute of being referenced by a geographic location.

State, county and local agencies and businesses have a constant need for geo-referenced data that can be merged and analyzed for decision making. Paper maps are not readily revised, are often of different scales, use different standards and symbols, all of which make merging information difficult. Many millions of dollars are spent each year on creating, mantaining and using these paper maps and related data In Wisconsin it has been determined that some \$27 per-person per-year was being spent. If these data were computer-based, spatially-related and standardized, however, substantial dollars could be saved while increasing the usefulness of the information.

Mapping and land-records methods in Arkansas have evolved little over the past 150 years from the earliest quillpen journal entries. However, mapping techniques and related information technologies have greatly advanced in the past decade. Many states, county and local governments and businesses have recognized that rapid and cost-effective access to map based data provides a critical economic advantage, improves responsiveness to the public and the customer base and enhances decision making abilities of public officials and business management. States around Arkansas are rapidly developing these systems.

Numerous state agencies, and county and local governments are independently developing in-house geographic information systems (GIS) to support and enhance the management of information. A recent survey by the UALR Department of Computer Science reported that more than 200 Arkansas agencies, and county and local government units were planning to develop or use such systems. County and city governments promote efforts to modernize mapping and land-records management at the local level. Academia is becoming involved in GIS and LIS (land information systems) in research and instruction. At least five major institutions of higher education in Arkansas now teach GIS/LIS courses as part of professional degree programs.

Without the ability to communicate and exchange basemap data, however, each GIS installation will re-create basemap data, causing redundancy and additional expense. At present the State of Arkansas has no means to facilitate the use of common standards, create a common digital basemap, or share data in an automated mapping and land-records information environment. As a result public monies have been spent to duplicate already existing digital map data and to create ditital mapping data that are not useful to other agencies or the public.

State agencies and county and local governments realize that with coordination and standardization, an automated information system could be shared by many users at significantly less cost. Implementation of standards and compatibility could be guided through a long-range strategic plan and a technically-capable coordination group. GIS will allow easier and faster transfer of information, reduce duplication of effort, provide updated data files, and assure that the data meet acceptable standards.

Thirty states have State Mapping Advisory Committees (SMAC), commissioned to formulate strategic plans to expand digital mapping resources, facilitate the use of geodata in GIS/LIS, and encourage the spread of computer-based technology in government.

Traditionally, state agencies maintain geographically referenced data on paper maps. The US Geological Survey and the Arkansas Geological Commission maintain a long-range plan to digitize these maps to provide a more cost-effective method of updating. The USGS requires state matching funds before they can move forward. They currently estimate that a state match of more than \$3.5 million dollars would be needed. The Arkansas Highway and Transportation Department is currently the leading in-state producer of digital map data related to GIS/LIS requirements. They have completed 47 of the states counties. AHTD projects that an additional \$500,000, over two years, would allow them to complete the state's transportation digital mapping and add information that would make this data useful to other agencies and the public.

Standards provide a verifiable basis for measuring quality. In terms of a technical product, standards mean fitness for the intended use. In multipurpose GIS/LIS applications, standards serve to categorize spatial data in terms of specific uses. Federal guidelines regarding modern standards have been promulgated through the National Map Accuracy Standards (NMAS).

The Board, in formulating recommendations for state oversight of geodata production by state and local government, has concluded that rigid threshold standards should be avoided and not enforced at this time. Focus should be on producing guidelines for standards, and programs leading to the voluntary participation of GIS/LIS developers in the use of common standards.

If the state continues to manage data without guidelines for common standards, and individual government agencies proceed building in-house GIS without coordination between agencies, the outcome is expensive information chaos. Without the application of standards, non-compatible computer hardware and GIS software prevent the delivery of uniform information, if any useful information at all. The MLRMAB has established five tenets: 1) Geographic and landrecords data are integral to the cultural, economic, and political lives of the citizens of Arkansas; 2) A vast majority of the information used in the management of government can be geo-referenced; 3) Coordinated GIS/LIS activities are most productive and cost effective when operated in conjunction with a central policy-making body; 4) GIS/LIS in Arkansas operates in independent, uncoordinated pockets unable to realize the fullest potential of information sharing that would benefit the citizens of the state; and 5) State, county, and municipal governments in Arkansas are not currently equipped with the guidelines, standards, and operating policy necessary to carry the state into the "Information Technology Arena" and the 21st Century.

Recommendations Of The MLRMAB

The State of Arkansas must put into place and support a permanent organization charged with developing, implementing, and updating a strategic plan aimed at modernizing mapping and land-records policies and methods relying on GIS/LIS and related technologies. Based on the findings and conclusions of the MLRMAB in response to the mandate of Act 150, the following actions are recommended.

1. Establish a Land Information Advisory Board (LIAB)

a). The LIAB will serve as an independent body to determine, recommend, and promulgate GIS/LIS policy and direction within the State of Arkansas. The Board will be empowered to propose, develop, and implement programs and guidelines for publicly financed digital geodata and land-records modernization activities, multi-level standards, metadata reports, a statewide basemap, a clearinghouse of geodata information, and direct state funds to qualified mapping and land information projects.

b). The governor will appoint thirty two (32) voting members and an unlimited number of non-voting members to serve on the board, including representatives from public and private GIS/LIS interest groups, an Executive Board will be elected from the full LIAB.

(c) LIAB will develop and annually update a land-records modernization strategic plan projecting goals and objectives over three- five- and ten-year periods.

(d) LIAB will coordinate development of a 1:12,000 or smaller-scale statewide digital basemap through the collaborative effort of the Arkansas Highway and Transportation Department, the Arkansas Geological Commission, and the Center for Advanced Spatial Technologies to be made available at nominal cost.

(e) The LAIB will have authority to set and collect fees for services provided to users.

(f) The LIAB will identify funding sources and establishment of a method of distributing funds to encourage participation by government entities in the modernization of mapping and land records through GIS.

(g) The LIAB will develop and disseminate a State Digital Data Catalogue and a Data Dictionary.

(h) The LIAB will consider other matters related to mapping and land-records modernization.

2. Establish the Office of Land Information Technical Support (OLITS)

To accomplish the board's objectives, we recommend that the Office of Land Information Technical Support (OLITS) be created to serve as an administrative interface between the LIAB and the state's GIS/LIS environment. The primary OLITS mission will be the implementation of methods to modernize mapping and land-records management in Arkansas as identified by the Mapping and Land Records Modernization Advisory Board. This mission will be the primary focus of a ten-year strategic plan. OLITS will be staffed as follows:

> Land Information Director State GIS/LIS Coordinator State Geodetic Advisor (Housed at the Land Survey office) Administrative Assistant GIS Technician

3. Complete a coordinated statewide digital basemap

A major limitation to the successful use of GIS technologies by state agencies, county and local governments and the private sector is the fact that only a portion of the state has completed digital basemaps. Without complete coverage many areas can not take advantage of GIS technologies and many statewide or regional efforts are, therefore, not feasible. Many agencies are working to develop portions of the basemap but these efforts are not coordinated and duplication of effort results. A coordinated effort to complete essential data layers should be implemented.

4. Develop a statewide digital map clearinghouse and archive

A statewide clearinghouse for digital map data is necessary. Under the current situation many agencies and other s are unable to locate existing data or often duplicate existing data at considerable unnecessary cost. When data does exist it is often in many different formats and technical specifications. A central clearinghouse would make all data easily available and could serve to translate/transfer data from one format to another.

5. Fund these initiatives through general revenue.

The MLRMAB believes acceptance and implementation of these recommendations are vital to the success of Arkansas state government as it moves into an age of rapidly evolving information technologies. The public's growing demand for accurate and timely information places new demands on government agencies. The estimate that 90% of the information used to run government can be referenced to a geographic point or definable area underlines a serious need to manage geodata sources. We believe the recommendations hereby submitted give the State of Arkansas that opportunity.

The first year costs of the various elements proposed are:

Office of Land Information Technical Support	\$336,970
Completion of essential basemap elements	\$390,000
Operation of clearinghouse and archive	\$150,000
First year Total	\$876,970

Second year costs are:

Office of Land Information Technical Support	\$312,292
Completion of essential basemap elements	\$250,000
Operation of clearinghouse	\$150,000
Second year Total	\$712,292

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MAPPING, LAND RECORDS, AND THE STATE OF ARKANSAS

Introduction

Ever since the first cave dweller scratched out a map in the dirt to show a companion where food might be found, people have looked for better ways to create geographic pictures of the land. From that beginning, maps have been drawn and redrawn for a multitude of reasons. Navigation, or getting from place to place, is probably the most common use of maps. Of equal, if not greater, importance is the recording of accurate information describing the land being mapped. Land records showing the location and ownership of land are integral parts of our cultural, political, and economic lives.

As Arkansas approaches the 21st century, we face the need to modernize outdated mapping and land-records management information systems. Decisions have to be made that will substantially improve the traditional way Arkansas manages maps and land records, or in modern terms, *spatially related or geo-referenced data*. As part of the global information technology family, Arkansas must enter the 21st century prepared. States around us are rapidly improving their mapping and land records and, like other information technologies, digital mapping and land records are rapidly becoming an essential component of our economic, environmental and political well-being. States and communities with modern mapping systems and land records are more economically competitive and better equipped to cost-effectively respond to the myriad of public needs.

Recognizing this critical situation, the 1993 Legislature passed Act 150 which created the state Mapping and Land Records Modernization Advisory Board. The Board was charged with assessing the state of mapping and land records today and proposing a plan for the future. This report summarizes the findings of the Board. The report presents the information on the current status of mapping in the state, why modernization is needed, the costs and benefits of such an effort and makes recommendations for a program to implement a statewide program of modernization.

Evolution of Information Technology

Until the early 1980s, mapping and land-records methods in Arkansas had evolved little over the past 150 years from quillpen journal entries. As is true in so many areas, however, computer technologies have dramatically changed how mapping and land-records information is obtained, stored and used. Digital data processed by the computer are stored, retrieved, analyzed, revised and passed along much more easily than paper-based data. The resulting potential for order-of-magnitude increases in productivity and quality of work is what has produced this burgeoning of computers in our society. In the early 1980's the management of spatial data– maps and land records– in the United States began to be facilitated by computer based "geographic information systems"– or GIS, which is defined as,

"a system of hardware, software, data, people, organizations, and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth".

A GIS spatially integrates layers of related information. It readily displays and reproduces data in the form of maps, but it is much more than a set of digital maps. A GIS supplements the human ability to assess, correlate and rearrange data. Extensive files of digital data with locational identifiers can be accessed and reviewed in relation to the map; for example, all the names and addresses of people living next to a certain utility or transportation corridor. Once analysis is complete, the system can generate a new map and a report.

In a GIS, paper-based maps and paper land-record files are transformed into electronic computer data. A great deal of paper data, including many maps, will never be converted to digital data because their utility to us in the world of computer-based information technology is not sufficient to justify the effort conversion would take. On the other hand, some paper-based data, and particularly many kinds of geo-data become even much more useful when converted to a digital form, since the computer driven GIS manipulates, tabulates, transfers, manages, retrieves and stores spatial data with great speed and accuracy. These data include timely information about our naturalresources, land-records, economic, agricultural, political, and demographic activities and trends. This is possible because these topics share a common attribute: they can be referenced by a specific geographic location or "georeferenced". Geo-referenced data are connected to an identifiable point or area on the earth. Obviously any information shown on a map is geo-referenced; but any data set tied to a street address (such as a water bill) is also georeferenced, as is a deed in the Circuit Clerk's Office which is identified with a definite patch of the earth's surface by its legal description. A federal study reveals that the great majority of all information used in the management of government can be referenced by a specific geographical point. Some estimates indicate that as much as 90% of all such data is geographically linked. When information is spatially related, its ability to inform us is enhanced. Relationships become apparent and their extent can be measured. Questions begin to be answered, such as:

- Which areas of the state have unemployment above 7%?
- Which intersections on this highway have the most traffic accidents?
- How many acres of this site are subject to flooding?
- Where did this 911 call come from?

In large part, the work of administering public and private sector activity is the process of answering questions that have a spatial component. The questions can arise within an organization in the course of doing its job today or planning for the future; or the questions can come from the public who expect government and business to provide reliable information quickly. This public investment in geo-referenced information, and its use has come to be recognized as a major infrastructure. On the national level it has been given the name, "National Spatial Data Infrastructure", which the National Research Council defines as, "the means to assemble geographic information that describes the arrangement and attributes of features and phenomena on the Earth. The infrastructure includes the materials, technology, and people necessary to acquire, process, store, and distribute such information to meet a wide variety of needs."¹

This infrastructure is in existence now. It has grown and evolved as the nation has grown. Until recently it was exclusively paper-based and fragmented into a myriad of uncoordinated sources of incompatible documents. Today the infrastructure is becoming a complex of computer based digital data with great potential for coordination and integration of data. With the increasing value of information in our economy, the importance of access to the infrastructure is becoming clear.

Public officials who must administer a massive amount of information related to land transactions, development, and taxation find their system of paper maps and cabinets full of paper files overwhelming. Planning is often handicapped and, frequently, the mere retrieval of information becomes so cumbersome and time consuming as to be essentially impossible.

State agencies charged with managing the use of our natural resources and protection of the environment have a constant need for many types of georeferenced data sets that can be merged and analyzed for decision making. Paper maps are not revised readily, are of different scales and use different sets of symbols; all of which makes merging their information difficult. Computer based sets of spatially related data can be correlated in any number of ways specified by the user.

The operation of a GIS requires extensive amounts of digital geo-data; digital maps and geo-referenced data sets. Even where there is management willing to make the institutional arrangements, knowledgeable staff with adequate hardware and up-to-date software; an incipient GIS can wither because of a lack of spatial data to work with. There is a pump-priming paradox; digital, geo-referenced data are necessary to produce digital, geo-referenced data. This growing demand for data is being meet in a variety of ways. Government agencies, units of government and the private sector often undertake their own projects to create new geo-referenced digital data to meet their needs or to convert the existing paper-based data they have to digital data through the processes of scanning or digitization.

There are problems and limitations with all of these approaches. Data compiled by vendors or the federal government may not meet the specific needs of the user. Data from vendors can be expensive and of uncertain quality. Mapping and data conversion projects are significant expenditures that are hard to place in an annual budget. However, rapidly advancing technology is producing partial solutions to the data acquisition problem.

Satellites in space provide platforms for mapping the earth by many means, all of which produce digital images. The military Navstar satellites also

¹ Mapping Science Committee, National Research Council. <u>Toward a Coordinated Spatial Data</u> <u>Infrastructure for the Nation</u> (Washington, D. C., National Academy Press, 1993), p. 16.

provide global positioning ("GPS") which allows observers with GPS receivers to determine precise positions on earth quickly. GPS is reducing significantly some of the costs of terrestrial surveying, mapping and geo-data collection. Scanning devices which automatically convert paper based materials into digital files are improving in quality, though a significant amount of human assistance is necessary to produce useable files.

Computer generated mapping and land-records information have become such powerful decision-making tools that many state agencies, counties, and municipalities are beginning to develop GIS capabilities. Some governmental entities are independently developing digitized basemaps inhouse to support and enhance the management of agency information. This is being done with little coordination of computer systems and software between agencies. Too often redundant, overly expensive, GIS databases are created. Agencies have begun to realize that with coordination, control, and standardization automated information systems could be shared by many users. Agencies reason that if basemaps were standardized and hardware and software were compatible, the citizens of the State of Arkansas would realize an extraordinary cost savings and at the same time experience better government. Standardization and compatibility, however, must be guided discreetly but firmly from a central point.

Because of the complicated nature of such automated systems, many governmental units, particularly at the local level, need assistance and guidance on many technical matters. Informal groups have therefore developed to exchange information and advice. Arkansas has followed the national pattern that has developed in this dialogue. People at various stages of GIS implementation begin talking about problems and solutions and the conversation soon expands to include academics and professionals in the fields of planning, computer science, surveying and mapping and other related areas. In Arkansas, a "GIS Users' Forum" was established in 1992 with the encouragement of the Department of Computer Services. More than 1,000 people participate in the Forum's activities and in 1993 and 1994 the Forum sponsored workshops where hundreds of people interested or involved in GIS shared information.

As state agencies and units of local government shared information about GIS, the need for a coordinated strategy supported by state government was recognized and the critical need for a state board or task force came into being. In response, the 79th General Assembly enacted Act 150. Act 150 established a State Mapping and Land Records Modernization Advisory Board. The Board was charged to study the mapping and land information needs of the state, make recommendations and report to the Governor by October 31, 1994. This report and its recommendations are the result of the Board's activities over the last eight months.

Why Should Land Records Be Modernized?

Currently, Arkansas land records are maintained almost entirely as paper documents with various means of indexing. All but a few of Arkansas' counties rely on traditional, manual record-keeping methods. The volume of these records continues to grow, making the creation, storage, and retrieval processes ever more difficult, more time consuming, and consequently more expensive. Comprehensive views of an area, a town, a county are virtually nonexistent. Studies to evaluate industrial development opportunities, check environmental pollution, or examine the ramifications of political redistricting, for example, are costly and time consuming, not to mention potentially inaccurate and incomplete.

Land Records At The County Level

While state-level mapping data are critically important, the great majority of land-records information resides at the county and local level and the largest component of this information consists of land records. A "Land Information System" ("LIS") is defined as a "geographic information system having, as its main focus, data concerning land records."² The existing system which organizes these records and guides access to it in Arkansas was established in the early part of the 1800s. The system is maintained in county court houses, abstract offices and other diffuse locations. The field books and plats of the original government surveys are archived in the offices of the State Land Commissioner. Copies of the original plats are archived in the county court houses. Records of land ownership and surveys are maintained in the office of the Circuit Clerk of each county. These records are supplemented by extensive private records held by abstractors, surveyors and others. Records of assessment of these lands are maintained by the Assessor of each county. The survey, platting, and sale of the public lands of Arkansas largely was completed during the period 1815 to 1849.³ In that period over 33 million acres of land in Arkansas passed from federal to private ownership. The land lines established then still define most ownership in the state and the record keeping methods created more than 150 years ago are still is use today.

However, the great limitation of the public land survey system is that its corners are not located in terms of latitude and longitude, state plane or any other geo-referenced, or "geodetic" system which would allow the coordination of their location with other geo-referenced data. For almost 20 years the Land Survey Division of the Arkansas Geological Commission has managed a program which encourages surveyors to place substantial state perpetuation monuments at the location of the original government survey corners. Over 10,000 monuments have been set thus preventing the loss of these vital corners. However, very few of these monuments have known geodetic positions. In fact, very few property corners in the state have known geodetic positions. Therefore most parcels of property in the state are not geo-referenced. If they were the parcels could be precise related to other geo-data. A simple example can illustrate this point. The US Soil Conservation Service is currently developing digital soil maps of the entire state. These soil maps are geodetically referenced. If land parcel boundaries had geodetic references then a computer could automatically compare land boundaries with soil mapping units. Such a comparison is required for tax assessment purposes, for farm conservation and commodity support plans and, in many areas, to determine

² American Congress on Surveying and Mapping, <u>op. cit.</u>

³Loberg, David. <u>The Mapping of Arkansas 1541-1900</u>. (Unpublished MS Thesis: The University of Arkansas, 1976), p. 58.

if septic systems will be effective. Today all these tasks must be performed manually, at considerable time and cost and often with substantial errors.

The land recordation system of the state is another more or less successful 19th century artifact which is encountering real limitations as a part of the late 20th century information infrastructure. The system was designed to protect the ownership of real property by providing certainty in matters of title. This served vital state interests of land settlement and development and supports property taxation. In some areas the information on land ownership and similar elements of the land recordation system are now being entered into computers. While this is of major benefit, the reference system of survey corners is not geodetically related, it is not tied to a mapping structure such as that provided by state plane coordinates. These factors close land records to the easy coordination with other data which computer-based information management provides. A member of the public visiting the Circuit Clerk's office can obtain a copy of the deed to a parcel of property, although the assistance of a deputy clerk, abstractor or other skilled person would be required. However, if they asked any number of other simple questions about the property such as: "what is the zoning?" "what is the street address?" or "how far away is the nearest school, fire hydrant or hospital?" they would be referred to any number of other offices and would have to put considerable time and effort into answering what would appear to be fairly simple questions. Property ownership plat maps would have to be manually compared to zoning maps, to street maps, or to community maps of the water or school system to permit the simple questions posed above to be answered.

A visit to an Assessor's Office in a populous Arkansas county will reveal a lively scene of activity. The Assessor's staff will be busily updating paper files of tracts referenced to paper maps which also must be revised as parcels are Realtors, surveyors, right-of-way purchasing agents and other split. professionals will be gleaning the files to do their work, and the tax-paying public will line up to request a variety of information. At the county level, the Assessor's office is perhaps the best example of where the new digital information technologies could have a dramatic effect on productivity. Assessors usually are among the leading advocates of LIS/GIS implementation. Without computer assistance, the correlation of all the data about a single parcel available in the offices of both the Assessor and the Circuit Clerk is a very labor intensive task. The typical data set could consist of owner name and address, legal description of the parcel and its acreage, copies of recent surveys, valuation for tax purposes, description and value of improvements, most recent sale and price, street rights-of-way and easements, names and addresses of neighbors, and more. The present division of land information between various offices is the result of a division of labor which makes good sense. Archiving paper data over a span of many decades takes a great deal of space; it makes sense to store different types of data in different offices. Since it was extremely difficult to relate the various paper data to each other, why Physical segregation reduces the possibility of not keep it separated? misplacing a document into the wrong archive.

With the evolving computer-based, land information system, however, it is now possible to electronically integrate these different data, even though they still remain in their original locations. The immense storage capacity of computers and their ability to sort information makes the integration of data feasible. Such integration of disparate land information in a common and readily accessible database promises to increase the efficiency of land record management. While no change in division of responsibility between the county offices is necessary, each office can share the same multi-purpose digital database. The operations of each office would be more informed and their ability to provide answers to queries from the public would be greatly enhanced.

Private abstract companies play a major role in organizing and providing access to land records. The transfer of public record information to abstract offices would be greatly enhanced if it was accomplished by electronic means, from one computer database to another. Similarly other professionals who rely on these public offices to obtain the information they need to do their work would find their productivity increased.

The difficulty of obtaining complete land information under the present system imposes real costs on all who use it. These costs as well as the added costs of less than optimal efficiency in government operations are paid by everyone as a kind of hidden real estate tax. In one state (Wisconsin) in which the real, but often hidden, costs of gathering and storing this land information was carefully calculated, it was determined to be more than \$14 per person per year. If only 1/2 of this number were to be applicable in Arkansas, this would indicate that more than \$15,000,000 are spent each year on the creation, storage and manipulation of land records throughout the state by public and private sources.

A second level of government with real land information needs is the community. In addition to the land records associated with parcels, the city or town has information on streets, utilities, zoning and other geo-coded data. The level of detail or precision necessary for mapping water-main locations, for example, may be substantial. In the larger communities computerized mapping systems are becoming essential to manage this complex information. It is clear that the information needs of a small rural county or community are quite different than those for the more urban or rapidly developing areas. In all areas, however, a key requirement is the "basemap".

The Statewide Digital Basemap

Introduction

A "basemap" is an essential part of land records. As land records move into a digital world this basemap must also be digital. The basemap is the point of reference for all other map data. As a result the basemap must be accurate, up-to-date and complete. In the past the USGS "quad" map has served as a basemap for most purposes. Around 1900 the USGS began publishing topographic maps of Arkansas as part of a national program to map the entire country and to facilitate the exploitation of natural resources. By 1985, complete paper map coverage of Arkansas was available on USGS 7 ½ minute "quadrangle sheets". The paper quadrangle sheets are 27"x 22" in size and depict an area of approximately 8½ miles by 7 miles at a scale of 1 inch = 2,000 feet (1:24,000). The sheets show a wealth of land information including: roads, streams and other bodies of water; ground elevation contours, houses and other buildings; tree cover; place names; and political boundaries. An approximation of the grid of public land survey lines is also shown.

One great source of their utility is that, unlike public land survey data, these maps are geo-referenced to latitude and longitude, UTM, and the Arkansas State Plane coordinates. Geodetic positions of objects on these USGS maps can be determined to the rough precision allowed by the map scale: +/-40 feet. Quad sheets are an example of a basemap or "geographic base data", which has been described as, "...a primary geographic spatial reference that is produced to a recognized standard of accuracy and is subjected to certified quality assurance programs. Typically this is the type of data produced by federal and state agencies responsible for cartographic products."⁴ Basemaps provide the framework which relates the other sets of geo-referenced data to each other. Different data sets are spatially co-registered by relating the coordinates of entities in the data sets to the controlling geodetic coordinate grid of the basemap. Geographic base data are indispensable for GIS/LIS implementation.

USGS digital basemapping

The US Geological Survey is pursuing a program of producing the quad sheets in digital form. Many GIS/LIS users purchase the digitized quad sheet or, in some cases, digitize the sheets themselves. Digitization is a process of converting paper maps and drawings to digital form. Digitization is a labor intensive process. The USGS map is converted into a number of digital "layers" or "themes". These include:

- transportation (highways, rail roads etc.)
- hydrography (streams, lakes etc.)
- Public Land Survey System (township/range and section boundaries)
- boundaries (communities, parks etc.)
- vegetative cover
- non-vegetative cover
- geodetic control points
- many man-made features
- elevation
- digital photography (digital ortho quarter quads).

The USGS National Mapping Program is a cooperative effort with the Arkansas Geological Commission. One of the stated purposes of Act 150 was to create a Board that also could act as an advisory committee to coordinate digital map development with the USGS. Similar committees exist in most states to set priorities for USGS digital map production.

⁴Mapping Science Committee, National Research Council. <u>Toward a Coordinated Spatial Data</u> <u>Infrastructure for the Nation</u> (Washington, DC, National Academy Press, 1993), p. 94.

The USGS has completed different amounts of each of these different themes. For example, the elevation theme has been completed for some 475 of the state's 917 quads in the state. The digitization is now conducted by the USGS primarily through a cost sharing program. It is estimated by USGS that the state portion of the cost share to complete all the state's quadrangles would be \$3,520,000.

The USGS has already completed one digital basemap for the entire state. This is coverage of transportation and hydrography but the map scale is 1:100,000 (1 inch = slightly more than 1.5 miles). While this basemap covers the entire state and is useful for many broad purposes, it does not have sufficient detail or locational precision for many critical needs. A county roads department could not use this basemap, for example, to monitor the status of their road maintenance, and an emergency dispatch (911) center could not use them to route ambulances. More detailed, (larger scale) digital maps are needed for these purposes.

Arkansas Highway and Transportation Department mapping

In 1936 the Arkansas Highway Department began a program of producing paper county maps. The maps do not show ground contours, but include a wealth of information on the transportation network. These maps are used widely by county offices, surveyors and engineers. The county maps were based on the public land survey grid which was used as a relational base for other topographic data the Department collected. The scale of the paper maps is 1 inch = 1 mile or 1:63,360.

In 1989 the Arkansas Highway and Transportation Department began production of the county maps in digital form at a scale of 1 inch = 1,000 feet or 1:12,000. These maps are geodetically controlled by USGS quadrangle sheets and Department ground control. This digital basemapping is available for 47 counties in the state. The data components for these maps include:

- county boundaries
- PLSS including section corners
- city boundaries and names
- parks and reservation boundaries
- primary lakes and rivers
- secondary streams and lakes
- US highways by major class
- state highways by major class
- county roads by major class
- city streets by major class
- bridges on county roads
- bridges on US highways
- bridges on state highways

- oils and gas field names and patterns
- levees and dikes
- railroads
- drainage ditch
- residential houses
- business establishments
- horizontal control points.

Other statewide digital basemapping programs

The US Census Bureau has developed a statewide digital basemap of considerable utility but with a number of limitations. This is the "TIGER" map data and its associated demographic and economic datasets. The TIGER data set covers the entire state and includes extensive transportation information. Because the data were derived from many sources and different map scales, however, there are numerous errors, and other problems. The data also includes the boundaries of all the Census tracts and blocks so that the Census data on population and economics can be mapped.

Three other federal agencies are developing digital mapping data that should be considered as part of the statewide digital basemap. The US Soil Conservation Service (SCS) is developing digital county soil maps at a map scale of 1:24,000. Working with the UofA Agricultural Experiment Station, SCS has completed five counties. The US Fish and Wildlife Service is digitizing the National Wetland Inventory and the Federal Emergency Management Agency is digitizing the FEMA floodplain maps.

The importance of geodetic control

All of the digital basemaps described here rely on the geodetic underpinning of horizontal and vertical control monuments established by the National Geodetic Survey, or "NGS". Unlike the monuments marking the public-land survey corners, the NGS horizontal control monuments have a known, precise geodetic position. All quality basemapping is tied to the NGS geodetic control. The geodetic infrastructure created by the NGS is vital for geo-referencing surveying and mapping. Many of these monuments were emplaced in the 1930's; most were emplaced prior to 1960. Construction and other human activities take their toll on these monuments and every year a few are destroyed.

The maintenance of these monuments is the responsibility of the state. NGS, however, has a program with which it partially funds the office of "State Geodetic Advisor". The Advisor's duties include the protection of existing geodetic monuments and the "densification" of geodetic control. "Densification" means increasing the number of available monuments. The state contribution and, therefore, the program of a state Geodetic Advisor is not currently funded in Arkansas. This study strongly recommends that it be initiated. Another program NGS has created and is supporting is the High Accuracy Reference Network, "HARN". This program will densify geodetic control in the state with a large cooperative global positioning effort in the state in 1995. Geodetic locations of existing monuments will be improved and new monuments established. The process of densification can lead to a large number of monuments which have highly precise coordinates associated with them. With such a starting point it becomes less costly for local surveyors to "tie" other local monuments into this precise grid. As a result, land records in an area can more easily be geodetically referenced and then be integrated with other, existing geodetically referenced data.

THE ECONOMIC IMPACT OF MODERNIZATION

Impact on Economic Development

As part of its study the Mapping and Land Records Modernization Advisory Board obtained information on the economic impact of land records on private sector economic development in the state. Though GIS technology is relatively new to the private sector the number of areas in which it is used is already substantial and current industry projections indicate significant growth. Specifics on the dollar impact of these technologies and the specific firms using them were not provided to the Board as they serve as important competitive advantages for those firms actively involved. Examples of current Arkansas uses are organized by major industry.

Public utilities

As may be expected utilities are major users of spatial data and land records. Most major utilities in the state maintain in-house records and mapping. Locations of transmission circuits, right-of-way permits, easements, servitude's, deeds, consents/licenses, and condemnations are maintained.

Utilities map transmission facilities digitally including data on land ownership, construction configuration, facilities characteristics, etc. Land record data are obtained by the utilities from the County Clerk or other county office. Most data are geographically referenced by use of USGS quadrangle maps. Some utilities are maintaining detailed digital databases on such data as pole locations and characteristics. These data are used to schedule maintenance and respond to emergency conditions. One utility uses GIS as a sales tool. Sales personnel can bring up a map of the location of fiber optic cable and estimate the distance and cost that new fiber would have to be run to a new customer. Many utilities utilize computer mapping systems based on AutoCAD while some are moving to full GIS systems including the InfoCAD, and Small World systems. If land records were digital and if there were a high quality, detailed state-wide digital basemap utility mapping would be substantially enhanced. If information on locations that are environmentally sensitive, such as wetlands, were electronically accessible this would substantially aid utility planning and reduce costs.

Retail

Many large retailers within the state are currently using GIS to target trade areas and locate new stores. Combining local information on streets with demographic data from the US Census and other sources, these firms are able to determine potential sales opportunities and the best location for new facilities. Firms are integrating market survey results with demographics and current purchasing profiles with spatial information from addresses, zip code areas and census data to develop store-specific product stocking plans.

Transportation

Using transportation information, along with street address data, delivery and trucking companies are developing optimal routing systems to minimize vehicle travel time and costs and to maximize loadings. In-vehicle navigation is now being used by some of these firms. Using digital street data and location information from global positioning systems the driver is provided with the fastest route from his current location to a new pickup.

Farming, forestry and agribusiness

Many of the same benefits for retail and transportation apply to farming and agribusiness. The forest products industry are increasingly moving towards the use of GIS to manage forest lands. A number of the larger forestry corporations in the state have or are planning to develop GIS based management systems.

Banking

In addition to the applications described for retail the banking industry is now using spatial data in a number of ways. In their response to federal regulations, banks are using GIS systems to assess the distribution of loans to produce community reinvestment act analysis and reports. They are using these data to improve the effectiveness of their marketing by targeting market areas and to identify locations for successful new market entry. These data are used in strategic planning, projections of growth and development trends, deposit structure changes and to pin point geographic changes in household finances and composition.

Real Estate

Real estate firms are using digital spatial data to perform site selection analyses to meet client needs and to identify school districts and other characteristics of homes. They are using these systems to develop market profiles by area and to assess neighborhood trends in market prices. GIS and other digital mapping programs are used to make client presentations and for market prospecting. Larger rental firms are using these systems for facility management for existing construction and to design large scale developments.

Health care

Doctors and other health care providers are using digital spatial data to determine locations for offices and clinics. Emergency vehicle providers are using GIS systems to provide shortest routes to emergency response. Some are using locational data on calls to position vehicles in locations with high potential for an emergency call.

Improved Ability To Respond To Federal Requirements

Increasingly construction and other economic development requires meeting a range of federal environmental regulations. The existence of accessible digital spatial data can provide the private sector with cost effective sources to create the needed studies. If standard statewide basemaps existed on such data as transportation, streams, wetlands and soils many studies could be performed more quickly, and accurately and with less conflict, saving considerable dollars.

Cost - Benefit Assessments

Assessment of cost/benefits from the development of the proposed program of land-records modernization involve a number of components. The components of costs associated with land-records modernization are easy to quantify. They include capital costs for needed computer hardware, staffing costs, costs for basemap development, costs for data archiving and distribution. The details of the costs associated with the specific land-records modernization program proposed here are included in the Recommendations section.

Benefits from such a program are both tangible (and subject to evaluation) and intangible - as a result in the improvement in the effectiveness of public decision making. Some key tangible cost benefits are reduction in redundant data development costs, reduced time to product for all public and private sector efforts which need digital map data, and reduced costs for program operations.

Reduction of redundant data development costs

The most easily identified benefits of land-records modernization will be in the elimination of costly redundant efforts in the development of digital data. As can be clearly seen in the state agency reports which follow, many agencies need the same or similar data. In many instances, they have been forced to digitize the data because it was not already available, not in an easily accessible format or because they were unaware that the data already existed. The development of a coordinated program, as proposed in this study, will reduce such duplication and lead to considerable cost savings. In order for data developed by one agency to be useful by another, however, steps must be taken to make all agencies aware of existing data, to provide or convert data into useful formats and to be sure that the data when it was created meets necessary guidelines of accuracy, detail etc.

If a coordinated program leading to a statewide digital basemap is created then individual agencies will not need to create this data and, because the data will be developed to meet national map accuracy standards, it can be used by agencies and the public with confidence.

Reduction in "time to product" and costs

The ready availability of accurate digital basemap data will mean that many state and local studies can be completed more rapidly and with more accurate results. In many current situations agencies must develop data before they can conduct a study which is needed to determine what actions are necessary. Because development of the data is time consuming, it can delay the production of results. With data already available, this process can be greatly streamlined. In addition, the laborious revision and replacement of paper maps is eliminated by converting to a digital map base.

Reduced program operation costs

GIS/LIS based analyses can be technically demanding. The existence of a technically skilled, coordination program, as proposed in this study, would provide a central source for technical guidance, expertise and information. Such a source would reduce costly errors which are likely, if sufficient technical expertise is not available.

Other benefits

Automation of an information-based office causes major quantitative and qualitative changes. The way work is done changes in a basic way as does the work product. Automation makes assembling and processing data easier. The typical output of the system whether a document, file, map, certificate, etc. will be based on more complete information. It will be found, revised and refiled more easily in the future. An information-based operation may have the same number of staff after becoming computer-based and the conversion will require a capital outlay, training, and new operation and maintenance arrangements.

Where is the increase in productivity to be found? There are a number of answers and combinations of answers to this question:

- The automated operation may be able to provide services and conduct types of analysis that were not previously performed because of limitations of time or feasibility;
- the value and suitability of the product to the consumer may be substantially higher;
- the operation may be able to absorb a steadily increasing demand for services with less stress and disruption;
- future increases in demand for services or changes in the nature of the services provided may be readily accommodated without an increase in staff, and
- uniform, easy to understand, standards will simplify the assessment of data by managers. Standards provide objective measurements which can help to avoid misunderstandings and mistakes in the use of data.

The intangible benefits of GIS/LIS implementation relate to the quality of public policy decisions made on the basis of spatial data. More complete information which is in a form that is more accessible and more readily meshed with other data for analysis, will support better, more easily justified decisions. The costs of bad decisions can be immense. Decisions about site selection or permitting of industries and residential developments involve analysis of a complex of land-related data. Large commitments of capital are at stake and controversy is always a possibility. GIS/LIS provides the decision maker with the best marshaling of facts available.

Successful management of the maintenance and expansion of municipal utilities requires constant analysis of geo-referenced infrastructure data. It is much less expensive to repair and replace before a line failure than afterwards. Facilities management is a valuable application of GIS/LIS technology.

GIS/LIS technology is a practical tool for real problems and challenges in government. At present it is the best and most cost-effective tool available to government for information management, planning, and decision making.

MAPPING AND LAND RECORDS IN OTHER STATES

State Programs

More than 30 other state governments are working actively to obtain the benefits of geographic information systems and land-records modernization. Strategies and levels of success are variable. Generally the first step is the formation of an advisory board or task force such as Act 150 created. Thirty states have some type of state mapping advisory committee, (or SMAC), usually established by executive order. SMACs are typically commissioned to formulate strategic plans for the state to implement programs which will expand digital mapping resources, facilitate the use of geodata in GIS/LIS and encourage the spread of computer based geographic information technology in government. SMACs also provide a focus of interface with federal agencies, programs and initiatives.

It is recognized that there must be a permanent center of activity in state government to support long term development of GIS/LIS. The various aspects of development must also have institutional support. The office of State Cartographer now exists in 10 states. The same number of states have an office of State Surveyor. The State Geodetic Advisor Program is now funded in 42 states, usually within a natural resource or transportation agency.

The following reviews some of the state programs.

Mississippi

In Mississippi the state legislature created the Mississippi Automated Resources Information System (MARIS) in 1986. Its primary role is to coordinate and facilitate the use of GIS technology in state agencies. An executive committee is drawn from a policy committee composed of agency heads. Agencies contribute staff and resources to a MARIS Task-Force which studies problems and needs in government. Local governments and federal agencies participate in the Task Force. MARIS maintains a technical center which provides detailed technical assistance, maintains a State Geographic database and sponsors a computer network to access the Database.

MARIS maintains a Spatial Data Catalog of the geographic data. The catalogue contains standard format entries about sets of geo-referenced data available. Managers use the catalogue to determine what data is available and its suitability.

Texas

The State of Texas has gone through a process of study initiated with a report by the State Comptroller in 1989. The object was to avoid duplication of effort and to standardize data. In 1989 the legislature passed the Information Resources Management Act which requires agencies to share information resources as fully as possible. A Department of Information Resources was established to develop standards for information and ensure compliance with

them. In 1992 the Department issued its first set of standards for small scale mapping. Quality and accuracy reports are required for all agency spatial data. Electronic data formats are prescribed to facilitate exchanges from one agency to another.

Georgia

The Georgia Legislature created a State Mapping Advisory Board in 1988. The next year the Board recommended that: (1) mapping standards be adopted; (2) geodetic monuments be densified; (3) a state data geodata catalog be established; (4) a state GIS Center be established to support education programs for policy level officials and technicians. The Georgia Board was strongly influenced by the program of GIS/LIS implementation in neighboring North Carolina.

North Carolina

The North Carolina Land Records Modernization Program was established in 1977 to provide technical and financial assistance to local governments in developing basemaps, cadastral maps, uniform parcel identifiers, and transferring land records to a computer base. Cadastral maps show parcels of land ownership in an area. They often are used to assist governments in taxation. Most North Carolina counties chose to develop orthophotographic basemaps tied to the state geodetic network. Orthophotos are aerial photos which have been recompiled to remove all distortion; this places all objects shown in the photographs in the correct spatial relationship as in a planimetric map. a state geodetic survey office densified control in county project areas. North Carolina also established a Land Resource Information Service to establish and maintain a digital land information base for the state. Cooperative efforts with local mapping projects and federal mapping activities have increased available digital mapping products.

Wisconsin

The North Carolina program is similar to state-sponsored programs in Wisconsin. In 1987 a committee, which had been formed by the governor two years earlier, recommended formation of a Wisconsin Land Information Board to administer an Office of Land Information and a program of grants in aid. These recommendations were incorporated into legislation passed in 1989. Grants in aid to local governments for GIS/LIS implementation are derived from an increased deed filing fee. Part of the augmented fee is retained at the county level. County Land Information Offices design and implement modernization projects. State agencies are required to submit land information integration plans every two years so duplication can be avoided, sharing data facilitated, and useful programs supported. State geodata resources are inventoried, evaluated and catalogued.

Arizona

In 1992 the Arizona Geographic Information Council submitted its strategic plan to the governor. The plan was designed, in the Council's

language, "to ensure that Arizona's public decision makers have access to geographic information that is complete, timely, accurate and reliable." The plan recommended achieving this goal by: (1) encouraging cooperation between agencies; (2) assigning priorities for types of geodata to be developed; (3) facilitating cost sharing and collaboration between agencies; (4) providing recommendations and strategies to local governments; and (5) fully funding the office of State Cartographer and the Arizona Land Resource Information System. The Arizona Strategic Plan pointed out that the state lacked a uniform map base and adequate geodetic control. Development of standards for digital data was recommended to obtain the uniformity of data quality necessary for successful integration of data from different sources.

Impact Of Federal Actions (NSDI And Its Role In The State)

At the Federal level the importance of digital spatial data has been recognized. The Federal Geodetic Data Committee (FGDC) is a group composed of many federal agencies who are developing a variety of programs to increase the nation's source of digital mapping data. An important part of this effort is the National Spatial Data Infrastructure (NSDI). The NSDI has been defined as a key element of the National Information Infrastructure (NII) by a recent Executive Order by President Clinton. While the full character of the NSDI is not yet complete, it is clear that states and local governments will be an important component. Data standards, accessible digital data and multi-level partnerships are all part of the NSDI. As mapping and land records modernization in the state moves forward, useful information and opportunities will result from coordination with the NSDI effort.

STATUS OF LAND RECORDS AND MAPPING IN ARKANSAS

State Agencies

The modernization of maps and land records in State Government has become a complex issue over the past 15 years. Natural-resource information and technical data have become critical to the development and management of the State's resources and infrastructure and the protection of the environment. The volume of technical data stored on various basemaps and in files by various agencies is huge. It has became cumbersome to manage, frequently causes duplication of effort, and the sheer volume of data makes it very time consuming and costly to research data sources. Each agency sets its own standard of data collection, storage, and indexing with little or no effort to coordinate with other agencies.

Traditionally, State agencies have maintained geo-referenced data on paper maps and in files. As described below, various agencies have already established some in-house GIS's to deal with growing databases. Some agencies have worked together in sharing information and technologies relating to transfer of data, but the lack of agreement on scales and types of standardized digital basemaps, or compatible hardware and software, and on uniform guidelines for standards, have caused problems in achieving an effective GIS statewide. All State agencies realize that it is time to make the transition from the non-uniform map sets and file systems maintained by each to uniform guidelines for digital mapping standards and inputting data using compatible hardware and software to ensure the accessibility and reliability of data.

Following, are descriptions of the status of mapping in some of the State agencies involved in collecting and mapping technical data.

Arkansas Geological Commission (AGC)

Geology Division

The Arkansas Geological Commission (AGC) is an information-resource and research-oriented state agency with the charge of developing and disseminating information on the geology, mineral, fossil fuel, and water resources of the State of Arkansas. These tasks involve the collection and management of large quantities of natural-resource data, conducting scientific investigations, and the distribution of information to users. The users range from other scientists, to citizens, academia, industry, consultants, and other government agencies (city, county, state, and federal). Essentially all of the data are geographically referenced. The AGC has long recognized the benefits of using GIS technology, but lack of funds has prevented any major development along these lines.

The AGC is the State Affiliate of the US Geological Survey's (USGS) Earth Science Information Center (ESIC), which provides information on earth science and cartographic data available from the federal government and the private sector. This database was originally stored on microfilm and microfiche but is now stored on CD-ROM's.

The AGC has the responsibility of coordinating the preparation of basemaps (topographic maps of various scales) of the state with the USGS. A cooperative program (50/50 matching) with the USGS Mid-Continent Mapping Center in Rolla, Missouri, has been in force for many years. Several years ago, the paper 7.5-minute topographic quadrangle series for the state was completed. Now the top priority is revision, keeping the maps updated in areas of fast growth or change. Not only does the AGC coordinate the topographic map program with the USGS, but it serves as the distribution point for sales in the state.

The 7.5-minute topographic map is the most commonly used basemap for geologic mapping and other field investigations by the AGC. The National Geologic Mapping Act of 1993 requires all new geologic mapping funded under this Act to be prepared in digitized format. As the AGC enters into future geologic mapping programs, the maps will be prepared on a GIS.

All of the geologic, mineral resource, water-resource, well locations, and other natural-resource information maintained by the AGC is referenced by geographic location in the State. The availability of a state GIS would enable the AGC to more effectively manage its data and make them more easily and quickly available to users.

The AGC currently has some digital capabilities in its cartographic section, including a 486DX2 PC computer, an HP plotter, an HP Laser Jet 4P printer, and a 24" x 36" digitizing tablet. As yet however, the AGC has not been able to acquire the necessary software and training to functionally achieve a true GIS. To effectively implement a GIS capable of processing the current data and that which will develop in the coming years, will require an investment in more hardware (processing and storage), compatible software (with continuing upgrades), training of personnel in the data entry and GIS use, and time to install and verify all the base information. The end result will be the ability to maintain databases, to provide better and more complete information to its patrons, supply customized maps and other information on demand, augment research that often leads to new economic benefits, and do it all faster and with less cost.

Land Survey Division (AGC)

The Land Survey Division of the Arkansas Geological Commission has the responsibility of accumulating and making available to the public all survey records relating to public and private surveys in Arkansas. The Division also is responsible for the preservation of original General Land Office (GLO) land section and ¼ section corners, a function accomplished through contracts with registered land surveyors who locate original monuments and then erect new monuments. The new monument certificate is microfilmed.

Land Survey records are maintained as paper files and on microfilm. A computer database of land records is being compiled by township and range. Land surveying standards have been established in order to promote uniformity and quality in surveying practices throughout the State. The Records Repository section maintains and provides safe storage facilities for

survey data concerning all monuments established by the United States Public Land Survey and other monuments placed by surveyors in the State of Arkansas. The Division also furnishes, upon request, copies of records created and maintained by the Division. This is currently done by providing photocopies of files. The Land Survey Division presently is the repository of GLO information, survey plats of the State, and National Geodetic Survey (NGS) information.

Arkansas Department of Health (ADH)

In 1984, the Arkansas Department of Health (ADH) purchased an automated geographic information system (GIS) to run on its in-house Wang Mini-Computer System. The Geographic Data Management System (GDMS) software, acquired from Geographic Technology Inc., is maintained by the Bureau of Environmental Health Services (BEHS) and support is provided to other Bureaus within the Agency on a project or program-area basis.

Equipment used by the Department in its GIS work includes the Wang Mini-computer, a CalComp 9100 digitizer, two 486 PCs running a graphical terminal emulation to the Wang, a Hewlett Packard 7596 Draftmaster II plotter, and a Hewlett Packard Paintjet XL plotter. The BEHS Division of Engineering has acquired Global Positioning System (GPS) technology.

The Department has acquired the Census Bureau's TIGER Line Files and Demographic Data from the 1990 Census for Pulaski County. The data were converted for use on the Wang system and map layers were created for the Census Tracts, Blocks, and Block Groups for Pulaski County. Work was conducted under an ATSDR Grant on the Jacksonville Dioxin Exposure Study and used a GPS unit to collect locations of the persons who participated in the Study. These points were read into the GIS system and an application was created that linked the participant's test-result data to their proximity to the actual Dioxin Incinerator. The Census Demographic Data were used for the Health Effects Portion of the Study. The system shows, down to the Block Group level, where the population is and what characteristics the populations have (sex, age, race, income, etc.).

Present GIS activities

ADH is in the process of establishing a more "open-systems" data processing environment of UNIX-based processors and Client-Server PC networks. The Department has chosen a PC-based system called WINGIS from the company PROGIS. WINGIS uses MS-Windows for its graphical operating environment and uses the GUPTA SQL-Windows product for relational database management (RDBMS) functions.

The Department is now converting the GDMS map layers over to WINGIS and has completed the importing of the County Boundary, Interstate Highway, and Pulaski Census Blocks, Tracts, and Block Groups map layers. WINGIS is currently running on stand-alone PCs but the Department plans to install a PC Local Area Network (LAN) with Client-Server processing to support the volume of GIS data that will be maintained. The major state-wide map layers ADH has either digitized or programmatically created are:

- roads (some names but no address ranges)
- hydrography (streams, rivers, lakes, some perennial streams)
- aquifers
- ADH Local Health Unit Locations
- Senate Districts
- House Districts
- towns & cities area boundaries
- public water system monitoring points
- public water system service area boundaries
- watershed areas for public water system surface sources
- Well Head Protection Act well locations
- landfills
- RCRA, NPDES Discharge, Superfund Sites
- Township & Range Boundaries
- Nuclear Regulatory Commission TLD Sites (Arkansas Nuclear One Area)
- Arkansas Nuclear One Siren Locations
- Arkansas Nuclear One 5-Mile Corridors & Emergency Planning Grid

Future projects

Under a grant from the Environmental Protection Agency (EPA), the ADH will begin the mapping of the blood-lead cases in Arkansas in October, 1994. Case locations will be address matched, and investigators will use WINGIS on a portable PC to improve travel routes and access case records.

Working with the Women, Infant, and Children (WIC) program, under a grant from the Food and Drug Administration (FDA), a pilot study of 5 counties in Arkansas will use Census data to target areas of possible WIC-eligible clients. This project is due to start in the October/November 1994 time period.

Other mapping related projects of the Department include on-going monitoring of Safe Drinking Water act activities well head protection, intake monitoring, discharge and runoff monitoring and fish mercury levels monitoring.

Arkansas Forestry Commission (AFC)

All of the AFC's basemaps are on paper. AFC foresters and rangers obtain resource information from aerial photos, county soil maps, 15-minute quad sheets, ownership maps, and actual on-site cruises. AFC personnel combine this information to produce a resource-type map for the respective landowner recipients of AFC services. The AFC produces between 1,100 to 2,000 resource type paper maps per year. These are filed in fifty offices around the state. AFC fire personnel use county highway maps to plot fires by cause by year. These are actually prepared on Mylar overlays for visual determination of fire-occurrence patterns. Other fire planning maps produced annually are hazard and risk maps, aerial detection maps, and resource locator maps.

Arkansas Department of Pollution Control and Ecology (ADPC&E)

The largest percentage of PC&E mapping needs center around the 1:24,000, 7.5-minute quad sheets. Although there are times when more detail is needed, it would not be cost effective at this time to digitize at a more detailed scale.

At the present time, the department is building a GIS system to contain all permitting information, as well as any information pertinent to the operation of the department. The system used in Arc/Info running on Digital Equipment Corporation workstations with the VMS operating system. Numerous digital data layers covering the state have been provided to PC&E by the regional office of EPA. Using GPS technologies PC&E staff are adding permit locations to the database.

Arkansas Soil and Water Conservation Commission (ASWCC)

The current GIS configuration of the Arkansas Soil and Water Conservation Commission (ASWCC) consists of one Intergraph TD2 (Intel Pentium 66 MHz) workstation running the Windows NT operating system. Intergraph MGE software has been installed with Analysis and 3D Modeling capability. This system is packaged with Microstation Version 5 for producing design files and the Oracle Version 7 database running on Windows NT. Other capabilities include CD-ROM as well as an 8 mm tape drive for importing or exporting data. These two formats are in addition to the standard 3.5" 1.44 MB floppy disk drive present on the system.

The current plans for the GIS systems include using state geographic reference data created by the Arkansas Highway and Transportation Department as a base for agency data coverages. Aquifer data compiled and mapped by the USGS and the UofA's CAST is stored using Arc/Info and GRASS. Ground-water level coverages will be utilized in ground-water management/critical area studies, as well as comprehensive ground-water protection and vulnerability studies. Data of over 52,000 registered water users statewide are currently stored using an Informix database. ASWCC plans are to utilize these data in the GIS system as well as permitted dam locations and information from around the state which is currently stored in Dbase IV. Engineering plans and as-built on all funded water, sewer, and solid-waste projects around the state are also maintained. These plans show water line sizes and locations but none of this geographic information has been digitized at this time. This is a project being evaluated for future GIS inclusion.

Arkansas Highway and Transportation Department (AHTD)

The present digital mapping program is based on a county map series, providing complete digital coverage by county, including all cities within those county. The Mapping Section has completed development of digital basemaps for forty-two counties in a 5 year and 7 months period. These maps are digitized in a polyconic projection file using the 1927 Datum with a secondary coordinate system, the State Plane Coordinate System. Prior to the development of the county maps statewide map showing all state-maintained highways, county outlines, township and range lines, major waterways, cities and towns in Arkansas was the first project that was developed and completed for departmental GIS. AHTD uses Intergraph UNIX workstations running Intergraph's Microstation and MGE GIS software.

As they are digitized the county is checked for accuracy using USGS horizontal control points. The checks have had an accuracy of plus or minus seventeen (17) feet. The horizontal control points within the 7 ½ minute frame in some cases are very limited in number. Digital data is derived from 1:12,000 (1" = 1000') compilation sheets. The sheets are prepared from full county coverage of aerial photos flown at a scale of 1:20,000. Legal descriptions for city limits and other boundaries are included on these sheets. The digital file is separated by layers of categorized information. Major data elements digitized by AHTD are described in an earlier section of this report.

Arkansas Industrial Development Commission (AIDC)

The Arkansas Industrial Development Commission uses paperbasemaps (USGS 1:24,000 scale, 7.5-minute quadrangles) for geo-referencing in their projects. They have Autocad and have created some site-specific basemaps to plot project data. A standardized digital basemap for the 1:24,000 topographic quads would be very beneficial to AIDC. AIDC does not have any plans to develop an in-house GIS.

Arkansas Department of Computer Services (DCS)

DCS mapping status includes two or three manually prepared layouts of (1) the data network and (2) the telephone network within state boundaries. The maps are updated manually as required. The Telecommunications Division from time to time uses small plat maps of university campuses or similar installations, for the purpose of monitoring the routing of cable. DCS has no "map" databases, nor is there indication that mapping will be a factor in future operations. DCS does not currently provide GIS-type services.

Arkansas Department of Education (ADE)

Over the past year, the Arkansas Department of Education (ADE) has developed a nearly complete geographical and statistical database of Arkansas. The database consists of four main ingredients:

- US Bureau of the Census Topologically Integrated Geographical Encoding and Referencing System (TIGER II);
- US Bureau of the Census Public Law 94-171 Redistricting Data (PL94-171);
- US Bureau of the Census Summary Tape Files (STF);
- US Bureau of the Census School District Special Tabulation Summary File Set I

This database, or parts thereof, are accessible through the Reaps Reapportionment and Redistricting System and Atlas-GIS and the Statistical Package for the Social Sciences for Windows is available.

The database has already been used for a variety of purposes:

- Verification of the Legislative Districts of the General Assembly;
- Geographic and numerical verification of a proposed legislative plan of the Arkansas Delta Area (Jeffers v. Tucker);
- Aiding the Arkansas Highway Department as they draw county maps of legislative districts;
- Aiding local School Districts draw election zones under the provision of Act 1169 of 1993;
- Assembling data for the Arkansas Department of Education Annual School District Report Card.

In the next couple of years, the US Census Bureau will begin gathering the geographic data necessary for Census 2000. During this period of time the Bureau will ask States to submit census tabulation block boundaries and voter tabulation district boundaries. Other than adjusting Census 2000 tabulation block boundaries, the database can be used for the following:

- Verification/creation of Legislative District Boundary Maps;
- Re-digitization of all School District Boundaries and creation of computer maps to be given to the State Department of Education and each County Board of Education;
- Incorporation of additional SFS data as it becomes available from the US Census Bureau;
- Creation of attendance zones, etc., for those School Districts requesting it;
- Creation of Court of Appeals Electoral Districts;
- Other preparatory work for the 2000 Reapportionment.

Arkansas Game and Fish Commission (AG&FC)

The AG&FC has two on-going projects directly related to mapping and land-records modernization. Currently the Wildlife Management Division is in the process of developing a digital habitat-management database for all Wildlife Management Areas. The AGFC has an existing computerized database for habitat inventory data. Digital maps that will be tied to our database are now being developed and used by our GIS computer system. This Division uses the Geographic Resources Analysis Support System GIS running on SUN UNIX workstations. The Federal Coordination and Support Services Division is painstakingly entering all of the recorded title deeds in relation to General Land Office notes and plats into the database for all Game and Fish lands. Entry into the system began with the Wildlife Management Areas, and is continuing with Fisheries lakes and access areas. This Division is using the Arc/Info GIS running on SUN UNIX computers. In a few year the AGFC should have a broad database that could be used for a wide variety of uses.

Department of Arkansas Heritage

DAH identified the need for a GIS system in 1989. DAH has state and federal mandates to locate and gather information on historic sites, archeological sites, exemplary natural communities, rare plants and animals, and the state's natural and freeflowing waterways. DAH has gathered and plotted this information use manual cartographic methods since the late 1970s. The department now utilizes a GIS operated in cooperation with the Arkansas Archeological Survey (AAS) located in Fayetteville and a recently installed system in Little Rock. Both systems utilize the Geographic Resources Analysis Support System GIS. The unit in Fayetteville is linked to the DAH Little Rock offices by a high speed wide area network. The network is a joint effort of the Department of Computer Services, Arkansas Public School Network, State Library and others. In Little Rock, DAH has a 486/66 microcomputer running X-terminal software and a SUN Sparcstation 20 UNIX computer. At the Fayetteville offices of the AAS there is a SUN Sparcstation 10 system.

Office of Emergency Services

The State Office of Emergency Services has been using Arc/Info's Emergency Information Systems/Arc running on a PC system since 1992. Using the Census TIGER files and other base maps, database records related to emergency management are located on the basemap using latitude and longitude. This pilot effort will serve as the base for a much expanded system that will provide users with access to the Office's resources.

Summary

These are examples from some state agencies of the processing and use of mappable data. As examples, they demonstrate the volume of data is huge, that it is growing at a rapid rate, and that a wide variety of data are being utilized. Many of the data are vital not only for state agencies, but also for county and local activities, and they are being increasingly used in the service, industrial, agricultural, and educational sectors of the state.

Working independently in large part, all agencies have made headway– to varying degrees– into the process of converting to electronic data-processing systems. However, without a coordinated approach and guidelines for standardization, problems in sharing data between agencies exist, and the efficiency of use and reliability and credibility of the datasets are compromised.

State agencies are ready to join forces and build a GIS for the state that can carry Arkansas into the 21^{st} century so decision maker's can be assured that the technical data utilized are accurate and reliable.

COUNTY AND LOCAL GOVERNMENTS

Many communities in the state have active GIS programs. The following briefly reviews a number of these programs.

PAGIS

The oldest and most comprehensive GIS program in any local government in Arkansas is the Pulaski Area GIS or PAGIS program. PAGIS was initiated in 1988 by the City of Little Rock, Little Rock Municipal Water Works and Little Rock Wastewater Utility. PAGIS now consists of two networks with one at the city and one at Water Works/Wastewater. There are a total of 22 Sun workstations at the two locations running the Arc/Info GIS. The digital basemap for PAGIS covers 125 square miles at a scale of 1" = 100' (1:1,200). Virtually everything visible in aerial photography has been digitized including transportation networks, water bodies, building footprints and numerous utility features. Topographic contours at two-foot intervals were also developed.

Applications include crime incident analysis, land use planning, utility automated mapping, facility management, support for preliminary engineering design and site location analysis for various facilities. Automation of the data has provided a means for more effective decision making by local officials and has provided support for activities that were simply not possible to perform prior to the development of PAGIS. Plans for 1995 include participation by MetroPlan, Pulaski County Planing and Pulaski County Assessors Office.

MetroPlan

MetroPlan is involved with planning efforts for a four county area (Pulaski, Faulkner, Lonoke and Saline Counties). They are currently using Arc/Info and ArcView running on two SUN Sparcstations. Digital basemapping includes enhanced US Census TIGER files, digital elevation data, and satellite derived landuse/and cover. The current focus is on transportation planning for the area.

MEMS

The Metropolitan Emergency Medical System (MEMS) is not itself a local government unit but is contracted by the City of Little Rock to provide ambulance dispatch to the city and surrounding area. MEMS uses a combination of GIS, digital mapping and global positioning systems to provide this service. A digital street map of the area along with street addresses and information on traffic loads is used to compute the "quickest" route for an ambulance to the accident scene. Ambulances are now equipped with global positioning systems to provide data on their current location which is fed back into the computerized dispatch. In addition, data on accident locations is studied to determine locations to preposition ambulances in areas where emergencies are likely. The MEMS system uses Intergraph computer hardware and software.

Fort Smith

The City of Fort Smith began their GIS program as a simple effort in computerized drafting of engineering basemaps using the Autocad drafting package. They immediately realized, however, that the greatest expense was the development of the digital maps and felt that they should be more useful than would be the case if they were simply used in a drafting environment. Following extensive study they decided, in 1989, to move to a full GIS. They selected the Genasys II GIS software. They use a combination of personal computers and high performance workstations for Hewlett Packard. There are currently ten users of the systems. Digital data developed includes parcels, water lines, sewers as well as planning and code enforcement maps.

Fayetteville

Fayetteville initiated its city-wide GIS efforts in 1992 with the development of a comprehensive plan for the next five years. The first element is the plan has been the development of a highly detailed digital basemap for the city and its surrounding area. Digital orthophotography and a two foot digital elevation map have been completed. Work is currently underway to digitize parcel boundaries and the city's transportation, utilities and other infrastructure.

Jonesboro

The City of Jonesboro has developed an emergency vehicle dispatch system using the MapInfo software running on a PC. Digital street maps along with addresses have been developed for the community.

Maumell

The City of Maumell is using ARC-Cad software in its engineering efforts.

Paragould

The Paragould Electric Department is using ARC-Cad. They have created some 15 digital map layers for the community.

Hoxie

Using the ARC-Cad and ARCView GIS software, Hoxie has developed an extensive digital basemap system. Data already mapped includes city streets, sewers, and waterlines.

Hot Springs

The City of Hot Springs began their GIS efforts in 1991. Since then they have spent nearly \$500,000 on hardware and software and data automation. Arc/Info software is used. The city has digital parcel, zoning, and easement maps and a street centerline map with street addresses attached. They are adding water lines and storm drainage maps as well. The data and GIS system is used in both city planning and engineering.

Benton County

Benton County has developed a county wide digital basemapping effort to map property ownership. Using Auto-Cad drafting software running on a PC, the Assessor's Office is working to produce a county wide digital parcel map.

UNIVERSITIES

University of Arkansas - Fayetteville

Center for Advanced Spatial Technology (CAST)

The Center for Advanced Spatial Technologies (CAST) was established at the University of Arkansas in September of 1991. It is a multi-college organization involving the Fulbright College of Arts and Sciences, the College of Agriculture and Home Economics the College of Architecture and the College of Engineering. The Center has a full time staff of 31 as well as a number of faculty and graduate student research associates. CAST focuses on research, data development, undergraduate and graduate education, user service, and professional education in GIS and related technologies. Much of CAST's research effort involves new approaches to spatial data and the development of new methodologies for analysis of these data, providing products to a variety of different audiences. Cooperative programs developed by CAST are designed to bring together the benefits of academic research and development, the resources of state and federal agencies and the private sector to provide the state and region with effective spatial technologies, trained practitioners, and low-cost digital data.

Center staff are key participants in the Open Geodata Interoperability Specification research effort. This work involves the development of software specifications which will allow different vendor's GIS software to access data from other systems without the need for data translation. This is essential when multiple software systems are in use by different groups. The Open Geodata Interoperability Specification is supported by a wide range of GIS vendors, Federal agencies, and the National Institute of Standards and Technologies (NIST).

Facilities

The Center is equipped with four large servers, 35 high-performance UNIX workstations (Intergraph, SUN, DEC and others), 25 NT workstations (Intergraph) and a full complement of peripherals including four digitizers, two E-size scanners, one A/B color scanner, digital photogrammetry workstations, photogrammetric quality scanners, D-size electrostatic, E-, A/B- and A-size ink jet and A size dye sublimation plotters. A total of more than 250 gigabytes of on-line disk is available including optical read/write disk juke-boxes, tape juke-boxes and other magnetic disks. A range of tape drives including 9 track, ¼ inch, 8 mm and 4 mm are available in the Center. The Center has a broad range of GIS and remote sensing system software systems, including Intergraph (twenty-eight UNIX and NT seats), Arc/Info (twelve UNIX workstation seats), GRASS (UNIX site license), MapInfo (one UNIX seat, two DOS seats), InfoCAD (two UNIX seats) PCI (UNIX site license) and ERDAS (ten UNIX seats)

National Center for Resource Innovation- Southwest

NCRI-SW is one of six congressionally supported regional centers located throughout the United States whose mission is to transfer Geographic Information Systems (GIS) technology to county and local governments. The NCRI-SW program has been based at the University of Arkansas since its inception in May of 1990, and in 1991, it became part of the Center for Advanced Spatial Technologies (CAST).

Digital Data Archive

One of the most essential components of a GIS is digital data. CAST, along with NCRI, is actively building a digital data archive. Initial efforts have focused on acquiring digital data sets for Arkansas, but the Center also maintains an extensive library of global, continental, and regional data sets. Additional data are being acquired constantly, and the Center is working closely with major data providers (such as the SCS and USGS) to speed up the efforts to create new digital data for the area. These data are maintained on two server systems at the Center and are accessible via the statewide digital network, ARKNet. More than 100 statewide data layers are currently available at CAST. These include all the existing 1:24,000 USGS-DEM datasets for the state (approximately 485 quads) all USGS 1:100,000 DLGs, all USGS Digital Ortho Quarter Quads, Landsat TM, SPOT MSS and pan imagery, digital NAAP and NHAP photography, SURGO soil mapping units, school and other planning units, and a variety of others. During 1993, the center entered into a workshare with the US Geological Survey to develop DEMs. Center staff have also developed software which automates the development of USGS standard spatial meta-data. This software makes the development of these critically needed data much easier and more consistent. A digital data catalogue is available describing the data. In addition to a printed version, an "on-line" version is also available. All these data are available at no or little cost.

Global Positioning System

Global positioning data from a twelve channel Trimble Base Station is in place on the University of Arkansas campus in the CAST facilities. Anyone within the operating range of the base station (approximately 300 miles) can access the files created by the GPS via ARKNet and Internet, or via modem connected to a PC or other computer. The Center also has six Trimble Explorer Series portable GPS receivers and two Trimble Pro-XL sub-meter accuracy portable systems. CAST offers pilot project/demonstration use of these receiver and the services for performing differential corrections to county and municipal governments through the NCRI program. Classes in GPS use are also offered.

Soil Physics Laboratory, College of Agriculture

The GIS facility in the College of Agriculture, Food and Life Sciences, at the University of Arkansas, is located in the Soil Physics Laboratory in the Department of Agronomy. The lab is closely associated with the Center for Advanced Spatial Technologies and hardware, expertise and data are shared between the programs.

Research

The Soil Physics Laboratory is a research and development with two major goals. The first goal is the education of students, both undergraduate and graduate, in the application of GIS techniques to agriculture and natural resources. This is achieved primarily through grant funding support from state and federal agencies. These grants are used to support the research projects of masters and doctoral candidates as well as the employment of several undergraduates. The research projects are normally conducted on a watershed basis that includes the development of a detailed GIS database characterization of the watershed as one of the project objectives. Numerical models are often applied to these databases to predict the transport of water, sediment and nutrients in he watershed. The second goal of the program is the development and completion of state-wide digital soils and surface geology databases. The digital soils database is being compiled in cooperation with the Soil Conservation Service in Little Rock. These data are being digitized from 7.5 minute quadrangle soil maps at a scale of 1:24,000. The digital surface geology database is being compiled form the Arkansas Geological Commission's 7.5 minute 1:24,000 scale masters of the 1:500,000 scale sate geological map. In addition to soils and geology data, the Laboratory has the capability to produce digital elevation and land use/land cover maps.

Facilities

The Lab has necessary facilities for the conversion of maps, various analysis capabilities and methods of presentation of maps. Examples of the GIS-related hardware and software include:

> Sun Sparcstation 10/40 Sun Sparcstation IPC (2) Contex FSS 8000 E size scanner Altek AC-30 digitizer Houston Instruments DMP-60 Plotter Tektronics 4697 Colorquick paint jet printer GRASS 4.1 LT4X 3.21 CADImage/Scan 1.3 IDRISI 4.1

GIS Laboratory, Department of Geography

The Department of Geography has a well equipped laboratory for GIS and remote sensing training. The facility is equipped with eight 486 and Pentium based PCs. Software includes IDRISI, AutoCAD, Arc-CAD and Colorix along with an assortment of peripherals. The laboratory is used for undergraduate GIS and computer mapping instruction and projects.

University of Arkansas - Monticello School of Forest Resources

Spatial Analysis Laboratory

The Spatial Analysis Laboratory (SAL) in the School of Forest Resources at the University of Arkansas at Monticello is an integral part of the teaching, research and outreach program. In addition, the SAL serves as a focal point for many of the research efforts of the Arkansas Forest Resources Center, a statewide program which emerged after the Forestry School was designated as a Center of Excellence by the University of Arkansas Board of Regents. The mission of the Center is to educate, to enlarge the body of knowledge and to disseminate new ideas and technology related to forest resources. The SAL utilizes geographic information systems (GIS), global positioning systems (GPS), remote sensing and expert system technologies to develop applications to help address this mission. This is accomplished by integrating high-tech computer facilities with the expertise of SAL staff and forest resources faculty to evaluate complex problems and provide solutions for more effective forest management strategies.

Facilities

Development of the Spatial Analysis Lab was made possible by a generous grant from the Roy and Christine Sturgis Educational Trust in 1991. The SAL is housed in newly renovated space within the School of Forest Resources on the University of Arkansas at Monticello campus. Six UNIX workstations (Sun Sparcstation IPX, LXs, Sparcstation 2 and Sparcstation 20) are networked in a configuration which allows optimal use of over 300 megabytes of memory and 12 gigabytes of disk space for software and data storage. A Sparcstation 20/61, with multiprocessing capabilities and 24-bit graphics, provides an excellent environment for image processing and complex analyses. Options for data transfer include: 4 mm, 8 mm and ¼ inch tape drives, 3 ½ disk and CD Rom drive. Spatial data input is accomplished using backlit digitizers and color scanner. Numerous high-quality output devices, including laser postscript printers, large format 8-pen plotter, small 6-pen plotter, large format color inkjet postscript plotter, and several small color inkjet postscript printers, permit the visualization of spatial and tabular information. An erasable optical disk subsystem adds disk storage and easy access to project databases. A Pentium and a 486/66 PC provide flexibility for project development. А 6-channel GPS receiver and five GPS receiver/dataloggers, along with software for mission planning and differential correction, enhance the functionality of the lab.

Current software includes relational database packages, word processing and publication packages, geographical information system packages (ARC/Info, PC ARC/Info, ARC/View, IDRISI, and GRASS), image processing packages (ERDAS and ELAS), and statistical software.

Research

The focus of work in the Spatial Analysis Lab is in natural resource management. This is an enormous task in which new technology can play an

important role. The objectives of the laboratory include: (1) investigate spatial errors and develop GIS applications for natural resource management, (2) investigate and quantify the correlations between remote sensing and forest biomass, (3) access the benefits, accuracy, and application of GPS in natural resource management, (4) develop and/or improve natural resource management expert systems that aid managers in natural resource decision making, and (5) provide a working laboratory in which these methodologies can be demonstrated and GIS/GPS technology transfer can be provided to natural resource managers. To meet these objectives, many cooperative projects have been instigated with both federal and state agencies. Data layers are being accumulated to provide base data for Arkansas and the southeastern region.

Technology Transfer

The School of Forest Resources has also developed a PC teaching facility which complements the SAL. This lab contains 486/66 PCs and peripherals which are used in the undergraduate teaching program. In addition, this lab will be utilized to meet continuing education needs of the forestry community, and technology-transfer of spatial analysis techniques and applications related to natural resource management. Short courses and workshops will include introductory, intermediate and advanced classes in GIS and GPS tailored to natural resource management needs. The SAL provides an avenue through which the expertise of the faculty and natural resource community, including public and private professionals, can be integrated with new technology to develop solutions to current and future problems. These efforts will make natural resource managers better able to compete economically, address a changing social climate and meet natural resource demands in the 21st century. These goals can be more quickly addressed with the cooperation and input of all state agencies involved in natural resource spatial and attribute data development. Sharing data and technology between agencies will ultimately provide maximum value for each taxpayer dollar.

University of Arkansas at Little Rock

Environmental Data Analysis Laboratory

In 1988, five members of the Departments of Biology and Earth Science recognized the need for analytical facilities for environmental studies and the growing area of integrating spatial relations with attribute data. In 1989, their idea was funded by the National Science Foundation. Since then, although several of the originators of the project have left UALR, other areas have been integrated into the project. Today the laboratory serves as a computational laboratory to serve in the analysis, visualization and storage of biological, chemical, geological, and geodetic data.

Facilities

The facilities in the Environmental Data Analysis Laboratory include those necessary for state-of-the-art analysis and visualization of geographic and environmental data. The hardware available includes workstations (Vaxstation 3100-76, Silicon Graphics Indigo2, two Sun IPC Workstations, six Pentium-P5-60 UNIX workstations, two Intel i486 UNIX workstations), and eight Intel 80286 terminals for Tektronix 4105 emulation. Input/output devices include Hewlett-Packard plotters and HPGL-2 printers, Hewlett-Packard color postscript printer, Hewlett-Packard ScanJet scanner, and an Altek 24" x 30" backlit digitizer. The software running on the workstations includes: ARC/Info, ERDAS, SAS, ERMapper and OzGIS. In addition to the GIS facilities above, the laboratory supports a national Geodetic station. This base station is monitored by an Ashtech GPS base station receiver. Two additional Ashtech and one Trimble rover GPS stations are available for obtaining Global Positioning System information.

Research

The laboratory is currently in the process of constructing a geographic information systems database for the Saline River drainage basin. The Saline River traverses through seven counties in Arkansas before joining with the Ouachita River. The habitats along this scenic river include upland forest and Mississippi delta. As such, it is important to know the effect of agricultural and industrial runoff on the biota of these areas. The Geographic Information System database currently consists of the following features: streams, roads, historic bridges, EPA runoff permitted sites, historic battlefields, endangered plants and animals, and environmentally "sensitive" habitats. The purpose of the database is to predict which areas are most sensitive to future pollution and which areas may be best preserved by wetlands acquisitions.

A student-originated project involves the construction of a GIS database for Drew County, Arkansas. In this project, the student has collected information concerning deer densities at various "deer camps" and hunting associations. Additional data from Landsat TM images will be classified, ground-truthed, and incorporated into the database. The goal of this project is to predict which areas can be most effectively managed for high deer quality and quantity.

Lyme Disease is an infectious disease carried by ticks. Although the ticks prefer deer as their host, other mammals may carry the vectors. The spread of the disease, its epidemiology, and its spatial distribution and associations are poorly understood. In this project, the laboratory has secured census, epidemiological, spatial and case data for the state of Wisconsin. The data span the years 1991 - 1993. The goal of this project is to use time-series analysis to elucidate the spatial distribution of the spread of the disease. These results will be used to determine which areas of the state are most vulnerable to the spread of the disease.

Data Available:

- Digital Chart of the World
- USGS Digital Line Graph (DLG) Data Series-4 1:2,000,000 (USA)
- TIGER/Line Census Files, 1990 (Arkansas)

- TIGER/Line Census Files Enhanced, 1992 (Arkansas)
- 1990 Census of Population and Housing Summary Tape File 1A :
- West South Central Division (Arkansas, Louisiana, Oklahoma)
- 1990 Census of Population and Housing Summary Tape File 3A (Arkansas)

Arkansas State University

Remote Sensing and GIS Facility, Department of Biological Sciences

The Remote Sensing and GIS Facility at Arkansas State University is fully equipped and staffed. The facility has the following hardware: two Silicon Graphics Indigo UNIX workstations, four personal computers, two mobile GPS receivers with data loggers, GPS basestation with software, large format plotter, large format digitizer, dye sublimation printer, two line printers, laser printer, CD ROM, 8 mm tape player, two 4 mm DAT players, and two SONY magnetic optical disk drives with platters. Image processing and GIS software for the UNIX workstations are as follows: Arc/Info, AGIS, and PCI. Image processing and GIS software for the personal computers includes PC AGIS and MAPIX. Digital data available for research projects includes satellite coverage of the state and NASA's airborne calibrated multispectral scanner sensor data for the Louisiana coast. The facility has five graduate students and one undergraduate student performing GIS research on various biological phenomena. The primary research focus for the facility is wetland ecology.

Arkansas Archaeological Survey (UA System)

The Arkansas Archeological Survey is an element of the University of Arkansas System with eight Research Stations located around the state. The Coordinating Office, located on the UAF campus, has an extensive GIS program. The Survey's GIS program began in 1982. Since then the Survey has developed a number of digital data layers with statewide coverage. The state's archaeological site data is in a GIS format as are many environmental data layers. The Survey works closely with the ADH in their joint programs. The survey has Sun Sparcstation IPXs, 10, digitizers, plotters and printers.,

MAPPING AND LAND RECORDS STANDARDS

Why Standards ?

The development of digital data can be costly. Because the data are digital, however, they can be easily transferred to others and easily used. Thus digital data can be reused over and over again, often for purposes for which it was not originally intended. When these data are reused then the public receives much greater value for its initial investment. As a result, it is critical that data which might be reused, and which has been developed with public dollars meet some basic standards which would insure that it can be safely used in new ways. A second reason for the use of standards is that the data may be used for public safety, health or policy decision-making. In these situations the data must be able to meet basic requirements of accuracy or completeness. If a transportation map is used to route emergency vehicles to an accident, it is essential that the roads be shown accurately. If the digital maps which are developed meet well known standards then future users can have more confidence in them. As a result, good standards, wisely applied, can save substantial money and increase the usefulness of the digital data.

Role and Impact of Standards

Standards provide an objective and verifiable basis for measuring the quality of a product. Quality in terms of a technical product means its fitness for its intended use. When there are many possible uses, such as multi-purpose GIS/LIS applications, standards can serve to categorize geo-data in terms of which uses it is suitable for. Standards state rules which are intended to achieve a clearly stated goal and to provide a way to measure results against that goal. They can both prescribe in detail how a task should be done and provide a scale against which to measure performance.

In long established technical endeavors, such as surveying and mapping, well understood standards abound and are used in contracts for the provision of spatial data. Today the question of the suitability of these venerable standards for measuring or categorizing digital geodata frequently arises. In the new technologies such as digital maps, GIS and GPS, new standards for data are coming into being.

Current Standards

In the field of surveying and mapping in Arkansas, three standards are currently used to review and categorize the production of spatial data: the National Map Accuracy Standards, the Standards and Specifications for Geodetic Control Networks, and the Arkansas Minimum Standards for Property Boundary Surveys and Plats.

National Map Accuracy Standards

The National Map Accuracy Standards, "NMAS", were put into effect by the US Bureau of Budget in 1947. The were intended to provide a uniform specification in government contracts for the production of paper maps derived from aerial photography. This standard has been universally accepted. However the NMAS were written before digital map technology came into being and were intended for paper maps. One of the factors used in the formula for measuring compliance is the scale of the map. However digital maps within a GIS are of variable scale. This complicates the application of NMAS. In recognition of this issue, the American Society of Photogrammetry and Remote Sensing in 1988 developed a set of "Interim Accuracy Standards for Large-scale Maps" specifically to deal with the questions of digital map data. These standards, or ones very similar, are shortly to be adopted as replacements for the existing NMAS.

One of the directives of Act 150 is, "The Board shall recommend technical specifications and standards for local and state government to use in the collection and distribution of land information and in particular that digital data development meet or exceed National Map Accuracy Standards"

The NMAS will continue to be specified by government contract officers until the new digital map standards are fully formulated and accepted. The most useful approach is to encourage the continued specification of NMAS as a standard for basemapping where accuracy requirements should be high, particularly for those maps which will be used widely such as the proposed statewide digital basemap or which may have legal or policy implications, recognize that many sets of geo-data do not need to be compiled to NMAS standards, and monitor the development new standards and keep the spatial data user community informed of developments.

Standards and Specifications for Geodetic Control Networks

The Standards and Specifications for Geodetic Control Networks were also developed by the federal government as a technical specification. They define several levels of accuracy for surveys, prescribe field procedures and equipment appropriate for each level and describe in mathematically verifiable terms the results required for each level of precision. Geodetic surveys determine the precise location and elevation of points on the earth's surface. These surveys can be used to gather geographic data directly, but usually are used to set control points for aerial photography and other forms of Good geodetic control is indispensable for topographic data collection. basemapping. These federal Standards for Geodetic Control Networks were promulgated before Global Positioning technology revolutionized geodetic The procedures and equipment specified rapidly are becoming surveying. obsolete. GPS has become the standard method of geodetic surveying today because it is more efficient and more precise than older methods. However, rigorous mathematical standards still are vital in the field of geodetic surveying. Inaccuracies at this basic level will undermine the accuracy of any other spatial information based on this geodetic control. New geodetic standards reflecting the significance of global positioning systems technologies are now being developed by many states.

From the forgoing it is obvious that technical standards relating to geodata are in flux. Arkansas needs to avoid an inflexible imposition of standards at this point, however, we must actively participate in the national exchange of information about standards. It is particularly important that the state have an organization charged with participation in this dialogue and with the responsibility of disseminating what is learned throughout state government.

Arkansas Minimum Standards for Property Boundary Surveys and Plats

The third set of standards in the field of geo-referenced data are the Arkansas Minimum Standards for Property Boundary Surveys and Plats. In 1992 these standards were adopted by the Land Survey Division of the Arkansas Geological Commission and made mandatory for land survey practitioners. These standards require that boundary surveys attain varying degrees of precision depending upon which of several categories of real property are the object of the survey. The categories of precision are related to the value, location, and use of the property.

Property surveys are not geodetic surveys, but they have their own high requirements of accuracy which are expressed in the Arkansas Minimum Standards. Property surveys are related to the system of public land survey and private subdivision corners. Most property survey corners do not have known geodetic positions (latitude and longitude, etc.), but the relative bearings and distances between survey corners are determined to a high level of precision by boundary surveys. This high level of precision in boundary measurements is demanded by the public because of the monetary value placed land and high societal value placed on certainty of property boundaries.

The present land information system for survey boundaries is paper based and consists of the voluminous plat data filed in various public offices along with other title records. There is a significant public interest to be served in converting this data to a digital base which can be related by geo-referencing to other data sets in a GIS/LIS. Increasing the accessibility of this data can lower costs of government operations, lower costs for real estate transactions and land development and generally increase the quality of all work which depends on research of the land records.

However, there is also a significant public interest in insuring that the accuracy of land boundary and title information is not degraded in the process of converting from a paper-based to a digital, computer based Land Information System. The existing Arkansas standards for land boundary surveys should not be compromised. The process of formulating new standards in the digital geodata environment should include additional standards to protect boundary and title data from corruption. Today survey and land title information is protected inside vaults in county court houses, abstract offices and banks. When this data resides in a computer system it becomes no less valuable.

Standards v. Guidelines

Standards can establish a threshold of quality that data must meet before it is accepted for the use governed by the standard. A digital map prepared by a private firm for a county GIS for use as a basemap may be rejected if it fails to meet the standard of accuracy (NMAS, for example) specified in the contract for services. Standards and specifications are very important guideposts in contracts between government and third parties and will remain so.

However, the Board in formulating recommendations for state oversight of geodata production by state agencies and local governments has concluded that formal standards should not be implemented at this time. The problem at present is with a lack of geo-referenced digital data and standards developed by others which have been shown to be fully effective in this rapidly evolving field. This suggests that the emphasis should be on the production of data rather than the exclusion of data. The consensus of the Board is that state efforts should be focused on producing guidelines for creating digital geodata. Guidelines can set forth the best available information on procedures and quality control for the production and use of spatial data without imposing penalties. Managers who are involved in GIS/LIS implementation are eager for any technical guidance available. If the state chooses to formulate guidelines it is very likely they would be followed closely. As the arena of digital mapping develops widely accepted, consensus guidelines that have been shown to be effective, then it may be appropriate, at that time, to codify them into standards. The continuing process of guideline formulation should involve the managers and technicians who are actively engaged in the production and use of different types of digital geodata. Guidelines can be fine-tuned and evolve based on experience gained. Eventually tested and accepted guidelines can be formalized as standards.

Metadata

More important than constructing premature standards is guaranteeing the informed use of data. The requirement of metadata to accompany digital data exchanges can accomplish this.

"Metadata" are data about data. Its use insures full disclosure of data quality to potential users. It employs a "truth in labeling" approach. "Metadata describe the content, ancestry and source, quality, database schema and accuracy of data. Metadata support data sharing by providing information on many aspects of spatial data, each aspect having meaning in particular application contexts."⁵ The Federal Geographic Data Committee has developed standards for digital map metadata. It is the consensus of the Board that all data developed with public moneys in the state should have metadata reports

⁵Mapping Science Committee, <u>op. cit.</u>, p. 97.

associated with them which meet these standards. The report would follow a required format. It would be attached to the data and transferred with the data. A potential user could access the data quality report and determine the suitability of data before requesting it.

Data Access And Transfer Standards

Effective data standards or guidelines and meta-data mean that data developed with public monies can be usable by more than just the agency or group developing the data. As important as the quality of this data. however, is the ability of agencies and the public to find existing data. In many instances costly data has been duplicated because an agency did not know it already existed. In other instances, data developed for one reason could be very useful by others for completely different purposes if only they knew of it.

A second element in data access is the problem created by many different data formats. Each GIS vendor has their own internal data format, there are many data formats from different federal agencies. The transportation data for the US Census Bureau, for example, is in a different structure than similar data from the USGS. In order to begin to address this problem the US Spatial Data Transfer Standard has been developed. This is a complex data standard to which all federal agencies must comply. This standard will only address part of the problem. Ultimately it is likely that new computer systems will be developed that will solve these complex issues. It will very likely be possible to link different computers running different GIS software over high performance wide-area networks and automatically transfer data from one to the other.

Data Clearinghouse

For the near term, however, an immediate solution for the State of Arkansas is needed. This is to set up a spatial data clearinghouse and archive. All digital data developed with public monies in the state would be deposited there and made available at the cost of reproduction to any one requesting a copy. Data deposited with the clearing house should be documented according to the meta-data standards discussed earlier. Because of the complexity of these standards it is most efficient to have staff associated with the data clearinghouse complete the meta-data reports in cooperation with the developing agency. The clearing house should have the technical capacity to store large amounts of data and the ability to translate the data into a number of standard formats to assist the data requester. For example data from federal and state agencies can be expected to be produced in a number of mapping systems (latitude and longitude, UTM - universal transverse mercator, and state plane coordinate systems), different geodetic datums (e.g. NAD27 and NAD83), different vendor software systems (e.g. Intergraph, Arc/Info, GRASS, etc.) and/or different data formats (e.g. SDTS, DLG, DXF, TIGER, etc.). The clearing house, working with the data developer, should have the capability of moving data among and between these formats and providing it to the consumer in a ready to use form. The clearing house should produce, on a regular basis, a catalogue defining what data are available and its characteristics. The clearing house should also coordinate with the various

federal agency digital-data providers in making state data available to the federal agencies and making federal data more available to the state.

The Expense Of A Non-Standardized Environment

What happens if guidelines are not established to set standards for a State GIS? If the state continues to manage data without standards, and individual government agencies proceed with building in-house electronic GIS's without any coordination between agencies, it will lead to a future disaster. Data that are not required to meet certain standards in the collection process, analytical process, and the interpretive process will all be treated as equal once entered in a GIS. Decision makers must rely on these data to make critical decisions that effect the development and use of the State's resources and the protection of the environment. It is imperative that the technical data and land records made available to the people of Arkansas be as accurate as possible and not loose any integrity when merged with other data or transferred to users.

It is clear that mapping technologies need to be updated to the digital capabilities of the modern computer age. The vast amount of data on file and the increasing volume of data produced each year are overwhelming manual attempts to meet the growing need to analyze, retrieve, and transfer data. The current state of available technology and methods make retrieval and utilization of data a cumbersome effort. Mismatched, and even obsolete hardware and software systems are common place across state agencies, counties, and municipalities. As land records and natural-resource information become more necessary in our everyday lives, it is to the advantage of the state to adopt a method to ensure that these entities have state-of-the-art GIS tools that enable them to manage data in a cost effective and productive automated manner.

With strong, legislative supported GIS, Arkansas will enter the 21st century in a mode where access to public documents will be easy and cheap. We can ensure greater reliability of the data. It will also allow easier and faster transfer of information, reduce duplication of effort, provide updated data files, and assure that the data meets acceptable standards.

The making of maps and gathering of geographic information has been going on in Arkansas for over 150 years. Each day that goes by without conversion to an electronic GIS makes the eventual transformation process more difficult and ultimately more costly.

ORGANIZATIONAL AND ADMINISTRATIVE NEEDS

Introduction

Land-records modernization involves agencies at all levels of government, the private sector, and universities and colleges. As a result, a coordinating body which draws upon all of the interested parties will be most successful. A large board, however, has the potential for being inefficient so a smaller executive group is also proposed. A small professional staff, with strong technical and administrative skills, is needed for day to day coordination and operational work and a structure to provide for the data clearinghouse and archive is also needed. It will also be necessary for the board to propose, develop, and implement programs and guidelines for publicly financed digital geodata, multi-level standards and metadata reports; to coordinate development of a statewide digital basemap and to direct state funds to qualified mapping projects.

Land Information Advisory Board

Based on the experience of other states with successful programs it is clear that the entity charged with coordinating mapping and land records modernization must draw upon the knowledge and support of many state agencies, local and county representatives form the private sector and academia. As a result a large board is proposed. To allow broad representation thirty two (32) voting members and an unlimited number of non-voting members are needed to serve on the board from whom should be drawn a nine member Executive Board.

Office of Land Information Technology

A unit should be created to serve as an administrative interface between the board and the state's GIS/LIS environment. Under the board's direction, this office can develop and implement on-going information and education programs for all levels of government; define and develop strategic plans aimed at accomplishing board goals and objectives; and provide technical advice and guidance to qualified entities planning, implementing, or operating GIS/LIS programs.

The primary mission will be the implementation of methods to modernize mapping and land-records management in Arkansas as identified by the Mapping and Land Records Modernization Advisory Board created by Act 150 of 1993. This mission will be the primary focus of a multi-year strategic plan.

The unit should operate as a functionally independent body attached to an existing state agency or institution, for the purpose of that agency or institution providing it with various administrative services, including personnel, budget, purchasing, fiscal, facility maintenance, and other non-GIS/LIS related services. The agency or institution providing such services should not have management nor policy making authority over the unit or the board.

OLIT staffing

The unit should be adequately staffed, this would include:

Land Information Director.

The director shall administer daily operations; serve as liaison between the Board and public/private sector entities; provide management and technical guidance in the definition and preparation of strategic plans; recommend to the board policies and procedures necessary for mapping and land-records modernization; and develop and implement information and education programs for delivery to state, county, municipal, and private sector interest groups. The director will provide technical consulting and guidance in the planning of new programs, and prepare and deliver reports to the governor, the general assembly and the board.

State GIS/LIS Coordinator.

The coordinator shall provide technical assistance, consultation, and education to public and private entities on projects involving the configuration of GIS computer hardware systems, mapping, and other aspects of the board's function. The coordinator shall also compile and maintain an inventory of statewide GIS installations for public and private access.

State Geodetic Advisor.

Co-funded by the National Geodetic Survey, this position will coordinate with NGS, state, and local government entities on the development and maintenance of geographic referencing systems in Arkansas. The State Geodetic Advisor will, in particular, coordinate mapping efforts including the High Accuracy Reference Network (HARN) and with the surveying community in actions to improve geodetic monumentation.

The State Geodetic Advisor will coordinate administratively with the State Surveyor.

Administrative Assistant.

This position serves as office manager. The position will assist in the development and implementation of information and education programs. Duties also include interface between the unit and the agency or institution providing administrative services.

Technical Assistant

The technical assistant will provide needed support the GIS/LIS Coordinator.

Facilities

The program will require office space and computer systems to support its activities and high speed network access to ARKNet, Arkansas Public School Net or another similar network. The staff will be working with state agencies, and county and local governments throughout the state and substantial instate travel will be required. Because of the rapid pace of development in the field, it will be necessary for staff to travel to other states to assess their programs and to various meetings to keep up-to-date. The Geodetic Advisor will require a vehicle and necessary technical equipment.

State Spatial Digital Data Clearing House

A state spatial digital data clearing house should be developed. The clearinghouse should have a strong technical capabilities in GIS data development, spatial data translation, and meta-data. The clearing house should have substantial computer facilities, including a suite of different GIS systems, hard disk capacity and a range of media on which to provide data. High speed linkage to ARKnet, Arkansas Public School Net and/or other high performance networks is also necessary. The clearing house should also have experience with NSDI matters and be capable of coordination with the Federal Geographic Data Committee's initiatives.

All state agencies developing digital data should provide the clearinghouse with copies of their data and work with clearinghouse staff in development of meta-data reports for the data. Requests for digital spatial data can then be meet by the clearing house rather than by the individual agency. County and local governments developing digital spatial data should provide the clearing house with information on their data and may, if they choose, provide the clearing house with copies of the data itself. Where the clearing house has such data it can meet requests for these data instead of the county or local government unit. The clearing house will provide copies of data in its archive at the cost of reproduction which will include media, computer and staff expenses. The clearing house will regularly produce a spatial digital data catalogue which lists all known digital data including the data in the clearing house archives and other digital data available from other sources. Clearing house staff will work towards the development of an on-line data system through which individuals could electronically access the data and obtain copies.

RECOMMENDATIONS

Based on the findings and conclusions of the MLRM Board in response to the mandate of Act 150, the following actions are recommended. These recommendations are consistent with Section 2, (d) and (e) of that legislation. Substantive argument and justification supporting these recommendations appear earlier in this report.

(1) Establish a permanent Land Information Advisory Board (LIAB)

The LIAB will serve as an independent body to determine, recommend, and promulgate GIS/LIS policy and direction within the State of Arkansas , as described in the attached <u>Draft Legislation</u>. The board will be empowered to propose, develop, and implement programs and guidelines for publicly financed digital geodata, multi-level standards, metadata reports; a statewide basemap, a clearinghouse of geodata information and to direct state funds to qualified mapping projects.

The governor will appoint thirty-two (32) voting members and an unlimited number of non-voting members to serve on the board., including representatives from public and private GIS/LIS interest groups. Members serving at the governor's discretion should include:

- (1) One (1) member of the Arkansas Senate
- (2) One (1) member of the Arkansas House of Representatives
- (3) The Commissioner of State Lands
- (4) The Director of the Department of Computer Services
- (5) The Director of the Department of Education
- (6) The Director of the Arkansas Industrial Development Commission
- (7) The Director of the Arkansas Game and Fish Commission
- (8) The Director of the Arkansas Geological Commission
- (9) The Director of the Highway and Transportation Department
- (10) The Director of the Department of Pollution Control and Ecology
- (11) The President of the University of Arkansas System
- (12) The Director of the Department of Health
- (13) The Director of the Public Service Commission
- (14) The Director of the Department of Heritage
- (15) The Director of the Arkansas Forestry Commission
- (16) The Director of the Arkansas Forestry Association
- (17) The Director of the Arkansas Soil and Water Conservation Commission
- (18) The Director of the Arkansas Oil and Gas Commission
- (19) The Director of the Office of Emergency Services
- (20) One (1) member of the Arkansas Association of Tax Assessors;
- (21) Two (2) members of the Arkansas Municipal League; one representing a city with a population of over 50,000 and the second from a smaller city.

- (22) Two (2) members of the Arkansas Association of Counties, one representing an urban county, one representing a rural county
- (23) One (1) member of the Rural Development Council
- (24) One (1) member of the Arkansas GIS Users Forum
- (25) One (1) member of the Arkansas Society of Professional Land Surveyors
- (26) One (1) member of the Arkansas Professional Civil Engineers Society
- (27) One (1) representative of a public regulated utility company
- (28) One (1) representative of the Arkansas Realtors Association
- (29) Two (2) representatives of the private sector

LIAB Executive Committee

A nine (9) member Executive Committee elected by the voting members from the voting membership will direct and advise an administrative organization charged with implementing GIS/LIS policy.

The Executive Committee will report to the governor and the legislature bi-annually regarding strategic planning objectives, accomplishments, and need for legislative support or action, and other related matters.

Board Responsibilities

The board will seek executive and legislative support or action on such issues as:

- a. The advocacy of guidelines setting multiple-level standards amenable to GIS/LIS data sharing, including the National Map Accuracy Standard, State Plane Coordinates for original capture scales of 1:12,000 or larger, neutral data interchange formats, and others.
- b. Establishment of a centralized digital data and metadata repository and clearing house within a location having broad and extensive GIS/LIS technical expertise.
- c. Development and annual updating of a land-records modernization strategic plan projecting goals and objectives over three, five, and ten year periods.
- d. Development of a statewide digital basemap through the collaborative effort the Arkansas Highway and Transportation Department, the Arkansas Geological Commission, and the Center for Advanced Spatial Technologies, to be made available to public or non-profit organizations at no or nominal cost.
- e. Authority to set and collect fees for services to deliver data to requesting users.

- f. Establishment of funding sources and fund distribution supporting the pursuit by government entities of mapping and land records GIS activities.
- g. Development and dissemination of a State Digital Data Catalogue and a Data Dictionary.
- h. And the consideration of other matters related to mapping and land-records modernization.

(2) Establish the Office of Land Information Technical Support (OLITS).

To accomplish the Board's objectives, it is recommended that the Office of Land Information Technical Support (OLITS) be created to serve as an administrative interface between the LIAB and the state's GIS/LIS environment. Under LIAB direction, OLITS will develop and implement on-going information and education programs for all levels of government; define and develop strategic plans aimed at accomplishing LIAB goals and objectives; and provide technical advice and guidance to qualified entities planning, implementing, or operating GIS/LIS programs.

The primary OLITS mission will be the implementation of methods to modernize mapping land-records management in Arkansas as identified by the Mapping and Land Records Modernization Advisory Board created by Act 150 of 1993. This mission will be the primary focus of a multi-year strategic plan. OLITS will report to the Executive Committee.

OLITS will operate as a functionally independent body attached to an existing state agency or institution, for the purpose of that agency or institution providing OLITS various administrative services, including personnel, budget, purchasing, fiscal, facility maintenance, and other non- GIS/LIS related services. The agency or institution providing such services shall have neither management nor policy making authority over OLITS or the LIAB.

OLTIS Staffing

OLITS will be staffed as follows:

Land Information Director. The director shall administer daily operations; serve as liaison between the LIAB and public/private sector entities; provide management and technical guidance in the definition and preparation of strategic plans; recommend to the LIAB policies and procedures necessary for mapping and land-records modernization; and develop and implement information and education programs for delivery to state, county, municipal, and private sector interest groups. The director will provide technical consulting and guidance in the planning of new programs, and prepare and deliver reports to the governor, the general assembly and the LIAB.

<u>State GIS/LIS Coordinator</u>. The coordinator shall provide technical assistance, consultation, and education to public and private entities on projects involving the configuration of GIS computer hardware systems, mapping, and other aspects of the LIAB's function. The coordinator shall also

compile and maintain an inventory of statewide GIS installations for public and private access.

<u>State Geodetic Advisor</u>. Co-funded by the National Geodetic Survey, this position will coordinate with NGS, state, and local government entities on the development and maintenance of geographic referencing systems in Arkansas. The State Geodetic Advisor will, in particular, coordinate mapping efforts including the High Accuracy Reference Network (HARN) and the surveying community in actions to improve geodetic monumentation.

The State Geodetic Advisor will coordinate administratively with the State Surveyor.

Technical Assistant. This position would provide technical support for the State GIS/LIS Coordinator. It is anticipated that this position may be filled through a program of internships of recent graduates of Arkansas colleges and universities.

<u>Administrative Assistant</u>. This position serves as office manager and secretary to the LIAB as required and to the OLITS. The position will assist in the development and implementation of information and education programs. Duties also include interface between OLITS and the agency or institution providing administrative services.

3. Complete a coordinated statewide digital basemap

A major limitation to the successful use of GIS technologies by state agencies, county and local governments and the private sector is the fact that only a portion of the state has completed digital basemaps. Without complete coverage many areas can not take advantage of GIS technologies and many statewide or regional efforts are, therefore, not feasible. Many agencies are working to develop portions of the basemap but these efforts are not coordinated and duplication of effort results. A coordinated effort to complete essential data layers should be implemented.

4. Develop a statewide digital map clearinghouse and archive

A statewide clearinghouse for digital map data is necessary. Under the current situation many agencies and others are unable to locate existing data or often duplicate existing data at considerable unnecessary cost. When data does exist it is often in many different formats and technical specifications. A central clearinghouse would make all data easily available and could serve to translate/transfer data form one format to another.

5. Fund these initiatives through general revenue.

Provision should be made to fund salaries and maintenance/operations from General Revenue. The OLITS budget would include a portion of the State Geodetic Advisor's salary, operating funds for establishment and operation of a metadata library function, and short-term professional/technical consulting contracts.

Budget Issues

A detailed budget is attached. General operating expenses should be higher for the first two-years after start-up, decreasing and leveling there after.

The first year summary costs of the various elements proposed are:

Office of Land Information Technical Support	\$336,970
Completion of essential basemap elements	\$390,000
Operation of clearinghouse and archive	\$150,000
First year Total	\$876,970
Second year costs are:	
	0010 000
Office of Land Information Technical Support	\$312,292
Completion of essential basemap elements	\$250,000
Operation of clearinghouse	\$150,000
Second year Total	\$712,292

The Office of Land Information Technical Support funds are needed to support the technical staff, office space, telephone and other similar office expenses and supplies, travel and, in the first year, the various capital expenditures needed to start the program. An important component of the first two years work of OLTIS is the development of a comprehensive statewide plan and funds to complete this important effort are included.

The basemap funding requested includes \$250,000 to be allocated to the Arkansas Department of Highway and Transportation in both years (total of \$500,000) and \$160,000 to be cost shared with USGS (one year only) who will match these funds. The AHTD funds are the amount projected by AHTD to allow them to speed up their 1:12,000 digital basemap work. To date 47 of the state's counties have been digitally mapped. Internal AHTD funds are planned to complete the remainder but additional technical requirements will have to be met by AHTD so that the data may be fully used by other agencies and county and local governments. In addition funds are needed to speed-up the process so that the data may be available within the next two years. With this funding augmenting their current level of support, AHTD would be able to complete all the map layers described earlier in this report for all the counties in the state and the digital data would meet National Map Accuracy Standards and have appropriate attributes and topology as needed by GIS software. A formal agreement would be implemented between LIAB and AHTD with the necessary technical specifications.

The USGS has projected that the state's share of digital data development under their program would require more than \$3.5 million dollars to complete the state at a map scale of 1:24,000. The program proposed by

AHTD is much less expensive and will provide counties with data at a much more useful level of detail. It is critical, however, that the AHTD products meet the specific technical standards met by USGS. One important basemap component which cannot be developed by AHTD is elevation. USGS can finish digital elevation maps for the roughly 450 remaining USGS 7.5 minute quadrangles at a projected total cost share by the state of \$160,000.

The operation of the clearinghouse is projected to cost \$150,000 per year. The efforts of the clearinghouse in both the first and continuing years would largely be focused on making the existing state agency digital map data more available, providing AHTD digtal map data to those requesting it and developing meta-data documentation for all state data.

LEGISLATION

The following is draft legislation designed to implement the recommendations