**STATE OF ARIZONA**
**OFFICE OF THE**
**AUDITOR GENERAL**

A USER NEED STUDY AND
SYSTEM PLAN
FOR AN

# ARIZONA NATURAL RESOURCES INFORMATION SYSTEM

PREPARED BY STAFF OF THE
NATIONAL CONFERENCE OF STATE
LEGISLATURES AND THE
COUNCIL OF STATE PLANNING
AGENCIES, NATIONAL
GOVERNORS' ASSOCIATION

OCTOBER 1980

A REPORT TO THE
ARIZONA STATE LEGISLATURE

REPORT 80-1.2

DOUGLAS R. NORTON, CPA
AUDITOR GENERAL

STATE OF ARIZONA
OFFICE OF THE
# AUDITOR GENERAL

November 17, 1980

The Honorable Bruce Babbitt
Members of the Arizona Legislature
Arizona State Land Department
Arizona Department of Transportation
Department of Administration, Data Processing Division
Department of Water Resources
University of Arizona, Office of Arid Lands Studies

Transmitted herewith is A User Need Study and System Plan for an Arizona Natural Resources Information System. The report is in response to a July 14, 1980, resolution of the Joint Legislative Budget Committee.

The blue pages represent a summary of the report; responses from three State agencies and the University of Arizona are found on the yellow pages preceding the appendices. In accordance with the Joint Legislative Budget Committee's rules and procedures, the Arizona Department of Transportation (ADOT) was provided a draft copy for review and comment on September 29, 1980, and a revised copy on October 10, 1980. As of November 17, 1980, ADOT had not exercised its right to submit a written response for inclusion in this report.

The report was prepared under the leadership of Mr. Paul Tessar and Ms. Loyola Caron from the National Conference of State Legislatures and Ms. Peggy Harwood from the Council of State Planning Agencies, National Governors' Association. Additional staff resources included:

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These individuals, my staff and I will be pleased to discuss or clarify items in the report.

Respectfully submitted,

Douglas R. Norton

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Enclosure

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October 8, 1980

Mr. Doug Norton, Auditor General
Room 200
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Phoenix, AZ 85007

Dear Mr. Norton:

Pursuant to our "Agreement for Technical Assistance Services," I hereby transmit to you the original copy of A User Need Study and System Plan for an Arizona Natural Resources Information System.

The completion of this report represents the culmination of a major effort on the part of NCSL and Council of State Planning Agencies staff over the past three months. I trust you will find the background work on technical considerations, institutional settings and user needs to be thorough, and the conclusions and recommendations to be well thought out and defensible.

If we can be of any assistance to your office in the future, please feel free to call upon us.

Sincerely,

Earl S. Mackey

Earl S. Mackey
Executive Director

ESM/rk

# A USER NEED STUDY AND SYSTEM PLAN FOR AN

# ARIZONA NATURAL RESOURCES INFORMATION SYSTEM

Prepared by Staff of the
National Conference of State
Legislatures and the
Council of State Planning
Agencies, National
Governors'Association

October 1980

A Report to the
Arizona State Legislature

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# EXECUTIVE SUMMARY

## I. BACKGROUND AND INTRODUCTION

In response to a request for technical assistance services by the Joint Legislative Budget Committee of the State of Arizona, the National Conference of State Legislatures (NCSL) and the Council of State Planning Agencies (CSPA) formed a Resource Team to evaluate the need for a statewide natural resource information system. The Resource Team formed by NCSL and CSPA was asked to evaluate current needs in Arizona for natural resource and related data, existing manual and/or automated natural resource information system(s) to meet those data needs, and institutional settings that might host such a system. Further, the Team was asked to make recommendations for an information system and appropriate institutional arrangements to house the system, should the needs of Arizona state entities justify development of the capability.

The Resource Team consisted of ten members having expertise in state information systems. In addition to NCSL and CSPA, it included individuals currently or previously affiliated with state governments (California, Georgia, Minnesota, North Dakota, South Dakota and Texas), a university, the U.S. Geological Survey, and the National Aeronautics and Space Administration. The Team was divided into task forces addressing three specific areas:

- User Needs;
- Systems and Software; and
- Institutional Arrangements.

The total time spent by these ten individuals during July, August, September and October, 1980, represents over six person months of effort.

The findings reported in this document indicate that Arizona State agencies do indeed have a need for natural resource data coordination and for a mechanism to access and analyze the data, such as could be provided by an information center with an automated capability. Given current capabilities and conditions in Arizona, the Resource Team unanimously recommends that such a mechanism be established in the Department of Transportation. The capability is referred to in this report as the Arizona Information Network For Operational Resource Management--the INFORM System.

## II. PRELIMINARY SURVEY OF USER NEEDS

To understand the needs for natural resource and related data in Arizona, the User Needs Task Force designed a survey instrument to be administered to state entities participating in the study. The purpose of the survey was to acquire specific details characterizing the types of data used or produced, and to summarize those needs for all participating agencies. The intent was to derive the capabilities a natural resource information system would need in order to accommodate the range of products desired. The instrument included the following variables:

- Major programs, ongoing or planned, identified in the organization
- Authority (Mandates/Responsibilities) for each programmatic area
- Standard Products (Deliverables)
- Project (Work Element) Descriptions
- Task Descriptions
- Data Characteristics
  - Data Item
  - Source Format
  - Scale or Resolution
  - Geographic Reference System
  - Required Currency of Data Item
  - Geographical Coverage (Acres, Miles)
  - Current or Anticipated Sources

- Collection Procedure, If Applicable
- Access Restrictions (Availability)
- Storage Medium and Approximate Volume
- Precision

- Product Characteristics
  - Data Product
  - Product Format
  - Scale or Resolution
  - Geographic Reference System
  - Updating Frequency
  - Geographical Coverage (Acres, Miles)
  - Time Constraints
  - Anticipated Users
  - Analysis Performed
  - Access Restrictions (Availability)
  - Storage Medium

- Costs for Data Accumulation

Fifteen state entities were surveyed during a two-week period in August and September. Although several other agencies and local government units remain to be surveyed (perhaps by systems staff in the future), the preliminary results based on the fifteen agencies support the substantial need for coordination of natural resource data in the state, and for a central access point to obtain and process these data.

Some observations which strengthened the conclusion that Arizona State entities have a need for natural resources data and a system to handle that data should be noted:

1) The concept of planning is still in its infancy. Most entities operate by reacting to areas of need as they arise.

2) The concept of a statewide natural resource information system was enthusiastically supported by agencies who participated in the user needs survey. However, they shared the concern that the system might be "buried" in an agency that would not be able to respond adequately to their needs.

3) Program efforts are restricted basically to activities that "must" be done. Other areas are addressed as resources are available.

4) State agency employees rely heavily on personal contacts to obtain secondary source data. Should an employee leave the agency, his/her knowledge about how and where to obtain data may leave with that person.

5) The consciousness-level of how an information system might help employees carry out their tasks is somewhat limited. Upon proper promotion of a system, however, it is probable that the agencies would soon realize and take advantage of the benefits provided through such a mechanism.

6) Agencies need to talk more to each other about what data needs they have in common. This would greatly assist systems staff in further defining data priorities and capabilities required.

The state agencies were ranked as primary or secondary users of natural resources data. Needs were based on each agency's perceived needs, the consistency of these needs, team judgments about the extent of geographic coverage involved, and the variety of data types required by the entity.

- Primary Users
  - State Land Department
  - Department of Water Resources

    Equal Ranking
  - Department of Transportation
  - Outdoor Recreation Coordinating Commission
  - Game and Fish Department
  - Department of Health Services
  - State Parks Board
  - Bureau of Geology and Mineral Technology
- Secondary Users (No ranking within category)
  - Legislative Bodies
  - Office of Economic Planning and Development
  - Oil and Gas Conservation Commission

- Agriculture and Horticulture Commission
- Local government
- Councils of Governments
- Other state agencies, many of which were not interviewed during this survey because of lack of time.

- Other Users
  - Public
  - Federal Agencies
  - Universities/Educational Institutions
  - Industry

A summary of the major data types required by the eight primary users is included in the table on page 6.

## III. SYSTEMS AND SOFTWARE TASK FORCE REPORT

The Systems and Software Task Force evaluated five technical data processing and user-support entities:

- Department of Transportation - Information Systems Group (ADOT),
- Department of Administration (DOA Data Center),
- Department of Water Resources (DWR),
- State Land Department - Information Resources Division (SLD/IRD), and
- University of Arizona - Office of Arid Lands Studies, Applied Remote Sensing Program (U of A).

Information was gathered through interviews, written materials provided, tours of facilities and demonstrations of capabilities.

### Hardware

ADOT - The ADOT Electronic Data Processing (EDP) Center was eliminated as a potential host for INFORM due to current heavy utilization.

## DATA NEEDS BY MAJOR CATEGORY

| ORGANIZATION \ CATEGORY | AIR QUALITY | ANIMALS | CULTURAL | GEOLOGY | LAND USE | OWNERSHIP | SOCIAL/ECON | SOILS | VEGETATION | WATER |
|---|---|---|---|---|---|---|---|---|---|---|
| State Land Department | | X | X | X | X | X | X | X | X | X |
| Department of Water Resources | | ? | | X | X | X | X | X | X | X |
| Department of Transportation | X | X | X | X | X | X | X | X | X | X |
| Outdoor Recreation Coordinating Commission | ? | X | X | X | X | X | X | X | X | X |
| Game and Fish Department | ? | X | X | ? | X | X | X | X | X | X |
| Department of Health Services | X | X | | X | X | X | X | X | X | X |
| State Parks Board | ? | X | X | X | X | X | X | X | X | X |
| Bureau of Geology and Mineral Technology | | | | X | X | X | X | X | X | X |

?: Anticipate use of this data type in the future.

X: Data type currently used.

DOA - The DOA Data Center could potentially support INFORM. INFORM's need for specialized hardware, however, makes the use of a minicomputer necessary.

DWR - DWR currently utilizes the ADOT and DOA data centers for its processing needs.

SLD - The IRD of SLD has a fairly sophisticated minicomputer and excellent graphics peripheral devices.

U. of A. - The Office of Arid Lands Studies has access to several sophisticated computer systems for research and development work.

### Software

There has been little Geographic Information System (GIS) or Landsat processing software implemented by any of the five entities evaluated. However, both SLD and DWR have plans to implement Landsat image-processing capabilities. SLD has been attempting implementation the last two years, but has only one simple routine (of at least 15-20 required) operational to date.

The U of A has a wide variety of software available from various sources, most of which is operational on one of its three computers. These packages, however, are used mostly for demonstration or pilot studies, and are not currently linked into a coherent geographic information system.

### Staff

See Chapter III in the body of the report for a discussion of the current staff capabilities of the five entities.

## IV. EXISTING INSTITUTIONAL SETTINGS

The Institutional Arrangements Task Force interviewed four entities identified as candidates or potential hosts for a natural resource information system in Arizona: The State Land Department, the Department of Water Resources, the Department of Transportation, and the University of Arizona -

Office of Arid Lands Studies. In an attempt to get an understanding of each candidate agency's present capabilities, and any future role they might play in structuring an information system, the task force asked questions of senior staff in each agency relative to how that agency: 1) handled their information needs, 2) provided information services, and 3) perceived existing efforts at information coordination in Arizona.

Because natural resource information systems in other states are perhaps the best models for evaluating the institutional arrangement most likely to be successful in Arizona, the task force developed a list of criteria common to these state systems. These criteria were used to examine the progress of the State of Arizona in developing a statewide information system, and for determining what additional institutional changes, if any, might be needed to improve performance. They are:

- Perceived need/Documented need
- Clear purpose and mandate
- Well-defined scope (Users, Data Types, Information Services)
- Functioning mechanism for user involvement
- Institutional home
- Implementation plan (Staffing requirements, Equipment/Software, User Education/Outreach, and Schedule)

## Institutional Options

The institutional options facing Arizona are as follows:

- Not Develop an Interagency System - The State may decide that the current level of user needs for natural resource and related data does not justify the cost of developing an information system.
- Add a Service Function to an Existing Agency Program - Though fairly easy to initiate, this approach may discourage wide use because the

service function tends to be limited by the scope of the agency's mission, would likely give priority to its funding agency, and would tend not to develop new capabilities for other agencies unless of benefit internally.

- Establish an Information Service Center in a Host Agency with an Interagency Guidance Committee - A special mandate, usually established with legislation, is required to create a separate information function different from the original mission of the host agency. Many states find this approach to be the most effective option for establishing a state system that will be responsive to the different needs of state agencies.
- Create an Independent Information Agency - This could well be the most costly option, as it would require establishing a new administrative structure to support the service function.

## Survey of Candidate Agencies

The University of Arizona did not feel it was an appropriate role for them to provide ongoing operational services to state, local and federal agencies, and they did not wish to be considered as a permanent host agency. Rather, university staff felt their preferred role was to provide technical assistance, training and research capacities. Therefore, the U of A was eliminated as a candidate host agency. The three remaining agencies were further evaluated to determine their institutional and technical suitability to host a state natural resource information system.

## Evaluation of IRD/ARIS in Relation to Institutional Criteria

IRD/ARIS could potentially meet two of the three criteria for an institutional home. They are supportive of the multiagency information system concept, and IRD has some expertise in data collection, storage and manipulation. The current expertise in automated spatial data processing, however, is inadequate to implement an interagency system. Further, IRD has yet to produce an acceptable implementation plan. They do not have an advisory group, and the current IRD mandate and program are too narrow to meet interagency needs.

## Ranking of Agencies

In consultation with other members of the Resource Team, the Institutional Arrangements Task Force evaluated the State Land Department, Department of Transportation and the Department of Water Resources. The agencies were ranked in order of current ability, as perceived by the Resource Team, to support a state natural resource information system. This ranking is not intended to be a reflection of the overall performance of the candidate agency, because an interagency information system is a separate activity over and above the agency's mission.

1. Arizona Department of Transportation. The Resource Team concurred that ADOT appeared to be the strongest candidate because:

- ADOT has extensive technical capabilities and staff expertise in areas such as remote sensing, environmental assessment, and computer processing which are related to operation of an information system.
- Senior staff has demonstrated experience in managing sophisticated technology and applications.

- The Agency has stability, with well established programs and proven performance in mission areas.
- As the third largest user, they are less likely to overload the system with their own agency priorities, and are, perhaps, in the best position to see that the data needs of all major users are met.

2. Department of Water Resources. The Resource Team concurred that DWR was also a strong candidate, but would be ranked below ADOT as a potential host for the state system because:

- DWR is currently responding to a major redirection of their planning and management authority relative to new groundwater legislation.
- DWR is not now experienced in supervising capabilities similar to those of an interagency information system.

3. State Land Department. The Resource Team concurred that SLD would be ranked below ADOT and DWR at this time because:

- It will be some time before SLD will have developed capabilities that would support its own needs, much less an interagency system.
- The senior staff expressed a lack of experience in managing sophisticated technology and applications.
- SLD is perceived to be in transition. The agency is redefining its role as trustee of public lands.
- Some disappointments with and bad impressions of the performance of the ARIS function are also associated with SLD. A new host agency might speed acceptance and use of a state information system.
- SLD's major focus is on resource management of state trust lands (about 17% of the State area). They do, however, have some statewide responsibilities.

- It is perceived that the level of Information Resources Division staff experience is insufficient to carry out the types of functions required for an interagency system.

Several positive factors of SLD should also be noted, including strong support of senior management, an appreciation of INFORM-type capabilities by SLD resource managers, and close contact with potential federal users (U.S. Forest Service and BLM).

## V. RECOMMENDED INSTITUTIONAL FRAMEWORK

The recommended framework for an Arizona Information Network For Operational Resource Management--the INFORM System--is as follows:

- Implementation of a "linked network" approach. The linked network concept defines certain agencies as members of the system, and includes individual agency data and capabilities within the scope of the system.
- Interagency involvement in INFORM should be ensured through establishment of an interagency policy board or guidance committee composed of representatives from key agencies which are primary users of natural resources information. These agencies would be the INFORM member agencies. Certain additional entities would be included as either voting or ex-officio participants, as appropriate.
- INFORM should be designed primarily to serve its member agencies. Other users should be served by the system to the extent possible within available resources.
- INFORM staff to support development and operation of the system should be established and housed in the host agency (Department of Transportation).

The manager of the INFORM staff should be hired with the "advice" of the policy board or guidance committee which is established to direct the system. Additional staff should be hired by the manager.

The Resource Team concurs that, given existing conditions, the Department of Transportation is the most viable candidate for hosting the core staff and capabilities for the state natural resource information system. Recommended functions for the system to be established in ADOT are:

- maintain index of available data and referral services, including participation in federal information systems;
- develop a geographic information system (data base, computer software and applications) and provide consultation and technical assistance services to users;
- provide outreach and training opportunities for state agencies;
- publish a newsletter for system users; and
- provide staff support to the Guidance Committee.

Membership of the Interagency Guidance Committee should be initially composed of the eight primary users identified in the User Needs Survey (see page 4).

In addition, ex-officio representation from the Governor's Office, from appropriate state universities, and from managing agencies of federal lands in Arizona -- Bureau of Land Management and U.S. Forest Service -- would be desirable. Other state, regional and local agencies could be added on the basis of need, as appropriate. The Arizona Department of Transportation would chair the committee and provide staff support through the INFORM system.

This Guidance Committee should be established as soon as possible to review this report and the recommended system plan. The Committee should also

develop mechanisms to see that all potential users are kept appraised of system plans and status, and that these users have the opportunity to provide input to systems development plans.

## VI. TECHNICAL RECOMMENDATIONS - DATA PROCESSING DEVELOPMENT PLAN

This section recommends a course of action leading to an operational natural resource data coordination and analysis network for the State of Arizona. The name proposed for this service bureau is the Arizona INFORM System. It is recommended that the Arizona Department of Transportation implement this system in consultation with the interagency Guidance Committee.

The plan document consists of a statement of Electronic Data Processing (EDP) objectives, a brief discussion of strategies and priorities, an outline of projects and tasks, and summaries of the resource requirements of the plan. The plan was prepared in accordance with DOA's EDP long-range planning guidelines.

As host agency to an Arizona data reference service and geographic information system data processing capability, ADOT will serve a wide array of state agencies in the area of natural resources management. Currently, ADOT has extensive EDP capabilities for performing traditional departmental tasks, but more manpower and hardware/software must be acquired to fulfill the expanded area of responsibility. Specific objectives include:

1. Establish and participate in an interagency policy group.
2. Provide map, aerial photo-related, and other data reference services.
3. Organize an office, including staff and computer facilities.
4. Maintain a user services and geographic data processing staff, of highest technical competence, responsive to the needs of user agencies.

5. Acquire new hardware, upgrade existing hardware and install software necessary to perform analysis of geo-referenced data.

The plan organizes a phased, three-year effort to develop automated resource analysis capabilities for the State of Arizona. Major tasks and equipment acquisitions are outlined in the balance of this plan.

One of the first major tasks is the development of an interim Landsat capability on the ADOT Amdahl computer. This capability is required to meet immediate and ongoing needs of the Department of Water Resources and the State Land Department.

Succeeding tasks in the plan call for the development of Geographic Information Systems and modeling capabilities on a dedicated Data General Eclipse Minicomputer. Such a dedicated system is required because of the interactive nature of geographic information system processing, and the many specialized peripheral devices required to support this capability.

The Information Resources Division of SLD currently has the basic computer hardware configuration required for INFORM. However, it was the judgment of the Resource Team that ADOT would be more capable of implementing the system. The team, therefore, recommends that the IRD computer be physically transferred to ADOT at the beginning of the 1982 fiscal year.

The resources required to support this plan represent a 20% increase over the FY 79 ARIS budget (including a 10% annual inflation adjustment). The redirection of efforts and enhanced staff capabilities proposed in this plan will provide the State with significant, sophisticated capabilities for analyzing land resource characteristics. As the system becomes operational, some services may be charged to users through a revolving fund. This could provide a source of income to help finance future system activities. The

capabilities of the system will greatly increase the amount and quality of resource data available to legislative and executive policymakers, offer significant assistance to State and local resource managers, and provide resource planners with the capability to model the impacts of alternative resource development scenarios.

This effort represents a significant undertaking and a substantial commitment on the part of the State. In the judgment of the Team, the benefits accruing to future generations of Arizonans, however, more than outweigh the costs.

## SUMMARY OF MAJOR RECOMMENDATIONS

1. The Arizona Legislature should take action to provide a broad mandate to implement INFORM as a new program in FY 82.
2. ADOT should implement the INFORM program, as outlined in this document.
3. An Interagency Guidance Committee chaired by ADOT and composed of representatives of the eight primary user agencies should be formed immediately to oversee the INFORM program.
4. The IRD program, with the exception of the Survey and Mapping Section, should be phased out.
5. The SLD/IRD computer should be transferred to ADOT.
6. The hardware and software of the system will need to be upgraded over time.
7. New personnel, with suitable qualifications to implement INFORM, should be hired by ADOT to staff the program.
8. Extensive recruitment for a systems manager should be anticipated.
9. A number of disciplinary teams should be formed to recommend to the guidance committee the capabilities and services they need.
10. The INFORM program should be initially staffed with six FTEs (full-time equivalent employees) and with eight FTEs in subsequent years. Computer equipment and related expenditures are estimated to be $116,500 for fiscal year 1981-82 with $94,000 and $46,000 suggested for the next two fiscal years. It will be necessary for ADOT management and budget analysts to prepare an actual budget that includes all operating expenses.

# I. BACKGROUND AND INTRODUCTION

## 1.1 BACKGROUND

In January 1980, the Arizona Auditor General's Office initiated a performance evaluation of the State Land Department's (SLD) Arizona Resource Information System (ARIS). This capability is housed within SLD's Information Resources Division. The audit was conducted in response to a July 19, 1979 resolution of the Joint Legislative Budget Committee.

In carrying out the evaluation of ARIS, the Senior Project Manager of the National Conference of State Legislatures' (NCSL) Natural Resource Information Systems (NRIS) Project provided technical assistance at the request of the Auditor General's Office. His function was to describe the ARIS hardware, software and data base, and evaluate its operational status. The report he submitted following this evaluation is contained in Appendix I-A.

The overall assessment of the ARIS computer system (as of March 12, 1980) was that:

> "ARIS, through a variety of circumstances, has developed a fairly sophisticated computer hardware configuration. System software, however, is in a rudimentary, developmental stage. Current software can, for the most part, be characterized as simple record-keeping routines.
>
> Based on demonstrations observed, there currently appears to be little software operational on the system...."

Further, with respect to the five applications currently operational on the system, the NRIS Senior Project Manager wrote:

> "These applications do not justify the current sophisticated configuration. They could be very easily supported on a time-share

administrative computer, although conversion to another computer system might be expensive and time consuming...."

The Senior Project Manager suggested that further technical assistance could be provided to the State of Arizona, if desired. In cooperation with the Council of State Planning Agencies, he proposed the formation of a resource team of persons with backgrounds in state geographic information systems to redesign and redirect ARIS, as requested, at no charge to the State. A team of individuals would be selected based on affiliation with various state governments, the National Aeronautics and Space Administration (NASA), the U.S. Geological Survey and universities.

## 1.2 REQUEST FOR TECHNICAL ASSISTANCE

Less than five months after the release of the Performance Audit of ARIS, the Joint Legislative Budget Committee requested additional technical assistance from the National Conference of State Legislatures. Specifically, they asked that the Resource Team proposed in March be formed, and that this Team assess needs, development of a system, and consideration of institutional factors for a natural resource information system for Arizona State government.

The "Agreement for Technical Assistance Services" is contained in Appendix I-B. Two service providers and three Arizona State agencies were parties to the agreement:

- Service providers:
  - National Conference of State Legislatures, represented by staff of the Natural Resource Information Systems Project; and
  - Council of State Planning Agencies (CSPA), represented by staff of the Earth Resources Data Project.

- Arizona State Agencies: - Office of the Auditor General;
  - Arizona Department of Administration (DOA), Data Processing Division; and
  - State Land Department.

The objectives of the technical assistance services were three-fold:

1. Develop and implement a survey instrument to identified potential users of a natural resource information system. Analyze the needs of these potential users and rank their needs in order of priority.
2. Specify and recommend manual and/or automated natural resource information system(s) to meet the data needs of natural resource agencies.
3. Analyze and recommend appropriate institutional (State agency) arrangements, if necessary, for implementation of the systems designed.

The Resource Team of ten members having expertise in state information systems was selected jointly by staff of NCSL and CSPA. In addition to the service providers, it included individuals currently or previously affiliated with state governments (California, Georgia, Minnesota, North Dakota, South Dakota and Texas), a university, U.S. Geological Survey, and NASA. These individuals were assigned to Task Forces as follows:

- <u>User Needs Task Force</u>

  Coordinator: Loyola M. Caron - NCSL NRIS Project, Staff Associate
  Timothy Hays - California Environmental Data Center
  David Peterson - NASA/Ames Research Center

- Systems and Software Task Force

  Coordinator: Paul A. Tessar - NCSL NRIS Project, Senior Project Manager

  Nickolas L. Faust - Georgia Institute of Technology

  Thomas R. Loveland - Technicolor Graphic Services, Inc., EROS Data Center

  William J. Todd - Technicolor Graphic Services, Inc., NASA/Ames Research Center

- Institutional Arrangements Task Force

  Coordinator: Peggy Harwood - Council of State Planning Agencies, Associate Director for Resource Information and Technology

  John Wilson - Texas Natural Resources Information System

  Don Yaeger - Minnesota Land Management Information Center

The time spent by these ten individuals during July, August, September and October, 1980, represents over six person months of effort. During this time, the Task Force members reviewed and evaluated the existing status of Arizona needs, systems and software, and institutional settings, and evaluated and recommended an appropriate framework for a natural resource information system in light of their findings. These findings and recommendations are reported in this document.

## 1.3 OVERVIEW

Chapter II contains a summary of user needs. This section documents data needs of 14 Arizona state entities and one regional user, based on interviews and surveys of staff during a two-week period. Although preliminary in nature, the findings support the great need by Arizona State entities for data coordination, central access and analytic capabilities for natural resource data.

Five technical data processing and user-support entities are evaluated in Chapter III. Those agencies are the Department of Water Resources, State Land Department, Department of Transportation, University of Arizona, and Department of Administration.

Chapter IV reviews criteria for a natural resource information system, and summarizes the existing institutional settings of four candidate agencies suggested as potential hosts for such a system. Agencies examined are: Department of Water Resources, State Land Department, Department of Transportation, and the University of Arizona.

Finally, Chapters V and VI recommend an appropriate institutional framework for an Arizona Information Network For Operational Resource Management (INFORM) System, and present a plan for implementing the System. It is recommended that INFORM be housed in the Arizona Department of Transportation.

# II. PRELIMINARY SURVEY OF USER NEEDS

## 2.1 INTRODUCTION

This report summarizes the results of a two-week effort by the User Needs Task Force of the Resource Team to assess natural resource and related data needs by Arizona State agencies. The objectives of the user needs assessment (from the Agreement for Technical Assistance Services dated August 7, 1980) are to:

> "Develop and implement a survey instrument to identified potential users of a natural resource information system. Analyze the needs of these potential users and rank their needs in order of priority based on any statutory mandate and frequency of demand for particular data products. Included would be the needs for aerial photography and satellite images and their interpretation, as well as manual or automated geographically based data systems."

The purpose of this survey was not to duplicate past efforts to quantify data needs and products of individual organizations, such as the "State Information Handbook: An Inventory of Users and Producers of Data and Maps in Arizona;" "A General Annotated Bibliography of Arizona Land Use and Resource Information;" and "Information References: Land and Natural Resource Planning." Rather, the purpose of the survey was to acquire specific details characterizing the types of data used or produced, and to summarize those needs for all participating agencies. The intent is to derive the capabilities a natural resource information system would need in order to

accommodate the range of desired products. (For example, is it necessary for the system to handle map data? If so, should the system be designed to convert one geographic reference system to another? Should the system have map compositing capabilities?) One way to obtain this information is to establish what the agencies have in common.

Because the survey was carried out by one individual during a two-week time period, it must be stressed that any conclusions reported are preliminary in nature. Not only was the time short, but the two-week window also happened to occur at the same time that many agencies were in the midst of preparing budgets for the following year. Although most agencies were very cooperative in the user survey effort, many simply did not have the time to dedicate to completing the forms in time to be useful for this report.

## 2.2 METHODOLOGY

The User Needs Task Force was composed of the following members:

| | | |
|---|---|---|
| Coordinator: | Loyola M. Caron | - National Conference of State Legislatures, Natural Resource Information Systems Project ) |
| | Timothy Hays | - California Environmental Data Center |
| | David Peterson | - NASA/Ames Research Center |

2.21 Development of a Survey Instrument. Prior to the first meeting of this Task Force in Phoenix (August 18-22, 1980), the coordinator reviewed existing user-needs surveys used by state and federal agencies to determine if a survey format was available that would meet the requirements of the Auditor General's Office: "The user-need study will include at least all those areas to be considered that were identified on page 21 of 'A Performance Audit of the Arizona Resource Information System.' These variables included:

- Data collected and needed,
- Local and State uses of the data,
- Private sector uses of data,
- Data collection procedures,
- Coverage needed,
- Frequency updates needed,
- Scale needed,
- Statistical reports or other products,
- Storage at the agency, and
- Personnel and funds devoted to data accumulation."

A survey developed by the U.S. Fish and Wildlife Service's Western Energy and Land Use Team appeared to fulfill the objectives, once minor modifications were made.* The coordinator distributed copies of the revised survey to the other task force members for review prior to their first meeting.

During the week of August 18-22, the User Needs Task Force again revised the survey instrument. A draft was then circulated to the State Land Department and the Department of Administration (participants in the Agreement for Technical Assistance Services) for review and comment.

*"User Needs Assessment Forms for an Operational Geographic Information System within the U.S. Fish and Wildlife Service, Region Six, Report 1.3," by Larry Salmen, James Gropper, John Hamill, George Nez, and Carl Reed. Information Systems Technical Laboratory, Federation of Rocky Mountain States, Inc. FWS/OBS-77/002; March, 1977.

Finally the survey instrument was field tested on three programs:

- State Land Department - Forestry Division
- Department of Water Resources
- Office of Economic Planning and Development - Planning Division

The field tests indicated that, in order for the survey to be successful, a strategy for presenting the survey had to be developed. For example, the interviewees must be given sufficient advance notice so that they can gather appropriate materials necessary for the survey. Further, it was evident that unless the participants were willing to set aside a block of time to devote to the survey forms, the desired overall assessment of state agency needs could not be accomplished.

Following the field tests, the survey forms were again revised to eliminate problem areas, and a set of definitions was prepared to define terms used in the forms. The final draft was sent to the State Land Department, Department of Administration, and Auditor General's Office for review and comment. All three entities accepted the survey as submitted. Copies of the survey and definitions are contained in Appendix II-A.

2.22 Implementation of the Survey. State agencies and other organizations to be included in the survey had been selected some weeks in advance by the Task Force Coordinator in consultation with the Auditor General's Office and the coordinators of the Systems and Institutional Arrangements Task Forces. (See Section 2.3, Arizona Entities Selected for User Survey.) Letters informing heads of those organizations about the Agreement for Technical Assistance Services and its purpose were sent by the Auditor General's Office. Agencies were asked to identify a liaison who could convey that entity's natural resources needs, and who would be available for participating in the survey.

The survey of needs was carried out during the weeks of August 25 through September 5 by the coordinator of the User Needs Task Force. Follow-up letters were sent to each liaison, together with copies of the user survey forms and definitions. This letter also offered suggestions for preparing relevant materials for the upcoming interview.

Because there were some 25 state and federal agencies identified as users and producers of natural resources data in Arizona, the strategy for conducting the survey was to meet with as many liaisons as soon as possible during the first week, essentially to orient them to the survey procedure. Each interview took anywhere from one to three hours, depending on the complexity of their data needs and their understanding of information systems development requirements. Additional agencies were contacted during the second week, and follow-up meetings held as necessary.

## 2.3 ARIZONA ENTITIES SELECTED FOR USER SURVEY

Fourteen Arizona state agencies, six Councils of Governments, and four federal agencies were selected to be surveyed for natural resource data needs. These entities and the liaisons chosen to represent them are identified in Table II-1.

Table II-1.

Arizona Entities Selected For User Survey

| ENTITY | LIAISON | TITLE |
|---|---|---|
| Radiation Regulatory Agency | Polly Gallardo | Administrative Services Officer |
| Office of Economic Planning and Development | Patricia Bergthold | Planner |
| Emergency Services | L.E. Fitzgerald<br>Dick Lockwood (Alt.) | |
| Game and Fish Department | John Carr | Planning Branch Supervisor |
| Department of Health Services | Dean Moss | |
| State Land Department | Bob Lane | Deputy Commissioner |
| Bureau of Geology and Mineral Technology (Univ. of Arizona) | Dr. Larry D. Fellows | State Geologist |
| Oil and Gas Conservation Commission | W.E. Allen<br>Don Whittaker (Alt.) | Executive Secretary |
| Outdoor Recreation Coordinating Commission | Mary Alice Bivens | State Liaison Officer |
| State Parks Board | Mike Pastika | Chief, Administrative Services |
| Department of Revenue | Jane Gresham | Research & Statistical Analyst |
| | Harold Scott | Assistant Director-Property & Special Tax |
| Department of Transportation | Louis Schmitt | Asst. Deputy Director - Planning |
| | Carl Winikka (Alt.) | Asst. State Engineer |
| Department of Water Resources | Tom Carr | |
| Agriculture & Horticulture Commission | James R. Carter | Director |

Table II-1 (Continued)

| ENTITY | LIAISON | TITLE |
|---|---|---|
| Maricopa Association of Governments | Tom Ford | Division Manager, Transportation |
| | Mark Frank | MAG 208 Coordinator |
| Pima Association of Governments | Jesse B. Brown | Physical Planning Manager |
| Northern Arizona Council of Governments | William T. Towler | Environmental Planner |
| District IV Council of Governments | Brian Babiars | Deputy Director |
| Central Arizona Association of Governments | Lester Snow | Regional Planning Director |
| Southeastern Arizona Association of Governments | Richard Francaviglia | |
| Bureau of Land Management | Paul Lance | Information Systems Manager for BLM-Arizona |
| Agriculture Stabilization and Conservation Service | Deferred to Soil Conservation | |
| Forest Service | Evan L. "Butch" Summers | Staff Dir., Computer Systems (Albuquerque) |
| | William C. Troxel | Staff Dir., Area Planning & Develop. |
| | Richard G. Krebill | Research Dir., Asst. Dir., ASU |
| Soil Conservation | Douglas S. Pease | State Soil Scientist |
| U.S. Geological Survey - Water Resources Division | Fred Boner | Operations Officer, Tucson, AZ |

## 2.4 ARIZONA ENTITIES SURVEYED

Because of the limited time available to implement the user needs instrument, not all of the entities selected to participate in the study were surveyed. Table II-2 lists the fifteen organizations that were actually involved in the assessment of needs. Interviewees and dates of contact are also included. Note that, in the interest of state needs, all state agencies with one exception were interviewed to some extent.

## 2.5 ORGANIZATIONS THAT SHOULD BE SURVEYED

Table II-3 lists Arizona State agencies, Councils of Governments and federal agencies that should be surveyed in the future, perhaps by information systems staff (provided Arizona decides to support development of a statewide system). In addition to those entities originally selected for participation in the user needs survey but not contacted due to lack of time, this table also includes other divisions of previously surveyed agencies that merit "looking in to," and entities suggested by state employees as being important data users and/or producers.

## 2.6 DATA NEEDS

This section summarizes the results of the interviews and surveys completed by participating organizations. Each factor relating to required characteristics of data sources and products is briefly reviewed.

Surveys were completed by the following agencies (See Appendix II-B):

- Department of Health Services
- State Land Department/Information Resources
  - /Urban and Commercial Development
  - /Forestry
  - /Natural Resources

Table II-2

Arizona Organizations Surveyed

August 25 - September 5, 1980

| ORGANIZATION | DIVISION | INTERVIEWEE(S) | DATE (S) |
|---|---|---|---|
| Agriculture and Horticulture Commission | | James R. Carter | 9/2/80 |
| Office of Economic Planning and Development | Planning Division<br>*--Policy Analysis<br>--Research<br>--Community Affairs | Patricia Bergthold<br>Eric Rasmussen<br>Jeff Fairman | 8/21/80; 8/27/80<br>8/27/80<br>8/28/80 |
| Game and Fish Department | Wildlife Management<br>--Planning and Evaluation Branch | John Carr--Planning Branch Supervisor | 9/2/80 |
| Department of Health Services | Environmental Health Services | Dean Moss | 8/26/80; 9/3/80 |
| State Land Department | Commissioner's Office | Bob Lane--Deputy Commissioner | 8/26/80 |
| | Information Resources<br>--Cartography Information<br>--Survey and Mapping | Mike Castro--Director<br>Bob Hesse--<br>Don Stinard-- | 8/28/80<br>9/3/80<br>8/28/80 |
| | Urban and Commercial Development<br>--Appraisal<br>-- | Ross Smith--Director<br>W. Fish--<br>Marci Ziesel-- | 8/29/80<br>8/29/80<br>8/29/80; 9/2/80 |

* Test case - interviewed to test user survey instrument.
**Surveys completed through direction of R. Yount, Natural Resources Conservation Section.

Table II-2. (cont.)

| ORGANIZATION | DIVISION | INTERVIEWEE(S) | DATE(S) |
|---|---|---|---|
| (State Land Department, Cont.) | *Forestry<br>--Fire Management | Mike Hart--Deputy Forester<br>Bruce DeVault | 8/20/80; 8/28/80<br>8/20/80 |
| | Natural Resources<br>--Natural Resources Conservation<br>--Range<br>--Minerals<br>--Hydrology | R. Yount<br>R. Oxford**<br>R. Brenner**<br>W. Allen; R. Young | 8/26/80; 8/28/80<br><br><br>8/26/80; 9/2/80 |
| Oil and Gas Conservation Commission | | W.E. Allen--Executive Secretary | 8/25/80 |
| Outdoor Recreation Coordinating Commission | Planning Office | Mary Alice Bivens--State Liaison Officer | 9/4/80 |
| State Parks Board | Administrative Services | Mike Pastika--Chief | 9/5/80 |
| Radiation Regulatory Agency | | Polly Gallardo--Administrative Services Officer | 8/29/80 (Telephone) |
| Department of Revenue | Property and Special Tax | Jane Gresham--Research and Statistical Analyst | 9/3/80 |
| Department of Transportation | Highways<br>--Environmental Planning Services | Carl Winneka<br>James Smith | 8/29/80 |

* Test case - interviewed to test user survey instrument.
**Surveys completed through direction of R. Yount, Natural Resources Conservation Section.

Table II-2. (cont.)

| ORGANIZATION | DIVISION | INTERVIEWEE(S) | DATE(S) |
|---|---|---|---|
| Department of Transportation (continued) | Transportation Planning --Demography and Land Use Section | Louis Schmitt<br>Art Auerbach--Supervisor, Demography and Land Use | 8/27/80<br>8/27/80; 9/2/80 |
| *Department of Water Resources | | Tom Carr | 8/21/80; 8/29/80 |
| Maricopa Association of Governments | Transportation<br>Water Quality | Tom Ford--Division Manager<br>Mark Frank--208 Coordinator | 9/5/80<br>9/5/80 |
| Southeastern Arizona Governments Organization | | Roger Manning--<br>Richard Francaviglia-- | 8/27/80<br>8/29/80<br>(Telephone) |
| Bureau of Geology and Mineral Technology--University of Arizona | Geological Survey Branch | Dr. Larry D. Fellows--State Geologist | 8/25/80 |

*Test case - interviewed to test user survey instrument.

Table II-3.

Organizations That Should Be Surveyed

State

Arizona Corporation Commission

Department of Tourism

Department of Real Estate/Insurance

Arizona Department of Transportation
- -Environmental Planning Services *
- -Material Services

Department of Economic Security
- -Planning Bureau

Game and Fish Department
- -Field Operations Division
- -Wildlife Management Division, Research Branch, Game Branch and Fisheries Branch

Department of Mineral Resources

State Land Department
- -Contracts and Records

Office of Economic Planning and Development*
- -(for work being done with remote subdivisions)

Department of Revenue *

Regional

Pima Association of Governments (PAG)

Northern Arizona Council of Governments (NACOG)

District IV Council of Governments

Central Arizona Association of Governments (CAAG)

Federal:

Bureau of Land Management
U.S. Forest Service
Soil Conservation
U.S. Geological Survey
- -Water Resources Division (Tucson)

U.S. Fish and Wildlife Service

*Briefly interviewed - need further evaluation.

- Outdoor Recreation Coordinating Commission
- Department of Transportation
- Department of Water Resources
- Southeastern Arizona Governments Organization (SEAGO)

Several other organizations participated in the study. However, staff were unable to complete the survey forms for this report. Summaries of the interviews with the liaisons for those organizations are included in Appendix II-C.

## 2.61 Characteristics of Data Sources/Products

The following is a brief summary of the characteristics of data sources and products required by Arizona State entities, as determined from surveys and interviews.

- Source Format - The most common source formats are reports, maps, tables/charts, and field notes. Other formats used include surveys, key-punched cards, tapes, disks, aerial photography and Landsat. (See Table II-4.)

- Product Format - The most common product formats are reports, maps, tables and charts. Several agencies also rely heavily on microfiche, tapes and disks. Models are used less frequently. (See Table II-5.)

- Scale or Resolution - Requirements call for virtually any scale, from 1" = 200' to 1:1,000,000, depending on the application.

- Geographic Reference System - The Public Land Survey (Township, Range, Section) is the most predominantly used reference system in Arizona, followed by Latitude/Longitude. Most agencies also access and produce data by county name and point location name (e.g. facility, well number, etc.). Names of regions, basins, watersheds, streams and various types of management units or districts are also commonly used. (See Tables II-6 and 7.)

- Currency of Data (Source) - Needs vary from real-time (e.g. air quality data) to 10 years or more (e.g. geology, soils).

- Updating Requirements (Product) - Vary from daily to not at all. Most common update time period was one year (for use in annual managing and planning functions).

- Geographic Coverage - Ranges from site specific (e.g. cultural sites, wells, stream guages) to statewide.

- Access Restrictions - A natural resource information system would have to accommodate varying degrees of security requirements:
  -- Restricted to in-house use only (e.g. information obtained from landowners, mining companies);
  -- Partially restricted: available to state agencies, and possibly others (e.g. cultural site data, rare and endangered species, cacti and reptiles);
  -- Non-restricted: no security requirements for the data.

- Precision - Varies from one foot to within a quarter section. Most stringent requirements are by the State Land Department's Survey and Mapping Section (for plats).

- Time Constraints - Vary from daily (e.g. emergency episodes) to within the time frame of a project (usually one or two years).

- Analysis Capabilities - Most agencies routinely perform area calculations, aggregations, statistics, transfer of data to maps, and overlaying of maps to derive composite information. Several agencies also handle aerial photography. Development of models and the need to do engineering calculations are required less frequently, but are extremely important where used. (See Table II-8.)

- Costs for Data Accumulation - Because these costs are typically absorbed into various line items, very few agencies completed this part of the survey forms. Therefore, no evaluation can be made.

## 2.62 Data Needs by Category

This section summarizes the categories of data that are required by natural resource research, planning and management entities. Uses, users, data types, existing systems, and typical output report titles are considered for each of the following general categories of data:*

- Air Quality (includes meteorological aspects)

* These categories are not meant to be of equal rank or weight.

- Animals (includes game and fish, insects, livestock, etc.)
- Cultural Data (Historical/Archaeological)
- Geologic Framework
- Land Use
- Land Ownership Type - public land ownership
- Social and Economic Data (demographics, economics, etc.)
- Soils
- Vegetation
- Water

Table II-9 presents an overview of data needs for all participating agencies, by category. Pages II-22 through II-34 contain detailed information for each of these categories.

Table II-4.

| ORGANIZATION \ CATEGORY | SOURCE FORMAT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | REPORT | MAP | TABLES/ CHARTS | FIELD NOTES | SURVEYS | PUNCHED CARDS | TAPE | DISK | MICRO-FICHE | AERIAL PHOTOS | LANDSAT |
| 1/ Agriculture and Horticulture Commission | X | X | X | X | | | | | | | |
| 1/ Office of Economic Planning and Development | X | X | X | X | | | | | | | |
| 1/ Game and Fish Department | X | X | X | X | X | | | | | X | |
| 2/ Department of Health Services | X | X | X | X | | X | X | X | | X | |
| 2/ State Land Department/ IRD - Cartography | X | X | | | | | | | X | X | X |
| 2/ State Land Department/ IRD - Survey and Mapping | X | X | | X | | | | | X | X | |
| 2/ State Land Department/ Urban and Commercial | X | X | X | X | | | | | | | |
| 2/ State Land Department/ Forestry | X | X | X | X | X | | X | X | | X | X |
| 2/ State Land Department/ NR - Nat'l Res. Comm. | X | X | X | X | X | | X | | X | X | |
| 2/ State Land Department/ NR - Minerals | X | X | X | X | | | X | | ? | X | |
| 2/ State Land Department/ NR - Range | X | X | X | X | | | X | | ? | X | |
| 1/ State Land Department/ NR - Hydrology | X | X | X | X | | | X | | ? | X | |
| 1/ Bureau of Geology and Mineral Technology | X | X | X | X | | X | | | | X | |
| 2/ Oil and Gas Conservation Commission | X | X | X | X | | | | | | | |
| 2/ Outdoor Recreation Coordinating Commission | X | X | X | ? | | | | | | ? | |
| 1/ State Parks Board | X | X | X | X | | | | | | X | |
| 2/ Dept. of Transportation/ Planning | X | X | X | X | X | X | X | X | X | X | X |
| 1/ Dept. of Transportation/ Highways | X | X | X | X | X | X | X | X | X | X | X |
| 2/ Department of Water Resources | X | X | X | X | X | | X | | | X | X |
| 1/ Maricopa Association of Governments | X | X | X | X | | | | | | X | |
| 2/ Southeastern Arizona Govts Organization | X | X | X | ? | | | X | | | X | |

? = Anticipate use of this source in the future.
X = Source currently used.

1/ Based on materials supplied by the agency, and/or inferences drawn through the interview process.

2/ Based on completed survey forms.

Table II-5.

| CATEGORY / ORGANIZATION | PRODUCT FORMAT | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | REPORT | MAP | TABLES/ CHARTS | MICRO-FICHE | TAPE | DISK | MODEL | OTHER |
| 1/ Agriculture and Horticulture Commission | X | X | X | | | | | |
| 1/ Office of Economic Planning and Development | X | X | X | | | | X | |
| 1/ Game and Fish Department | X | X | X | | | | | |
| 2/ Department of Health Services | X | X | X | | X | | | |
| 2/ State Land Department/ IRD - Cartography | X | X | | X | | | | |
| 2/ State Land Department/ IRD - Survey and Mapping | X | X | | | | | | |
| 2/ State Land Department/ Urban and Commercial | X | X | | | | | | |
| 2/ State Land Department/ Forestry | X | X | X | | X | X | X | |
| 2/ State Land Department/ NR - Nat'l Res. Comm. | X | X | X | X | X | X | X | |
| 2/ State Land Department/ NR - Minerals | X | X | X | X | X | X | | |
| 2/ State Land Department/ NR - Range | X | X | X | X | X | X | | |
| 2/ State Land Department/ NR - Hydrology | X | X | X | X | X | X | X | |
| 1/ Bureau of Geology and Mineral Technology | X | X | X | | | | | |
| 1/ Oil and Gas Conservation Commission | X | X | X | | | | | |
| 2/ Outdoor Recreation Coordinating Commission | X | X | X | | | | | |
| 1/ State Parks Board | X | X | X | | | | | |
| 2/ Dept. of Transportation/ Planning | X | X | X | | | | | |
| 1/ Dept. of Transportation/ Highways | X | X | X | | X | X | | |
| 2/ Department of Water Resources | X | X | X | | X | X | X | |
| 1/ Maricopa Association of Governments | X | X | X | | | | | |
| 2/ Southeastern Arizona Govts Organization | X | X | X | | | | | |

X = Product Format currently used.

1/ Based on materials supplied by the agency, and/or inferences drawn through the interview process.

2/ Based on completed survey forms.

Table II-6.

| ORGANIZATION \ CATEGORY | GEOGRAPHIC REFERENCE SYSTEM (SOURCE) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TWNSHP/ RANGE | LAT/ LONG | ST. PL. COORD. | UTM | PT. LOC NAME | TWNSHP NAME | COUNTY NAME | REGION NAME | BASIN NAME | WATER-SHED | STREAM NAME | STREAM NAME | OTHER |
| 1/ Agriculture and Horticulture Commission | X | | | | | | X | | | | | | |
| 1/ Office of Economic Planning and Development | X | | | | | | X | | | | | | |
| 1/ Game and Fish Department | X | | | | | | X | X | | | X | | Game Mgmt Unit |
| 2/ Department of Health Services | X | X | | | X | | X | | X | X | X | X | |
| 2/ State Land Department/ IRD - Cartography | X | X | X | X | | | X | | | | | | Flt. Index Quad, etc. |
| 2/ State Land Department/ IRD - Survey and Mapping | X | X | X | | X | X | X | | | | | | Quadrangle |
| 2/ State Land Department/ Urban and Commercial | X | X | | X | X | X | X | X | X | X | X | X | |
| 2/ State Land Department/ Forestry | X | | | | | | X | | | | | | |
| 2/ State Land Department/ NR - Nat'l Res. Comm. | X | X | | | | | X | | | | | | |
| 2/ State Land Department/ NR - Minerals | X | X | | | | | X | | | | | | |
| 2/ State Land Department/ NR - Range | X | X | | | | | X | | | | | | |
| 2/ State Land Department/ NR - Hydrology | X | X | | | | | X | | X | | X | | |
| 1/ Bureau of Geology and Mineral Technology | X | | | | | | X | | | | | | |
| 1/ Oil and Gas Conservation Commission | X | | | | | | X | | | | | | Quadrangle |
| 2/ Outdoor Recreation Coordinating Commission | X | | | | | | X | | | | X | | |
| 1/ State Parks Board | X | | | X | X | | X | | | | X | | |
| 2/ Dept. of Transportation/ Planning | X | | X | X | X | | X | X | | | X | | ADOT Dists |
| 1/ Dept. of Transportation/ Highways | X | | X | X | X | | X | | | | X | | ADOT Dists |
| 2/ Department of Water Resources | X | X | | | X | | X | | X | X | X | X | AMAs |
| 1/ Maricopa Association of Governments | X | | | | X | | X | X | | | X | | |
| 2/ Southeastern Arizona Govts Organization | X | | | | X | | X | X | | | X | | |

X = Geographic Reference System currently used.

1/ Based on materials supplied by the agency, and/or inferences drawn through the interview process.

2/ Based on completed survey forms.

Table II-7.

| ORGANIZATION \ CATEGORY | GEOGRAPHIC REFERENCE SYSTEM (PRODUCT) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TWNSHP/ RANGE | LAT/ LONG | ST. PL. COORD. | UTM | PT. LOC. NAME | TWNSHP NAME | COUNTY NAME | REGION NAME | BASIN NAME | WATER-SHED | STREAM NAME | STREAM MILE | OTHER |
| 1/ Agriculture and Horticulture Commission | X | | | | | | X | | | | | | |
| 1/ Office of Economic Planning and Development | X | | | | | | X | | | | | | |
| 1/ Game and Fish Department | X | | | | | | X | X | | | X | | Game Mgmt Unit |
| 2/ Department of Health Services | X | X | | | X | | X | | X | X | X | | |
| 2/ State Land Department/ IRD - Cartography | X | X | X | X | | | X | X | X | X | | | Quadrangle |
| 2/ State Land Department/ IRD - Survey and Mapping | X | X | X | | X | X | X | | | | | | |
| 2/ State Land Department/ Urban and Commercial | X | | | | | | X | | | | | | |
| 2/ State Land Department/ Forestry | X | X | | X | X | X | X | X | X | X | X | X | |
| 2/ State Land Department/ NR - Nat'l Res. Comm. | X | X | | | | | X | | | | | | |
| 2/ State Land Department/ NR - Minerals | X | X | | | | | X | | | | | | |
| 2/ State Land Department/ NR - Range | X | X | | | | | X | | | | | | |
| 2/ State Land Department/ NR - Hydrology | X | | | | | | X | | X | | X | | |
| 1/ Bureau of Geology and Mineral Technology | X | | | | | | X | | | | | | |
| 1/ Oil and Gas Conservation Commission | X | | | | | | X | | | | | | Quadrangle |
| 2/ Outdoor Recreation Coordinating Commission | X | | | | X | | X | | | | X | | |
| 1/ State Parks Board | X | | | X | X | | X | | | | X | | |
| 2/ Dept. of Transportation/ Planning | X | | X | X | X | | X | X | | | X | | ADOT Dist. |
| 1/ Dept. of Transportation/ Highways | X | | X | X | X | | X | | | | X | | ADOT Dist. |
| 2/ Department of Water Resources | X | X | | | X | | X | | X | X | X | | AMAs |
| 1/ Maricopa Association of Governments | X | | | | X | | X | | | | | | |
| 2/ Southeastern Arizona Govts Organization | X | | | | X | | X | | | | | | |

X = Geographic Reference System currently used.

1/ Based on materials supplied by the agency, and/or inferences drawn through the interview process.

2/ Based on completed survey forms.

Table II-8.

| ORGANIZATION \ CATEGORY | ANALYSIS PERFORMED | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | AREA CALCULA-TIONS | AGGREGA-TIONS | STATIS-TICS | PHOTO INTERP. | TRANS. DATA TO MAPS | OVERLAY | MODELS | ENGIN. CALCULA-TIONS | DRAFT-ING |
| 3/ Agriculture and Horticulture Commission | | | | | | | | | |
| 1/ Office of Economic Planning and Development | X | X | X | X | X | X | X | | X |
| 3/ Game and Fish Department | | | | | | | | | |
| 2/ Department of Health Services | X | | | X | X | | | | |
| 2/ State Land Department/ IRD - Cartography | | X | | | | X | | | |
| 2/ State Land Department/ IRD - Survey and Mapping | X | X | | X | X | X | | X | X |
| 2/ State Land Department/ Urban and Commercial | X | X | X | X | X | X | | | X |
| 2/ State Land Department/ Forestry | X | X | X | X | X | X | X | | X |
| 2/ State Land Department/ NR - Nat'l Res. Comm. | X | X | X | X | X | X | X | | |
| 2/ State Land Department/ NR - Minerals | X | X | X | X | X | X | | | |
| 2/ State Land Department/ NR - Range | X | X | X | X | X | X | | | |
| 3/ State Land Department/ NR - Hydrology | X | X | X | X | X | X | | | |
| 3/ Bureau of Geology and Mineral Technology | | | | | | | | | |
| 2/ Oil and Gas Conservation Commission | | | | | | | | | |
| 3/ Outdoor Recreation Coordinating Commission | X | X | X | | X | X | | | |
| 2/ State Parks Board | | | | | | | | | |
| 1/ Dept. of Transportation/ Planning | X | X | X | X | X | X | X | | X |
| 2/ Dept. of Transportation/ Highways | X | X | X | X | X | X | X | X | X |
| 3/ Department of Water Resources | X | X | X | X | X | X | X | | |
| 2/ Maricopa Association of Governments | | | | | | | | | |
| Southeastern Arizona Govts Organization | X | | | X | X | | | | |

X = Analysis currently performed.

1/ Based on materials supplied by the agency, and/or inferences drawn through the interview process.

2/ Based on completed survey forms.

3/ Information not available for this survey.

Table II-9.

| ORGANIZATION \ CATEGORY | DATA NEEDS BY MAJOR CATEGORY | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AIR QUALITY | ANIMALS | CULTURAL | GEOLOGY | LAND USE | OWNER-SHIP | SOCIAL/ ECONOMIC | SOILS | VEGE-TATION | WATER |
| 1/ Agriculture and Horti-culture Commission | | X | | | X | X | X | ? | X | X |
| 1/ Office of Economic Plan-ning and Development | | ? | X | ? | X | X | X | ? | ? | X |
| 1/ Game and Fish Department | ? | X | X | ? | X | X | X | X | X | X |
| 2/ Department of Health Services | X | X | | X | X | X | X | X | X | X |
| 2/ State Land Department/ IRD - Cartography | ---------- INTERACTS WITH ALL SECTIONS OF THE ---------- | | | | | | | | | |
| 2/ State Land Department/ IRD - Survey and Mapping | ---------- STATE LAND DEPARTMENT ---------- | | | | | | | | | |
| 2/ State Land Department/ Urban and Commercial | | | X | X | X | X | X | X | X | X |
| 2/ State Land Department/ Forestry | | X | | X | X | X | X | X | X | X |
| 2/ State Land Department/ NR - Nat'l Res. Comm. | | | | | X | X | X | X | X | X |
| 2/ State Land Department/ NR - Minerals | | | | X | X | X | X | | | |
| 2/ State Land Department/ NR - Range | | X | | | X | X | X | X | X | X |
| 2/ State Land Department/ NR - Hydrology | | | | X | X | X | X | ? | | X |
| 1/ Bureau of Geology and Mineral Technology | | | | X | X | X | X | X | X | X |
| 1/ Oil and Gas Conserva-tion Commission | | | | X | X | X | X | ? | | X |
| 2/ Outdoor Recreation Coor-dinating Commission | ? | X | X | X | X | X | X | X | X | X |
| 1/ State Parks Board | ? | X | X | X | X | X | X | X | X | X |
| 2/ Dept. of Transportation/ Planning | X | X | X | X | X | X | X | X | X | X |
| 1/ Dept. of Transportation/ Highways | X | X | X | X | X | X | X | X | X | X |
| 2/ Department of Water Resources | | ? | | X | X | X | X | X | X | X |
| 1/ Maricopa Association of Governments | ? | ? | ? | ? | X | X | X | X | X | X |
| 2/ Southeastern Arizona Govts Organization | ? | ? | ? | ? | X | X | X | X | X | X |

? = Anticipate use of this data type in the future.
X = Data type currently used.

1/ Based on materials supplied by the agency, and/or inferences drawn through the interview process.

2/ Based on completed survey forms.

AIR QUALITY (includes meteorologic aspects)

- Identified Uses of Data:

  - Compliance checking
  - Baseline monitoring
  - Trend evaluation
  - Air quality maintenance planning
  - Comparison against standards

- Identified Users:
  - Department of Health Services*
  - State Land Department (Forestry)
  - Department of Transportation
  - Local governments (includes COGs)

- Possible or Potential Users:

  - Game and Fish Department
  - Universities
  - Industry
  - Legislative bodies
  - Public
  - Federal agencies: Soil Conservation Service
    Bureau of Land Management

- Identification of Existing Systems in Arizona:

  - Department of Health Services' Monitoring Section operates the State Air Quality Monitoring (SLAMS) network of 46 stations and 60 instruments or monitoring devices; and the National Air Surveillance Network (NASN) stations, in Arizona.

- Data Types:

  - Air emission quality/quantity
  - Air quality data by parameter
  - Climatological data

- Output Report Titles:

  - Annual Strategy
  - Annual Report and Reasonable Futher Progress and Emission Inventory
  - Emergency Episode Reporting
  - State Implementation Plan Documentation
  - Environmental Assessments

*Primary data user.

ANIMALS

- Identified Uses of Data:

  - Impact assessment
  - Game and fish management planning
  - Site location evaluation
  - Range management
  - Eradication of pests

- Identified Users:

  - Game and Fish Department*
  - Outdoor Recreation Coordinating Commission*
  - State Parks Board*
  - Federal agencies: Fish and Wildlife Service*
    Bureau of Land Management
    Forest Service
  - Department of Health Services
  - State Land Department
  - Agriculture and Horticulture Commission
  - Universities

- Possible or Potential Users:

  - Department of Water Resources
  - Department of Transportation
  - Office of Economic Planning and Development
  - Local governments (includes COGs)
  - Public
  - Industry
  - Other federal agencies

- Data Types:

  - Rare, endangered, and threatened species
  - Distribution of fish and wildlife populations
  - Density of fish and wildlife populations
  - Wildlife habitat
  - Harvests of fish and game
  - Non-game animals (including insects)
  - Pest detection surveys

- Output Report Titles:

  - Strategic Plans for Big Game Animals and Fishes
  - Habitat Management Plans

*Primary data user.

CULTURAL DATA (HISTORICAL/ARCHAEOLOGICAL)

- Identified Uses of Data:

  - Identify existence of cultural values on lands to be sold or developed
  - Land use planning studies
  - Corridor analysis
  - Planning for federal projects

- Identified Users:

  - State Parks Board*
  - Nature Conservancy*
  - Outdoor Recreation Coordinating Commission*
  - Game and Fish Department
  - Office of Economic Planning and Development
  - Department of Transportation
  - Federal agencies: Bureau of Land Management
    Forest Service
  - Industry
  - Local governments (includes COGs)
  - Historical societies
  - State Land Department
  - Universities
  - Legislative bodies

- Data Types:

  - Descriptions and locations of all historical and archaeological data

- Identification of Existing Systems in Arizona:

  - University of Arizona's State Museum has initiated computerization of archaeological site data. Arizona State University also has computerized archaeological site data.

*Primary data user.

GEOLOGIC FRAMEWORK

- Identified Uses of Data:

  - Resource management planning
  - Construction planning
  - Site management
  - Mineral resources mapping
  - Permit application and monitoring
  - Urban planning
  - County/Regional planning
  - Statewide planning
  - Mineral leasing and management
  - Highway planning and construction
  - Mineral exploration and development
  - Recreation planning
  - Land use planning
  - Community assistance planning
  - Land assessment and valuation
  - Emergency service planning

- Identified Users:

  - Department of Mineral Resources*
  - Bureau of Geology and Mineral Technology*
  - Oil and Gas Conservation Commission*
  - Department of Water Resources*
  - State Land Department*
  - Department of Health Services
  - Department of Transportation
  - Outdoor Recreation Coordinating Commission
  - State Parks Board
  - Universities
  - Local governments (includes COGs)
  - Federal agencies
  - Industry
  - Emergency Services

- Possible or Potential Users:

  - Radiation Regulatory Agency
  - Office of Economic Planning and Development
  - Game and Fish Department

- Data Types:

  -Surficial material maps
  -Subsurface geology maps

*Primary data user

GEOLOGIC FRAMEWORK (continued)

- Data Types (continued):

  - Bedrock geology maps
  - Mineral resource maps
  - Major landforms
  - Topography
  - Mine files
  - Floodplain maps
  - Geologic hazard maps
  - Fault maps
  - Geologic cross sections
  - Earthquake epicenter maps
  - Paleontological data
  - Library of rock cuttings and cores

- Output Report Titles:

  - Field Notes (Quarterly Newsletter)
  - Geologic reports
  - Theses
  - Guidebooks to geology in specific areas along highways
  - Bibliographies of geology

LAND USE

- Identified Uses of Data:

  - Land use planning
  - Planning control of use
  - Industrial (and other facility) site planning
  - Determine potential for development
  - Community planning assistance
  - Water quality planning
  - Lease management: grazing/minerals/agricultural
  - Land assessment and valuation
  - Land use treatment needs

- Identified Users:

  - State Land Department*
  - Department of Water Resources*
  - Department of Transportation*
  - Local governments (includes COGs) *
  - Office of Economic Planning and Development
  - Game and Fish Department
  - Department of Health Services
  - Outdoor Recreation Coordinating Commission
  - State Parks Board
  - Federal agencies
  - Agriculture and Horticulture Commission
  - Industry
  - Universities
  - Legislative bodies

- Possible or Potential Users:

  - Radiation Regulatory Agency
  - Bureau of Geology and Mineral Technology
  - Oil and Gas Conservation Commission

- Data Types:

  - Land use classification maps
  - Inventories of: rangeland
    agricultural uses and patterns
    municipal/industrial uses
    flood plains
    mines
    mineral resources/occurrences
    known and potential geologic hazards
    seismicity
    young faults
    geologic features/land forms
    reservoirs
    wilderness areas
  - Intensity of land use
  - Aerial photography/orthophotoquads

*Primary data user.

LAND USE (continued)

- Output Report Titles:

  - Management Plans (e.g. State Highway System and State Airport System)
  - Updated Local Government Plans
  - Absentee Land Ownership Study
  - Report on Land Use and Airport Relationships
  - Farm and Ranch Conservation Plans
  - Construction Plans
  - Trespass, Misuse and Abuse Reports
  - Livestock Carrying Capacity Reports
  - Trust Lands Resource Reports
  - Annual Range Inventory Report
  - Mine Reclamation Plans
  - Statewide Inventory of State's Land and Natural Resources
  - State Lands Available for Sale or Lease

LAND OWNERSHIP (public land ownership)

- Identified Uses of Data:

  - Law enforcement
  - Site selection
  - Recreation needs identification and planning
  - Right-of-way planning
  - Urban planning
  - Route and corridor analysis

- Identified Users:

  - All state, federal and local units of government*
  - Public
  - Legislative bodies
  - Industry
  - Universities

- Data Types:

  - Land ownership: surface and subsurface
  - Lease status maps and data
  - New lease applications files
  - Sales and exchanges application files

- Output Report Titles:

  - State Trust Lands map - surface and subsurface
  - Bureau of Land Management maps - surface and subsurface
  - U.S. Forest Service maps
  - National Park Service maps
  - Indian Reservations
  - Game refuge maps

*Preliminary data user.

SOCIAL AND ECONOMIC DATA

- Identified Uses of Data:

  - Demographic description and projections
  - Planning
  - Needs assessment
  - Recreation needs identification and planning
  - Planning for health services
  - Law enforcement planning
  - Site selection
  - Local planning and technical assistance
  - Applications for zoning changes (county and city levels)

- Identified Users:

  - Department of Economic Security*
  - Department of Transportation*
  - Local governments (includes COGs)*
  - Office of Economic Planning and Development
  - Outdoor Recreation Coordinating Commission
  - State Parks Board
  - Department of Administration
  - Industry
  - Universities
  - Department of Water Resources
  - Department of Health Services

- Possible or Potential Users:

  - Most other state agencies and some federal agencies
  - Local communities (e.g. Chambers of Commerce)

- Data Types:

  - Population projections
  - Land parcel value

- Output Report Titles:

  - Community Profiles (updated yearly)
  - Monthly Report on Park Attendance
  - Transportation Plans
  - Numerous reports not well documented during this survey

*Primary data user.

SOILS

- Identified Uses of Data:

  - Land evaluation and assessment
  - Construction development planning
  - Development of management practices for soils (e.g. irrigation, grazing, etc.)
  - Reclamation development planning
  - Permit evaluation and monitoring
  - Vegetation production management (e.g. forests, crops, etc.)
  - Water quality planning

- Identified Users:

  - Department of Transportation*
  - Department of Health Services*
  - Game and Fish Department*
  - State Land Department*
  - Department of Water Resources*
  - Local governments (includes COGs)*
  - Federal agencies: Soil Conservation Service*
    Bureau of Land Management
    Forest Service
    Geological Survey
    Fish and Wildlife Service
  - Outdoor Recreation Coordinating Commission
  - State Parks Board
  - Universities
  - Industry

- Possible or Potential Users:

  - Agriculture and Horticulture Commission
  - Office of Economic Planning and Development
  - Bureau of Geology and Mineral Technology
  - Oil and Gas Conservation Commission
  - Department of Mineral Resources

- Data Types:

  - Soils maps (type, slope, etc.)
  - Soil erosion classification map
  - Soil capability
  - Soil characteristics (e.g. shrink and swell)

- Output Report Titles:

  - Soil Surveys

*Primary data user.

VEGETATION

- Identified Uses of Data:

  - Vegetation production management
  - Animal management planning
  - Land use planning
  - Reclamation development and monitoring
  - Recreation development
  - Evaluation of forest fuel levels

- Identified Users:

  - Game and Fish Department*
  - State Land Department*
  - Outdoor Recreation Coordinating Commission*
  - State Parks Board*
  - Agriculture and Horticulture Commission
  - Department of Health Services
  - Department of Transportation
  - Department of Water Resources
  - Local governments (includes COGs)
  - Industry
  - Universities
  - Federal agencies: Bureau of Land Management
    Fish and Wildlife Service
    Forest Service
    Soil Conservation Service

- Identification of Existing Systems in Arizona:
  - Arizona Heritage Program (sponsored by the Nature Conservancy) has a computer system for occurrences of plant species representative of Arizona flora.

- Data Types:

  - Vegetation classification maps
  - Distribution of vegetation
  - Wildlife habitat
  - Riparian vegetation communities
  - Density, age, condition, species composition, etc. of timber stands

- Output Report Titles:

  - "Digitized Classification System for the Biotic Communities of North America, with Series and Association Examples of the Southwest." (May, 1979. Published by Academy of Science.)
  - "Digitized Systematic Classification for Ecosystems with an Illustrated Summary of the Natural Vegetation of North America." (June, 1980. General Technical Report RM-73. Rocky Mountain Forest and Range Experiment Station).

*Primary data user.

WATER

- Identified Uses of Data:

  - Land management planning
  - Recreation development
  - Community and industrial development planning
  - Water quality planning
  - Determine grandfathered rights
  - Determine irrigation water duties
  - Adjudication of water rights
  - Flood control planning
  - Flood plain planning
  - Irrigation scheduling
  - Water resources conservation

- Identified Users:

  - Game and Fish Department*
  - Department of Health Services*
  - State Land Department*
  - Outdoor Recreation Coordinating Commission*
  - State Parks Board*
  - Department of Water Resources*
  - Local governments (includes COGs)*
  - Federal agencies: Geological Survey*
    Soil Conservation Service*
    Forest Service
    Fish and Wildlife Service
    Bureau of Land Management
  - Agriculture and Horticulture Commission
  - Office of Economic Planning and Development
  - Bureau of Geology and Mineral Technology
  - Oil and Gas Conservation Commission
  - Department of Transportation
  - Industry
  - Universities

- Identification of Existing Systems in Arizona:

  - U.S. Geological Survey's STORET: Stores data from all states on surface water parameters.

- Data Types:

  - Basic hydrologic and geohydrologic data
  - Flood hazard boundary areas
  - Major aquifers
  - Water recharge areas
  - Drainage
  - Surface water quality/quantity
  - Groundwater quality/quantity
  - Water discharge data
  - Industrial facilities information
  - Historical water use

*Primary data users.

WATER (continued)

- Data Types (continued):

  - River levels
  - Precipitation amounts
  - Groundwater levels
  - Subsidence due to groundwater withdrawals

- Output Report Titles:

  - Technical standards for drinking water
  - Technical standards for discharges
  - Permit documents
  - Statewide Water Resources Plan
  - Active Management Area Resources Plan
  - Flood Control Planning Reports
  - Water Conservation Plans
  - Groundwater Model
  - Best Management Practices Reports
  - Erosion Inventories
  - Water Quality Management Plan
  - Solid Waste Assessment Report
  - Wastewater Treatment Facility Plans
  - Wastewater Treatment Facility Designs and Specifications
  - State Water Pollution Control Strategy
  - State Drinking Water Strategy

2.63 Uses of Natural Resources Data. Below are some samples of the types of activities being carried out by Arizona State agencies. These are not meant to be comprehensive in nature, but rather to describe the extent of ongoing data requirements needed for planning and management functions.

The State Land Department must manage resources on state-owned lands, and has some joint management responsibilities on adjacent federal lands. In addition to overseeing timber and range resources, they must also plan for the best and most profitable use of state lands adjacent to municipalities. They are also responsible for maintaining lease records and for adjudicating water rights where state trust lands are involved. These activities require virtually all data types describe in Section 2.6. For example, in order to manage and protect Arizona's timber stands, the Forestry Division requires accurate and up-to-date information about the stands, including species composition, age, volume, soil type, density, acres of each type, etc. This information is used for determining fuel types, planning for harvests and reforestation, specification of rotations to obtain maximum yields, controlling insects and other pests, etc.

The Department of Transportation must evaluate economic, social, and environmental factors as they affect and are affected by highway projects. For example, alternative routes for a proposed highway must be compared to determine corridors having the greatest cost/benefit ratios, while having the least adverse impact to the land. This evaluation must consider a range of factors, including archaelogical site data, geologic hazards, soil types, wildlife habitat and relevant demographic information.

The Department of Water Resources is faced with an enormous job in carrying out recent groundwater legislation. One of their tasks is to document historical water use for irrigation of agricultural lands since

1975. This information will be used to establish future allocations of water in the agricultural sector. By using imagery acquired from Landsat satellites, they will be able to quickly and accurately delineate irrigated acreage and identify crop types for each year.

The Arizona Outdoor Recreation Coordinating Commission (AORCC) must prepare and update a state comprehensive outdoor recreation plan. This plan requires a synopsis of all major land, water, and social/economic factors pertinent to locating a variety of recreational facilities throughout Arizona. The plan also documents existing facilities. AORCC uses the plan to make recommendations about where new facilities could be developed to support Arizona's recreational needs. In order to select these potential sites, AORCC must have information about the landscape (i.e., vegetation, land use, soils, geology, water) and its amenities (e.g. air quality, animals, cultural data). Further, they must evaluate each potential site in light of its proximity to major populations, ease of access, demands by people for certain types of facilities, etc. Finally, they must know who owns the land under consideration so that appropriate follow-up action can be taken.

On the basis of these types of needs which requires a range of natural resource and related data, it is evident that the State of Arizona would benefit greatly by implementing an information center which would act as a focal point for obtaining and processing information, and would provide applications assistance.

## 2.7 OBSERVATIONS/CONCLUSIONS

A number of factors became apparent during the two-week process of interviewing staff members of Arizona state agencies and other personnel:

- Most entities responsible for natural resources and related issues operate by reacting to areas of need as they arise. In general, the concept of planning is still in its infancy. The reason for this is probably because natural resource entities are operating with limited staff and financial resources.
- Most entities using or producing natural resources data were very supportive of the concept of a statewide natural resource information system. Many, however, expressed concern that if such a system is recommended for the state, they did not want that system to be "buried" in an agency that would not be able to respond adequately to state needs. That is, the institutional arrangements must accommodate the needs of multiple entities, and must ensure that those entities can access the system with relative ease.
- Because state agency employees are accustomed to operating with limited resources, the present methods of acquiring secondary source data and producing end products are well established on an individual basis, often built on personal contacts. Should an employee leave the agency, his knowledge about how and where to obtain data may leave with him.
- For the most part, the consciousness-level of the capabilities of natural resource information systems (automated or manual) is somewhat limited. (Departments of Water Resources, State Land, and Transportation are notable exceptions.) Once again, employees may be "used to" obtaining data through specific channels and in certain formats. There is generally no clear understanding of how an information system might help them.

- There is a need for the state agencies to talk to each other about data needs they have in common. Recently established mechanisms such as the State Data Coordination Network and subgroups such as the Mapping Advisory Committee are an excellent beginning. However, current efforts appear to be oriented toward specific data types or specific agencies, rather than towards considering all data types "across the board."

Table II-10 presents the observations of the User Survey Task Force coordinator, based on a two-week survey of participating agencies (see Table II-2), about which Arizona entities have a broader range of needs for a natural resource information system. The State Land Department, the Department of Water Resources, and the Department of Transportation are ranked as the three primary users of natural resources data. These three agencies are also candidates for potential host of an Arizona natural resource information system (see Chapter IV).

The State Land Department is responsible for the management and use of approximately 9.6 million acres (surface) of state lands. (The Department also manages more than 10 million subsurface acres.) These lands are intensely managed for the express purpose of providing revenues to the state, mostly to educational institutions.

The Department of Water Resources is responsible for carrying out the requirements of the recently enacted Groundwater Management Act, which encompasses groundwater and other resources statewide. These resources are of major interest to virtually every state agency, the federal government, local entities, industries, universities, and the legislature.

Table II-10.
STATE AGENCIES: RANKED BY CURRENT PERCEIVED NEED *

Primary Users:

- State Land Department — EQUAL RANKING
- Department of Water Resources
- Department of Transportation
- Outdoor Recreation Coordinating Commission
- Game and Fish Department
- Department of Health Services
- Bureau of Geology and Mineral Technology

Secondary Users: (No ranking within category)

- Legislative bodies
- Office of Economic Planning and Development
- Oil and Gas Conservation Commission
- Agriculture and Horticulture Commission
- Local governments
- Councils of Governments
- Other state agencies, many of which were not interviewed during this survey because of lack of time

Other Users:

- Public
- Federal Agencies
- Universities/Educational Institutions
- Industry

*Needs based on each agency's perceived needs, team judgments about the extent of geographic coverage involved, and the variety of data types required by the entity.

The Department of Transportation has statewide responsibilities for transportation planning (highways, airports, rail, other corridors) and requires a wide range of natural resources information. Based on current needs, a natural resource information system could be well justified for these three state agencies alone, and indeed these agencies support the concept of a statewide information system.

It is suggested that, if a natural resource information system is implemented for the State of Arizona, systems staff assemble a number of teams to describe on an ongoing basis the capabilities and services they need and desire. The teams might be comprised of representatives of state, federal and local governments and others who are expected to be primary users of the system. The teams may be organized by discipline (Air Quality, Animals, Land Use, Water, etc.). They should elaborate on input data requirements, output report details, processing, analysis and modeling requirements.

# III. SYSTEMS AND SOFTWARE TASK FORCE REPORT

## 3.1 INTRODUCTION

The Systems and Software Task Force of the NCSL/CSPA Resource Team evaluated five technical data processing and user-support entities:

- The Department of Transportation (Information Systems Group),
- The Department of Administration (DOA Data Center),
- The Department of Water Resources,
- The State Land Department (Information Resources Division), and
- The University of Arizona (Applied Remote Sensing Program).

Information was gathered through interviews, written materials provided, tours of facilities and demonstrations of capabilities.

The information gathered is presented in two formats (tabular and narrative) and is organized into four component areas (hardware, software, staff and general procedures).

## 3.2 HARDWARE

### 3.21 ADOT Hardware

Review of Arizona Department of Transportation electronic data processing (EDP) activities revealed that the ADOT computer facilities were efficiently managed and heavily used. Two mainframe computers, an IBM 370/158 and an Amdahl 470V5II, make up ADOT's EDP Data Center. While

both machines offer excellent processing speed, available memory, necessary operating systems, and peripheral devices (tape and disk drives, plotters, and printers), they are so heavily used that they cannot be considered as a host for a natural resource information system. The IBM 370/158, for instance, is at 90 to 100 percent utilization, with the bulk of its use by law enforcement officials searching the ADOT license data base. The Amdahl 470V5II is used to 75 percent capacity during the daytime shift and 40 percent overall. The low overall utilization is because the Amdahl was installed only recently to relieve the burden on the IBM. Its use will be stepped up rapidly. CPU time on the Amdahl for bulk processing ("number crunching") probably will be available during the third shift soon.

ADOT EDP officials made it clear that the data processing center was not in a good position to increase the number of users. Under the current hardware configurations, no more time-sharing users can be added to the system. This forces the users into a strictly batch mode of operation, a mode not conducive to software development. In addition, users wishing to take advantage of the limited available resources would need to work evening hours. Overall, such limitations do not aid production-oriented analysis such as a natural resource information system would be expected to provide.

The Arizona Department of Transportation has felt the effects of declining gas tax revenues in recent years. As part of ADOT, this has meant lower funds for its EDP Center. This causes a redirection of efforts to ensure that the Information Systems Group meets ADOT's Data Processing needs before additional services are made available to outside users. As a result, there are no plans for major hardware acquisition

software development, or upgrades for the currently overcrowded physical facilities of the ADOT Data Center.

In summary, although ADOT's Data Center possesses the hardware needed by a natural resource information system, the center is too heavily used to allow additional users access to the system. For a synopsis of technical characteristics of the ADOT computer system, refer to Tables III-1, III-2 and III-3, "Summary of Electronic Data Processing Sysytem and Organizations."

### 3.22 DOA Hardware

The Department of Administration was responsive and helpful in our interview. Overall management of the data processing function seems to be highly structured and efficient. The project structure in DOA is very user responsive because the funding source for the DOA system includes individual projects for 40 to 45 state agencies rather than allocation from the Legislature. Quality of work in such a system normally tends to be high because future projects hinge on the success of present work. DOA personnel seem to be willing to accept new challenges and new programs aimed at user satisfaction.

The DOA system consists of a Honeywell 66DPS3, a large mainframe with dual central processors. It has 768,000 36-bit words and operates with 6-bit characters. The processing speed of the system is approximately the same as an IBM 370/158 system. The operating system supports both batch and time-sharing users with access to tapes and large disk files from either system. The time sharing option (TSO) response time is approximately five seconds. The Honeywell 66DPS3 has 20 dual-density tape drives and 34 disk drives with an average of 200 megabytes per drive.

Currently, the disk space utilization is low due to recent upgrades, with 60 percent of the total disk space available for user scratch space. User memory is allocated on demand, up to 64K words per user. The charge structure for the DOA system is based on system resource units with individual rates per resource unit (i.e. disk storage, CPU time, printer paper, etc.). The security of the system for disaster situations seems to be good with a halon emergency system. Because the system contains dual processors, a hardware failure in one system can be controlled by a system hardware reconfiguration. A software security system of passwords and user keys seems to be adequate for protection of sensitive data.

The DOA system currently has no graphics peripherals and is normally used for business-oriented work. While the system supports FORTRAN and COBOL, the majority of the programming done by DOA is in COBOL. Major statistical packages such as SPSS are included in the Honeywell system, as well as several nongeographic-oriented data base software systems.

### 3.23 DWR Hardware

The Department of Water Resources currently does not manage a computer system. It relies on the DOA and ADOT Data Centers for computer services. DWR does own several terminals and plans to acquire a tablet digitizer to support work in implementing the new groundwater law.

### 3.24 SLD Hardware

The Information Resources Division of the State Land Department has a fairly sophisticated minicomputer hardware system. The Data General S130 CPU is relatively fast and can be made much more efficient with the addition of 256K bytes of memory. The two disks (one 10MB and one 192MB)

are adequate for near-term operations. The tape drive is marginal in several respects. It is not dual density (only 800BPI), and it is somewhat dated and prone to equipment failure.

The IRD graphics peripherals are excellent. The large tablet digitizer and 36" four-pen plotter are more than adequate. There are also two Tektronics Graphic CRTs (Model 4010) which could be used for mapping and general computer graphics (pie charts, histograms, line plots, etc.).

The IRD CPU is a rental unit. The Joint Legislative Budget Committee refused to appropriate state funds for this unit during the current fiscal year. Funds were obtained from the U.S. Forest Service, and the DOA Data Processing Division approved a 6-month lease pending completion of this study so that SLD could continue current services. If further action is not taken, the CPU will have to be returned on 1/1/81. The Systems and Software Task Force recommends that SLD be allowed to retain this unit until 7/1/81, so that SLD can continue running current applications and have time to provide alternatives for future services after that date. These alternatives will, of necessity, be a function of legislative decisions regarding IRD and the recommendations contained in this report.

### 3.25 U of A Hardware

The University of Arizona, Office of Arid Lands Studies, Applied Remote Sensing Program has access to several computers, and each is used for particular types of applications.

Time-sharing is handled by a dedicated dual CPU DEC System 10. The DEC is linked to a CDC Cyber 175 which handles batch processing. These computers are used for both research and teaching.

The Applied Remote Sensing Program also has a dedicated image-processing system. The system has a DEC PDP 11/70 CPU, a 67MB disk, an 800BPI tape drive and a color CRT.

A wide variety of graphics peripherals are available at various campus locations, including digitizers, planimeters, drum plotters (12" x 36"), an electrostatic printer and a film writer.

### 3.3 SOFTWARE

There is currently little Geographic Information System (GIS) or Landsat processing software implemented by any of the four departments. There are some contouring and 3-D capabilities on the ADOT Amdahl, and some limited GIS software at SLD/IRD. Also, DWR has several complex hydrological models used for ongoing water resources planning.

Both SLD and DWR have plans to implement Landsat image-processing capabilities. SLD has been attempting implementation the last two years, but has only one simple routine (of at least 15-20 required) operational to date. Also, the SLD programmer is knowledgeable but not proficient in FORTRAN, which is used almost exclusively for such applications. A final complication at SLD is that, in response to the JLBC resolution and pending development of a long-term data processing plan for the entire department, the Data Processing Division placed a temporary freeze on new software development and applications on the IRD computer.

The Department of Water Resources could implement an initial Landsat capability fairly rapidly. The Jet Propulsion Laboratory has developed a software package (VICAR/IBIS) which is written in FORTRAN and is 370/360/Amdahl-compatible. This package, which is in the public domain, is available through the NASA software distribution facility (COSMIC at the University of Georgia) at a nominal fee. Once this software is

acquired by the state, NASA/AMES staff are willing to assist in the installation of the complete package at ADOT. This could be accomplished in a matter of days; ADOT staff and the DWR FORTRAN programmer could easily maintain and run the VICAR/IBIS system.

The U of A has a wide variety of software available from various sources, most of which is operational on one of its three computers. These packages, however, have not been extended to large area, operational applications. While the U of A may have most of the pieces, they need to integrate them into a manageable system and increase their capacity and efficiency in some cases. The existing software capabilities, however, represent a powerful research tool.

## 3.4 ARIZONA DATA PROCESSING STAFF OVERVIEW

The evaluation of staff capabilities unfortunately involves the use of objective categories having mostly subjective criteria. In addition, any staff evaluation is biased in favor of the larger data centers (ADOT, DOA, U of A) because their staff sizes permit specialization in specific areas, and because budgets are usually directed towards maintaining staffs capable of meeting user requirements in order to guarantee a continued flow of income. However, because staff capabilities are the single most important element in the successful operation of a data processing facility, it was felt that even a subjective evaluation is important if technical capabilities are to be understood. Therefore, it should be noted that the following narrative is based only on collective impressions of the technical evaluation panel.

### 3.41 ADOT

The Department of Transportation maintains a large staff versatile in

the use of PL1, FORTRAN and COBOL programming languages. It is made up of a core of experienced programmers, systems analysts and operators plus a group of inexperienced personnel. Turnover is a problem with the inexperienced staff but a trainee program that offers on-the-job experience and instruction is improving the situation. Trainees are not leaving for outside opportunities at as fast a rate as before. The majority of ADOT staff works in a services or production-oriented mode with specific assignments varying from routine accounting tasks to more complicated modeling. ADOT does offer limited services in spatial data analysis. Specifically, it has capabilities for processing photogrammetric and engineering design data. However, it does not have staff currently engaged in image processing or geographic information system programming.

ADOT offers limited opportunities for continuing education. Because of budget restrictions, training is limited to vendor-provided seminars. ADOT management recognized this as perhaps its primary limiting factor. Fortunately, Amdahl has assisted by providing training in recent months.

In terms of user support, the ADOT Data Center enforces strict documentation standards, and offers comprehensive back-up capabilities to ensure that user files are protected. In addition, ADOT manages a password security system, and regulates accessibility to the computer facilities.

The concensus was that ADOT does a commendable job of providing a capable staff considering its strict budget limitations.

3.42 DOA

The Department of Administration data processing staff is similar in many ways to that of ADOT. They, as well, have both experienced and

inexperienced programmers with turnover a big problem. DOA works in a production or service direction, and manages excellent security and data back-up programs. Programming, however, is done primarily in COBOL with limited assistance in FORTRAN offered. Most of the work is considered to be simple accounting and bookkeeping rather than complex modeling tasks. None of the DOA Data Center work involves manipulation of spatial data. Training opportunities for the DOA staff are greater than those of ADOT. An attempt is made to provide 15 days of training each year. DOA also maintains a trainee program to help satisfy its staffing needs.

More than ADOT, DOA works as a user-support facility and, thus, activities are designed to meet the needs and budgetary limitations of the user group. DOA will attempt to provide an applications programmer who is qualified in specialized areas if the demand is present. Its documentation standards also are dependent on user standards. If the user does not request thorough documentation, only limited efforts to document programs are made. DOA will go into considerable detail, however, if asked to do so.

Of all Arizona data centers, the DOA staff appeared most flexible in tailoring activities to the user. It did also appear that the user should know what standards are desired to ensure success.

### 3.43 DWR

The Department of Water Resources data processing group consists of one programmer and a handful of digital data users. The latter group has considerable experience in data analysis but its technical competency was not evaluated. The programmer was experienced and knowledgeable in FORTRAN and highly user-oriented. He was aggressive in his interest in

spatial data analysis and appears eager to initiate several complex, spatial data analysis programs, including image processing, that support DWR functions.

Because DWR has such a small data analysis staff and because its data processing tasks are done only to support mandated water resource management responsibilities, it is not relevant to address DWR user support directions. It should be noted that impressions of DWR staff are based only on anticipated data analysis activities rather than on current activities. DWR does, however, appear extremely aggressive in desiring to establish a staff of talented scientific, spatially-oriented programmers and data analysts.

### 3.44 SLD/ARIS

As with the DWR data processing group, the SLD/ARIS data processing staff is small. It consists of one programmer and several data analysts. The data analysts are limited mostly to digitizing maps and the use of a plotter. The programmer has been with ARIS for a short time only, so it is difficult to assess his productivity and technical expertise. The programming languages used are primarily BASIC and APS with limited FORTRAN. From the data analysis software viewed, it appears that most software development falls into the simple accounting/bookkeeping group with some simple spatial data analysis programs beginning to be developed.

Top SLD management is very interested in the concept of a statewide natural resource information system. They are currently somewhat frustrated with the progress of the IRD in implementing geographic information system capabilities. Current IRD systems development, however, is in hold due to a ban on new applications by DOA's Data Processing Division

pending the outcome of the Resource Team study and completion of an acceptable long range data processing plan.

User assistance activities are included in ARIS staff responsibilities. The staff manages a good security program and routinely backs up user files for data protection. They also engage in limited documentation, but it was not possible to determine how thoroughly.

The ARIS programmer has received training by Data General (DG) to aid him in familiarity with the DG programming environment. Because of limited staff, it is impractical for ARIS to maintain a formal training program.

The preceding narrative of ARIS staff capabilities does not truly represent the evaluation panel's impressions of staff abilities. While ARIS staff, like DWR staff, is pointed in the right direction, and even though neither DWR nor ARIS has accomplished a great deal in the area of spatial data analysis, the overall feeling was that the ARIS staff lacked the aggressiveness and direction to accomplish the tasks that are required for land and water resource evaluation. To assist users, a production attitude is vitally needed. Without it, any service organization will ultimately discourage participation by outside users.

3.45 U of A

Because U of A staff felt that provision of ongoing, operational services was not an appropriate role for the University, the Systems and Software Task Force did not perform a U of A staff evaluation. The task force consensus is that the staff functions under a research and development atmosphere rather than a production setting, and they are well-qualified to provide highly technical, complex programming. However, no specific observations were made to support this contention.

## 3.5 SUMMARY

Observations of the Systems and Software Task Force are summarized in the following tables.

Table III - 1

Summary of Electronic Data Processing
Systems and Organizations
-HARDWARE-

| | Arizona Department of Transportation | | Department of Administration | Department of Water Resources | State Land Department/IRD | University of Arizona | | |
|---|---|---|---|---|---|---|---|---|
| Charge Structure | Resource Billing Very high rates | | Resource Billing Reasonable rates | N/A | Expenses covered by state appropriations | Resource Billing uncertain of rates | | |
| CPU | | | Dual Processor | | | | | |
| - type | IBM 370/158 | Amdahl 470V5II | Honeywell 66 DPS3 | Currently use DOA Honeywell and ADOT Amdahl | Data General S130 | CDC Cyber 175 | DEC System 10 (Dual) | PDP 11/70 |
| - speed | Very fast | Very fast | Fast | | Medium speed | Very fast | Fast | Medium |
| - % utilization | 100% | 75% prime time 40% overall | 85% prime time 70% other times | | 20% - memory limited | High | Very high | Low |
| - batch turnaround | N/A | 2-4 hours | 4 hours | | 1 hour or less | 30 min | TS only | --- |
| - user memory avail | N/A | 512K bytes | 292K day, 900K night | | 64K bytes | 1 MB | --- | 64K |
| - total memory | 4 megabytes | 4 megabytes | 3.426 megabytes | | 256K bytes | 5.6 MB | --- | .5 MB |
| Disk storage | | | | | | | | |
| - total | 48 3350 compatible disks of 317 megabytes | | 34 large disks of 200 megabytes average | N/A | 1 192 megabyte 1 10 megabyte | Information not collected | | 1 RK03 67 MB |
| - work space | Very limited | | Plenty available | | 100 megabytes | | | |
| - dedicated packs available | No space for additional drives | | Some space available, and old disks could be upgraded | | Up to 3 192 MB disks could be added on present controller | no | no | no |
| Tape drives | | | | | | | | |
| - number & density | 8 dual density drives (800-1600 BPI) | | 20 dual density tape drives | N/A | 1 800 BPI drive | About 10 (800-1600, 6250 BPI) | | 1 800 BPI |
| - availability | Day shift - max 2 Night shift - max 6 | | Time sharing - max 4 Batch - no limit | | | | | |
| Graphics peripherals | Zionetics flatbed (5' x 8') Zeta drum (36") with 3 pens Large, offline tablet digitizer | | None currently: business oriented system | Planning to acquire a tablet digitizer | Zeta 36" drum Plotter with 4 pens Large on-line tablet digitizer 2 Tektronics graphics CRTs | 12" & 36" Calcomp Plotter Digitizers Color CRT & Image Processor Electrostatic printer/plotter Film writers | | |

Table III - 2

Summary of Electronic Data Processing
Systems and Organizations
-SOFTWARE-

| | Arizona Department of Transportation | Department of Administration | Department of Water Resources | State Land Department/IRD | University of Arizona | | |
|---|---|---|---|---|---|---|---|
| Operating Systems | SVS-VSII | G COS III | Use ADOT & DOA | AOS release 2 | CYBER NOS | DEC10 | PDP 11/70 RSX11 |
| Interactive facilities | TSO & other systems | Several systems | | Yes | None | Yes | Yes |
| - memory available | 512K | 260K | | 64K | N/A | --- | 40K |
| - response times | 5-10 seconds | 3 seconds | | 3-5 sec for 1-2 users 15-30 sec for 5 | N/A | Varies | Fast |
| GIS software | Some | None | A number of spatial hydrological modeling systems | Range vegetation mapping system near operational use | Spatial information processing system | | |
| - polygon processing | no | | no | no | yes | | |
| - contouring | yes | | no | no | yes | | |
| - 3D capabilities | yes | | no | no | yes | | |
| Landsat software | No | None | Plan installation of VICAR/IBIS at ADOT | Plan installation of various software** | Several packages available | | |
| - reformatting | | | yes* | yes** | yes | | |
| - geometric correction | | | yes* | yes** | yes | | |
| - radiometric correction | | | yes* | yes** | yes | | |
| - training field selection | | | yes* | yes** | yes | | |
| - clustering | | | yes* | yes** | yes | | |
| - statistics editing | | | yes* | yes** | yes | | |
| - classification alternatives | | | yes* | yes** | yes | | |
| - data cleaning and correction | | | yes* | yes** | yes | | |
| - aggregation | | | yes* | yes** | yes | | |
| - visual enhancement | | | yes* | yes** | yes | | |
| - principal component | | | yes* | yes** | yes | | |

* when installation is complete, NASA will provide technical assistance for such installation.

** additional staff familiar with Fortran required for installation. Also, DOA has prohibited installation of new software at SLD/IRD.

Table III - 3

SUMMARY OF ELECTRONIC DATA PROCESSING
SYSTEMS AND ORGANIZATIONS
-STAFF AND GENERAL-

| | ADOT | DOA | DWR | SLD/IRD | U of A |
|---|---|---|---|---|---|
| STAFF | | | | | |
| -Technical Expertise | High | High | User-High Technical systems - limited | Moderate | High |
| -Languages used | PL1, Fortran, Cobol | Cobol, Fortran | Fortran | Basic, APS | All |
| Aggregate Experience | Experienced Core w/some inexperienced staff | Experienced Core w/some inexperienced | 1 experienced Programmer | 1 Programmer w/basic skills | High |
| -Complexity of current work | Complex | Simple | Complex | Simple | Complex |
| -Production Orientation | High | High | N/A | Low | Low |
| -Spatial Orientation | Moderate | None | Moderate | Low | High |
| -Work Planning Process | Excellent | Depends on User | N/A | Poor | N/A |
| OTHER | | | | | |
| -DOC Standards | Excellent | Depends on User | N/A | Poor | N/A |
| -Backup Capabilities | Excellent | Excellent | N/A | Good | N/A |
| -Staff/user training | Adequate | Good | N/A | Adequate | N/A |
| -Security System | Excellent | Excellent | N/A | Good | N/A |

# IV. EXISTING INSTITUTIONAL SETTINGS

## 4.1 INTRODUCTION

This report summarizes the observations and evaluations of the Institutional Arrangements Task Force of the Resource Team. The objectives of this effort stated in the Agreement for Technical Assistance Services signed August 7, 1980,.(Appendix I-B), are to "analyze and recommend appropriate institutional (state agency) arrangements, if necessary, for implementation of the [technical] systems designed [by the Systems and Software Task Force]". This report also summarizes the combined experiences of other states in developing and maintaining a successful information system. No "how to" manual exists for coordinating natural resource data and information and providing services in this area. Consequently, membership of the Institutional Arrangements Task Force was carefully selected by CSPA and NCSL from two states that have the longest history in evolving statewide information systems. The Task Force members are:

- Peggy Harwood, Task Force Coordinator - Associate Director for Resource Information and Technology, Council of State Planning Agencies, and formerly a participant in the conceptual design and implementation of the Texas Natural Resources Information System.
- John Wilson - Manager of the Systems Central Staff, Texas NaturalResources Information System.
- Don Yaeger - Manager of the Mapping and Remote Sensing InformationCenter, Minnesota Land Management Information Center.

The Institutional Arrangements Task Force acknowledges the support of the individuals and agencies surveyed on existing and potential institutional arrangements for a statewide information system. The Task Force appreciates its own limitations. Without support and assistance from state officials, it would be very difficult in the span of a few days to adequately understand any state government, much less recommend an approach for an interagency information system that might satisfy the majority of users.

## 4.2 METHODOLOGY

As stated in the Agreement, the Institutional Arrangements Task Force "will utilize interviews with...candidate agencies; observation of current system capabilities; and experiences of other states in implementing resource information systems to analyze and recommend an institutional arrangement for a natural resource information system."

4.21. Interviews of Candidate Agencies. The Institutional Arrangements Task Force of the NCSL/CSPA Resource Team spent three days interviewing key State offices with an interest in natural resource data and/or information systems. The Auditor General's office had scheduled interviews for the Task Force with four entities identified as candidates or potential hosts for a natural resource information system in Arizona: the State Land Department, the Department of Water Resources, the Department of Transportation, and the University of Arizona - Office of Arid Lands Institute. The Task Force also visited with staff of the Office of Economic Planning and Development and the Department of Administration, including the central computer facility.

In an attempt to get an understanding of each candidate agency's present capabilities, and any future role they might play in structuring an information system, the Task Force developed a standard set of questions designed to gather the most consistent and complete information in the limited time available. Summaries of these interviews are included in Appendix IV-A. The questions asked of the senior staff in each agency are listed in Figure IV-1.

Figure IV-1. Interview Questions for Candidate State Agencies

1. What type of information system do you have?

   Manual and/or computer
   Scope: Purpose, users, data types, services provided
   Computer Equipment/Software Available
   Staff Expertise
   Data Processing Accomplishments

2. Are there plans to create or expand your information system?

3. Do you use other information services?

4. To whom do you provide information services? Occasionally? Routinely?

5. What would it take for your system to provide information services to other agencies?

   - More funding, staff?
   - Clear mandates, etc.?

6. What are your perceptions and/or expectations of the Data Coordination Network and Mapping Advisory Committee chaired by the Office of Economic Planning and Development? Do you perceive that such organizations are needed In Arizona?

7. What are your perceptions and/or expectations of ARIS, as it is today? What is your understanding of its original goals and intended services?

4.22 Additional Evaluation Criteria. Natural Resource Information Systems in other states are perhaps the best models for evaluating the institutional arrangement most likely to be successful in Arizona. The Institutional Arrangements Task Force developed a list of criteria common to these state information systems (Figure IV-2), based on the personal experience and knowledge of Task Force members. The way each state addresses these criteria and the different histories of development account for the diversity and uniqueness found in existing systems.

The Institutional Arrangements Task Force used these criteria for examining the progress of the State of Arizona in developing a statewide natural resource information system, and for determining what additional institutional changes, if any, might be needed to improve performance.

Figure IV-2. Criteria for A State Natural Resource Information System

- Perceived need/Documented need
- Clear purpose and mandate
- Well-defined scope
  - Users
  - Data types
  - Information services
- Functioning mechanism for user involvement
- Institutional home
- Implementation plan
  - Staffing requirements
  - Equipment/Software
  - User education/Outreach
  - Schedule

4.23 Recommendation of an Institutional Arrangement. The Institutional Arrangements Task Force performed the initial interviews during the week of August 18, 1980, and requested comments from each candidate agency on the accuracy of interview summaries.

Following completion of the draft User Needs Survey (see Chapter II), representatives of the full Resource Team met during the week of September 15, 1980, to integrate results of the User Needs Survey, the interviews of the Institutional Arrangements Task Force and the investigations of the Systems and Software Task Force. The evaluation of candidate agencies and institutional recommendations were performed by the Institutional Arrangements Task Force in consultation with the entire Resource Team.

## 4.3 CRITERIA FOR A STATE NATURAL RESOURCE INFORMATION SYSTEM

The concept of data coordination has led a number of states to establish special institutions called "natural resource information system centers." Being able to access federal, state and local data through a single state center has helped to decrease the high costs associated with collecting, handling and analyzing these data. Another benefit to these states has been that more information services and new technologies can be justified where shared through an information system than could be afforded by individual projects or agencies.

Although system details vary depending on individual state circumstances, specific criteria appear to be common to most such systems:

- Need. The state natural resource agencies must perceive the benefits of data coordination to help fulfill ever expanding program needs and minimize costs. A user needs survey is a first step in designing a state system.

- Mandate and Purpose. A major criterion for development of a state level natural resource information system is a well conceived mandate for data coordination, from the executive and/or legislative branches of state government. A mandate should identify the purpose of the system to fulfill state needs in clear, unambiguous terms. Such a statement of purpose would foster coordination among data providers and users, and help ensure acceptance of the information system.

- Scope. A mandate to establish a state natural resource information system also may provide general guidelines regarding the scope of the system. Generally included in the scope is a definition of the users, data types and information services to be provided by the system. The scope should be flexible and reflect resources available to the system. A major pitfall to be avoided by a new information system is developing a user community with expectations far beyond what the system can provide.

- Functioning Mechanism for User Involvement. In order to ensure that the developing capabilities are responsive to user needs, a mechanism should be established for user involvement in the design and operation of a natural resource information system. A guidance committee or user advisory group is usually established to provide this linkage. It is important that the system respond to the group's recommendations in a timely fashion to ensure continued participation.

- Institutional Home. Whether the information system is centralized (i.e. all data stored in a single location) or a linked network of agencies holding data, an information center with a "core staff" will be required for system development and operations. An important consideration in establishing the information center is the mechanism for administration of this staff.

Most states install the information center in an operational agency as a convenience for funding and administration. The host agency should: 1) be supportive of the natural resource information system concept which benefits each participating agency equally; 2) have expertise in data collection, storage, and manipulation; and 3) have expertise in automated data processing techniques for spatial data analysis.

- Implementation Plan. Perhaps the most important criteron is the document that describes the goals, objectives and conceptual design for a state natural resource information system. Such a plan also would include definitions of (1) the scope of the system based on need (users, data and services), (2) the organizational approach (composition and function of the user guidance committee, and the institutional home for the system staff and capabilities), (3) the types of staff expertise, computer equipment and software needed to provide services, and (4) the proposed schedule for developing and implementing capabilities and services.

4.31 Additional Observations of Existing State Information Systems. Most state information systems do not develop as a natural consequence of some already ongoing process. They require dedication of some individual or team to design and implement the capability. Generally, these systems are interagency in nature, service-oriented, and committed to coordination of data and information processing services. As a result, these systems have accumulated experience in several areas that would be useful to the State of Arizona.

- Neutrality. As a mechanism to coordinate data and information and provide related services to state agencies, a state natural resource information system must be politcally neutral. The missions of state agencies

can lead to conflict, such as can happen when a decision must be made between use of a site for wildlife habitat or water impoundment. Consequently, information and services available through the system must be equally available to all users, and the system must not be involved directly in resource management activities.

- Funding. As with all state programs, the amounts and sources of funding must be carefully examined. Most states have found that an appropriated funding base is needed to ensure that the system is accountable and able to give priority to state users. Usually the state funding base provides for some core staff and equipment needed to provide services to state agencies. Additional staff and capabilities are supported by user fees. All users are expected to pay some costs associated with services, such as computer time, data and map reproduction, and special projects. Federal grants have been used to increase state capabilities, but should not be relied on for ongoing support.

- Capabilities.* As a rule, state information systems do not replace existing agency capabilities. It is expected that data collection and analysis capabilities that are needed and frequently used by state agencies will still be developed in-house. However, individual state agencies usually do not have staff to promote outside use of these capabilities, and indeed cannot afford to have too many outside users distract them from their missions. Consequently, state information systems develop capabilities and

*For additional information on capabilities see Appendix IV-B.

perform functions that individual state agencies usually cannot. For example, most of these systems:

- maintain an index of available data, and provide the necessary consulting and referral services to assist users;
- develop needed technical capabilities that can be cost-effectively shared, such as an automated geographic information system, and provide the necessary consulting services to assist users; and
- provide training and joint project opportunities to expand system use and develop new applications in state agencies.

- Staff Expertise and Dedication. The success of a system will ultimately come down to people. The best made plans will not work if the right talents are not present. Any multi-agency or multi-functional effort will require input from individuals with backgrounds in various disciplines and work experiences. Those most actively involved in the system must also be skilled in working with people. Such a mix must be present in the system staff, and cultivated in the wider user community.

- Institutional setting. The location of where the "work gets done" is not dependent on the location of a host computer. Modern technologies of data transfer do not require proximity. The key ingredient is for the supporting computer facility to be responsive and accessible. State natural resource information systems often start by using a general state computer or developing links to research computers at universities. Eventually some states have purchased dedicated minicomputers when their track record demonstrated that the purchase of dedicated equipment was warranted. (In Arizona, however, this may not be a workable alternative. For example,

implementation of a system at the University of Arizona in Tucson might result in analytical capabilities developed in relative isolation from state agencies.)

A far bigger institutional issue than "owning" a computer is the authority to pull a system together. Generally, the "perfect" agency to create a comprehensive, interagency natural resource information system does not exist. Usually, no existing agency in state government has such a broad mission. In virtually every state that has an operating system, the legislature, the governor, or both, established a new organizational structure for ensuring interagency and interdisciplinary cooperation. In many states, new programs are established in a host agency with the specific charge to serve a larger community of users beyond the agency which houses them.

In Arizona, as in other states, many agencies collect natural resource data. Some data are collected because of statutory charge; other data are collected to assist in carrying out agency functions. While it is always advisable to review data collection programs for duplication, it is obvious that many data collection efforts must remain in the agencies. One key element of a good information system is to develop the institutional setting that allows better use of the data being collected, while perhaps augmenting it with new interdisciplinary data.

4.32 Institutional Options. The institutional options available to Arizona include:

- Not Develop an Interagency System. A natural resource information system as discussed in this report does involve additional cost over and above the investment in agency capabilities. The State of Arizona may decide the cost is not justified. However, states that have established interagency

information systems have found that the benefits far outweigh the costs of starting and maintaining them. For example, having a central focus for natural resource information reduces duplication of data collected or purchased by state agencies, increases use of the data, and increases communication and cooperation among state agencies.

- Add a Service Function to an Existing Agency Program. State agencies with fairly broad responsibility in natural resources usually already have some capabilities desired in a state system. On their own, or at the request of the governor or legislature, these agencies may add additional staff to assist outside users. Without an independent image, however, such a service function would tend to be limited by the scope of the host agency's mission, would be expected to give priority to its funding agency, and would tend not to develop new capabilities for other agencies unless of benefit to the host agency. Though fairly easy to initiate, this approach may discourage wide use and have difficulty expanding to meet demand for services.

- Establish an Information Service Center in a Host Agency with an Interagency Guidance Committee. Many states find this to be the most viable option for establishing a state system. Usually legislation is required to create a separate information function different from the original mission of the host agency. Attaching the center to a host agency can provide mutual benefits. For example, the center would have access to some of the host agency's resources when needed, and the host agency would develop additional capabilities and more information than it might have developed on its own. The center's neutrality is assured by having it respond to an interagency guidance committee that sets priorities for developing capabilities, and provides an ongoing forum for system modification.

- Create an Independent Information Agency. Independent status would guarantee that the system was not dominated by a host agency; however, this route may well be the most costly option for the state. Information systems in other states are located in state agencies for a variety of practical reasons. Existing agencies already have the administrative structure in place (including personnel and aministrative services) to support the staff required for a state natural resource information system. Most state systems, for example, have a staff of 5 to 25 persons, depending on how long they've been in existence and the variety of services they offer. Installing the information center within an agency having existing capabilities similar to those desired also ensures that the system will have ready access to experienced management and related staff skills.

## 4.4 SURVEY OF CANDIDATE AGENCIES

The Institutional Arrangements Task Force interviewed the following four state entities as potential candidates to host a natural resource information system for Arizona:

- Department of Water Resources (DWR)
- State Land Department (SLD)
- Department of Transportation (ADOT)
- University of Arizona - Office of Arid Lands Studies (U of A)

These four were suggested by the Office of the Auditor General on the basis of agency needs for multi-resource information, and demonstrated expertise in some aspects of computer processing to support resource management applications. Summaries of interviews with each agency are found in Appendix IV-A.

The interviews were intended to identify "tangibles" such as technical capabilities and resources, and assist the task force in understanding "intangibles," such as general awareness within each candidate of the benefit of an interagency information system and the effort that would be involved in supporting one. Additional information used by the task force was developed by the User Needs and Systems and Software Task Forces.

In general, all four candidates demonstrated awareness of the unique nature of a natural resource information system as distinct from their mission. SLD and ADOT specifically mentioned that a broader mandate was required for them to support an interagency natural resource information system. Each candidate indicated that some additional staff would be required for them to develop and provide services for other state agencies. U of A and ADOT suggested the System should have dedicated staff and appropriated funding. DWR observed that the staff size would be dependent on the amount of promotion undertaken to encourage use. All four also indicated a concern that the system be responsive to user needs. ADOT specifically suggested that a user guidance committee would be needed.

During the course of the interview with U of A staff, extensive discussions were conducted on their preferred role in a state natural resource information system. They felt that their mission was one of research and development, technical and applications training, technical assistance, and advice on systems design and implementation. They did not feel it was an appropriate role for them to provide ongoing operational services to state, local and federal agencies, and they did not wish to be considered as a permanent host agency. The Resource Team felt their preferred role was appropriate and, therefore, eliminated the U of A as a candidate host agency.

The three remaining agencies were further evaluated to determine their institutional and technical suitability to host a state natural resource information system. The user needs survey also confirmed that these agencies rated highest in terms of the need for statewide, multi-resource information. (See Chapter II).

4.41 Ranking of Candidates to be the Host Agency for a State Natural Resource Information System. The Institutional Arrangements Task Force evaluated the State Land Department, Department of Transportation and Department of Water Resources in consultation with other members of the Resource Team. Some of the reasons behind the ranking are understood to be based on intangibles, and rely on experiences in other states. This evaluation was approached as though Arizona were starting from scratch to build a system* and an appropriate institutional framework.** This ranking is

*It was the judgment of the Resource Team that, because existing SLD/IRD analysis capabilities were limited, the development of spatial data analysis software should be considered as a new undertaking.

**The capability at SLD originated as the "Arizona Resource Information System" or ARIS. When the capabilities acquired by ARIS were transferred to SLD, the mandate was redefined so that SLD is the primary recipient of services. The mandate for SLD to provide services through ARIS to other agencies is apparently no stronger than for any other agency to do do.

not intended to be a reflection of the overall performance of the candidate agency, because an interagency information system would be a separate activity from the agency's mission. The candidates are ranked in order of current ability to support a natural resource information system as perceived by the Resource Team.

1. Arizona Department of Transportation. The concensus of the Resource Team was that ADOT appeared to be in the best position to house a system for a number of reasons:

- ADOT has extensive technical capabilities and experience in many areas useful to a state system, such as remote sensing, environmental assessment, computer processing, and cartography.
- The senior staff has demonstrated experience in managing sophisticated technology and applications.
- ADOT has a history as a stable state agency with well established programs and proven performance in mission areas.
- As the third largest user in the User Needs Survey, they are less likely to overload the system with their own agency priorities, and are, perhaps, in the best position to see that the data needs of all major users are met.

2. Department of Water Resources. The Resource Team concurred that DWR was also a strong candidate, but would be ranked below ADOT as a potential host for the state system because:

- DWR is currently responding to a major redirection of their planning and management authority relative to groundwater. This will probably dominate their priorities for some time.

- Senior management is not experienced in supervising the sophisticated technology and applications useful to an interagency information system.
- There is added recognition that the national water community would provide a support network for the Department of Water Resources. However, DWR will not be in a position to expand capabilities for some years, because they are just now preparing to investigate their needs for an Electronic Data Processing System in response to the recently enacted groundwater legislation.

3. State Land Department. The Resource Team concurred that SLD would be ranked below ADOT and DWR at this time for several reasons. They appear to have the fewest advantages and the most disadvantages of the three candidates:

- SLD has many program areas that would benefit from modern computer technology. Some work is being accomplished in this area; however, it will be some time before SLD will have developed capabilities that would support its own needs, much less an interagency state information system as envisioned in this report.
- Over the past 2 1/4 years, the SLD/IRD system has developed only very limited analysis capabilities for in-house use. While IRD staff have discussed sophisticated capabilities, and have assembled a relatively sophisticated hardware configuration, current applications are limited to rudimentary record keeping operations.* It is the team's perception that the level of IRD staff experience is insufficient to carry out the types of functions required for an interagency system.

*See Appendix I-A, "Technical Analysis of the Current and Proposed Arizona Resource Information System (ARIS)."

- The senior staff expressed a lack of experience in managing sophisticated technology and applications.
- SLD is perceived to be in transition. The agency is redefining its role as trustee of state-owned lands, and is restructuring many program areas to increase revenues.
- SLD (ARIS) has acquired a reputation of not being able to respond as advertised to other State agencies. This reputation would be a negative factor in establishment of an operational information system. It is believed that a new host agency would speed acceptance and use of a state information system.
- SLD's principal mission is administration and resource management on state trust lands (about 17% of the State area). They do have some statewide responsibilities, but their perspective is not as broad as the other two candidates.

Several positive factors of SLD should be noted. These include:

- SLD senior management is very supportive of the concept behind the proposed INFORM system. They believe that quantitative information can improve their resource management activities.
- SLD resource managers place much importance in having access to a sophisticated natural resource information system.
- SLD has close contact with federal resource management agencies (the U.S. Forest Service and the Bureau of Land Management) who are potential system users.

4.5 Evaluation of IRD/ARIS in Relation to Institutional Criteria. Because SLD/IRD is the only candidate with an active natural resource information system program (ARIS), the Task Force evaluated IRD/ARIS in relation to the institutional criteria outlined in Figure IV-2.

IRD staff are generally aware of user needs. However, they have failed to make any effort to formally survey user needs prior to the Resource Team effort.

The IRD/ARIS mandate limits their responsibilities to the SLD. There appears to have been past confusion, however, regarding the scope of this mandate on the part of IRD staff.

IRD staff are aware of potential major users. However, they have never formally documented the full range of geographic data types they plan on using in their system, or the different types of information services they plan on offering to their potential users (now within IRD). IRD has developed some user services. For example, as the National Cartographic Information Center (NCIC) affiliate office, IRD has developed information referral services for Landsat data and aerial photography collected by NASA and the U.S. Geological Survey. IRD also sells copies of the State's orthophotoquads, which are reproduced and distributed by ADOT.

In its early years, the ARIS program had a functioning user advisory group. This group, however, became inactive, and the IRD/ARIS no longer has a formal mechanism for user involvement. Several agencies indicated such a group would be needed for any interagency project.

SLD/IRD could potentially meet two of the three criteria for an institutional home. SLD is supportive of the multi-agency information system concept, and the IRD has some expertise in data collection, storage and

manipulation. The current expertise at IRD in automated spatial data processing, however, is inadequate to implement an interagency information system.

The IRD has yet to produce an acceptable implementation plan. Because of this, the Data Processing Division of the Department of Administration has disapproved two inadequately justified equipment acquisition requests. IRD also has not developed a documented strategy for user education or outreach.

The entire Resource Team perceived a dissatisfaction among Arizona State agencies with existing IRD/ARIS program performance. ADOT and the University of Arizona Office of Arid Lands Studies observed unresolved conflicts between the University and IRD over remote sensing functions, and a lack of remote sensing analysis capabilities at IRD. DWR has experienced instances of IRD promises which were not fulfilled with the delivery of products.

4.6 Observations Regarding the State Data Coordination Network and Mapping Advisory Committee. As part of the institutional evaluation, the task force considered the characteristics of two entities that might be developed into a mechanism for user input to a natural resource information system: The State Data Coordination Network (SDCN) and a subgroup--the Mapping Advisory Committee (MAC). Both of these efforts were found to be valuable for the functions which they were designed to serve. However, neither was felt to be appropriate for a user advisory committee because:

- The SDCN is relatively new and has not yet had enough meetings to begin addressing their specific responsibilities. They have not yet developed their own constituency, and are not in a position to encourage or provide guidance to an information system.

- The SDCN objective is to encourage communication among users of all types of data, not just natural resource data. Because of this, the scope of the SDCN is too large to serve as an effective program "board of directors".
- The MAC subgroup is perceived by State agencies to have accomplished a great deal. However, their objectives are too specific for such a function. It is their job to develop state priorities for the production of topographic and other maps by the U.S. Geological Survey. Any state natural resource information system should, however, coordinate its activities with the MAC, and probably will be composed of many of the same participants.

# V. INSTITUTIONAL RECOMMENDATIONS

## 5.1 RECOMMENDED INSTITUTIONAL FRAMEWORK

The following paragraphs describe the recommended framework for a Natural Resource Information System for Arizona. For sake of convenience, the program will be referred to as the Arizona Information Network For Operational Resource Management--or the INFORM System. The narrative is intended to provide a summarized "conceptual design" as a point of departure. A great deal of work is, of necessity, left to be done by Arizona State agencies which ultimately would be responsible for the success of the system.

A "linked network" approach for an Arizona INFORM System is recommended for several reasons. The linked network concept defines certain agencies as members of the system and includes individual agency data and capabilities within the scope of the system. Such an approach would take advantage of current work in data collection and analysis capabilities within Arizona's agencies, and it could be established without a large "start up" general revenue appropriation.

Interagency involvement in INFORM should be ensured through establishment of a policy board and/or guidance committee composed of key natural resource agencies which are major users of natural resource data in Arizona. These major users would constitute the member agencies of the system. Certain other state or federal agencies and universities could be included as either voting or ex-officio participants, as needed. A high level of "user" input should

be available from the agencies to help guide the system development. Such a committee would help ensure that the system was responsive to all member agencies equally.

INFORM should primarily be designed to serve its member agencies. The best way to provide for continued participation in INFORM development is to provide benefits which equal or exceed member agency contributions. By cooperating in this effort, each participating agency will have access to a broader range of data and more sophisticated analytic capabilities. Other users should be served by INFORM to the extent possible within available resources.

An INFORM staff to support development and operation of the system should be established and housed in a host agency The scope of activities would dictate the size of the staff. For instance, a staff of 1 or 2 could conduct and publish inventories of state-held data, refer data users to those entities which collect and store the data, and provide technical assistance to users in the analysis and manipulation of natural resource and remote sensing data. Development of new automated capabilities to process geographic information and/or remotely sensed data would require a larger staff.

Additional functions which should be included in INFORM are: 1) train users in acquiring and using data, 2) monitor and interface with other systems in the federal government, in other states, or other operations in Arizona such as the State Data Center for census data, as appropriate, and 3) keep accurate accounting records to document system utilization.

The manager of the INFORM staff should be hired with the "advice and consent" of the policy board or guidance committee which is established to direct the system. (A draft job description for such a manager is contained

in Appendix V-A.) Additional staff should be hired by the manager. Approval of INFORM staff job descriptions by the committee may be desirable.

## 5.2 RECOMMENDED HOST AGENCY, AND INFORMATION SYSTEM FUNCTIONS

The Resource Team concurs that, based on current capability, the Arizona Department of Transportation is the most viable host agency for the core staff and capabilities for the INFORM System. An INFORM staff should be established and housed in an ADOT Division, perhaps Transportation Planning, to be determined by the ADOT management. Recommended functions for the information center to be established in ADOT are:

- maintain index of available data and referral services, including participation in such federal information systems as the National Cartographic Information Center (NCIC)*. Maps and orthophotoquads currently housed at SLD to support the NCIC function should be transferred to ADOT;
- develop a geographic information system--the data base, computer software and applications--and provide consultation services to users;
- develop Landsat analysis capabilities and conduct demonstrations with member agencies;
- provide outreach and training opportunities for state agencies;
- publish a newsletter for system users; and
- provide staff support to the Guidance Committee.

*The State Land Department is currently the NCIC affiliate office on behalf of the State of Arizona. NCIC is a service function established by the U.S. Geological Survey to index maps, aerial photography and Landsat imagery.

## 5.3 RECOMMENDED MEMBERSHIP OF THE INTERAGENCY GUIDANCE COMMITTEE

The Resource Team recommends that the Interagency Guidance Committee initially be composed of the eight primary users identified in the User Needs Survey. These are:

- State Land Department
- Department of Water Resources
- Department of Transportation
- Outdoor Recreation Coordinating Commission
- Game and Fish Department
- Department of Health Services
- State Parks Board
- Bureau of Geology and Mineral Technology (University of Arizona)

In addition, ex-officio representation from the Governor's Office, from appropriate state universities, and from managing agencies of federal lands in Arizona--the Bureau of Land Management, and the U.S. Forest Service--would be desirable. Other state, regional and local agencies could be added on the basis of need, as appropriate. The Arizona Department of Transportation would chair the committee and provide staff support through the INFORM staff.

The Guidance Committee should be established as soon as possible to review this report and the recommended system plan. This committee should also develop mechanisms to see that all potential users are kept appraised of system plans and status, and that these users have the opportunity to provide input to systems development plans.

# VI. DATA PROCESSING DEVELOPMENT PLAN

## 6.1 INTRODUCTION

The purpose of this document is to recommend a course of action leading to an operational natural resource data coordination and analysis network for the State of Arizona. The name proposed for this service bureau is the Arizona INFORM System -- Information Network For Operational Resource Management. The authors have recommended that the Arizona Department of Transportation (ADOT) implement this system.

This plan consists of a statement of Electronic Data Processing (EDP) objectives, a brief discussion of strategies and priorities, an outline of projects and tasks, and summaries of the resource requirements of the plan.

This systems planning effort was conducted on behalf of the Arizona Office of the Auditor General at the request of the Joint Legislative Budget Committee (JLBC). The Auditor General's Office, Performance Audit Division, recently completed a performance audit of INFORM's predecessor, the Arizona Resource Information System (ARIS), with technical assistance from the National Conference of State Legislatures (NCSL). At the conclusion of NCSL's technical assistance effort, NCSL staff offered to form a "Resource Team" to study the need for, and appropriate directions of, a resource analysis capability for Arizona State and local government.

During the July meeting of the JLBC, the committee passed a motion directing the Auditor General's Office to request NCSL assistance in

conducting the "Resource Team" efforts. NCSL, in cooperation with the Council of State Planning Agencies (CSPA), an affiliate of the National Governor's Association, formed a team of ten consultants with expertise in user needs, institutional arrangements and geographic information systems. During July, August, September and October, 1980, this group spent over six person months assessing the current situation and needs, and developing institutional and technical recommendations for a course of action for Arizona. This Electronic Data Processing (EDP) Development Plan represents the technical recommendations of the team, and has been written in accordance with the Department of Administration Data Processing Division's long range planning guidelines.

Members of the team had experience in developing similar programs in six states: Texas, Georgia, North Dakota, South Dakota, Minnesota and California. In addition, staff from NCSL, CSPA, NASA and the U.S. Geological Survey having similar experiences also participated actively in the project.

The Systems and Software Task Force of the "Resource Team" feel this plan lays out a number of critical elements needed to develop a sound system to locate, acquire, analyze and output resource-oriented data to assist policymaking, planning and management of Arizona resources.

## 6.2 EDP OBJECTIVES STATEMENTS

As host agency to an Arizona data reference service and geographic information systems data processing capability, the Department of Transportation will serve a wide array of state agencies in the areas of natural resources management. ADOT itself has important information systems objectives and needs, but they must be combined with the specific

needs and objectives of other state agencies. Currently, ADOT has an extensive EDP capability for performing traditional departmental tasks, but more manpower and hardware/software must be acquired to fulfill the expanded area of responsibility mentioned above. Specific objectives include:

1. Establish and participate in an interagency policy group to form policy and guidelines for an Arizona geographic data processing facility (the Arizona INFORM Program).
2. Provide map, aerial photo-related, and other natural resource data reference services to State, local and Federal agencies, the private sector and the public.
3. Organize an office, including staff and computer facilities, to process geographic data for Arizona user agencies.
4. Maintain a geographic data processing staff, of highest technical competence, responsive to the needs of user agencies. Staff capabilities will include program management, earth resources management and analysis, data location and analysis, systems analysis and computer programming.
5. Acquire new hardware to upgrade the existing hardware configuration and install software necessary to perform analysis of georeferenced data. As shown in the Plan Summaries, key families of software must be implemented, phased according to analysis requirements and complexity.
    a. Install a turnkey Landsat processing system on the Amdahl computer, conduct training in use of the software and conduct small project demonstrations. Landsat digital

satellite data is available routinely over the entire State, and can be processed to provide basic earth resources/land cover data for a number of key state agencies. The Department of Water Resources, for example, has an immediate and ongoing need for mapping irrigated croplands within the state; Landsat data can be used to provide this information. The State Land Department also has needs for Landsat-derived information.

b. Install basic computer file-manipulation and utility package on the INFORM minicomputer hardware. In order to incorporate other types of geographic digital data, fundamental utility functions must be implemented.

c. Implement polygon data capture and editing capability. Earth resources analysis and management is complex and usually involves consideration of a number of spatial variables. To digitally process geographic, spatial data, they must be digitized and placed in a machine-compatible, X-Y format. Techniques must be developed to correlate attribute data to each polygon and to allow for editing of digitizer data.

d. Implement a grid-based geographic information system. After geographic data has been converted to a digital format, it will be spatially aggregated and referenced to a grid (cell)-based format. When a set of such data has been referenced to a common base map projection, the data overlays can be compared and cross-tabulated, cell-to-cell.

e. Capture of data variables for a statewide data base. There are a number of basic earth resources data variables --

geology, vegetation, terrain, climate, land cover, land use, hydrology, soils, land ownership -- which are applicable to a wide array of applications for a number of state agencies.

f. Develop user-oriented site selection models and analysis packages. Once a required data base has been constructed, a state agency will have specific data modelling needs, e.g., specific analysis methodologies for quantitatively combining variables.

g. Implement basic Landsat processing capability, followed by implementation of advanced capability and integration into the geographic data base information system. In the paragraphs above, we described the immediate implementation of an off-the-shelf, turnkey Landsat processing system. Although such a system will be adequate to supply quickly the immediate data needs of key state agencies, a tailored system must be implemented to: 1) offload the Amdahl computer, 2) establish an interactive data processing capability, and 3) interface with geographic information system (data base) capabilities.

h. Implement a polygon-based geographic information system. As the last software implementation project of a three-year plan, the polygon-based GIS is the remaining package to be implemented to give the state complete, state-of-the-art GIS/Landsat EDP capability.

i. Upgrade/acquire hardware.

1) Almost immediately, a new CPU with 512K bytes memory and an internal array processor must be added to the existing hardware, and a new operating system (AOS Release 3.11) obtained. These upgrades will provide an extensive increase in data processing power.

2) Very soon afterward, procedures for obtaining a color matrix or ink jet printer/plotter and dual density tape drives should be started.

3) Six months after the above upgrades/acquisitions, a 192 MB disk and color image processing system CRT must be acquired.

4) During the third year of the INFORM program, operational services will be offered to primary users. New communications equipment and six user terminals must be acquired to service these users.

## 6.3 STRATEGIES AND PRIORITIES

This plan organizes a phased, three-year effort to develop automated resource analysis capabilities for the State of Arizona. Major tasks and equipment acquisitions are outlined in the balance of this plan.

One of the first major tasks of the plan is the development of an interim Landsat capability on the ADOT Amdahl computer. This capability is required to meet immediate and ongoing needs of the Department of Water Resources and the State Land Department.

The next major task is the assembly of the computer system which will do the processing for INFORM. The Information Resources Division of SLD currently has the basic computer hardware configuration required for INFORM. It was the judgment of the resource team that ADOT would be more capable of implementing the system, and the team, therefore, recommends that the IRD computer be physically transferred to ADOT at the beginning of the 1982 fiscal year.

Succeeding tasks in the plan call for the development of Geographic Information Systems (GIS) and modeling capabilities on the dedicated Data General Eclipse Minicomputer. Such a dedicated system is required because of the interactive nature of GIS processing, and the many specialized peripheral devices required to support a GIS capability.

Once a basic GIS capability is operational, system staff will concentrate on developing a Landsat capability on the DG Eclipse. This will allow much more sophisticated Landsat data analysis, and much more timely output production.

The final software development task will be implementation of an advanced GIS capability. This will provide sophisticated, state-of-the-art analysis capabilities for Arizona agencies.

It is anticipated that almost all of the above software will be adopted from existing packages. A number of states have developed Landsat and/or geographical information systems, and most are willing to share the results of their efforts with sister states for little or no cost. Georgia and South Carolina, for example, have developed DG Eclipse-based Landsat/GIS capabilities. Many Federal agencies and universities have similar systems, and might be willing to share. While such "begging and borrowing" sometimes takes a little creative research, the time saved on software development can be significant.

Hardware acquisitions called for in this plan are keyed to capability development efforts. The new CPU, color printer/plotter, tape drives and new operating system requested for the fiscal year 1982 budget are required for an efficient and balanced initial computer capability. The additional disk and color CRT requested in the fiscal year 1983 budget are required to support data base development and demonstration and Landsat interactive processing respectively. The final acquisitions--communications equipment and user terminals--are required to support operational applications and teleprocessing.

One of the initial objectives of the resource team effort was to design systems to meet three alternative levels of service:

- Mandated requirements only;
- Mandated requirements plus common user needs; and
- All practical user needs.

The computer systems and software required to meet the first two alternatives would be almost identical. A slightly larger systems staff and a great deal more user agency participation, however, would eventually be required to implement the second alternative. It is the recommendation of the Systems and Software Task Force that the program guidance or user advisory committee determine which options to implement within the next 18 months.

The task force felt that implementation of the third alternative would not be appropriate at this time. The initial system should be implemented and proven before the third service level is seriously considered.

## 6.4 SUMMARY

The resources required to support this plan represent a 20 percent increase over the FY 79 ARIS budget (including a 10 percent annual inflation adjustment). The redirection of efforts and enhanced staff capabilities will provide the State of Arizona with significant, sophisticated capabilities for analyzing land resource characteristics. These capabilities will greatly increase the amount and quality of resource data available to legislative and executive policymakers, provide significant assistance to state and local resource managers, and provide resource planners with the capability to model the impacts of alternative resource development scenarios.

This effort represents a significant undertaking and a substantial commitment on the part of the State. In the judgement of the Team, the benefits accruing to future generations of Arizonans, however, more than outweigh the costs.

## 6.5 PROJECT DESCRIPTIONS AND PLAN SUMMARIES

Following this section are a series of tables. The format of these tables was developed by DOA/DPD for use in developing long range data processing plans. Table VI-1 is a summary of the staff time (in person months) required to implement the first three years of the INFORM program. Table VI-2 is a summary of the salary and hardware expenses for the program over the same period. Table VI-3 and its continuations are project planning worksheets detailing the allocation of staff time to the various tasks required to develop the recommended INFORM capabilities. All three tables include several small but crucial long lead time activities which the Systems and Software Task Force feel should be initiated by ADOT and DWR in the current fiscal year.

It is important to note that Table VI-2 includes only salary and hardware estimates. The INFORM program should be initially staffed with six FTEs (full-time equivalent employees) and with eight FTEs in subsequent years. Computer equipment and related expenditures are estimated to be $116,500 for fiscal year 1981-82 with $94,000 and $46,000 suggested for the next two fiscal years. Items such as employee benefits, rent, photocopying, travel, supplies, telecommunications, printing, overhead, cost of living raises, R & D contracts with universities, and other similar expenses are not included. It will be necessary for ADOT management and budget analysts to prepare an actual budget submission based on the task force estimates and the types of expenses noted above.

It is the recommendation of the resource team that staff growth, additional hardware and a portion of the base be funded by user charges beginning in the 1985 fiscal year. Creation of a revolving fund will be necessary to facilitate interagency and intergovernmental fund transfers required to assess user charges for data and services. This revolving fund should be authorized in the INFORM enabling legislation.

Table VI-1
MANPOWER SUMMARY

| DEVELOPMENT PROJECT MANPOWER (FTE) | FY 81 | FY 82 | FY 83 | FY 84 |
|---|---|---|---|---|
| Amdahl Landsat system | 4.0 | | | |
| Staffing | 1.0 | 1.25 | | |
| Polygon capture development | | 6.0 | | |
| Utility package | | 1.5 | | |
| Grid GIS | | 8.0 | 12.0 | |
| Statewide data capture | | | 18.0 | 18.0 |
| Modeling and analysis | | 3.0 | 3.0 | |
| Basic Landsat | | | 27.0 | 4.0 |
| Advanced Landsat | | | | 36.0 |
| Preliminary Polygon GIS | | | | 3.0 |
| Hardware/software upgrade # 1 | .5 | 3.75 | | |
| Hardware/software upgrade # 2 | | 2.25 | | |
| Hardware/software upgrade # 3 | | 1.5 | 2.0 | |
| Hardware/software upgrade # 4 | | | .75 | 1.5 |
| NCIC support | | 6.0 | 6.0 | 6.0 |
| TOTAL PROJECTS | 5.5 | 33.25 | 68.75 | 68.5 |
| OTHER MANPOWER: PROGRAM MAINTENANCE | | | | |
| OPERATIONS | | | | |
| DATA ENTRY | | | | |
| OTHER | | | | |
| TOTAL OTHER | | | | |
| ( In Person Months) TOTAL MANPOWER | 5.5 | 33.25 | 68.75 | 68.5 |

Table VI-2
PLAN SUMMARY

| DEVELOPMENT PROJECT COST ($000) | FY 81 | FY 82 | FY 83 | FY 84 |
|---|---|---|---|---|
| Amdahl Landsat system | 8.3 | | | |
| Staffing | 2.0 | 2.6 | | |
| Polygon capture development | | 14.6 | | |
| Utility package | | 3.1 | | |
| Grid GIS | | 22.9 | 25.0 | |
| Statewide data capture | | | 27.0 | 27.0 |
| Modeling and analysis | | 6.2 | 6.2 | |
| Basic Landsat | | | 56.2 | 8.3 |
| Advanced Landsat | | | | 75.0 |
| Preliminary Polygon GIS | | | | 6.2 |
| Hardware/software upgrade # 1 | 1.0 | 7.8 | | |
| Hardware/software upgrade # 2 | | 4.7 | | |
| Hardware/software upgrade # 3 | | 3.1 | 4.2 | |
| Hardware/software upgrade # 4 | | | 1.6 | 3.1 |
| NCIC support | | 9.0 | 9.0 | 9.0 |
| TOTAL PROJECTS | 11.3 | 74.0 | 123.4 | 128.6 |
| OTHER COSTS: Equipment Purchase | | 84.5 | 71.0 | 23.0 |
| Maintenance | | 17.0 | 23.0 | 23.0 |
| Hardware maintenance equipment | | 15.0 | | |
| ADOT travel | 1.25 | | | |
| DWR software purchase | 1.8 | | | |
| TOTAL OTHER COSTS | 3.05 | 116.5 | 94.0 | 46.0 |
| TOTAL COSTS | 11.35 | 190.5 | 217.4 | 174.6 |
| TOTAL MANPOWER (FTE'S) (In Person Months) | 5.5 | 33.25 | 68.75 | 68.5 |

Table VI-3

# PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

**DESCRIPTION**

- Installation of turnkey Landsat processing software on Amdahl for Department of Water Resources and State Lands (most of staff provided by user agency)
- Training
- Small Project demos

**SCHEDULE**

| | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Installation | | X-X | | | | | | | | | | | | | | |
| Training | | X- | ----- | X | | | | | | | | | | | | |
| Small Project Demos | | | X- | ---- | ---- | ---- | ---- | -X | | | | | | | | |
| Interim Operational Landsat Capability | | | | | X- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | -X |

**COST ($000)**

| | FY 81 1 Q | 2 Q | 3 Q | 4 Q | FY 82 1 Q | 2 Q | 3 Q | 4 Q | FY 83 1 Q | 2 Q | 3 Q | 4 Q | FY 84 1 Q | 2 Q | 3 Q | 4 Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| 1. ADOT (travel) | | 1.25 | | | | | | | | | | | | | | |
| 2. Software purchase (DWR) | | 1.8 | | | | | | | | | | | | | | |
| TOTAL | | 3.05 | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE's (person months) | | 1.0 | 2.0 | 1.0 | (As required by user applications projects) | | | | | | | | | | | |

Table VI - 3 (cont.)

# PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

**DESCRIPTION** — STAFFING

- Definition of criteria
- Project manager recruitment
- System software specialists recruitment
- Applications software specialists recruitment
- Secretary
- Data encoding technicians/draftsmen

**SCHEDULE**

| | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Definition of criteria | | X-X | | | | | | | | | | | | | | |
| Project Mgr. search/hire (1) | | | | X----- | -X | | | | | | | | | | | |
| Secretary (1) | | | | X----- | -X | | | | | | | | | | | |
| Systems search/hire (2) | | | | X-------- | | -X | | | | | | | | | | |
| Applications search/hire (2) | | | | X-------- | | -X | | | | | | | | | | |
| Data encoders search/hire (2) | | | | | | | | X----- | -X | | | | | | | |

**COST ($000)**

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE'S (person months) | | .5 | .0 | .5 | 1.0 | | | .25 | | | | | | | | |

Table VI - 3 (Cont.)

# PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

DESCRIPTION: PROVISION OF NCIC SERVICES

| SCHEDULE | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| NCIC Services | | | | | X---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| COST ($000) | | | | | | | | | | | | | | | | |
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE'S (person months) | | | | | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |

Table VI - 3 (cont.)

PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

DESCRIPTION

Implementation of Polygon data capture and editing capability

- Arc/node digitizing/capture procedure integration
- Arc/node conversion (chaining) to polygon
- Interactive data editing
- Ancillary data file entry and manipulation
- Conversion of files to geographic data base structure (cells, polygons) coordinate system

| SCHEDULE | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Arc/node capture | | | | | | X---- | ----X | | | | | | | | | |
| Chaining | | | | | | X---- | ----X | | | | | | | | | |
| Editing | | | | | | X---- | ----X | | | | | | | | | |
| Ancillary File | | | | | | | XX | | | | | | | | | |
| Resample | | | | | | | X-X | | | | | | | | | |

| COST ($000) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE'S (person months) | | | | | | 2.0 | 4.0 | | | | | | | | | |

Table VI - 3 (cont.)

PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

DESCRIPTION

Basic File manipulation and utility package

- Copy files and tapes
- Polygon to grid conversion
- Binary, ASCII, EBCDIC, hexadecimal, integer dump routines

| SCHEDULE | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Copy files | | | | | | | X--X | | | | | | | | | |
| Polygon to grid | | | | | | | X---X | | | | | | | | | |
| Dump utility | | | | | | | X--X | | | | | | | | | |
| COST ($000) | | | | | | | | | | | | | | | | |
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE'S (person months) | | | | | | | 1.5 | | | | | | | | | |

Table VI - 3 (cont.)

PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

**DESCRIPTION**

Implementation of Grid based Geographic Information System (IMGRID type system)

- Data display
- Overlay
- Index (weighted)
- Matrix
- Recode
- Search (proximity)
- Asearch
- Normalize

-etc-

**SCHEDULE**

| | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Implementation | | | | | | | X- | ---X | | | | | | | | |
| Training | | | | | | | | X--- | X | | | | | | | |
| Demonstration projects on Arizona data | | | | | | | | X-- | ------ | --X | | | | | | |
| Operational Geographical Analysis Capability | | | | | | | | | X--- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

**COST ($000)**

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE's (person months) | | | | | | | 3.0 | 5.0 | 6.0 | 6.0 | (as required by project coord. | | | | | |

Table VI - 3 (cont.)

PROJECT PLANNING WORKSHEET

PROJ. NO. _____

USER _____

DATE _____

PRIORITY _____

DESCRIPTION

Capture of data variables for statewide data base

| SCHEDULE | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Data capture | | | | | | | | | X---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| COST ($000) | | | | | | | | | | | | | | | | |
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE's (person months) | | | | | | | | | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |

Table VI - 3 (cont.)

PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

**DESCRIPTION**

Development of user oriented site selection models and analysis packages

Water runoff
Physical site selection
Multi-resource combination models
Proximity models

Simulation modeling

**SCHEDULE**

| | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Model development | | | | | | | | X- | - | - | - | - | - | - | - | - |
| Test and Evaluation | | | | | | | | X- | - | -X | | | | | | |
| Operational modeling capability | | | | | | | | | | X- | - | - | - | - | - | - |

**COST ($000)**

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE's (person months) | | | | | | | | 3.0 | 3.0 | | | | | | | |

Table VI - 3 (Cont.)

PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

**DESCRIPTION**

Implementation of basic Landsat processing capability
- Data display (grey scale)
- Integration of image analysis system software and hardware
- Clustering
- Training sample selection (histograms,etc.)
- Maximum liklihood classification
- Level slicing and density stretch (linear or nonlinear)
- Polygon retrieval of Landsat classified data
- Dehazing
- Destriping

**SCHEDULE**

| | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Implementation and conversion of basic Landsat software | | | | | | | | | | X---- | ------ | -X | | | | |
| Testing and evaluation of software | | | | | | | | | | | X---- | ----- | --X | | | |
| Training | | | | | | | | | | | X---- | ----- | --X | | | |
| Operational Capability | | | | | | | | | | | | | X--- | ---- | ---- | ---- |

**COST ($000)**

| | FY 81 1 Q | 2 Q | 3 Q | 4 Q | FY 82 1 Q | 2 Q | 3 Q | 4 Q | FY 83 1 Q | 2 Q | 3 Q | 4 Q | FY 84 1 Q | 2 Q | 3 Q | 4 Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE's (person months) | | | | | | | | | | 5.0 | 11.0 | 11.0 | 4.0 | | | |

Table VI - 3 (Cont.)

PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

**DESCRIPTION**

Implementation of advanced Landsat Processing capability and its integration into a geographic data base

Image Enhancement
- spatial filtering
- sinusoidal stretch
- ratioing
- principal axis
- linear combination

Geometric Corrections
- geometric rectification (raw or classfied)
- geometric registration (raw or classified)
- change detection
- integration into geodatabase by resample

**SCHEDULE**

| | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Implementation | | | | | | | | | | | | | X---- | ----- | ----X | |
| Testing and Evaluation | | | | | | | | | | | | | | X--- | ----- | ----X |
| Training | | | | | | | | | | | | | | | X--- | ----X |
| Enhanced operational capability | | | | | | | | | | | | | | | | X---- |

**COST ($000)**

| | FY 81 1 Q | 2 Q | 3 Q | 4 Q | FY 82 1 Q | 2 Q | 3 Q | 4 Q | FY 83 1 Q | 2 Q | 3 Q | 4 Q | FY 84 1 Q | 2 Q | 3 Q | 4 Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE's (person months) | | | | | | | | | | | | | 6.0 | 11.0 | 11.0 | 8.0 |

Table VI - 3 (Cont.)
PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

DESCRIPTION

Implementation of Polygon based Geographic Information system
- Display and retrieval of polygon information
- Retrieval of ancillary data
- Polygon overlay (by line segment)
- Polygon overlay (conversion to grid for overlay)
- Statistics compilation
- Error correction and update
- Multiresource modeling using binary decisions

| | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| SCHEDULE | | | | | | | | | | | | | | | | |
| Implementation | | | | | | | | | | | | | | | | X---- |
| COST ($000) | | | | | | | | | | | | | | | | |
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE's (person months) | | | | | | | | | | | | | | | | 3.0 |

Table VI - 3 (cont.)

# PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

## DESCRIPTION

- Procure a new CPU with internal array processor and 512K memory ($44-54K)
- Move, reconfigure and operationalize system and peripheral devices
- Install new operating system (AOS release 3.11--$3.5K)

## SCHEDULE

| | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Develop specs & issue RFP | | | X--- | -X | | | | | | | | | | | | |
| Obtain bids | | | | X | | | | | | | | | | | | |
| Selection, award & purchase | | | | X----- | -X | | | | | | | | | | | |
| Delivery and acceptance | | | | | X---- | -X | | | | | | | | | | |
| Move existing equipment | | | | | X-X | | | | | | | | | | | |
| Integrate all devices in new configuration | | | | | X-X | | | | | | | | | | | |
| Equipment/OS operational | | | | | | X---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- | ---------- |

## COST ($000)

| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE's (person months) | | | .25 | .25 | 3.0 | .75 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |

Table VI - 3 (Cont.)

PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

**DESCRIPTION**

Obtain color matrix or ink jet printer/plotter ($14K- $16K)

Obtain 2 dual density tape drives ($11K)

**SCHEDULE**

| | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Develop specs & issue RFP | | | | | X---X | | | | | | | | | | | |
| Obtain bids | | | | | | X | | | | | | | | | | |
| Selection, award & purchase | | | | | | X---X | | | | | | | | | | |
| Delivery & acceptance | | | | | | | X-----X | | | | | | | | | |
| Equipment operational | | | | | | | | X---------- | | | | | | | | |

**COST ($000)**

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE's (person months) | | | | | .25 | .25 | .25 | 1.5 | | | | | | | | |

Table VI - 3 (Cont.)

PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

DESCRIPTION

Add 192MB disk - $31K

Add color CRT - $30-$40K

| SCHEDULE | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Develop Specs & issue RFP | | | | | | | X---- | X | | | | | | | | |
| Obtain bids | | | | | | | | X | | | | | | | | |
| Selection, award & purchase | | | | | | | | X---- | X | | | | | | | |
| Delivery and acceptance | | | | | | | | | X---- | X | | | | | | |
| Equipment operational | | | | | | | | | | X---------- | | | | | | |

| COST ($000) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE'S (person months) | | | | | | | 1.0 | .5 | 2.0 | | | | | | | |

Table VI - 3 (cont.)

## PROJECT PLANNING WORKSHEET

PROJ. NO. _____
USER _____
DATE _____
PRIORITY _____

**DESCRIPTION**

- Acquire new communications equipment $15K
- Acquire 6 user terminals $7-8K

**SCHEDULE**

| | FY 81 | | | | FY 82 | | | | FY 83 | | | | FY 84 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q | 1 Q | 2 Q | 3 Q | 4 Q |
| Develop specs & issue RFP | | | | | | | | | | | X----- | X | | | | |
| Obtain bids | | | | | | | | | | | | X | | | | |
| Selection, award & purchase | | | | | | | | | | | | X----- | X | | | |
| Delivery & acceptance | | | | | | | | | | | | | X---- | X | | |
| Equipment operational | | | | | | | | | | | | | | X---- | ---- | ---- |

**COST ($000)**

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL | | | | | | | | | | | | | | | | |
| EQUIPMENT | | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | |
| ANNUAL TOTALS | | | | | | | | | | | | | | | | |
| MANPOWER - FTE'S (person months) | | | | | | | | | | | .25 | .5 | 1.5 | | | |

DEPARTMENT OF ADMINISTRATION
DATA PROCESSING DIVISION

STATE OF ARIZONA

THE CAPITOL
PHOENIX, ARIZONA 85007
(602) 255-3669

BRUCE BABBITT, GOVERNOR
ROBERT C. DICKESON, DIRECTOR
JACK STANTON,
ASSISTANT DIRECTOR

October 3, 1980

Ms. Coni R. Good
Office of the Auditor General
Legislative Services Wing
State Capitol Room 200
1700 West Washington
Phoenix, Arizona 85007

Dear Coni:

SUBJECT: REPORT ON USER NEEDS ASSESSMENT AND SYSTEM PLAN FOR AN ARIZONA NATIONAL RESOURCE INFORMATION SYSTEM

We have reviewed the report of the study team and, with respect to those matters of concern to this office, fully concur in and support the conclusions and recommendations presented. It is our feeling that the Data Processing Development Plan, while ambitious in terms of the past record, is not only the correct course of action but is an urgently needed formula for restoring the natural resource information function to a high level of usefulness in the State of Arizona.

The extremely valuable work of the study team, as reflected in their report, warrants a serious commitment by all of us to move forward and complete the job they have defined.

Very truly yours,

Jack Stanton
State Automation Director

JS:jf

THE UNIVERSITY OF ARIZONA

TUCSON, ARIZONA 85719

OFFICE OF ARID LANDS STUDIES
APPLIED REMOTE SENSING PROGRAM
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October 10, 1980

Ms. Coni Good
Office of the Auditor General
Legislative Services Wing
Room 200
State Capitol
Phoenix, AZ 85007

Dear Ms. Good:

I have received a draft copy of the report prepared by the NCSL/CSPA Resource Team, "User Needs Assessment and System Plan for an Arizona Natural Resources Information System." Aside from some minor corrections in the text, we are in general concurrence with the report, so far as it affects this office and our program.

As we stated in the interview, we feel the appropriate role of our program to be one of providing technical support and training. We were pleased to see that this was recommended in the report. Regardless of the impact of the NCSL/CSPA report, we will continue to pursue our perceived role of supporting the state in any of its resource activities.

Thank you for allowing us the opportunity to comment.

Sincerely,

CF Hutch

Charles F. Hutchinson,
Director, Applied Remote
Sensing Program

CFH/jcf

XC: J. Johnson
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BRUCE BABBITT
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OFFICE OF
STATE LAND COMMISSIONER

October 27, 1980

Ms. Coni Good
Supervisor
Performance Audit Division
Legislative Services Wing
Suite 200 - State Capitol
Phoenix, Arizona 85007

RE: Final Report of the NCSL/CSPA Resource Team

Dear Ms. Good:

The purpose of this letter is to comment on the final report of the NCSL/CSPA Resource Team. These comments supercede the comments made in the Commissioner's October 1st letter to you.

Hardware and Software Capabilities
The State Land Department (SLD) concurs with the findings of the report regarding the level of sophistication of available computer hardware and software in the IRD system.

User Needs
SLD is in agreement with the report's conclusion that there is an overwhelming need for coordination of natural resources in the state, and for a central access point to obtain and process those data. SLD agrees with the conclusions in the report that SLD divisions would be major users of such a system.

Institutional Issues
SLD agrees with the Task Force that the ideal institutional approach to data collection and dissemination would be an Information Services Center established in a host state government agency with an inter-agency guidance committee. However, in our opinion, the host agency approach would provide better service if the host agency is a major user of the system and the major users of the system, particularly SLD and Department of Water Resources, were housed in the same building.

There are several reasons why this is important. First, any major user must be close to the source regardless of which agency is designated host agency. Second, it would reduce the need for more terminals. Third, closer contact would be provided for computer analysts, programmers, and systems specialists employed by the host agency, thereby improving coordination. And finally, it would enhance the ability of major users in the development of programs that would solve their mutual needs and problems.

With respect to the discussion beginning on page 10 of the report concerning institutional arrangements SLD offers the following comments:

1. SLD disagrees that the Arizona Department of Transportation (ADOT) and Department of Water Resources (DWR) are more suited as a host agency for INFORM than SLD. Given adequate levels of staff and funding as recommended by the report any of the three agencies could suitably perform the task as host for the system.

2. SLD takes exception to the statement "it will be some time before SLD will have developed capabilities that would support its own needs, much less an inter-agency system" in light of the strong Task Force recommendations for increased funds and staff. In the absence of proper funding and staffing levels the above quoted statement would probably be true for ADOT and DWR as well.

3. The report describes SLD as being in transition and re-defining its role as trustee of public lands. We believe this is a positive factor in support of SLD rather than a negative factor as used in the report. Greater emphasis is being placed on strengthening trust responsibilities, particularly in the areas of revenue production and resource management. One tool SLD plans to rely heavily upon in improving management of state lands is the IRD/ARIS data base system. Therefore, the emphasis placed on IRD, the vital source of information for decision making, has grown dramatically within the last year. The results of the Task Force's User Needs Study is indicative of the importance placed by departmental managers on a sophisticated data base system. This new awareness should credit the Land Department in the evaluation.

4. Another point made to support ranking SLD below ADOT and DWR is insufficient staff experience. Again, if the success of INFORM is dependent upon adequate staff and funding yet to come, then this point is not relevant.

The Department would caution that rising expectations of a successful INFORM system could be jeopardized by failure to recognize that basic data collection is necessary before sophisticated data manipulation can become a reality. In many state agencies, including the State Land Department, natural resources data is sparse or outdated for many areas of the state. For example, the Land Department presently has about 16% of all sections platted. Completion of plats is essential before sophisticated modeling can be done with the water, range, forest, and other data that is being collected by various divisions within the Department. In short, we must be able to walk before we can run.

SLD would like to commend the Task Force for their diligent efforts in performance of a difficult task in such a short period of time, particularly in the area of Users Needs Study.

Sincerely yours,

Robert K. Lane
Deputy State Land Commissioner

RKL:sjb

Mailgram:
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cc: Joe Fallini

State of Arizona

DEPARTMENT OF WATER RESOURCES

222 North Central Avenue, Suite 850, Phoenix, Arizona 85004

October 29, 1980

Ms. Coni Good
Auditor General's Office
112 N. Central Ave.
Suite 600
Phoenix, AZ 85004

Dear Ms. Good:

We have reviewed the task force recommendations for an Arizona Natural Resources Information System. We agree that the agencies of the State need automated capabilities to store and process large amounts of natural resources data. We also feel that given the current capabilities of natural resource agencies in the areas of data processing applications, the Department of Transportation is the logical choice for host at this time of an automated natural resources information system.

However, any recommendations which are made regarding such a system should stress the requirement that the basic reason for creating the system is to serve the needs of the several users. Equipment, personnel and the necessary funds must be dedicated to support an interagency data network which would be centered at DOT. The staff manager of this program should be totally responsible to the proposed Interagency Guidance Committee. All policy and program decisions should be made by the proposed committee to insure that the needs of the user agencies are met. The purpose of the proposed natural resources information system must be to support the operation of the natural resource agencies. If this purpose is not met the potential benefits of this information system will most likely not be realized.

Sincerely,

Wesley E. Steiner
Director

# APPENDIX I-A

## TECHNICAL ANALYSIS OF THE CURRENT AND PROPOSED ARIZONA RESOURCE INFORMATION SYSTEM (ARIS)

# TECHNICAL ANALYSIS OF THE CURRENT AND PROPOSED ARIZONA RESOURCE INFORMATION SYSTEM (ARIS)

Final
Report

Prepared by:

Paul A. Tessar, Director
Natural Resource Information Systems Project
National Conference of State Legislatures
1405 Curtis Street
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## BACKGROUND

The Arizona Auditor General's Office, Performance Audit Division, is currently performing a program audit of the Arizona Resource Information System (ARIS). The ARIS program, formerly a division of the Department of Revenue, is being implemented by the Information Resources Division of the State Land Department.

Staff from the Auditor General's Office requested technical assistance in executing the program audit from the National Conference of State Legislature's Natural Resource Information Systems Project. This report is intended to respond to this request and address the specific technical assistance objectives of the Auditor General's Office. (See Appendix B)

The focus of this report is on the hardware, software and applications - present and future - of ARIS. The National Cartographic Information Center (NCIC) local assistance function, the orthophotoquad program, and especially the engineering section were not investigated in depth and are dealt with only in a cursory fashion.

The findings in this report are based on two three-day visits to Phoenix, several interviews with ARIS staff, numerous phone conversations, several demonstrations of current ARIS capabilities and the expertise of the author in implementing a similar program in the State of South Dakota over a three-year period. All conclusions are those of the author and do not represent official views of NCSL or any other organization.

NCSL would like to thank the Arizona Auditor General's Office for providing this opportunity to supply technical assistance services to the Arizona Legislature.

## ARIS SOFTWARE, DATA FILES AND APPLICATIONS

ARIS, through a variety of circumstances, has developed a fairly sophisticated computer hardware configuration. System software, however, is in a rudimentary, developmental stage. Current software can, for the most part, be characterized as simple record-keeping routines.

*System Software - Current*

Based on demonstrations observed, there currently appears to be little software operational on the system. The software package utilized for most applications is ADS/APS (Applications Definition System/Applications Processing System). This package is used for three basic purposes:

- compose CRT "screens" for data input, onto which a clerk superimposes the desired inputs for archival;
- compose CRT "screens" for data retrieval, upon which data from the archives is displayed; and
- format hard copy reports and summaries of system files.

These applications do not justify the current sophisticated hardware configuration. They could be very easily supported on a time-share mainframe administrative computer although conversion to another computer system might be expensive and time consuming. Current applications programs utilizing this ADS/APS facility and their present, near future and eventual uses include:

- Water Rights Claimant Master Record System. Contains 1 record for each "statement of claimant" that has been filed under the adjudication process of the State Water Commission. Information stored will include name of the claimant; date, amount and source of the claim; and types, quantities and areas of permitted uses. There are currently about 2,800 claims in the file, with about 10,000 total claims expected upon completion of the two basins in the adjudication process. Currently operational capabilities are limited to inquiries and summary reports

of claims already entered into the system.

Major near future uses could include automation of adjudication of claim disputes, provision of input data for water use models, and evaluation of the impacts of applications for new claims. According to ARIS staff, some parts of the water use model are implemented (for example, total water use by 50-square mile areas can be calculated), some are not; all require a hydrologist's skills to run, and the model is not currently used.

Eventual usage, in conjunction with Landsat data, could be to monitor irrigation areas to assure that claimants utilized no more water or irrigated no more land than their permits allowed. This application is of interest to the State Water Commission and the Agricultural Appraisal Section of the SLD.

- Fire Management System. There are two major data files in this system. The station file contains information such as the station name, phone numbers and location, and supervisor's name and home phone. The equipment file contains listings and descriptions of all equipment. Current software allows inquiries on equipment and personnel by individual stations and summary reports of all stations and equipment. Some state stations (approximately 200 of the 2,000 existing) and equipment (approximately 1,500 pieces of 5,000 total) are in the data files. Current procedures are to manually locate stations near a fire on a map and use the software and files to determine personnel and equipment available to assist their dispatch in a timely fashion.

  Major near future use will be to automatically locate the three stations nearest to a fire site. A zone file will be used to divide the state into districts for each station's immediate range of effective response. Federal rural fire stations and equipment will also be added to the system.

In two years, the information in this system will be used to help prepare the state fire management plan. Eventually, a fire fuel model will also be added to the system. This will allow fire control personnel to model the dynamics of a wildfire so that real time management decisions can be made, such as whether to suppress a fire, merely contain it, or allow it to run its course.

- Urban Forestry Data File. There are three types of records in this system. The first is the Master Town File which has administrative information on participating municipalities (Phoenix, Scottsdale, Fredonia, Pima County Parks, Tuscon and South Tuscon). The second is the species file, which contains individual records of 105 species, their value, etc. The third type is the individual tree file, which contains thousands of records - one for each park and street tree - and includes information such as species, location, condition, value, required maintenance, etc. The major applications (by only Scottsdale to date) were scheduling of tree maintenance, valuation of existing municipally-owned trees, assisting the budget process, and assistance in planning future plantings.

  This application system is not currently used. Most of the user agencies are no longer funded for this program, and the State Land Department staff person who knew how to run the system and utilize the results has left for other employment. There are plans to hire a new Urban Forester in the Forestry Division of SLD, and it is likely that Phoenix will renew funding to participate in the system at that time.

- Forestry Tree Seedling Management System. This system has two basic types of data files. The first, which contains about 25 records, is the seedling availability file which lists the number of trees available by species. The second, which contains hundreds of records, is the

seedling order file. Each pickup or mailout order is listed on one record, along with information on the orderer and order costs, shipping dates, and purpose of the planting (e.g. windbreak).

There are data in the files on tree orders back through 1976. Current uses are to schedule seedling removal, keep track of inventory still available, coordinate distribution to orderers (by mail) or to pickup centers, and summarize program activities for management purposes. These tasks were formerly done with manual files. They were automated because of the difficulties of storing, organizing and accessing the data in a manual system with a staff of two clerks. This staff is now able to keep ahead of the workload because of the assistance of the computer. The system is operated remotely from the Flagstaff office.

Near future use, after software development is completed, will be to select a random sample of customers after one- and five-year periods to determine whether the trees were planted properly and to document their current conditions. State law requires all orders to be checked on after one- and five-year intervals, but limited manpower makes this impossible.

- Automated Drafting System. This system is used to assist the engineering section by automating the drafting of maps of State Trust Lands and land status. Proprietary routines from ESCATEC, Engineering Automation ("Eagle" Package), Talos digitizer and Zeta plotter have been combined in this system to interface the necessary hardware and software.

Rough, hand-drawn maps are input to the system via the Talos digitizer. Engineering calculations (e.g., bearing and range, areas, etc.) are performed within the system automatically. Final output maps (each of a 1-square mile area) are drawn on the Zeta plotter at varying scales.

An additional option exists to input standard legal descriptions rather than digitized map data. Calculations and output are the same as above.

*Systems Software - Developmental*

A number of software systems are currently in varying stages of development. These include:

- ESCATEC - A generalized Geographic Information Systems (GIS) software package developed by a California firm for Data General minicomputers. To date, only those routines needed to support automated drafting applications by the engineering section have been implemented (see preceding section).

  Implementation of the remaining portions of the package should allow more sophisticated geographic data entry, manipulation, analysis and output.

- Landsat Analysis Software - Several software packages (from Georgia Tech, JPL and NASA/Ames) are available but have not yet been implemented due to time constraints.

- ECOSIM Model - An ecological component simulation for use in forest management. Version 1 is available but nonfunctional. Software modules developed by the University of Arizona did not function and were not properly documented. A functioning and documented Version 2 is currently being developed by the U.S. Forest Service Range Experiment Station at Arizona State University with cooperation from the Flagstaff SLD office, and will be implemented by ARIS when complete.

- Water use simulation model - Will use data from Water Rights file to model surface and groundwater usage and aquifer depletion. Appears to be only conceptual at this point.

- Range carrying capacity and herbage production model - Will use data from the Range Division and Landsat to determine range carrying capacity, occurrences of overgrazing, vegetation regeneration etc., for use in range modeling and management, with a capability to produce map outputs. According to ARIS staff, 2/3's of the software is ready to use, mapping is just getting underway, and the software for the range management model must still be developed.
- Minerals system - To be implemented during the next fiscal year. According to ARIS staff, engineering data on mine location, size and dimensions will be entered to the system for baseline data to enforce lease provisions in court. Eight thousand records of mineral and mining operations, located at three different sites, will be entered, centralized and streamlined.

*Summary of Current Range of Applications*

The current system, once ongoing data entry and limited software development are complete, will support the following missions:

- Systemize and automate water rights records to simplify adjudication of competing claims and to assist allocation of new water rights;
- Assist city park departments in scheduling tree maintenance and monitoring tree conditions (not currently used);
- Assist State Forester in administering tree seedling program and monitoring program results and compliance; and
- Automate the drafting of State Trust Lands and land status maps.

*Future Range of Applications*

With the existing hardware, moderate software enhancement and expanded automated data files, the system could support the following missions and applications:

- Automate fire station and equipment inventories to assist in timely and adequate responses to wildfire emergencies;
- Assist the assembly, input, preprocessing, analysis, comparison and use of various types of mapped or imaged natural resource data (e.g., land cover, hydrology, soils, topography, geology/minerals, environmental quality, development constraints, wildlife habitat, agricultural productivity, climatic factors, etc.);
- Produce output maps and statistics to facilitate use of quantitative natural resource data factors and models in resource planning, management and monitoring;
- Monitor land and water cover and surface conditions on a monthly, state-wide basis through the use of Landsat data;
- Assist forest management of state lands through the use of ECOSIM model;
- Analyze and quantify groundwater usage to assist in water resource development and management;
- Monitor water usage (irrigation) to determine if permitted water rights are being observed through the use of Landsat and water rights files;
- Monitor agricultural land usage (double or triple cropping) through the use of Landsat and a state lease provision file, to determine if lease provisions on state-owned lands are being observed;
- Assist the management of state-owned rangelands; and
- Assist the enforcement of mineral leases on state lands.

*Future Range of Landsat Applications*

Landsat is one of the most promising applications technologies being incorporated in ARIS. In 1982, two new Landsats with a ground resolving power of less than 100 ft. will be launched. Many applications requiring finer detail than current satellites can provide (260 ft.) will become feasible. Given Arizona's relatively cloud-free skies, repetitive, statewide coverage every eight days should be available. Below is a sampling of the types of applications possible in Arizona with this next generation of Landsat.

- Water Resources
  - Locating and mapping surface water bodies;
  - Mapping the extent of snow cover to predict future supplies and warn of potential flood conditions;
  - Estimation of water usage by irrigated agriculture; and
  - Monitoring of flood extent and damage.
- Agriculture
  - Crop and cropland inventories;
  - Estimation of yields;
  - Monitoring of crop disease and insect infestations;
  - Mapping and identification of irrigated crops; and
  - Rangeland management.
- Forestry
  - Timber inventories;
  - Forest type mapping;
  - Forest harvest monitoring; and
  - Disease and stress detection.

- Routing and Siting
  - Selection of transportation and transmission corridors;
  - Analyzing environmental impacts of energy facility development; and
  - Location of potential resource development opportunities.
- Wildlife Habitat Analysis
  - Mapping of vegetation types;
  - Monitoring urban encroachments on wildlife areas; and
  - Estimation of carrying capacities.
- Geologic Applications
  - Mineral exploration;
  - Detection of geologic hazards (faults, slide zones, etc.); and
  - Exploration for groundwater.
- General Applications
  - Mapping of urban and rural land cover;
  - Land cover change detection;
  - Location of flood plain areas;
  - Monitoring of surface mine expansion and reclamation; and
  - Studying man's impact on the land.

*Status of Other Data Files*

The general applicability of any geographic resource information system must rest upon a solid foundation of spatial data files. While there are spatial attributes in some of the previously discussed files (i.e., location of fire stations, water diversion points or wells), they are not geographically based files.

Although there are many plans to develop a spatial data base, and many promising applications of such data, there are currently no systematic, automated files on land cover, range resources and conditions, forested areas, wildlife habitat areas, mineral resources, water resources or any other topics of interest. A state-wide digital topographic file is currently on order and, once the ESCATEC package is running, will provide useful topo and slope data.

## ARIS HARDWARE

This section is rather technical. Some readers may choose to skip ahead to the next section, *Remote Sensing Applications*, beginning on Page 20.

*Current Hardware Configuration*

- Data General Eclipse S130 Central Processing Unit with 256K main memory
- Data General Nova 800 CPU with 32K memory
- 800 BPI tape drive
- 192 Megabyte (MB) removable disk pack
- 10 Megabyte removable disk pack
- 2.5 Megabyte disk pack
- Three 1 Megabyte disk packs (currently inoperable)
- 300 lines per minute line printer
- Teletype Model 33 terminal with paper tape reader
- Dasher CRT master console
- Communications hardware for dial-up user terminals
- Digitizer Station
  - Very large Talos graphic tablet digitizer table
  - CRT control station (COPS-10)
  - Microprocessor control
  - Rear projection equipment to use digitizer as a "screen" for image data
- Graphics Station
  - Zeta 36" 4 pen plotter
  - Tektronics 4010 Graphics CRT
  - Microprocessor control
  - Dasher CRT user terminal

- National Cartographic Information Center Remote Inquiry Station (not interfaced with rest of system)

  - Tektronics 4010 Graphics Terminal

  - Dedicated phone line and modem

*Uses of Hardware*

- CPU's - S130 is the heart of the system. It performs all data processing except routine formatting and calculations performed by digitizer and graphics microprocessors. The S130 is also used to "drive" all the rest of the system peripherals. Main memory of 256K Bytes is barely adequate for current applications.

  - The Nova 800 CPU is a virtual "museum piece".

  Unavailability of maintenance service along with extremely limited memory (32K), and inability to concurrently service multiple users severely limits capabilities on the old CPU.

- Data Storage Hardware - 800 BPI tape drive is used for tape input and output. Through the use of tape, large data files can be stored "off-line" until they are needed, thus minimizing the need for "on-line" storage. The lack of a capability to read 1600 BPI tapes presents a small, but not insurmountable, problem.

  - 192 MB removable disk drive is used for all "on-line" data storage and retrieval. All systems and application software, as well as the current small data files are housed on this drive.

  - The three 1 MB disk packs are currently inoperable. They are dated, outmoded, and their manufacturer has gone out of business.

- Input/Output Peripherals - Teletype 33 is used for systems console on the Nova 800.

  - Dasher Terminals. One is used as a user work station. The other is used as a systems console for the S130. Both are adequate alphanumeric terminals.

- Line Printer is used for alphanumeric hard copy listing. The 300 lines per minute output speed is adequate for current and future operations.

- Tektronics 4010 Graphics Terminals. One is used as an alphanumeric NCIC terminal. The other is used as an alphanumeric control terminal for the ZETA plotter. Neither are currently used in graphic mode.

- Talos digitizer is used to translate mapped or image data to a computer compatible format. This allows the data to be processed digitally. A COPS-10 terminal is used in conjunction with the Talos as a central unit.

- ZETA drum plotter is used to output digital data files in a graphic format.

*Level of Equipment Utilization - Current and Recommended*

- CPU's - The NOVA 800, Teletype 33 console, and 2.5 MB disk are not currently utilized. The 800 should be surplused, the Teletype used as either the console for the S130 or as an additional user terminal, and the 2.5 MB disk either surplused or used on the S130 system.

  - The Eclipse S130 is currently very underutilized, but will be used much more fully in production mode. Use of a sophisticated Dasher terminal as a systems console is probably not necessary - the teletype or another cheap ( $1000) terminal would be adequate for this function. CPU speed is adequate for implementation of an operational system. Memory may be adequate for initial development phase, but will soon need to be expanded to 512K for any operational work.

- Data Storage Hardware - 800 BPI tape drive does not appear to be over-utilized. This single tape drive should be adequate, although uncomfortably, for systems development phase. A second 1600/800 BPI tape drive will be required for a fully operational system. For now, 1600 BPI tapes can be translated to 800 BPI format using the ADOT or other large computers, and the 192 MB disk used for intermediate output files with a copy step to tape for later archival. The latter is somewhat inconvenient and time consuming, but should not present major problems.

  - 192 MB Disk Pack is currently very underutilized. This situation will change as data files are filled, however.

  - 10 MB Disk Pack is used to store backup operating system and other software. This pack should be used to store primary and applications software and data files, such as the fire station file, which must be accessible at all times. This would allow multiple disks to be mounted on the single 192 MB drive sequentially. This would require

scheduling of users in some cases, but would greatly increase disk storage capacity at very little cost ($50 per disk pack).

- 3 - 1MB disk packs are currently inoperable and should be surplused.

- Input/Output Peripherals - Dasher terminals should both be used as user work stations. I have no basis for judging amount of current utilization.

- Teletype 33 is not currently used. Could probably be used as a systems console on S130 or user terminal.

- Line Printer is somewhat underutilized at present, but will be used more extensively as more applications become operational.

- Tektronics 4010 terminals are not utilized in graphics mode, but should be. Using them as alphanumeric terminals utilizes very little of their capabilities. Graphics terminals such as the 4020 have the capability to draw maps and other graphic data displays such as pie charts, line plots and histograms. Alphanumeric terminals can only display letters and numbers in fixed rows and columns. Dashers or other cheap alphanumeric terminals should be used as alphanumeric work stations, with the 4010's being saved for use as graphic work stations.

- Talos digitizer capabilities are underutilized, even if the device is busy full time. Current capabilities are limited to simple acreage calculations using microprocessor and support of automated drafting applications on the S130. Both of these applications could be supported on a much smaller table. Input of map data (e.g., a soil survey) to a polygonal or grid data base would more fully utilize the capabilities of this sophisticated device. A Graphic CRT (e.g., 4010) should be interfaced with the Talos to allow real time previewing of digitizing to facilitate error correction.

- Zeta plotter is currently very underutilized. The only operational application is in support of automated drafting by the engineering section. With the proper data base and software, this plotter could be a powerful tool to output multicolor source or analytical maps.

*Limitations of Existing Hardware*

The current hardware configuration (including the leased S130 CPU) has very few serious limitations. The system constraints have more to do with speed of processing, number of users who can concurrently utilize systems resources, and total throughput than with actual level of capabilities possible. System constraints and bottlenecks and suggested solutions (additional hardware) are outlined below.

- Need for the S130 CPU. The Nova 800 CPU is obsolete and of little use. The S130 Eclipse is a reliable, powerful and cost-effective replacement and should be retained unless the IRD is to be disbanded. The current unit can be purchased for about $36,000 or rented for about $18,000/year (according to IRD staff).
- Only 256K of memory on the Eclipse S130 CPU. This will limit the number of concurrent system users, and will not allow implementation of upgraded operating systems. For approximately $8,000, an additional 256K of core can be installed. This should be considered for the 1981 fiscal year.
- Only 1 - 800 BPI tape drive available. It will not be possible to read or write 1600 BPI tapes. Most digital data files available are at 1600 BPI. They can be reformatted to 800 BPI elsewhere, however, in a few days' time. Also, because there is only 1 tape drive, it will be impossible to read one tape, process the data, and write an output tape. The large disk, however, can be used as an intermediate output file and later copied to tape. This will reduce overall throughput substantially for Landsat data processing. Once throughput becomes a

problem, an additional 1600/800 BPI tape can be added for about $12,000.

- Potentially inadequate number of user terminals. Two terminals are not enough to support systems development and multiple applications. Utilizing the Teletype 33 or an inexpensive Decwriter (approximately $1600) for the systems console will free up one Dasher terminal. Interfacing the NCIC terminal (Tektronics 4010 - about $100-200) with the Eclipse will bring the total to four. If this is inadequate, Decwriters or other inexpensive terminals can be added for $800 - $2,000 apiece.
- On-line storage may not be adequate in the long range. As data bases grow in size and more sophisticated users demand rapid access to them, it may be necessary to add a second or even third big disk. One large disk would always be on-line, and the other could be used in swap mode. A 192 MB disk can be purchased for about $31,000.
- Lack of a color image display device. As Landsat applications increase, it will probably be necessary to add such a terminal to the system. This will greatly increase analyst productivity and data throughput, and will also provide for enhanced color output capabilities. Approximate cost range is $20,000 - 45,000.

*Required Hardware Upgrade for Basic Capabilities*

With the exception of retention of the Eclipse S130 CPU and the addition of 256K memory, all of the above hardware additions can be delayed until an adequate user base is developed and demands on the system outstrip available resources. At that time, it may be feasible to finance system upgrades through user charges rather than state appropriations.

The basic system (including the S130) is quite powerful in terms of hardware capabilities. All the applications described above will be possible in development and limited operation mode. Every user will not be able to have access to the system on demand, but with a little scheduling and adequate facilities management, every user will be able to get their job done in a fairly timely manner. As bottlenecks and resource conflicts become serious, steps can be taken to ameliorate them.

## REMOTE SENSING APPLICATIONS

*Current Libraries*

ARIS currently has complete orthophotoquad coverage (1972-3 vintage) available statewide. ADOT provides reproduction services.

In addition, access to national airphoto and satellite libraries is facilitated through affiliation with the National Cartographic Information Center. Reproduction services are provided by the EROS Data Center and others.

ARIS currently has complete Landsat photographic and digital coverage (1977 vintage) available statewide. They are currently considering ordering complete 1978, 1979 and 1980 coverage. They should also consider ordering complete coverage for 1972, 1973 or 1974, as this data (or any other Landsat data acquired before 11/76) will no longer be available from the federal government after the end of 1980.

*Current Remote Sensing Analysis Capabilities*

ARIS staff currently have the capability to visually (or manually) interpret aerial or satellite photos using standard photogrammetric techniques.

There is also a capability for semi-automated image interpretation of aircraft or satellite photos. Using the rear projector, remote sensing data (including multiple images or maps) can be superimposed on the digitizer, and visual interpretations entered directly to the computer via the Talos digitizer. These are currently entered in plot command format, which does not allow area calculations or permanent archival of the data. Future input by polygons will get around these problems.

The capability to digitally interpret Landsat data is in the early stages of development. A program to make line printer maps of pre-categorized Landsat data is currently operational. The baseline hardware configuration will support image processing applications.

*Future Remote Sensing Analysis Capabilities*

Complete Landsat digital interpretation capabilities will be developed in the future. End to end computer processing capabilities will have to include the following procedures:

- Data reformatting - to put information in an easier-to-use format.
- Geometric correction - to deskew and rotate the Landsat data so that it is North-oriented and to scale.
- Selection of sample data - to extract "training fields" to teach the computer to recognize various land cover types.
- Categorization of large areas - to classify the data for various sized study areas.
- Map preparation - to output the categorized data for varying areas, with varying aggregations of categories, at varying scales.
- Map comparison - to facilitate analysis of changes in land cover over time.

A LONG ROW TO HOE

A great deal of work remains before Arizona will have a fully operational statewide geographic information system. If this were the Creation, ARIS would be about at 10:30 Monday morning. Successful implementation will require the following:

- Retention of the existing leased Eclipse S130 with 256 or 512 K ($36,000 - $44,000 purchase price)
- Two to three calendar years
- Six to nine person years
  - two systems analysts
  - one manager/user liason person
- Interagency and Interdivisional Cooperation to define:
  - user needs (data, software, processing requirements)
  - system financing assistance (once operational)
  - existing data sources of general interest to input to data base

Landsat data processing will require the gathering of ground truth or ground verification data. Approximately 1 to 3 person months would be required to gather one-time statewide ground truth from USDA records and available air-photos for each date of Landsat coverage.

*Range of Alternatives to Restructure Program*

There are several alternatives available to restructure the ARIS program should the legislature wish to do so. The recommended level of service should be based upon the results of a thorough user need study and the availability of staff and funding to provide such services. Potential options include:

A. Information reference center only - 1 FTE required (NCIC clerk)

1. Maintain Orthophotoquad Collection and basic user assistance function.
2. Maintain NCIC affiliate status to assist users in locating and ordering maps and remote sensor data
3. Transfer engineering section to another division of SLD

B. Computer service center for State Land Department - 3 professional FTE's required (Director, NCIC Clerk, Systems Analyst)

1. Capabilities in A above to all state agency users
2. Basic computer services for State Land Department (capabilities as outlined in A & B of Appendix A)
3. Retain engineering section in IRD

C. Computer service center for state natural resource agencies - 4 professional FTE's required (Director, NCIC Clerk, Systems Analyst, User Liaison staff)

1. Capabilities in A & B above to all users
2. Capabilities as outlined in C of Appendix A for State Land Department

D. Full state-wide agency-wide geographic information system service (all capabilities outlined above and in Appendix A)

5 professional FTE's required (Director, NCIC Clerk, Systems Analyst, Systems Programmer, User Liaison staff)

*Technical Assistance Available to Arizona to Review and Systematize ARIS Systems Design*

Further NCSL Assistance

Up to two weeks of NCSL Natural Resource Information Systems Project staff time could be provided over the next five weeks at no charge to the state. Potential activities include:

- Further assistance to Auditor General's Office in preparation and presentation of the ARIS program audit.
- Detailed review of ARIS Systems Design with recommendations as to further required planning and user needs survey elements.

Formation of a Resource Team

In cooperation with the Council of State Planning Agencies (CSPA), NCSL staff could coordinate the formation of a "resource team" of state geographic information system experts. CSPA and NCSL could fund travel and subsistence expenses for such a group for a one-week period. Potential areas of expertise and consultants are:

Coordinators: Paul Tessar, NCSL and Peggy Harwood, CSPA
Hardware/Software: Nick Faust, Georgia Tech
Software Systems: Willie Todd, NASA Ames
User Needs Surveys: Frank Westerland, University of Washington
Landsat Applications: Sue Norman, NASA Ames
Institutional Arrangements: Dave Ferguson, Texas Natural Resources Information System
Graphic Information Systems: Tom Dundas, Montana Geo-Data System
Tom Loveland, EROS Data Center

Additional consultants could be located as other areas of expertise were identified. Formation of such a resource team would assist in the redesign and redirection of the ARIS program, if so desired. Specific tasks could

be identified, and quantitative and qualitative performance criteria established. This approach could facilitate a follow-up program audit to determine program status at a later date.

If the use of a resource team is desired, a fair amount of planning and scheduling would be required. Approximate timing and tasks are outlined below:

| Task | Time Required | Cumulative Time |
|---|---|---|
| Assemble Team and get travel clearances | 3 weeks | 3 weeks |
| First working session | 1 week | 4 weeks |
| Administer User Needs Survey | 2 weeks | 6 weeks |
| Summarize survey results | 1 week | 7 weeks |
| Develop final Resource Team report and recommendations | 3 weeks | 10 weeks |

If the final report and recommendations are needed by July 1, it would be necessary to request this assistance by April 15.

APPENDIX A

Characterization of Stages of GIS Development/Sohpistication

A. Manual Capabilities

1. Ability to locate and apply mapped or imaged spatial data
2. Ability to visually interpret remote sensing data and manually produce maps

B. Rudimentary Computer Capabilities

1. Ability to input mapped spatial data or visually interpreted remote sensing data to a data base (e.g., calculate acreages)
2. Ability to do simple single factor manipulations
   a. Translation of categories (e.g., soil type to physical property)
   b. Aggregation of categories to a higher level classification (e.g., Residential or Industrial to Urban)
   c. Change of scale (larger or smaller than source data)

C. More Advanced Capabilities

1. Ability to do more advanced single factor manipulations
   a. Map derivation (e.g., calculate slopes from elevation data)
   b. Change analysis (e.g., land cover change using 1975 and 1980 data)
2. Ability to do two factor compositing (e.g., croplands on steep slopes)
3. Ability to digitally interpret Landsat data

D. Full Compositing/Modeling Capabilities

1. Ability to develop and solve complex spatial models
   a. Calculate expected soil erosion by water based on land cover, slopes, physical properties of soils, precipitation, etc., for 1-acre cells.
   b. Predict crop yields based on crop type, potential soil productivity, precipitation, crop condition, etc., by quarter section.
   c. etc.

2. Ability to produce advanced output products

   a. Line plotter maps

   b. Color-coded maps

   c. Detailed statistics (e.g., 3-level cross-tabulation such as crop type vs. slope vs. soil erodibility)

**********

E. ARIS Current Capabilities

   1. All manual capabilities

   2. Computer capabilities - B.1 only

F. ARIS Capabilities currently under development

   1. Near term - All through B.2 and C.3

   2. Eventual - All--according to ARIS staff

APPENDIX B

DEFINITION OF TECHNICAL
ASSISTANCE NEEDS FROM NCSL
By March 1, 1980

OBJECTIVE 1:

To determine status of present "natural resource information system."

1. What is the equipment being utilized and for what?
2. What portion of equipment capabilities are being utilized? What is not utilized?
3. What are the programs/applications of the system (including their status, who uses them and why)?

   Includes, but not limited to, following system program/applications:

   a. Water Rights Claimant Master Record System
   b. Urban Forestry Geo-master Data File
   c. Forestry Tree Seedling Management System
   d. Ecosystem Component Simulation Models
   e. Water Interactive Simulation Model
   f. Rangeland, carry and herbage production simulator program.

4. What is the status of files by type of "natural resource"? -- i.e., range, minerals, habitat, water, etc.

OBJECTIVE 2:

To determine capabilities and limitations of current system.

1. Utilizing results of demos, document and note range of applications possible with existing equipment, software and files.
2. With additional software, what further applications are possible?
3. What are limitations of existing system even with software additions?
4. What additional applications would be possible with minimal additional monies ($50,000 or less)?

OBJECTIVE 3:

To determine capability of using and usage of aerial photography or other remote sensing methods.

1. Document current library of photos.
2. Document usage and staff capability for interpretation.

OBJECTIVE 4:

To determine "how far" current systems status is from a state-wide geographic natural resource information system.

1. Compare current system capabilities (documented from Objectives 1 and 2 plus ARIS staff capabilities) to what is needed to obtain full state-wide system, including:

a. amount of additional equipment
b. time to develop system (calendar years)
c. staff time to develop (man years)
d. amount of inter-agency cooperation
e. amount of ground verification needed

2. What would be capabilities and limitations of such a state-wide natural resources information system?

FINAL PRODUCT

Written analysis that answers questions outlined and results in achievement of Objectives.

Oral analysis to be provided before leaving Phoenix.

Written analysis to be completed by February 22, 1980.

Additional Documentation Requested Orally on 2/13

- Characterization of stages of GIS development/sophistication, including analysis of where Arizona is.
- Range of alternatives to restructure program.
- Potential Technical Assistance available to Arizona to systematically and rigorously design ARIS.

DOUGLAS R. NORTON, CPA
AUDITOR GENERAL

STATE OF ARIZONA
OFFICE OF THE
AUDITOR GENERAL

# Agreement For Technical Assistance Services

Providers of Services:

National Conference of State Legislatures
Natural Resource Information Systems Project
Denver, Colorado

National Governors' Association
Council of State Planning Agencies
Earth Resources Data Project
Washington, D.C.

Primary State of Arizona Participants:

Office of the Auditor General
Phoenix, Arizona

Department of Administration
Data Processing Division
Phoenix, Arizona

State Land Department
Phoenix, Arizona



LEGISLATIVE SERVICES WING • SUITE 200 • STATE CAPITOL • PHOENIX, ARIZONA 85007 • 255-4385

## Contents of Agreement

A. Definition of Terms

B. Statement of Services to be Provided

   1. Goal
   2. Objectives

C. Duration of Agreement

D. Statement of Roles and Responsibilities of Service Providers and Participants

   1. National Conference of State Legislatures

   2. National Governors' Association, Council of State Planning Agencies

   3. Office of the Auditor General

   4. Department of Administration, Data Processing Division

   5. State Land Department

E. Description of Technical Assistance Methodology, Criteria and Products

   1. User-need Study

   2. Alternatives and Recommended Systems, Software and Data Base

   3. Alternatives and Recommended Institutional Arrangements

F. Description of Workplan and Time Schedule

   1. User Needs Survey Task Force

   2. Systems, Software and Data Base Task Force

   3. Institutional Arrangements Task Force

   4. Final Report Compilation

G. Remuneration for Services

A. Definition of Terms

| | | |
|---|---|---|
| Aerial photograph | - | Generally, any photograph of the terrain taken with a camera mounted in an aircraft. |
| Natural resources information system | - | A natural resource information system is composed of at least three elements;<br>- a geographic information system (hardware, software and data bases),<br>- the necessary professional staff to run the geographic information system and work with users, and<br>- appropriate institutional structure to manage and support the system.<br>The geographic system component can input, manipulate and analyze geographically referenced natural resource data in order to support the decision-making needs of a defined user community. |
| Review and advisory technical comment | - | Reading of a draft copy of a written report or sections of it to provide statements on its content and feasibility that are not binding on the resource team. |
| Satellite images | - | The visual representation of energy recorded by remote-sensing instruments on orbiting satellites or reproduction of objects and/or phenomena as sensed or detected by cameras, scanners, radar or other equipment. |
| System plan | - | A statement of actions to be taken, purpose for taking these actions, the results expected and the costs of an information system for each year of a future time period. |
| Technical assistance | - | Staff expertise provided on a particular subject, such as natural resource information systems. |

B. Statement of Services to be Provided

Through this agreement, the representatives of the National Conference of State Legislatures and the Council of State Planning Agencies will provide technical assistance services to the State of Arizona for assessment of needs, development of a system, and consideration of institutional factors for a natural resource information system for Arizona State government.

1. Goal

The goal of these technical assistance services is to produce, in written form, a user-need study and system plan for natural resources information that is:

1. Useful to Arizona's elected representatives in their decision-making regarding the future of a natural resources information system,

2. Accurate in reflecting the needs and priorities of potential system users, and

3. Acceptable as meeting prescribed system plan guidelines of the Department of Administration, Data Processing Division.

2. Objectives

The objectives of these technical assistance services are three-fold:

1. Develop and implement a survey instrument to identified potential users of a natural resource information system. Analyze the needs of these potential users and rank their needs in order of priority based on any statutory mandate and frequency of demand for particular data products. Included would be the needs for aerial photography and satellite images and their interpretation, as well as manual or automated geographically based data systems.

2. Specify and recommend manual and/or automated natural resources information system(s) to meet the data needs of natural resource agencies. Three alternative levels of service will be examined 1.) to meet mandated requirements, 2.) to meet mandated requirements and common user needs, and 3.) to meet all practical user needs. For each alternative hardware configuration, staffing requirements, budgetory estimates and basic capabilities will be defined.

3. Analyze and recommend appropriate institutional (State agency) arrangements, if necessary, for implementation of the systems designed.

C. Duration of Agreement

This technical assistance agreement will exist from August 1, 1980, through written-report by September 30, 1980, and oral presentation of the report, if required to the Arizona Legislature, Joint Legislative Budget Committee (JLBC).

D. Statement of Roles and Responsibilities of Service Providers and Participants

Two service providers and three Arizona State agencies are parties to this technical assistance agreement.

1. National Conference of State Legislatures

The first service provider is the National Conference of State Legislatures (NCSL), represented by staff of the Natural Resource Information Systems Project. The primary role of the NCSL is overall organization, leadership and production of the final written report in conjunction with the Council of State Planning Agencies. Specific responsibilities include, but are not limited to, the following:

a. Organize the resource team by identifying appropriate State and Federal staff.

b. Appropriate staffing of the three individual task forces of the technical assistance project - user-need; systems, software and data bases; and institutional arrangement.

c. Identify and assign work tasks to resource team members.

d. Provide overall direction to resource team members.

e. Organize and edit the final written report to the Arizona Legislature.

f. Oral presentation, if scheduled, of the written report to the Arizona Legislature, its committees or subcommittees.

g. Maintain the workplan and time schedule so the written report is completed by September 30, 1980 (unless officially waived by the Arizona Joint Legislative Budget Committee until a later date).

h. Supervise staff assigned and provide leadership for two task forces - systems, software and data bases; and user-need. Write the final report segment for these sections.

2. Council of State Planning Agencies

The second service provider is the Council of State Planning Agencies (CSPA), represented by staff of the Earth Resources Data Project. The primary role of CSPA is to assist the overall organization, leadership and production of the final written report. Specific responsibilities include, but are not limited to, the following:

C. Duration of Agreement

This technical assistance agreement will exist from August 1, 1980, through written-report by September 30, 1980, and oral presentation of the report, if required to the Arizona Legislature, Joint Legislative Budget Committee (JLBC).

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a. Organize the resource team by identifying appropriate State and Federal staff.

b. Appropriate staffing of the three individual task forces of the technical assistance project - user-need; systems, software and data bases; and institutional arrangement.

c. Identify and assign work tasks to resource team members.

d. Provide overall direction to resource team members.

e. Organize and edit the final written report to the Arizona Legislature.

f. Oral presentation, if scheduled, of the written report to the Arizona Legislature, its committees or subcommittees.

g. Maintain the workplan and time schedule so the written report is completed by September 30, 1980 (unless officially waived by the Arizona Joint Legislative Budget Committee until a later date).

h. Supervise staff assigned and provide leadership for two task forces - systems, software and data bases; and user-need. Write the final report segment for these sections.

2. Council of State Planning Agencies

The second service provider is the Council of State Planning Agencies (CSPA), represented by staff of the Earth Resources Data Project. The primary role of CSPA is to assist the overall organization, leadership and production of the final written report. Specific responsibilities include, but are not limited to, the following:

2. (Continued)

a. Obtain the participation of and provide travel and subsistence expenses for resource team members.

b. Appropriate staffing for the three resource team task forces of the technical assistance project - user-need; systems, software and data base; and institutional arrangements.

c. Review and approve work tasks assigned to individual team members.

d. Assist in providing overall direction to resource team members.

e. Review and approve the final organization and edit of the written report to the Arizona Legislature.

f. Participate in the oral presentation, if scheduled, of the written report to the Arizona Legislature.

g. Maintain the workplan and time schedule so the final report is completed by September 30, 1980 (unless officially waived to a later date).

h. Supervise staff assigned and provide leadership for one task force - institutional arrangements. Write the final report segment for one section.

3. Office of the Auditor General

The first of the Arizona agency participants is the Office of the Auditor General. The primary role of this Office is coordination and oversight of the technical assistance to:

1. Assist in the timely development of a credible product, and

2. Ensure adherence to the intent of the legislative request for an objective and factual user-need study and system plan. Responsibilities include, but are not limited to, the following:

   a. Provide logistical support in identifying appropriate State agency contacts in Arizona and arranging appointments, interviews or problem-solving sessions.

   b. Provide appropriate background information to resource team members.

c. Provide working space for the resource team in Arizona and on-site clerical assistance.

d. Draft and prepare a technical assistance contract agreeable to major affected parties.

e. Review and require edit, if justified, of the user-need survey instrument to comply with provisions on page 21 of the Arizona Resource Information System performance audit report.

f. Review and, if required, edit the final written report to adhere to criteria of accurate and factually based analysis. Assist in the preparation, if needed, of oral presentations of the written report to the Arizona Legislature.

g. Provide status reports regarding this technical assistance project to the Arizona Legislature as required.

4. Arizona Department of Administration (DOA), Data Processing Division

The second Arizona agency participant is DOA, Data Processing Division. The primary role of this agency is the provision of planning guidelines, technical advice and review. Responsibilities include, but are not limited to, the following:

a. Provide technical planning guidelines to be followed in the preparation of a system plan.

b. Provide examples of acceptable plans by other Arizona agencies.

c. Provide historical background, technical advice, and suggestions regarding resource team methodology.

d. Review and provide technical advisory comment on the user-need survey instrument.

e. Review and provide technical advisory comment on the draft of the written report to the Arizona Legislature.

f. Review and provide written comments to the Arizona Legislature regarding the final report expressing DOA's position concerning the acceptablility of the analysis and recommendations and standards for data processing operations and documentation. These comments will be included in the report.

5. State Land Department

The third agency participant is the State Land Department (SLD). Its primary role is to provide background on and accessibility to the Arizona Resources Information System (ARIS) as now constituted in the Information Resources Division (IRD). Responsibilities include, but are not limited to, the following:

a. Provide technical information concerning the equipment, software and users of the ARIS (IRD).

b. Provide accessibility to the equipment, software and staff involved in ARIS (IRD).

c. Review and provide technical advisory comment on the user-need survey instrument and draft of the written report.

d. Review and provide written comments to the Arizona Legislature on the final report expressing SLD's position regarding the analysis and recommendations. These comments will be included in the report.

E. Description of Technical Assistance Methodology, Criteria and Products

The following section contains description of:

- The basic methodological approach to each of the three areas of technical assistance,
- The minimum criteria to be used in each area, and
- Characteristics of a minimally acceptable product.

1. User-Need Study

Methodology - In conducting the user-need study a survey instrument will be developed; field tested on three programs in different state agencies; reviewed by SLD and DOA - Data Processing Division; modified as needed; and administered by NCSL staff through interviews with managers of State programs, selected Federal agencies and Councils of Governments.

Criteria - The user-need study will include at least all those areas to be considered that were identified on page 21 of A Performance Audit of the Arizona Resources Information System. These variable included:

- Data collected and needed,
- Local and State uses of the data,
- Private sector uses of data,
- Data collection procedures,
- Coverage needed,
- Frequency updates needed,
- Scale needed,
- Statistical reports or other products,
- Storage at the agency, and
- Personnel and funds devoted to data accumulation.

Further, the user need task force staff will consider the advisory comments from SLD and DOA-Data Processing Division, as well as field test results in developing the instrument

Product - The product will consist of:

1. Compiled results of all surveys administered,

2. Analysis of the results, and

3. A listing of needs in order of priority.

2. Systems, Software and Data Base

Methodology - In developing the systems, software and data bases section, the task force will utilize the results of the user-need study; the software status and equipment status; and experiences of other states in their development of natural resource information systems to design a plan for appropriate system development.

Criteria - The plan developed will be acceptable to the DOA-Data Processing Division and follow its guidelines for system plans. The plan will meet the user needs identified for the State at alternative levels of expenditure. The plan will also contain the resource team's recommendation for level and type of expenditure.

Product - The plan will itemize a projection of three years of objectives, tasks, products and system costs at alternative levels of expenditure.

3. Institutional Arrangements

Methodology - The task force will utilize interviews with data processing managers and staff in candidate agencies; observation of current system capabilities; and experiences of other states in implementing resource information systems to analyze and recommend an institutional arrangement for natural resource information system.

Criteria - The resource team will determine variables to consider prior to interviews and observations. Variables considered will include, at a minimum, the computer equipment, software, staff expertise, user needs, data processing accomplishments and revisions to the current agency operations that would be required to assume natural resource information system responsibilities.

Product - The product will, at a minimum, include an analysis of the criteria for each potential institutional arrangement and recommendations.

F. Description of Workplan and Time Schedule

1. User-Needs Survey Task Force

a. August 4-15; Ms. Loyola Caron (NCSL)

i) Review existing user-needs surveys.
ii) Study relevant literature.
iii) Draft preliminary survey instrument for Arizona.

b. August 18-19; Ms. Caron, Mr. Tim Hays (Acting Director of the California Environmental Data Center), Mr. Dave Peterson (National Aeronautics and Space Administration).

i) Background briefings on ARIS.
ii) Preliminary review of draft survey.
iii) Discussion of draft with SLD and DOA.
iv) Modifications as appropriate.

c. August 20-21; Ms. Caron, Mr. Hays and Mr. Peterson

i) Field test on three separate programs, one by each task force; tentative choices are:

a. SLD program
b. Department of Water Resources (DWR) program
c. Arizona Department of Transportation (ADOT) program

ii) Review results/problems/deficiencies.
iii) Modifications as appropriate.
iv) Final review by DOA, SLD and Auditor General (AG).
v) Prepare final instrument.
vi) Develop list of programs and program managers to be interviewed.
vii) Review list for additions (DOA, SLD and AG).

d. August 22; Ms. Caron.

i) Present instrument to entire resource team.
ii) Participate in review of systems and institutional reports.

e. August 25 - September 5; Ms. Caron.

i) Administer survey to natural resource program managers.
ii) Review preliminary results with AG.

f. September 9-12; Ms. Caron.

i) Compile and analyze results of interviews.
ii) Develop list of priority needs.

g. September 15; Ms. Caron.

i) Present results of survey to entire team.
ii) Discuss/adjust list of priority needs.
iii) Distribute to AG, DOA and SLD for review.
iv) Distribute to Systems and Institutional task forces to incorporate results in their reports.

2. Systems, Software and Data Bases Task Force.

a. August 18-19; Mr. Paul Tessar (NCSL), Mr. Willie Todd (NASA/AMES), Mr. Tom Loveland, U.S. Geological Survey (USGS/EROS), and Mr. Nick Faust (Georgia Tech).

i) Background briefing on ARIS/SLD
ii) Review "Technical Analysis of Current and Proposed ARIS" prepared for Performance Audit Report.
iii) Develop system evaluation criteria and report format.
iv) Visit ARIS facility - talk with staff, view hardware, demonstration of software, etc.

b. August 20-21; Mr. Tessar, Mr. Todd, Mr. Loveland and Mr. Faust.

i) Visit DOA computer facility.
ii) Visit ADOT facility.
iii) Write reports on SLD, DOA and ADOT systems.
iv) Visit University of Arizona (U of A) facility.
v) Write report on U of A system.

c. August 22; Mr. Tessar.

i) Participation in review of user needs and institutional reports.
ii) Present summary of existing systems to entire resource team.
iii) Distribute draft of existing-system report to AG, DOA, SLD, ADOT and U of A.

d. September 8-12; Mr. Tessar.

i) Gather comments from system operators and others.
ii) Modify draft report as appropriate.

e. September 15-19; Mr. Tessar, Mr. Todd and Mr. Faust.

i) Review results of user-needs surveys.
ii) Develop system design to meet priority needs on a phased basis over three years.

2. Systems, Software and Data Bases Task Force (continued)

e. (Continued)

iii) Document according to DOA guidelines for a three year period.
iv) Develop cost and staff time estimates.
v) Develop enhanced alternative to meet all needs and scaled-down alternative to meet top priority needs only.
vi) Distribute systems design report to AG, DOA and SLD.

f. September 23-24; Mr. Tessar.

i) Gather comments from system operators and others.
ii) Modify draft report as appropriate.

3. Institutional Arrangement Task Force.

a. August 18-19; Ms. Peggy Harwood (NGA/CSPA), Mr. Dave Ferguson (Director of the Texas Natural Resources Information System Task Force), and an additional member to be named.

i) Background briefing on ARIS.
ii) Develop institutional evaluation criteria and report format.
iii) Visit with management of prospective statewide system operators at SLD, ADOT and DWR.
iv) Write reports on institutional environments of SLD, ADOT and DWR.

b. August 20: Ms. Harwood, Mr. Ferguson and additional member.

i) Visit with management of U of A.
ii) Write report on institutional environment at U of A.

c. August 21; Ms. Harwood, Mr. Ferguson and additional member.

i) Develop pros/cons for various institutional alternatives:
a) SLD
b) ARIS/Independent Agency
c) ADOT
d) DWR
e) U of A

c. August 21; Ms. Harwood, Mr. Ferguson and additional member. (Continued)

ii) Analyze track record of accomplishments for feasible alternatives.
iii) Assess revisions required to upgrade current capabilities to develop a Statewide service center.
iv) Review user-needs survey and field-test results.
v) Participate in modifications of user-needs survey.

d. August 22; Ms. Harwood.

i) Participate in review of user needs and system reports.
ii) Present preliminary report on institutional environment and pros and cons to entire resource team.
iii) Distribute report to AG and DOA for review and comment.

e. September 8-12; Ms. Harwood.

i) Gather comments from prospective system managers.
ii) Modify draft report as appropriate.

f. September 15-19; Ms. Harwood, Ms. Caron, and other members as appropriate.

i) Review results of user-need surveys.
ii) Determine if user needs warrant a Statewide service bureau approach (vs. a single-agency system or multiple single agency system).
iii) Modify report draft as appropriate.

iv) Analyze alternative sites in terms of feasibility and ability to meet user needs.
v) Develop recommendation.
vi) Distribute to AG, ARIS, DOA and SLD, DWR and ADOT for review.

g. September 22; Ms. Harwood.

i) Gather comments from reviewers.
ii) Modify draft as appropriate.
iii) Express mail to Mr. Tessar.

4. Final report compilation.

a. September 23-26; NCSL staff.

i) Gather three reports.
ii) Develop introduction, summary and table of contents.
iii) Express mail to Ms. Coni Good, AG staff.

b. September 29 - October 3; Ms. Good.

i) Review entire report.

b. September 29 - October 3; Ms. Good (Continued)

ii) Modify as necessary.
iii) Reproduce and distribute to SLD, DOA for review and preparation of written comments.
iv) Compile comments and report, obtain approval of Auditor General.
v) Reproduce in sufficient quantities.
vi) Distribute to JLBC, the Arizona Governor, team members, SLD, ADOT, DOA and U of A and others upon request.

G. Remuneration for Services

Since the State of Arizona has already paid its assessment to receive services from the National Conference of State Legislatures and the National Governors' Association, no monies will be provided by the State for these technical assistance services. In addition, no monies will be exchanged among the Arizona State agencies involved.

We, the undersigned, have read and agree to our respective roles and responsibilities, and have no material objections to the goals, objectives, methodology, criteria, defined products and workplan described in this agreement.

Douglas R. Norton 8-1-80
Douglas R. Norton Date
Auditor General

Jack Stanton 8-1-80
Jack Stanton Date
Assistant Director
Data Processing Division
Arizona Department of Administration

Joe T. Fallini 8/1/80
Joe T. Fallini Date
Commissioner
Arizona State Land Department

Paul A. Tessar 8-7-80
Paul A. Tessar Date
Project Director
Natural Resources Information Systems
National Conference of State Legislatures

Peggy Harwood 8-5-80
Peggy Harwood Date
Project Director
Earth Resources Data Project
Council of State Planning Agencies
National Governors' Association

ORGANIZATION SURVEY FORM

Organization: _____ Date: _____

Division: _____ Interviewee(s): _____ Title(s): _____

_____ _____

| (1) Current | (2) Desired | (3) MAJOR PROGRAMS | (4) AUTHORITY (MANDATES/RESPONSIBILITIES) | (5) STANDARD PRODUCTS (DELIVERABLES) |
|---|---|---|---|---|
| | | | | |

# PROGRAM ANALYSIS FORM

Organization: _____

Division: _____

Director: _____

Telephone: _____

Date: _____

Interviewee(s): _____

_____

Title(s): _____

_____

| PROGRAM (6) | PROJECT (WORK ELEMENT) DESCRIPTION (7) | TASK DESCRIPTIONS (8) |
|---|---|---|
| | | |

DATA CHARACTERISTICS

Organization: _____ Interviewee(s): _____

Division: _____ _____

Program (6): _____ Date: _____

Element (7): _____

| (9) Presently Used | (10) Desired | DATA ITEM (11) | SOURCE FORMAT (12) | SCALE OR RESOLUTION (13) | GEOGRAPHIC REFERENCE SYSTEM (14) | REQUIRED CURRENCY OF DATA ITEM (15) | GEOGRAPHICAL COVERAGE (ACRES, MILES) (16) | Current or ANTICIPATED SOURCES (17) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

DATA CHARACTERISTICS

(continued)

| DATA ITEM (11) | COLLECTION PROCEDURE, IF APPLICABLE (18) | ACCESS RESTRICTIONS (AVAILABILITY) (19) | STORAGE MEDIUM AND APPROXIMATE VOLUME (20) | PRECISION (21) | OTHER (22) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## PRODUCT CHARACTERISTICS

Organization: _____ Interviewee(s): _____

Division: _____ _____

Program (6): _____ Date: _____

Element (7): _____

| (22) Presently Produced | (23) Desired | DATA PRODUCT (25) | PRODUCT FORMAT (26) | SCALE OR RESOLUTION (27) | GEOGRAPHIC REFERENCE SYSTEM (28) | UPDATING FREQUENCY (29) | GEOGRAPHICAL COVERAGE (ACRES, MILES) (30) | TIME CONSTRAINTS (31) | ANTICIPATED USERS (32) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

PRODUCT CHARACTERISTICS

(continued)

| DATA PRODUCT (25) | ANALYSIS PERFORMED (33) | ACCESS RESTRICTIONS (AVAILABILITY) (34) | STORAGE MEDIUM (35) | OTHER (36) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

COSTS FOR
DATA ACCUMULATION

Organization: _____

Division: _____

Interviewee(s): _____

_____

Date: _____

| PROGRAM (37) | STAFFING (38) | | ESTIMATED COSTS FOR DATA COLLECTION AND ANALYSIS (39) |
|---|---|---|---|
| | Number | Title | |

Definitions of terms used in the Survey Forms.

1. Current - Program presently active.
2. Desired - Program planned for the future, or under development.
3. Major Programs - Name and specific features of individual programs identified in the organization's work plan (i.e., major programmatic areas)
4. Authority (Mandates/Responsibilities)- Mandates specifically authorized by enabling legislation (title and year enacted). Responsibilities include programs managed for other agencies, or in the performance of day-to-day administrative duties. (This may include activities that are contracted for.)
5. Standard Products (Deliverables) - May include workplans, final and/or statistical reports, management plans, models, maps, thematic information, etc.
6. Program - Name of program described in (3).
7. Project (Work Element) Description - Name and goals of specific projects undertaken to fulfill the objectives within each programmatic area.
8. Task Description - Specific tasks which need to be undertaken within each project to produce the final product or meet the final objective.
9. Presently Used - Data that are currently being used in a project.
10. Desired - Data which an organization anticipates may be needed in the future, within constraints of budget.
11. Data Item - Specific data (often primary source data) required to produce a final product (e.g. vegetation type, soil series, topography).
12. Source Format - Description of format in which the data item (11) is available.
13. Scale or Resolution - For data items in map form.

14. Geographic Reference System - specific scheme(s) used to define the location of various phenomena in relation to one another (e.g. State Plane Coordinates, public land system, UTM grid).

15. Required Currency of Data Item - In order for the data to be useful, how frequently must it be collected, or updated?

16. Geographical Coverage (Acres/Miles) - Extent of area under consideration (e.g. statewide, 10 square miles in a county, township).

17. Current or Anticipated Source(s) - Location of data source (e.g. person, agency, document, field studies).

18. Collection Procedure - Description of how the data are collected, if applicable (e.g. method of survey used - core drillings, windshield survey, King census, etc.)

19. Access Restrictions - Type of security restrictions (confidentiality), if any, placed on a given data item by the "owner" of the data (e.g. "must submit justification for obtaining access to relevant data on a site-by-site basis to the director of the agency holding the source data").

20. Storage Medium and Approximate Volume - Describes way(s) in which the source data are stored (e.g. filing cabinet, magnetic tape, microfiche, etc.), and approximate quantity of data to be stored.

21. Precision - What is the geographical precision of data items required for information analysis? For example, how closely must ground locations be identified?

22. Other - Any additional comments.

23. Presently Produced - Data required to fulfill the objectives of the project.

24. Desired - Data that would be a useful supplement for fulfilling the objectives of the project.

25. Data Product - End product resulting from assimilation of data (e.g. critical aquatic habitats, probable location of rare and endangered species).

26. Product Format - Required format(s) of the data products (e.g. map, report, tables).

27. Scale or Resolution - For data products that will be produced in map form.

28. Geographic Reference System - Specific scheme(s) needed to define the location of various phenomena in relation to each other (e.g. State Plane Coordinates, public land system, UTM grid).

29. Updating Frequency - How often must the data product be updated to be of value for planning and management functions? (e.g. yearly, weekly, one-time only).

30. Geographical Coverage - Specific locations associated with the data product.

31. Time Constraints - How quickly must the product be available?

32. Anticipated Users - Names of federal, state, local, private and other entities that require the data product for their planning and managment functions.

33. Analysis Performed - Specific capabilities required to produce the data product (e.g. simulation, classification, subjective area calculations, photo interpretation, etc.).

34. Access Restrictions (Availability) - Type of security restrictions (confidentiality), if any, to be placed on the availability of the product.

35. Storage Medium - Way(s) in which the products are stored.

36. Other - Pertinent remarks not elsewhere recorded.

37. Program - From #6.

38. Staffing - Number of people employed, by job type.

39. Estimated Cost for Data Collection and Analysis - Estimated breakdown of the funding expended for collection of data, including salaries.

# APPENDIX II-B

COMPLETE SURVEY FORMS
(Only in limited copies of this report)

# APPENDIX II-C

## SUMMARIES OF INTERVIEWS

Commission of Agriculture and Horticulture
Office of Economic Planning and Development
Game and Fish Department
Bureau of Geology and Mineral Technology
Maricopa Association of Governments
Oil and Gas Conservation Commission
Outdoor Recreation Coordinating Commission
State Parks Board
Arizona Radiation Regulatory Agency
Department of Revenue
Department of Transportation - Environmental Planning Services

Arizona Commission of Agriculture
and Horticulture
State Office Building, Room 421
1688 West Adams
Phoenix, Arizona 85007
(602) 271-4373

Interviewee: James R. Carter, Director
Date: September 2, 1980
Authority: A.R.S. 3-101

(See attached summary of program information for major activities of the Agricultural and Horticultural Commission.)

This Commission is basically regulatory in nature. Its major function is to identify and/or anticipate insect and disease problems and to take proper actions to ensure that those problems are prevented or contained. It is also responsible for protecting native plants of Arizona, especially cacti.

For the most part, the Commission uses very little natural resources-related data on a routine basis because of its regulatory nature.

Efforts are carried out in response to immediate and specific circumstances, and hence their needs are often unpredictable. In many cases, information is acquired through personal contacts or through existing mechanisms designed to forewarn of an impending problem. For example, the USDA's Animal Pest Health Inspection Service (APHIS) may inform the Commission of the possibility that Japanese beetles might be carried on an airplane due to arrive in Phoenix. The Commission responds by sending staff to the airport to inspect the plane upon arrival and destroy the beetle, if present.

Protection of native plants is one effort that requires support information in the form of ownership data. Before the transfer of (salvageable) native plants is allowed the Commission verifies that the owner of the land on which the plants are to be removed has granted permission that they can be taken. Ownership data is obtained from the Assessor's Office.

Protection of native plants is one effort that requires support information in the form of ownership data. Before the transfer of (salvageable) native plants is allowed the Commission verifies that the owner of the land on which the plants are to be removed has granted permission that they can be taken. Ownership data is obtained from the Assessor's Office.

STATE OF ARIZONA

PROGRAM INFORMATION

FY 1981-82

Agency Arizona Commission of Agriculture & Horticulture Program Summary (ARS 3-101)

Program Director James R. Carter Title Director Phone 255-4373

The Commission protects the public from harmful agricultural and horticultural plant pests and diseases. It protects the public by insuring the guarantees of seed, feed, fertilizer, and pesticide. It regulates the sale and use of pesticide. It provides standards for citrus and fresh fruit and vegetables. It provides for the certification of laboratories and laboratory services. It protects the native plants of Arizona.

A review of each activity area follows:

1. DIVISION OF COMPLIANCE AND DISTRICT OFFICES (ARS 3-231, 3-571 and 3-901)

   This division coordinates the inspection and sampling of seeds; conducts Native Plant Law investigations and regulates hay broker operations. Licenses all seed dealers and hay brokers. Maintains District Offices in the principal irrigated crop areas and part-time inspectors in all other parts of the State.

2. DIVISION OF PLANT QUARANTINE (ARS 3-113, 3-201 and 3-221)

   The thrust of this program is to prevent the introduction and establishment of damaging pests and plant organisms into Arizona. Major services provided by this division are:

   (1) Operation of nine border inspection stations in carrying out provisions of ARS 3-113 to prevent the entry of dangerous plant pests and disease organisms into the State's agricultural and residential areas;

   (2) conduction of terminal inspections inside Arizona at major truck docks, air cargo terminals, plant nurseries, U.S. Post Offices and United Parcel Service Offices, and major fresh fruit, vegetable and nursery market outlets;

   (3) enforcement of 20 State Quarantines and 10 Federal Quarantine Regulations in carrying out a pest exclusion and inspection program throughout Arizona; and

   (4) issuance of phytosanitary certificates (plant health) required by other states and foreign countries for Arizona farm commodities destined for out-of-state and export markets.

3. DIVISION OF PEST CONTROL (ARS 3-113, 3-201, 3-372.02 and 3-801)

   Conducts pest detection surveys and eradication programs to protect agricultural crops, plant nurseries and home plantings from the invasion of dangerous plant pests. Enforces citrus budwood registration and certification rules to insure disease-free trees for Arizona's citrus industry. Inspects apiaries for detection and eradication of serious bee diseases. Monitors pesticide applicators and investigates cases of suspected violation of State and Federal pesticide laws.

Agency Arizona Commission of Agriculture & Horticulture Program Summary (ARS 3-101)

Program Director James R. Carter Title Director Phone 255-4373

4. AGRICULTURAL LABORATORY (ARS 3-141)

The laboratory provides laboratory services for the Commission to carry out its missions in regulating the agricultural community. It provides for certification of laboratories providing analysis in the agricultural area.

5. FRUIT AND VEGETABLE STANDARDIZATION (ARS 3-441, 3-471, 3-481 and 3-531)

Insures that all citrus fruit and all other fruit and vegetables offered for sale as fresh product by commercial outlets meet minimum standards of grades and packaging and of product quality. This activity covers pecan marketing and date standardization. The program is 100% self-supporting.

6. OFFICE OF THE STATE CHEMIST (ARS 3-269, 3-350 and 24-908)

The Office of the State Chemist licenses commercial feed distributors and analyzes commercial feeds; licenses fertilizer distributors and samples and analyses fertilizers; and registers, samples, and analyzed pesticides distributed in Arizona. He also is responsible for issuing "Special Local Need" registrations under the Federal laws concerning pesticides. Through these programs the State Chemist is able to monitor the quality of feeds, fertilizers, and pesticides distributed in the State.

7. BOARD OF PESTICIDE CONTROL (ARS 3-371 and 3-391)

This Board, composed of fifteen members appointed by the Governor, regulates the sale, distribution, use and application of registered pesticides. It shares staff with the Commission of Agriculture and Horticulture. It issues permits to sell or use pesticides. It licenses custom applicators and aircraft pilots. It licenses pest control advisors. It certifies both custom and private applicators.

Office of Economic Planning and Development
Planning Division
State Capitol
Phoenix, Arizona

Interviewee: Patricia Bergthold, Policy Analysis
Date: August 21 and 27, 1980
Interviewee: Eric Rasmussen, Research
Date: August 27, 1980
Interviewee: Jeff Fairman, Community Affairs
Date: August 28, 1980

In general, the Office of Economic Planning and Development (OEPAD) is policy-oriented, and its activities therefore are not static. Data needs vary almost "from day to day," depending on what issues have developed requiring their attention. Thus, their data needs may include all natural resource information.

Ongoing activities include:

- Arizona Copper Employment Model (Eric Rasmussen, Research).
- Remote Subdivisions - inventory of land subdivisions in the unincorporated (remote) areas of Arizona.
- Natural Areas Inventory - inventory of established and proposed areas (program administered by State Parks Board).
- Economic - Demographic Projections.

Other major activities of OEPAD lie in the area of coordination. The "State Information Handbook: An Inventory of Users and Producers of Data and Maps in Arizona," represents an index to data sources. This Handbook by the State Data Coordination Network was established by the Governor.

OEPAD also chairs the Arizona Mapping Advisory Committee.

# DATA CHARACTERISTICS

Organization: OEPAD

Interviewee(s): Eric Rasmussen

Division: Planning--Research

Program (6): Copper Employment

Date: 8/27/80

Element (7):

| (9) Presently Used | (10) Desired | DATA ITEM (11) | SOURCE FORMAT (12) | SCALE OR RESOLUTION (13) | GEOGRAPHIC REFERENCE SYSTEM (14) | REQUIRED CURRENCY OF DATA ITEM (15) | GEOGRAPHICAL COVERAGE (ACRES, MILES) (16) | Current or ANTICIPATED SOURCES (17 |
|---|---|---|---|---|---|---|---|---|
| X | | Copper Production | Tables | | | Annually (like it to come out monthly) | Establishment basis statewide | Department of Mineral Resources |
| X | | ES 202 Series<br>Employer Reports | Reports and Tables | | County Identifier | Comes out quarterly<br>-reports monthly | Establishment basis for all counties | Department of Economic Security |
| | | | | | | | | |
| | | | | | | | | |

DATA CHARACTERISTICS

(continued)

| DATA ITEM (11) | COLLECTION PROCEDURE, IF APPLICABLE (18) | ACCESS RESTRICTIONS (AVAILABILITY) (19) | STORAGE MEDIUM AND APPROXIMATE VOLUME (20) | PRECISION (21) | OTHER (2 |
|---|---|---|---|---|---|
| Copper | Survey | N/A | On Paper | N/A | Many variables not related to N.R. data involved in the mod |
| | Survey | State agencies have access to it (thru agreement) | Microfiche and tape (magnetic); some reports | 60,000 establishments surveyed | |
| | | | | | |
| | | | | | |

# PRODUCT CHARACTERISTICS

Organization: OEPAD

Interviewee(s): Eric Rasmussen

Division: Planning-Research

Program (6): Copper Employment

Date: 8/27/80

Element (7):

| (22) Presently Produced | (23) Desired | DATA PRODUCT (25) | PRODUCT FORMAT (26) | SCALE OR RESOLUTION (27) | GEOGRAPHIC REFERENCE SYSTEM (28) | UPDATING FREQUENCY (29) | GEOGRAPHICAL COVERAGE (ACRES, MILES) (30) | TIME CONSTRAINTS (31) | ANTICIPATED USERS (3 |
|---|---|---|---|---|---|---|---|---|---|
| X | | AZ Copper Employment Model | U of A computing center on disk | by establishment -aggregate to area | | quarterly or as needed | establishments statewide | turnaround: request to output--one week | U of A - Division of Economics & Business Research (part of their state economet model--JLBC) |
| X | | Forecasts | report | aggregate to area | | Same as above | Statewide - Sub-County | | Local government; JLBC; DES; in-house mining companies |
| | | | | | | | | | |
| | | | | | | | | | |

PRODUCT CHARACTERISTICS

(continued)

| DATA PRODUCT (25) | ANALYSIS PERFORMED (33) | ACCESS RESTRICTIONS (AVAILABILITY) (34) | STORAGE MEDIUM (35) | OTHER ( |
|---|---|---|---|---|
| | based on regression model - econometric model | confidential | disk | forecast mining & smelting employment and use it to test policy implication of real world events. |
| | model | N/A | tables | |
| | | | | |
| | | | | |

Game and Fish Department
222 West Greenway Road
Phoenix, Arizona 85023

Interviewee: John Carr, Planning Branch Supervisor
Date: September 2, 1980
Authorities: A.R.S., Title 5 (relates to Boating and Water Sports)
A.R.S., Title 17 (wildlife laws)
Federal and State grant-in-aid funds:
- Federal Aid in Wildlife Restoration Act of 1937 - (Pittman-Robertson Act: money collected from the excise tax on sporting goods available for use on wildlife research and development projects)
- Federal Aid in Fish Restoration Act of 1950 - (Dingell-Johnson Act: federal funds, collected through excise taxes on fishing equipment, available for fisheries research and development projects)
- Commercial Fisheries Program
- Firearm Safety Program
- Federal Aid to Watercraft Program
- Federal Aid to Law Enforcement
- State Lake Improvement Fund

SUMMARY OF INTERVIEW:

The eight divisions of the Game and Fish Department have recently been consolidated into three: Wildlife Management Division responsible for Research, Game, Fisheries, Enforcement, and Planning and Evaluation; Field Operations Division which oversees activities in the State's five Regions; and Special Services Division, which includes Information and Education, Engineering, Development and Maintenance (includes improvements made on state lands to enhance fish and wildlife habitat or recreation), Funds Coordination, Finance and Data, and Supply.

The function of the Planning and Evaluation Branch with respect to natural resources data is two-fold: compile and publish all fish, wildlife and research data collected by all of the Game Management Units in the State; and review environmental impact statements of projects that may affect the well-being of game and fish habitat and populations.

The Planning Branch is small, having one individual to coordinate statewide game activities, and one for fisheries activities.

In the Planning Branch, virtually all data needs are supplied by field personnel from the Game Management Units. Major products prepared through compilation of the data include Strategic Plans for big and small game and fish, distribution maps, Arizona Big Game Management Information Report, and total harvest information.

ADDITIONAL AREAS IN NEED OF SURVEY:

Field Operations Division -

1. Regional Offices

Each of the five regions has a Regional Supervisor, a Fish Management Specialist, a Game Management Specialist, a Law Enforcement Specialist and several Wildlife Managers. Each Wildlife Manager is assigned to a Game Management Unit.

In general, Wildlife Managers operate in a passive mode because of limited staff and financial resources. Their activities include:

- Game and Fish Enforcement (may represent up to 50% of resources)
- Fisheries Management
- Information and Education
- Watercraft Registration and Enforcement
- Miscellaneous - Special Projects, Search and Rescue, etc.

Typically, Wildlife Managers do not collect baseline habitat information; rather, they acquire the data through cooperative agreements with the Bureau of Land Management, U.S. Forest Service, State Land Department and other entities. Where habitat data do not exist or are outdated, field personnel may conduct their own inventories.

2. Wildlife Management Division - Research Branch

This Branch is responsible for conducting long-term problem-oriented studies about fish and wildlife.

3. Natural Areas Program

The Game and Fish Department is working cooperatively with the Arizona Outdoor Recreation Coordinating Commission (AORCC) and Arizona State Parks Board to review sites for the Natural Areas Program. Funding is provided by the Nature Conservancy and AORCC through the Land and Water Conservation Fund.

# DATA CHARACTERISTICS

Organization: Game & Fish Department

Interviewee(s): John Carr

Division: Wildlife Management

Program (6):

Date: 9/2/80

Element (7):

| (9) Presently Used | (10) Desired | DATA ITEM (11) | SOURCE FORMAT (12) | SCALE OR RESOLUTION (13) | GEOGRAPHIC REFERENCE SYSTEM (14) | REQUIRED CURRENCY OF DATA ITEM (15) | GEOGRAPHICAL COVERAGE (ACRES, MILES) (16) | Current or ANTICIPATED SOURCES (17 |
|---|---|---|---|---|---|---|---|---|
| X | | Distribution Data | Map | ½" = 1 mile consolidated to 1:1,000,000 and other scales | Township & Range | as needed | by Management Unit, statewide except Indian Reservations | Field Personnel and other resourc agencies |
| | X | LANDSAT | Tapes, Imagery | | | | Statewide | |
| X | | Vegetative Maps | | ½" = 1 mile and other scales | Township/Range | As Needed | By Game Management Unit, Statewide except Indian Reservations | USFS; BLM;SLD Universities, etc. AGFD Field Personnel |
| | | | | | | | | |

DATA CHARACTERISTICS

(continued)

| DATA ITEM (11) | COLLECTION PROCEDURE, IF APPLICABLE (18) | ACCESS RESTRICTIONS (AVAILABILITY) (19) | STORAGE MEDIUM AND APPROXIMATE VOLUME (20) | PRECISION (21) | OTHER ( |
|---|---|---|---|---|---|
| Distribution data | Wildlife surveys by field personnel | Is available at scale of 1:1,000,000 and some others to agencies | Map files | | |
| LANDSAT | | | | | To identify and monitor habitat for big and small game |
| Vegetative Maps | compile data from all units into one map for the State. | Is available to agencies and others on request | Map files | | Produce statewide map at 1:500,000 |

# PRODUCT CHARACTERISTICS

Organization: Game & Fish Department

Interviewee(s): John Carr

Division: Wildlife Management, Planning & Evaluation Branch

Planning Branch Super.

Program (6):

Date: 9/2/80

Element (7):

| (22) Presently Produced | (23) Desired | DATA PRODUCT (25) | PRODUCT FORMAT (26) | SCALE OR RESOLUTION (27) | GEOGRAPHIC REFERENCE SYSTEM (28) | UPDATING FREQUENCY (29) | GEOGRAPHICAL COVERAGE (ACRES, MILES) (30) | TIME CONSTRAINTS (31) | ANTICIPATED USERS (3 |
|---|---|---|---|---|---|---|---|---|---|
| X | | Strategic Plan for big, small game and fisheries | Reports and tables | | | Yearly, or as possible | statewide | | Big Game Plans: Intend to publish as one document by late 1980 (will print abc 1,000). |
| X | | Distribution maps for Wildlife | map | 1/2" = 1 mile and other scales | Township & range | as needed | statewide | | |
| X | | AZ Big and Small Game Management information; Fisheries | Report | | | Yearly | by game management unit; statewide fisheries by AGFD Region and | Waterbodies | |
| X | | Total Game Harvest Information | Table | | | Yearly | Statewide by G.M. Unit for big game; statewide for small game | | |

PRODUCT CHARACTERISTICS

(continued)

| DATA PRODUCT (25) | ANALYSIS PERFORMED (33) | ACCESS RESTRICTIONS (AVAILABILITY) (34) | STORAGE MEDIUM (35) | OTHER ( |
|---|---|---|---|---|
| Strategic Plan | Compilation of data from Game Management Units - presented as a Statewide Summary | | Report | Includes Agency responsible for habitat, by %; distribution map; demand and supply; problems and strategies for managing, and Dept. Goals and Objectivies for Management. |
| Distribution Map | Same as Above | Maps available in summary form: 8½" x 11" map. | | changing scale in future. 1:500,000 in publishing part of Strategic Plan. |
| AZ Small Game and Big Game Management Information ; Fisheries Mgmt - collected by bodies of water or streams | Collection of field surveys submitted by each Game Management unit. | N/A | Reports | |
| Total Harvest | Via questionnaires sent to a sample of hunters | N/A | | Included in AZ Game Management Information. |
| Fisheries | A fisheries questionnaire is being developed and will be implemented in 1981. | | | --Fish Management and Planning |

Bureau of Geology and Mineral Technology
Mineral Technology Branch
University of Arizona
Tuscon, Arizona 85721

Interviewee: Dr. Larry D. Fellows
Date: August 25, 1980
Authority: A.R.S. 27-1

The interview with Dr. Fellows was brief, and because we met at the Capitol and he did not have access to relevant materials, he submitted a summary of Bureau activities for Fiscal Year 1979-1980 at a later date (See page IV - B18).

Major activities carried out by the Bureau include:

- Information and Assistance
- Geologic Framework
- Mineral and Energy Resources
- Geologic Factors Affecting Land Use

BUREAU OF GEOLOGY AND MINERAL TECHNOLOGY

Fiscal Year 1979-1980

by Larry D. Fellows

An understanding of Arizona's geologic framework and mineral resources has never been needed more than now. Demands for knowledge about land with respect to urban development, agriculture, highways, mineral exploration, mining, recreation, waste disposal and other uses are increasing. Many land-use decisions could be made more efficiently if the surface and subsurface distribution of earth materials and conditions were known.

The State Legislature (Arizona Revised Statutes, Chapter 27-1) specified that the objectives of the Arizona Bureau of Geology and Mineral Technology are to inform the public, encourage the wise use of land and mineral resources, and provide technical advice and assistance on the geologic setting, mineral resources and geologic factors that affect land use. In order to accomplish this, Bureau scientists must continue to learn about the geology and mineral resources of the State by making inventories of a diversity of earth materials, making studies of their characteristics, and by collecting and evaluating data (rock cuttings and cores, published and unpublished maps and reports, etc.).

Activities of Bureau personnel directed toward meeting these responsibilities during fiscal year 1979-1980 are described and summarized below.

## Information and Assistance

Information is made available to the public by (1) publishing geologic, mineral resource and other maps, as well as the results of geologic studies, (2) keeping unpublished data on open file, (3) answering written and telephone requests, (4) talking with visitors, and (5) preparing a quarterly newsletter, Fieldnotes.

During the year, publication sales totaled nearly $19,100, compared with $17,400 for the preceding year. More than 2,400 persons visited our offices, and many more telephoned or wrote for assistance. These requests increased substantially over the previous year.

Geologic Framework

Geologic maps and cross sections are used to show the geologic setting of the State. These maps show not only the distribution of rock and unconsolidated materials, but also, depending on scale, where there has been folding, tilting, fracturing or displacement by faults. A cross section is an interpretation of how a hypothetical slice through the earth would appear. The fundamental importance of the third dimension--the structure and dynamics of the earth beneath our feet--is all too often forgotten until an occurrence like Mt. St. Helens reminds us that this earth is not inanimate.

An anticipated Bureau project is an up-to-date, more detailed geologic map of the State. The current map, printed in 1969, is based largely on reconnaisance mapping that was done during or prior to the 1950's. Making a new, more detailed state map will be a major effort requiring careful planning and many months of work. The first step is in progress--collecting all available geologic maps and preparing an index designed to indicate those parts of the state that need additional mapping attention.

A map showing unconsolidated materials (alluvium, sand dunes, landslide deposits, talus, etc.) is being prepared with financial assistance from the U.S. Geological Survey (USGS). The scale of the map will be 1:1,000,000 (one inch on the map equals 16 miles on the ground).

Work on the state gravity map at a scale of one inch to eight miles and a contour interval of five milligals is nearing completion. A series of more detailed gravity maps are also being prepared at a scale of 1:250,000 (one

inch equals four miles) and a contour interval of two milligals. These maps are being completed as part of the Bureau's geothermal assessment project and in cooperation with the University of Arizona Geosciences Department, with funding from the U.S. Department of Energy (DOE).

Mineral and Energy Resources

Arizona has led the nation in production of copper for many years. Approximately 65% of the copper produced in the U.S. comes from Arizona mines. Copper also accounts for more than 80% of the total annual mineral value produced in Arizona. In terms of metal production (copper, molybdenum, silver, gold, lead, zinc, etc.), Arizona leads the nation. In terms of the value of all mineral commodities produced (metals, non-metals or industrial minerals, mineral fuels), the State ranks about tenth. Industrial minerals produced in Arizona include asbestos, cement, clays, gypsum, halite, lime, pumice, sand and gravel, stone, feldspar, fluorspar, perlite, and zeolites. Coal and crude oil are fuels produced in the State.

Current Bureau projects include research on the relationships among the occurrence of metals, the chemistry of the igneous rocks to which they relate, and plate tectonics, i.e. the dynamics of earth structures. Various compilations are in progress: An inventory of known molybdenum occurrences (funded by the USGS), is nearing completion; a study of other elements, also funded by USGS, has just begun; and a research project on all known uranium occurrences is being implemented with funding from the DOE. One Bureau geologist has been a participant in a University of Arizona Geosciences Department project, funded by the DOE, to evaluate the potential for uranium in certain crystalline rocks. The Bureau is also studying the geology of Arizona's industrial minerals, with most recent emphasis on evaporite deposits (salt, gypsum).

Active mineral technology projects include the recovery of minerals and the specification of methods for their recovery from mine dumps in Mohave County (funded by the U.S. Bureau of Mines), and a study of metal recovery from super alloy scrap.

A statewide assessment of potential geothermal resources, funded by the DOE, is in its fourth year. To date, 37 areas have been identified that are believed to have geothermal potential. More detailed, site-specific studies are being conducted at seven sites. In addition, a Geothermal Resources map of Arizona is being prepared at a scale of 1:500,000 (one inch equals eight miles). The U.S. Department of Water and Power Resource Services, formerly the Bureau of Reclamation, funded an assessment of the geothermal potential in the Phoenix-Casa Grande area.

Geologic Factors Affecting Land Use

Year-in and year-out, hydrologic activity (flooding, etc.) is the most devastating natural hazard in Arizona. The Phoenix region, for example, has experienced "100-year floods" for three successive years. However, the potential for damaging earthquakes capable of affecting parts of Arizona may have been underestimated. Land subsidence due to the pumping of groundwater is becoming increasingly serious. In parts of central and southeastern Arizona, water levels have been lowered by more than 200 feet since the 1950's because of groundwater withdrawal. This lowering has been accompanied locally by subsidence of six to 12 feet.

Identification of areas having potential geologic hazards or limitations is based on knowledge of the geologic framework, including rock and unconsolidated materials present at the surface and in the subsurface, depth to bedrock, type of materials present, location of faults and fractures, ground-

water conditions, topographic characteristics, and processes of erosion and deposition. This requires field observation, data collection, including geologic mapping, analysis of drill hole records, and other procedures to get the basic data on which evaluations, interpretations, decisions and applications can be based.

Work in progress includes the preparation of a catalog of earthquakes of historic record and an epicenter map (funded by the Nuclear Regulatory Commission and the USGS), a report on the 1887 Sonoram (Mexico) earthquake (the strongest recorded quake to be felt in Arizona), and a statewide assessment of potential geologic hazards, funded by the USGS.

The final two maps of a 10-map series on applied geology in the McDowell Mountains area in suburban Phoenix were drafted and published by the Bureau. Field work for this project was done by geologists at Arizona State University.

Maricopa Association of Governments
1820 West Washington Street
Phoenix, Arizona 85007

Interviewees: Tom Ford - Division Manager, Transportation
(602)261-7867
Mark Frank - MAG 208 Coordinator
(602)262-8528
Date: September 5, 1980
Authority: Voluntary - includes membership from Maricopa County's 19 cities and towns; financing is from federal and local sources.

A. 208 Water Quality Planning

The primary emphasis by MAG in the 208 program is on groundwater. All surface water in the county is effluent from sewage, and as such is handled under Waste Water Systems planning.

Sources used to access historical or existing groundwater quality data are:

- Irrigation Districts - existing data relates mostly to the use of groundwater for agricultural purposes;
- Department of Water Resources - primary data for quality of groundwater is minimal;
- Department of Health Services - stores data mainly on quality of surface waters;
- Salt River Project (SRP) - electrical generating utilities company; and
- U.S. Geological Survey - cooperative arrangement for a $3 million Southwest Alluvial Basin Study.

Because the quality of groundwater is of primary importance in this rapidly developing county, MAG has collected primary data for quality to fill in data gaps. Information is required on pollutants by geographical area, by depth, and over time. This information is vital for assessing the status of aquifers, and more importantly, for trend analysis.

At the time of the interview the status of MAG's 208 future activities with respect to groundwater (non-point) pollution was uncertain. The program is funded until October 1, 1980. The Environmental Protection Agency has not yet decided if they will continue the program.

B. Transportation

Planning is oriented towards urban areas, and includes prediction of future traffic volumes, regional transit planning, etc. (This effort is actually funded by the Arizona Department of Transportation, since Phoenix is a Standard Metropolitan Area. Therefore the Federal Highway Act of 1962 requires that it have an on-going transportation plan. MAG is hence under contract to ADOT.) Very little natural resources-related data (with the exception of population projections) is used on a routine basis.

Oil and Gas Conservation Commission
1645 West Jefferson, Suite 420
Phoenix, Arizona 85007

Interviewee: W.E. Allen
Date: August 25, 1980
Authority: A.R.S. Title 27, Chapter 4; Article 4

The Oil and Gas Conservation Commission regulates the development and production of oil, natural gas, helium, and geothermal resources within the State for the purpose of conservation and protection against waste of these resources.

The interviewee indicated that the Commission requires access to little natural resources data beyond that collected in its own activities. However, many of the maps and reports summarizing oil, gas, helium and geothermal resources and development activities are used by other State and federal agencies, universities and the private sector. The attached "List of Available Publications" summarizes the types of products available through the Commission.

## LIST OF AVAILABLE PUBLICATIONS
## SEPTEMBER 1979

OIL AND GAS CONSERVATION COMMISSION
1645 West Jefferson Street, Suite 420
Phoenix, Arizona 85007
(602) 255-5161

### REPORT OF INVESTIGATION

RI-3. A geophysical and geological investigation of potentially favorable areas for petroleum exploration in southeastern Arizona, by Carlos L. V. Aiken and John S. Sumner, 1974; 39 pages, 17 figures, 4 tables, and 3 plates at scale of 1:500,000 (1 in. = approx. 8 mi.) also available as separates:

- Pl. 1. Bouguer gravity anomaly map (see GG-3 for description)
- Pl. 2. Residual aeromagnetic map (see GG-4 for description)
- Pl. 3. Drill hole map (see A-2 for description)

RI-4. Selected Paleozoic stratigraphic sections in Arizona, by Edward A. Koester, 1973; 24 pages and 4 tables; 323 sections keyed to map; scale 1:1,000,000 (1 in. = approx. 16 mi.).

RI-5. Arizona well information, Supplement 1--Records of wells drilled for oil, natural gas, helium, and stratigraphic information since publication of Arizona Well Information (Arizona Bureau of Mines Bulletin 185, 1972), by James R. Scurlock, 1973; 28 pages.

RI-6. Thermal gradient anomalies, southern Arizona, by Salvatore Giardina, Jr., and J. N. Conley, 1978; 49 pages, 3 plates. A report based on a study of temperature data abstracted from the records of numerous wells drilled for water and other earth resources in Arizona.

RI-7. ~~Favorable and potentially favorable areas for hydrocarbon and geothermal energy sources in northeastern Arizona, by J. N. Conley and Salvatore Giardina, Jr., 1979. A report of work performed under Four Corners Regional Commission Contract No. 181-099-058-1.~~

Out of Print

### SPECIAL PUBLICATION

SP-1. Review of the development of oil and gas resources of northern Arizona, by J. N. Conley, 1974; 10 pages, 5 figures, and 3 tables.

SP-3. Index of maps selected for energy-resource investigations in the State of Arizona, June 1976, by J. N. Conley, J. R. Scurlock, and O. A. Stacey, 1976; 3 plates, 6 figures, and 9 tables. Maps indexed: geologic, aeromagnetic, gravity, structure, lineament, and fracture systems; temperature; and oil, natural gas, and helium development.

SP-4. Geologic review of northwestern Arizona for petroleum exploration investigators, by Salvatore Giardina, Jr. An overview of northwestern Arizona, including structure, stratigraphy, and historical exploration data, 35 figures, 72 pages.

## MAPS - WELL LOCATION

### State Series

4. Sheet 1. Wells drilled for oil, natural gas, helium, and geothermal resources; selected wells drilled for stratigraphic or mineral information; and oil and natural gas pipelines.

   Sheet 2. Oil, natural gas, and helium pools in northeastern Arizona.

   Companion text contains supplementary well data, keyed to maps, pertaining to public land survey location, operator, elevation, completion data, total depth, and stratigraphic unit or geologic system at total depth.

### County Series

Maps show the location of wells drilled for oil, natural gas, helium, and geothermal resources; most of the wells drilled for potash, halite, stratigraphic, structural, and acquifer information; and selected wells drilled for water; scale 1:500,000 (1 in. = approx. 8 mi.). Except for No. 9, supplementary tabulated well data printed on map or on a separate sheet: identification number; location; type of well; elevation; completion date; total depth; geologic age or lithology of rock at total depth; and availability of geophysical, lithologic, and drillers' logs, and samples of drill-bit cuttings.

1. Maricopa, by J. N. Conley and Edward A. Koester, 1972; 2 sheets
2. Yuma, by J. N. Conley and Edward A. Koester, 1972
3. Pinal, by Edward A. Koester and J. N. Conley, 1972
4. Cochise, by Edward A. Koester and J. N. Conley, 1972
5. Yavapai, by Edward A. Koester and J. N. Conley, 1973
6. Mohave, by Edward A. Koester and J. N. Conley, 1973
7. Pima and Santa Cruz, by J. N. Conley and Edward A. Koester, 1974
8. Graham and Greenlee, by J. N. Conley and Edward A. Koester, 1974
9. Apache, Coconino, Navajo, and portions of Gila, Mohave, and Yavapai, by J. N. Conley, 1975 (oil, natural gas, and helium pools shown at enlarged scales); in envelope with 45-page bound text and well-data tabulation.

### Pool Series - Oil, natural gas, and helium

Maps of the pools listed below and pools near the extreme northeast corner of Apache County (Four Corners region) which include data through June 30, 1977, are shown on State Map No. 4.

P-2. Dineh-bi-Keyah oil field, Apache County, Arizona, by Charles E. Druitt, 1974; scale 1:63,360 (1 in. = 1 mi.).

## MAPS - TEMPERATURE

GT-2. Mean annual temperature map, State of Arizona, by Charles E. Druitt, 1976; isotherm interval 5° Fahrenheit; scale 1:2,000,000 (1 in. = approx. 32 mi.).

GT-3. Tabulation of temperature measurement data, State of Arizona, with maps:

- GT-3A. Map showing location of wells penetrating subsurface basement rocks
- GT-3B. Map showing location of wells penetrating subsurface suprabasement rocks

## GEOLOGIC STRUCTURE/CORRELATION SECTIONS

GXS-1. Set of 4 sections across portions of the eastern Mogollon Slope region in east-central Arizona, by J. N. Conley, 1977.

## MISCELLANEOUS

Chart: C-1. Oil and natural gas occurrence in Arizona, by J. N. Conley, 1974.

Catalogs: 1. Index of samples of drill-bit cuttings and/or cores of wells drilled in Arizona, by J. N. Conley, 1971.

1-A Rev. Index of samples of drill-bit cuttings and/or cores of wells drilled in Arizona, July 1971 through April 1978.

Directory: Sources of information on exploration for petroleum and geothermal resources in the State of Arizona, 1974.

## MAPS - REGIONAL

### Eastern Mogollon Slope region, east-central Arizona

(Encompasses Permian Supai evaporite basin)

Well-data tabulation for Eastern Mogollon Slope region maps, 1976; 18 pages.

A-1. Well location map, 1976 (revision of former Holbrook area, 1975). Blueline print shows: wells drilled for oil, natural gas, and helium; information pertaining to potash, structure, and stratigraphy; and selected water wells penetrating the Permian Coconino Sandstone; scale 1:250,000 (1 in. = approx. 4 mi.).

G-6. Structure map--Top of Permian Coconino Sandstone, by J. N. Conley and J. R. Seurlock, 1976; contour interval 100 feet; scale 1:250,000 (1 in. = approx. 4 mi.).

G-6A, G-7, G-8. Set of three structure maps (also available as separates); scale 1:500,000 (1 in. = approx. 8 mi.):

G-6A. Top of Permian Coconino Sandstone (reduction of G-6).

G-7. Base of Permian Fort Apache Member of Permian Supai Formation, by J. N. Conley, 1977; contour interval 200 feet.

G-8. Top of basement, by J. N. Conley, 1977; contour interval 200 feet.

### Southeastern Arizona

A-2. Drill hole map of southeastern Arizona, by J. N. Conley, 1974; separate of Plate 3, Report of Investigation 3; scale 1:500,000 (1 in. = approx. 8 mi.). Map covers Cochise County and portions of adjacent counties and shows: location of all wells drilled for oil, natural gas, and stratigraphic information; selected wells drilled for water; and data pertaining to shows of oil and gas and geologic age of rock at total depth. Companion tabulation presents supplementary data, including available information as to geologic age or lithology of rock encountered beneath the valley-fill.

## MAPS - GEOPHYSICAL

GG-3. Bouguer gravity anomaly map of southeastern Arizona, by Robert E. West and others, 1973; separate of Plate 1, Report of Investigation 3. Printed in color, map shows: areas of pre-Cenozoic sedimentary, volcanic, and intrusive rocks; station control; lines of gravity/aeromagnetic profiles; and wells referred to in text; contour interval 5 milligals; scale 1:500,000 (1 in. = approx. 8 mi.).

GG-4. Residual aeromagnetic map of southeastern Arizona, by William A. Sauck and John S. Sumner, 1970; separate of Plate 2, Report of Investigation 3; contour interval 25 gammas; scale 1:500,000 (1 in. = approx. 8 mi.).

Arizona Outdoor Recreation Coordinating Commission
(AORCC)
1333 West Camelback, Suite 206
Phoenix, Arizona 85013

Interviewee: Mary Alice Bivens, Director
Date: September 4, 1980
Authority: A.R.S. 41-511
A.R.S. 5-382

The Arizona Outdoor Recreation Coordinating Commission (AORCC) was created in 1965 by an act of the Arizona State Legislature. AORCC's primary responsibility is to administer the Land and Water Conservation Fund (LWCF) and the State Lake Improvement Fund (SLIF) programs.

The Commission is composed of seven members, two of whom are designated by statute with the remaining five appointed by the Governor. Three of the appointed Commissioners are selected from full-time Directors of Arizona county and municipal Park and Recreation Departments, while the other two are selected from the general public.

Responsibilities of the Commission include: the establishment of policies governing the disposition and use of LWCF and SLIF monies, the coordination of federal/state/local and private recreation planning and development, and the evaluation and assessment of applicable public or private efforts that influence outdoor recreation in Arizona.

THE LAND AND WATER CONSERVATION FUND (LWCF)

In 1965, Congress enacted legislation establishing the Land and Water Conservation Fund to provide assistance to the states for the enhancement of public outdoor recreation resources and opportunities. The funding for this

program, which is derived from federal surplus property sales, motorboat fuel tax, entrance fees to National Parks, and outer continental shelf oil and gas lease revenue, is made available to the states in the form of 50-50 matching grants for outdoor recreation planning, acquisition and development.

To be eligible to participate in the LWCF program, states are required to prepare and maintain an acceptable Statewide Comprehensive Outdoor Recreation Plan (SCORP). LWCF grants may be used to acquire public park lands or recreational waters and/or develop outdoor recreation facilities which meet state and local needs identified in the SCORP.

Prior to final grant approval, projects are reviewed by the Heritage Conservation and Recreation Service (HCRS) of the federal government, which administers LWCF.

The major purpose of the SCORP is to provide a comprehensive framework for the orderly planning, acquisition, development and administration of Arizona's outdoor recreation resources. A major part of the plan documents the following natural resources-related data required for this assessment:

Geology and Mineralogy

Climate

The River System

Vegetation

Wildlife

Ecology and Environmental Concerns

Socio-Economic Factors

Population Projections

Land Ownership

It is also through the Land and Water Conservation Fund that AORCC participates in Natural Heritage Program to identify areas in Arizona having endangered plants and animals, unique geologic features and other natural areas.

THE STATE LAKE IMPROVEMENT FUND (SLIF)

The State Lake Improvement Fund is derived from boating license fees and a percentage of motor fuel tax revenues. This percentage is determined every three years by a Marine Fuel Tax Survey conducted by the Arizona Department of Transportation in cooperation with the Arizona Game and Fish Department.

Monies in the Fund are available for projects which are annually reviewed by the Arizona Watercraft Advisory Council, recommended for funding by AORCC, and approved by the State Legislature for construction and/or purchase of facilities on waters where boating is permitted.

Because AORCC must identify potential recreation sites statewide (regardless of land ownership) and make recommendations regarding their development, the needs for natural resource data of all types is tremendous. The Director of the Commission actively supports the idea of a natural resource information system for the State, provided that such a system would not be buried in an agency where access by others would be difficult. She also stated that AORCC would be very interested in participating in a pilot program for developing a statewide system, although such an effort would probably require some type of financial commitment from the State.

State Parks Board
1688 West Adams, Room 122
Phoenix, Arizona 85007

Interviewee: Mike Pastika
Date: September 5, 1980
Authority: A.R.S. 41-511; 41-1352 and R2-3-42 through R2-3-46; 41-846; ASM Rule No. 1

The Arizona State Parks Board is charged with acquiring, developing and maintaining a State Park System; providing for the use of the State's natural and cultural resources for recreation; and preserving significant elements of the State's natural and cultural heritage for future generations.

Major programmatic efforts include:

- Arizona Trails Program - trails may cross any land ownership jurisdictions, including local government.
- State Park Site Operations - development of sites.
- Natural Areas Program.
- Historical Preservation Program - registry program for all cultural sites (historic, archaeologic, and paleontological).

Because of the broad responsibilities of the State Parks Board, there is a significant need for natural resources data on a statewide basis. Interviewee indicated a strong interest in a geographic information system, provided the system would be responsive to <u>all</u> state agencies requiring these types of data.

See attachments for details of the State Park Board programs.

ARIZONA TRAILS PROGRAM

The goal of the Arizona Trails Program is to identify and preserve hiking and equestrian trail recreation options and opportunities within Arizona. To this end, the State Parks Board appointed a Hiking and Equestrian Trails Committee to advise them on trail matters within the State. This Committee is developing a coordinated, integrated statewide hiking and equestrian trails network: The Arizona Trails System.

The Committee's efforts are concentrated on the establishment and maintenance of existing trails through coordination with local, state and federal agencies. Designations for Recreational and Historic Trails within the Arizona Trails System have been developed with one trail each receiving this status: The Sun Circle Trail, and the General Crook Trail. Presently, designation is made on other agencies' land with their concurrence and with no change in ownership or management. The designation identifies trails which are significant in Arizona for a valuable recreational experience, or for providing an historic experience by traversing significant routes used in earlier times.

The Committee inventories existing trails and identifies other areas of concern which include coordinating multiple ownership of potential trails, aiding communities in trail planning efforts, historic trail planning and implementation, development of criteria and trail standards, and coordination of volunteers for trail maintenance. The Committee also provides representation to federal trail planning efforts, including national scenic recreational and historic trails which occur in Arizona.

Several pieces of legislation have been passed to aid trail efforts: Placement of trail responsibilities with State Parks, and authorizing counties to request trail easements in new subdivision applications.

ARIZONA NATURAL AREAS PROGRAM

The Natural Areas Program identifies sites within Arizona's natural landscape which represent the array of unique and representative ecosystems, geologic features and limited or unusual habitats which contain endangered, rare, or peripheral species.

The public needs served by the program are maintenance of native floral or faunal genetic pools, providing research or educational opportunities, and identification of important biological or geological sites for land use planning and preservation efforts.

A Natural Areas Advisory Council, composed of ten scientists representing various disciplines and institutions, is nominated by the Arizona/Nevada Academy of Science and appointed by the Parks Board to provide professional expertise to the Natural Areas Program, recommend registration of sites, and to advise on other related matters. The Council awards proposed status to selected and studied areas, thereby providing a judgement on a site's conformance to natural area criteria and its level of significance within the state, and confers eligibility for registration.

Registration of a site is accomplished through a Memorandum of Agreement, or a Letter of Understanding, both non-binding documents, between the Parks Board and the owner/agency. The Memorandum identifies values and present management, and contains an agreement to communicate should changes in either occur. The Letter of Understanding received by the Parks Board from the owner/agency, recognizes the area's natural values and states the owner/agency's intent to continue the existing management.

A Certificate of Recognition may be awarded to an agency or owner unable or unwilling to put anything in writing or to enter into a formal agreement, but whose management reflects concern for a site's natural values and maintenance.

Protection through public awareness is one benefit of providing statewide recognition to an important state resource.

Presently, there are 87 proposed natural areas, 7 registered sites, and two areas whose owners/managers have received a Certificate of Recognition for their stewardship of the land.

The Natural Area Advisory Council meets three times each year to consider awarding proposed status to sites and to recommend registration of sites to the Parks Board. Other natural resource management issues which relate to Natural Areas are also considered.

## ENVIRONMENTAL REVIEW/CULTURAL RESOURCE COMPLIANCE

Applicable Federal Laws, Rules, Regulations, Procedures & Guidelines

I. LAWS (directly pertaining to Environmental Review/Historic Preservation)

Antiquities Act of 1906 (PL 59-209)

Historic Sites Act of 1935 (PL 74-292)

Reservoir Salvage Act of 1960 (PL 86-523)

National Historic Preservation Act of 1966 (PL 89-665)

National Environmental Policy Act of 1969 (PL 91-190)

Executive Order 11593 of May 13, 1971

"Protection and Enhancement of the Cultural Environment" (36 CFR 8921)

Archaeological and Historic Preservation Act of 1974 (Amendment to the Reservoir Salvage Act of 1960) (PL 93-291)

1976 Amendments to the Land and Water Conservation Fund Act of 1965 and the National Historic Preservation Act of 1966 (PL 94-422)

President's Memorandum on Environmental Quality and Water Resources Management (dated July 12, 1978)

American Indian Religious Freedom Act of 1978 (PL 95-341)

LAWS (indirectly pertaining to Environmental Review/Historic Preservation)

Department of Transportation Act of 1966, as amended (PL 89-670)

Federal Aid Highways Act of 1966, as amended (PL 89-574)

"Surplus Real Property Act" Amendment to the Federal Property and Administrative Services Act of 1949 (PL 92-362)

Housing and Community Development Act of 1974 (PL 93-383)

Emergency Home Purchase Assistance Act of 1974 (PL 93-449)

Public Buildings Cooperative Use Act of 1976 (PL 94-541)

AMTRACK Improvement Act of 1974 (PL 93-496) as amended by the Rail Transportation Act of 1976 (PL 94-555)

Public Works Employment Act of 1976 (PL 94-369)

Community Emergency Drought Relief Act of 1977 (PL 95-31)

II. FEDERAL AGENCY'S RULES, REGULATIONS, PROCEDURES, AND GUIDELINES

Advisory Council on Historic Preservation (ACHP)

36 CFR Part 800

Procedures for the Protection of Historic and Cultural Properties

Guidelines for Making "Adverse Effect" and "No Adverse Effect" Determinations for Archaeological Resources in Accordance with 36 CFR Part 800 (dated August 20, 1976)

FR, Vol. 43, No. 210, Monday, October 30, 1978

Proposed amendments to existing regulations (revision of 36 CFR Part 800)

Council on Environmental Quality (CEQ)

40 CFR Part 1500

Preparation of Environmental Impact Statements: Guidelines

FR, Vol. 43, No. 230, Wednesday, November 29, 1978

Implementation of Procedural Provisions (Final Regulations)

Department of Agriculture (DOA)

Soil Conservation Service (SCS)

7 CFR Part 656

Procedures for the Protection of Archaeological and Historical Properties Encountered in SCS-Assisted Programs (Final Rule)

FR, Vol. 43, No. 118, Monday, June 19, 1978, Addition of More Detailed Actions (Amendment to 7 CFR Part 656, Section 656.7) (Final Rule)

Department of Commerce (DOC)

Economic Development Administration (EDA)

13 CFR Part 316

Local Public Works Capital Development and Investment Program (Republication - combining all amendments to 13 CFR Part 316) (Published in FR, Vol. 41, No. 204, Wednesday, October 20, 1976)

Environmental Review Requirements for the Local Public Works Program (EDA guidelines for the Regional Offices)

13 CFR Part 318

Community Emergency Drought Relief Program: Requirements and Procedures (Final Rule) (Published in FR, Vol. 42, No. 102, Friday, May 27, 1977)

Department of Defense (DOD)

Department of the Army (ARMY)

Corps of Engineers (CORPS)

Technical Manual 5-801-1

Historic Preservation: Administrative Procedures (published November, 1975)

Technical Manual 5-801-2

Historic Preservation: Maintenance Procedures (published February, 1977)

Environmental Regulation No. 1105-2-460

Planning: Identification and Administration of Cultural Resources (dated April 3, 1978) (to be codified as 33 CFR 305)

Department of Health, Education and Welfare (HEW)

DHEW Historic Preservation Procedures (dated April 9, 1977)

Department of Housing and Urban Development (HUD)

40 CFR Part 58

Environmental Review Procedures for the Community Development Block Grant Program

24 CFR Part 201

Property Improvement and Mobile Home Loans, Historic Preservation Loans

24 CFR Part 570

Community Development Block Grants:

Subpart C: Eligible Activities;

Subpart D: Entitlement Grants;

Subpart F: Small Cities Program

HUD-465-F

Guidelines for Rehabilitating Old Buildings (published April, 1977)

Department of the Interior (DOI)

36 CFR Part 60

National Register of Historic Places: Nominations by States and Federal Agencies

36 CFR Part 61

Criteria for Comprehensive Statewide Historic Surveys and Plans

36 CFR Part 63

Determinations of Eligibility for Inclusion in the National Register of Historic Places

36 CFR Part 64

Criteria and Procedures for the Identification of Historic Properties (Draft)

36 CFR Part 66

Recovery of Scientific, Prehistoric, Historic, and Archaeological Data: Methods, Standards and Reporting Requirements (proposed regulations)

Bureau of Land Management (BLM)

BLM Manual - Section 8100

Cultural Resource Management

BLM Manual - Section 8111

Cultural Resource Inventory and Evaluation (upland)

Instruction Memorandum No. 78-339

Guidelines for Cultural Resource Evaluation (dated 7/3/78)

Bureau of Reclamation (BR)

43 CFR Part 422

Procedures for the Identification and Administration of Cultural Resources (Final Rule)

Heritage Conservation and Recreation Service (HCRS)

HCRS Manual - Grants-in-Aid Series, Part 660, Chapter 4, Project Agreement General Provisions (Land and Water Conservation Fund Project Agreement: General Provisions)

National Park Service (NPS)

NPS Manual, Chapter V

Cultural Resource Management and Preservation

Department of Transportation (DOT)

Federal-Aid Highway Program Manual

FHPM 7-7-2 (content of the Environmental Impact Statement; Section 4(f) Statements; Historic and Cultural Preservation Procedures)

Policy and Procedure Memorandum 20-7 (PPM 20-7)

Archaeological and Paleontological Salvage

Policy and Procedure Memorandum 90-1 (PPM 90-1)

Environmental Impact and Related Statements

Environmental Protection Agency (EPA)

Program Guidance Memorandum (no. 52) (PGM-52)

Nuclear Regulatory Commission (NRC)

Environmental Standard Review Plan

ES Section 2.5.3 Socioeconomics: Historic and Archaeological Sites and Natural Landmarks (Appendix A)

Office of Management and Budget (OMB)

OMB Circular A-95

## HISTORIC PRESERVATION GRANTS-IN-AID AND TAX CERTIFICATION
Applicable Laws, Rules and Regulations

- Section 2124 Tax Reform Act of 1976
- 36 CFR 67 Historic Preservation Certifications pursuant to the Tax Reform Act of 1976
- 26 CFR 7 Temporary Income Tax Regulations under the Tax Reform Act of 1976
- Secretary of the Interior's Standards for Historic Preservation Projects October 1978
- 36 CFR 61 Criteria for Comprehensive Statewide Historic Surveys and Plans
- Office of Management and Budget Circular A-102 Uniform Administrative Requirements for Grants-in-Aid to State and local governments.
- Draft Grants Management Manual. 306 pagesi
- National Historic Preservation Act
- Civil Rights Act of 1964 (Public Law 88-352) as amended.
- 43 CFR 17 Department of the Interior Policies
- Part 506 Department Manual - Department of the Interior
- Section 504 Rehabilitation Act of 1973 as amended.
- FMC 77-4 Allowable Costs
- Architectural Barriers Act of 1968, 42 USC 4151 (41 CFR 101-19.603)
- Executive Order 11988 relating to flood hazards
- Executive Order 11288 relating to water pollution
- Executive Order 11990 relating to wetlands
- Flood Disaster Protection Act of 1973 (PL 93-234), 42 USC 4104
- 40 CFR 15 EPA's list of Violating Facilities.
- 41 CFR 101-7 Standardized Government Travel Regulations
- National Environmental Policy Act of 1969, Public Law 91-190 as amended 42 USC 4321 (40 CFR 6)
- Hatch Political Activity Act, 5 USC 1501
- Freedom of Information Act, 5 USC 552
- National Occupational Safety and Health Act of 1920 (20 CFR 1910)
- OMB Circular #A-95
- Uniform Relocation Assistance and Real Acquisition Policies Act of 1970 (Public Law 91-646)
- Federal Management Circular 74-8
- 41 CFR 114-50 Department of Interior regulation on displacement
- HCRS - Grantee Advisory Council Memorandum of Agreement.
- Historic Preservation Grants-in-Aid Policies and Procedures, June 1973 edition.
- Public Law 93-449 Loan insurance program FHA of HUD
- ARS §42-139 Historic Property Classification
- Article III, R12-8-60, R12-8-61, R12-8-62, R12-8-63, R12-8-64 of ASPB Rules.

Arizona Radiation Regulatory Agency
(Formerly: Atomic Energy Commission)
925 South 52nd Street, Suite 2
Tempe, Arizona 85281
(602) 255-4845

Interviewee: Polly Gallardo, Adminstrative Services Officer
Dates: August 26, 1980 (telephone)
September 2, 1980
Authority: A.R.S. 30-691

The State of Arizona Radiation Regulatory Agency carries out radiation programs concerned with public health and safety. These programs include a radiological environmental monitoring system and laboratory capability designed to evaluate existing and future radioactive levels; certification of radiologic technologists; radiation emergency response capability; licensing and inspection of radioactive materials; x-ray registration and compliance inspection; assessment of low level radioactive waste; and transportation of radioactive materials.

Department of Revenue
State Capitol, West Wing
Phoenix, Arizona 85007

Interviewee: Jane Gresham, Research and Statistical Analyst
Date: September 3, 1980

The Department of Revenue was not adequately surveyed due to lack of time. This agency should be included in future surveys.

Arizona Department of Transportation
Highways Division
Environmental Planning Services
205 South 17th Avenue
Phoenix, Arizona 85007

Interviewees: Carl Winneka
Jim Smith
Date: August 29, 1980

The Environmental Planning Services accumulates and evaluates data concerning economic, social, and environmental factors as they affect and are affected by highway projects. Their efforts are concentrated on specific project areas, yet may cover as much as a 250-mile radius in some instances where the project has far-reaching (regional) effects.

Date are obtained from a number of State and federal agencies. Requirements range from cultural site data, to geologic hazards, wildlife habitat, demographics, locations of state parks, land ownership, land use, and so on.

Because there was not time to survey this branch of the Department of Transportation, it is recommended that future surveys fully examine and document their needs.

# APPENDIX IV-A

## SUMMARIES OF INTERVIEWS WITH CANDIDATE AGENCIES (INSTITUTIONAL SETTING)

DEPARTMENT OF WATER RESOURCES

1. What type of information system do you have?
   - Existing system is largely manual, with some modeling and record-keeping software and supporting data bases on computers at the Department of Administration (DOA) and the Arizona Department of Transportation (ADOT).
   - The scope of the system has been historically an "in-house" operation, with users, data types and services designed to support agency programs.
   - Existing computer equipment consists of remote terminals to access other computers via telephone.
   - Existing DWR staff have limited data processing backgrounds. Three professional staff members are assigned to existing computer tasks in functional Divisions.
   - Data processing accomplishments are limited to operating water resource-planning models and record-keeping functions.

2. Are there plans to create or expand your information system?
   - With new groundwater legislation, DWR does anticipate a need for a larger capability.
   - There are plans to analyze in-house needs and prepare a data processing system plan.
   - May also want to process Landsat data in-house to monitor irrigated lands in Active Management Areas.

3. Do you use other information services?
   - Currently use computer services at ADOT and DOA.
   - Have a special project with the Office of Arid Lands Studies at the University of Arizona to design a reference system for water "information" (average depth to water in an area), as opposed to water "data" (specific water depth, water chemistry, etc. for a single water well).

- Rely on information from a variety of sources:
  - Population projections from the Department of Economic Security (DES).
  - Crop reporting statistics from U.S. Department of Agriculture.
  - Cooperative program with U.S. Geological Survey (USGS) for water data collection.
  - WATSTORE - a computer water data/information system of USGS.
  - Early warning system for floods with the U.S. Weather Service.

4. To whom do you provide information services? Occasionally? Routinely?
   - DWR responds to requests for water data only.

5. What would it take for your system to provide information services to other agencies?
   - An increased staff would be required.
   - The size of the staff would depend on the amount of promotion and resulting demand for services.

6. What are your perceptions and/or expectations of the Data Coordination Network and Mapping Advisory Committee chaired by OEPAD? Do you perceive that such organizations are needed in Arizona?
   - Support the concept of data coordination as beneficial to Arizona.
   - No comment on current effort.

7. What are your perceptions and/or expectations of ARIS as it is today? What is your understanding of its original goals and intended services?
   - There is a tendency to claim more capability than exists.
   - ARIS has been unable to provide products.
   - Would be willing to use an efficient capability, such as ARIS has the potential to be.

DEPARTMENT OF TRANSPORTATION (ADOT)

1. What type of information system do you have?
   - ADOT has a large computer information system for record keeping and engineering design with computer graphics.
   - Scope of system is to provide data and information services for in-house user requirements.
   - ADOT has large IBM and Amdahl main-frame computer hardware with computer graphics capabilities.
   - Staff expertise includes computer programmers and analysts, transportation planners and engineers.
   - Data processing accomplishments routinely support a variety of operational requirements.

2. Are there plans to create or expand your information system?
   - The existing system capabilities will be expanded only to meet in-house requirements.

3. Do you use other information services?
   - Use information for transportation planning from outside sources, such as:
     - Population projections and census data from DES, and
     - Flood hazard and other water data from DWR and USGS.

4. To whom do you provide information services? Occasionally? Routinely?
   - ADOT provides photographic, remote sensing, and computer services to DWR and others on request, but only as capacity is available on existing system.
   - ADOT users and requirements take priority over other users.

5. What would it take for your system to provide information services to other agencies?
   - ADOT is not asking for added responsibility to provide state-wide natural resource information services.
   - However, for ADOT to provide additional services, the following changes would be needed:
     - An additional, dedicated service staff to assist users, and develop information sources and services,
     - Appropriated funding for basic services to State agencies,
     - A clear legislative mandate beyond the present DOT charters, and
     - A guidance committee made up of key State agencies, Federal agencies and substate government representatives.

6. What are your perceptions and/or expectations of the Data Coordination Network and Mapping Advisory Committees chaired by OEPAD? Do you perceive that such organizations are needed in Arizona?
   - The Data Coordination Network is a good concept, but not defined, and has had too few meetings to be effective.
   - Mapping Advisory Committee appears to be working well.
   - There is a need for coordination of remote sensing activities of State agencies and universities.

7. What are your perceptions and/or expectations of ARIS, as it is today? What is your understanding of its original goals and intended services?
   - Originally had hoped ARIS would develop a wide information base and supporting computer capabilities for State natural resource agencies, including ADOT.
   - A computer capability was planned but not funded.

DEPARTMENT OF TRANSPORTATION (ADOT) (Cont'd)

- Original base data was the orthophotoquad program, that could have been expanded using other types of remote sensing to monitor changes in population distribution, cropping patterns, etc. (For example, ADOT could use such information to predict increased runoff-caused flood hazards from upstream development that might endanger bridges.)
- Currently, updating is not being addressed by the Information Resources Division at SLD that inherited ARIS, and there is no mechanism for State agency input to develop needed services.

THE UNIVERSITY OF ARIZONA

OFFICE OF ARID LANDS STUDIES

APPLIED REMOTE SENSING PROGRAM (U of A)

1. What type of information system do you have?
   - Manual and computer information system capabilities are available at U of A.
   - Scope of system is designed to support individual research projects--that is, system capabilities and inventory data use limited to individual project areas and project objectives, and primary users are U of A research staff. No statewide natural resource data base is available, except for bibliographic data.
   - U of A hardware includes CDC and DEC computers. Landsat image analysis and GIS software are available for research purposes.
   - Applied Remote Sensing Program staff are primarily applications specialists and are research-oriented. Computer programming and analytical staff support are available at U of A.

2. Are there plans to create or expand your information system?
   - Existing capabilities could be expanded to handle new requirements.

3. Do you use other information services?
   - U of A does not use outside computer services, but does use outside data and information sources, i.e. Lockheed's DIALOG, RECON.

4. To whom do you provide information services? Occasionally? Routinely?
   - Currently U of A provides services to Federal, State and local governments, Indian tribes, and private sector clients on a cost-reimbursable project-by-project basis.
   - A bibliographic service for the U.S. Department of Interior, Office of Surface Mining (SEAM ALERT) was the only long-term information service mentioned.
   - Routinely provide water resources bibliographic information to eleven western states. Information originates from DOE's RECON system.

5. What would it take for your system to provide information services to other agencies?
   - An appropriate role for the U of A is to provide technical assistance and training, and conduct special studies, but not provide ongoing, operational services for government agencies.
   - If requested, U of A could design an operational information system under contract to the State to be implemented after one or two years in State government.
   - An operational system should have some independent, appropriated funding and dedicated staff to encourage small State agencies to use services.

6. What are your perceptions and/or expectations of the Data Coordination Network and Mapping Advisory Committee chaired by OEPAD? Do you perceive that such organizations are needed in Arizona?
   - U of A is a member of the Data Coordination Network, but has no comment, since to their knowledge there has not been a meeting.
   - They do participate on the Mapping Advisory Committee.
   - Such coordinating organizations are useful and worthwhile.

7. What are your perceptions and/or expectations of ARIS as it is today? What is your understanding of its original goals and intended services?
   - The initial scope or character of ARIS was good.
   - U of A participated on early advisory committees.
   - Problems U of A experienced with ARIS included apparent conflicts over remote sensing services.

- U of A perceives ARIS developed existing problems because:
  - There were no products,
  - No interpretive capability for orthophotoquads, and
  - The system moved too much from agency to agency.
- Suggestions for improving ARIS include:
  - Having some kind of executive policy committee for system to be accountable to the Governor.
  - Having a working committee of users, and
  - Developing a referral service for State analytical capabilities, data holdings and data collectors.

STATE LAND DEPARTMENT (SLD)

1. What type of information system do you have?

   - Existing agency-wide information system is largely manual, with some automated capability and record keeping.
   - Scope of system is primarily for in-house use, and includes State land-oriented data, forestry and unprocessed Landsat data. Information services for outside users include the National Cartographic Information Center (NCIC) function* and the Arizona orthophoto quads.
   - Existing computer equipment includes a rented Data General Eclipse minicomputer, some state-owned computer plotting/mapping, digitizing, and graphic display equipment with limited automated mapping software capability.
   - Staff expertise is in remote sensing, engineering and land surveying.
   - Data processing accomplishments include some in-house capabilities, such as a tree seedling inventory.

2. Are there plans to create or expand your information system?

   - Yes. The SLD would like additional hardware, and also plans to create an automated geographic information system (GIS) and a Landsat digital processing capability in the Information Resources Division (IRD) to handle SLD-mandated programs.

* NCIC is a National clearinghouse for maps, aerial photography and Landsat data produced by USGS and NASA. State-flown photography is included through cooperative agreements.

3. Do you use other information systems?

- SLD, because of the pattern of land ownership in Arizona, participates in a considerable amount of joint planning and management of Arizona rangelands, which requires sharing BLM data obtained from their information system.
- Coordination of programs with the U.S. Forest Service requires SLD to utilize data from various data systems.
- SLD functions as the Arizona affiliate office for the National Cartographic Information Center. This system is used to access archived maps and imagery data sources to assist the mapping, inventorying and data handling segments of the Department. SLD has remote terminal equipment to access the NCIC computer index.

4. To whom do you provide information services? Occasionally? Routinely?

- IRD provides services mostly to Land Department divisions and Natural Resource Conservation Districts.
- As State member of NCIC, provides remote sensing and map information, on request.
- IRD can conduct workshops, training, and briefings on request, to continue and improve the use of products and information provided.

5. What would it take for your system to provide information services to other agencies?

- In order to provide expanded services to outside users, SLD would need more staffing, particularly in the area of Landsat interpretation and programming, and a clarification of the law establishing scope of the system and services to be provided. Existing mandate in legislation is only specific for SLD.

6. What are your perceptions and/or expectations of the Data Coordination Network and Mapping Advisory Committee chaired by OEPAD? Do you perceive that such organizations are needed in Arizona?

- The SLD (IRD) participates as a member of both the Data Coordination Network and the Mapping Advisory Committee.
- In its short life, the DCN/MAC has been an excellent forum to establish state priorities for mapping and natural resource information.

7. What are your perceptions and/or expectations of ARIS as it is today? What is your understanding of its original goals and intended services?

- SLD supports the original concept of ARIS. However, SLD is concerned that others might expect something beyond existing charter.
- SLD believes that ARIS is a valuable decision-making tool with far greater applications than are presently being realized. It should serve all natural resource agencies.

(Excerpt from "A Legislator's Guide to Natural Resource Information Systems", a publication produced by the National Conference of State Legislatures.)

## A. Goals of an Information System

A natural resource information system is a formal process for gathering, storing, analyzing and disseminating information about natural resources and related socioeconomic data. The goal is to provide cost effective fulfullment of specific statutory or administrative responsibilities of government agencies that are involved in planning, developing, managing and conserving natural resources.

Some specific objectives for developing a system are to:

- Improve cataloging of existing data bases, including federal information systems;
- Reduce time spent by users to obtain information by providing a single point of contact for resource information;
- Reduce multiple requests and time spent responding to information requests;
- Provide a mechanism for making remotely sensed data available, and for entering such data into the data base of natural resources; and
- Provide a mechanism for assembling data from a variety of sources into a single package around a political, geographical, or planning district boundary.

Accomplishment of these goals should lead to maximum availability of resource information to state, federal, regional, local and private entities that will support a variety of activities. Further, it will provide a mechanism to eliminate duplication of effort in collecting, storing and processing resource data.

Information systems of one type or another have generally been an important tool for decision-making at various levels of government. Automated natural resource systems can provide decision-makers with many kinds of information more quickly than manually-accessed systems. It is only recently, however, that more and more states are attempting to better organize and use data resources by establishing a geographic (or spatial) framework for referencing and retrieving data. This framework provides a common link between land areas and the data pertaining to those areas. Emphasis in this guide will be placed on natural resource information systems characterized by this geographic referencing component and by automated entry, manipulation and retrieval capabilities.

B. What is the Geographic Component of an Information System?

Many types of natural resource data have a "geographic" or "spatial" component; i.e., they can be referenced to a specific location on the Earth's surface. A geographic reference system can thus be established to define specific areas, lines, or points (census tracts, transportation networks, air quality monitoring stations, etc.).

The ability to access information based on geographic location is clearly advantageous because virtually all natural resource data are collected on a site specific basis. Retrieval of data is greatly simplified when an individual has the option of specifying the geographic boundaries for which data are required, thereby automatically retrieving only that information which is relevant to the area under consideration. For example, a person studying sedimentation and stream erosion problems for a particular river could define the boundaries of the river's watershed and then request all pertinent information for that area (rainfall, soil

types, land cover, etc.). Further, the data can then be displayed as maps, visually illustrating the location of various phenomena in relation to each other.

A number of systems are used to handle the geographic referencing of data. They include geographic coordinates based on latitude and longitude; and rectangular systems such as state plane coordinates, Universal Transverse Mercator (UTM) grid, and the public land system based on 6-mile-square townships. The particular scheme used to describe locational data in any given geographical information system is often a function of availability of base maps, traditional use of a particular scheme, or degree of accuracy required by the users of the system.

C. Analytical Capabilities of an Automated Geographic Information System

The development of geographic analysis techniques to be used for decision-making is both an art and a science. There is no single best way to develop or implement such a system, because the type of system created depends on who will use it and for what purposes. A well-thought-out set of analysis capabilities will be one that is flexible enough to respond to spontaneous needs for entry, analysis and display of different kinds of data.

Systems vary, but a number of capabilities can be built into a geographic information system that allow a user to perform a wide variety of analyses. They include:

- Searching - The ability to find features which are of a certain size, or are within a given distance from another feature. "How many archaeological and historical sites lie within a proposed six-mile corridor for a natural gas pipeline?" This capability is required for analysis of networking and routing alternatives so that a proposed route can be evaluated regarding impacts to any land that is crossed.

- Scale Variations - Ability to change the scale of map outputs.

- Resolution Variations - Ability to summarize detailed categories of data. "Generate a statewide land cover map that aggregates the categories of coniferous, deciduous and mixed stands from several county maps into one category. Label this category 'Forested Lands'."

- Area Measurement - Ability to measure areas of any feature in any unit (e.g., acres, hectares, square miles). "How many acres of wetlands are in Ramsey County?"

- Simple Statistics - The capability to do simple trend analysis (i.e., correlation, regression) and other statistics. "What is the average number of acres irrigated per permit by township or county?"

- Composite Mapping - Ability to overlay data from two or more maps to generate a composite map. "Where are coal deposits located that have overburdens of 50 feet or less, are privately owned, and are not covered by important farmlands?"

- Simulation and Modeling - Capability to develop a system of conditions, data, and inferences as a mathematical description which simulates real life conditions and projects events that may occur through time or as a result of changes. For example, a model can be developed to project the increase in population and subsequent demands for public services (increased school enrollments, police and fire protection, medical services, etc.) that may result from the construction of a power plant or the development of a large strip mine.

The capabilites described above represent the range of techniques available. In general, the more features built into a system, the higher the cost will be for specialized equipment and computer programs needed to carry out the desired analyses.

## D. Limitations of an Automated Information System

Just as automated information systems have their advantages, they also have their limitations. Legislators should be aware of those limitations in making decisions concerning the establishment and operation of such systems.

An information system will not provide all of the information needed for major policy decisions. Certain kinds of relevant information may not be available in a format appropriate for inclusion within a system. Other information involving qualitative factors or data on a particular locale may be inherently difficult to include in any information system. Moreover, any major policy decision involves value judgments - judgments that can be made only by the persons responsible for the decision.

Besides technical limitations on the information included in an automated system, there are also budgetary limitations that lead to certain editorial judgments about what items of information are, or are not, important to include in a system. These editorial judgments are, in fact, policy decisions about what kinds of information ought to be brought to the attention of decision-makers on a continuous basis. Legislators may wish to give this issue careful consideration, because resource information can affect public perceptions and decisions concerning those resources.

DRAFT

JOB DESCRIPTION

JOB TITLE: Manager, Arizona INFORM Program (Information Network For Operational Resource Management)

QUALIFICATIONS:

- Masters degree in Planning, Computer Science, or an Earth Science or related field;
- 3+ years natural resource data processing experience in State Government;
- 3 years experience managing a staff including systems analysts, operational personnel, and natural resource scientists;
- excellent communication skills (verbal and written);
- familiarity with development and use of specialized automated systems including Geographic Information Systems and Remote Sensing Information Systems;
- familiarity with a variety of natural resource programs as applied to state government;
- ability to coordinate multi-agency projects;
- demonstrated success in implementing a complex, technological, multidisciplinary information system;
- ability to prepare budgets for funding the activities of INFORM; and;
- ability to manage a variety of diverse projects based on priorities established by INFORM participating agencies.

DUTIES AND RESPONSIBILITIES:

1. Manage INFORM core staff;
2. Attend meetings of the INFORM coordinating committee and provide input on staff activities;
3. Interface with member agency staff to maintain current inventories, needs, capabilities, and staff expertise;
4. Interface with users and assist them to meet their data and information needs;
5. Provide briefings on INFORM and attend applicable symposia and seminars to monitor advancements in natural resource information system technology;
6. Maintain complete records on each identifiable INFORM project;
7. Provide status information to supervisor as needed;
8. Establish and implement procedures for review of all system documentation prior to publishing and disseminating it;
9. Assist in development and maintenance of efficient procedures for INFORM;
10. Prepare work plans and budgets, as required.