TOWARD THE DEVELOPMENT OF A STATEWIDE LAND USE INFORMATION SYSTEM FOR IOWA :

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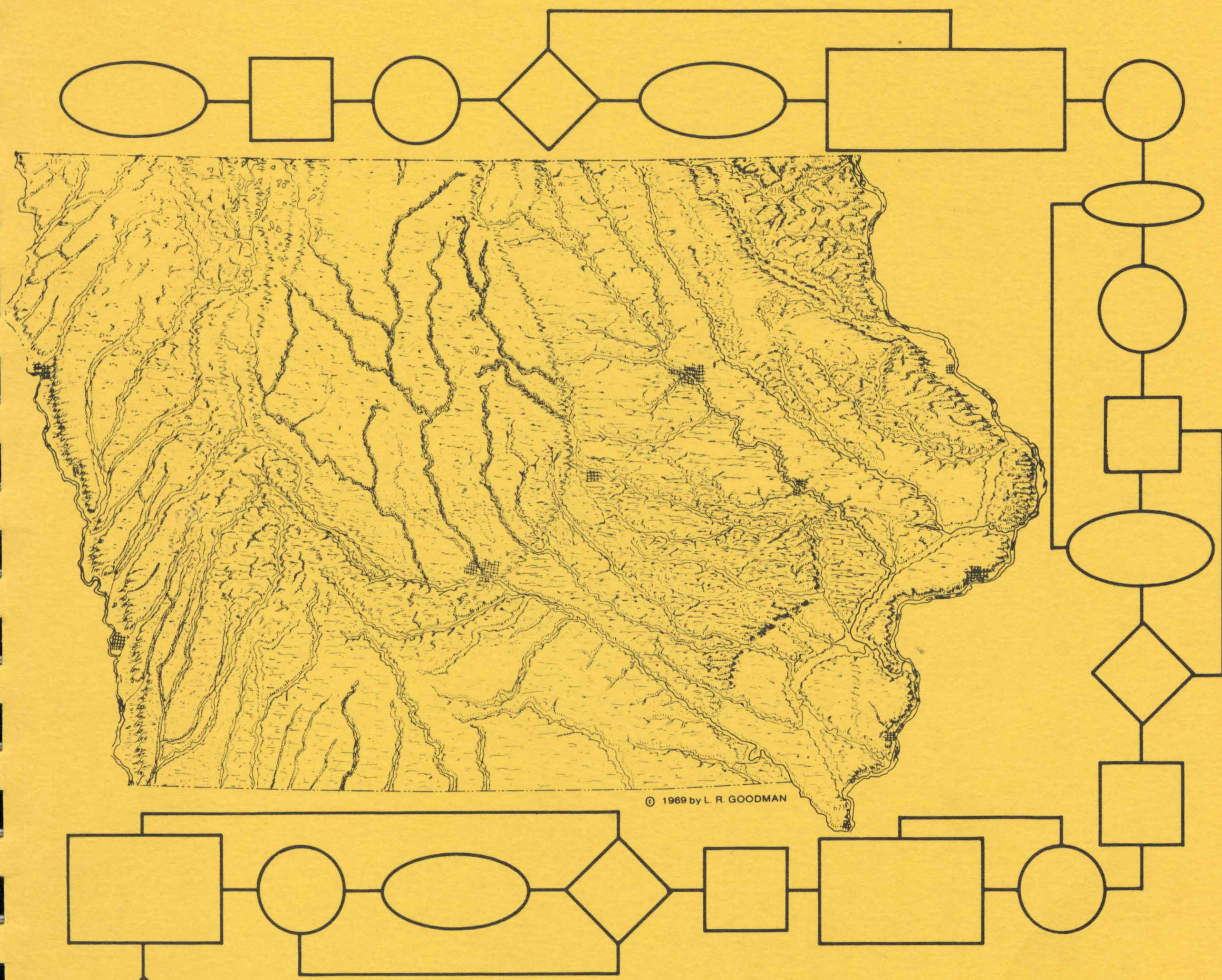

By C.M. Austin & Donald Wade
Department of Geography And
Center For Business And Behavioral Research
University of Northern Iowa
For The Office Of Planning And Programming
State of Iowa
1974

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C. M. AUSTIN
Associate Professor of Geography and Regional Science
Department of Geography
University of Northern Iowa

and

DONALD WADE
Research Associate
Center for Business and Behavioral Research
University of Northern Iowa

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PREFACE

The following report was produced at the University of Northern Iowa under the auspices of the Center for Business and Behavioral Research and the Department of Geography, and was funded by a grant from The Office of Planning and Programming of the State of Iowa. Because of the limited time period available for the research and preparation of this report, it can only be considered as an overview and introduction to the problems involved in designing a Statewide Land Use Information System.

The research was carried out under the direction of Dr. C. M. Austin, Associate Professor of Geography and Regional Science. The research team consisted of Dr. Austin and Mr. Donald Wade with assistants William Martin and Marvin Kinney. A number of individuals had suggestions and ideas which were very useful in the performance of the research. Among these were Dr. Frank Horton of the University of Iowa; Dr. Kenneth Dueker and Mr. James Mulligan of the Institute for Urban and Regional Research in Iowa City; Mr. Kenneth Cox, Mr. John Selby, and Mr. Donald Horton of the Computer Center at the University of Northern Iowa; Dr. Richard Morrill of the University of Washington; Dr. Barry Wellar of the Ministry of State for Urban Affairs, Ontario, Canada; Dr. Michael Goldberg of the University of British Columbia; Dr. Stanley Morain of the University of Kansas; and Dr. Basheer Nijim and Mr. Michael Miller of the University of Northern Iowa. Special gratitude is owed to Dr. Robert Morin, Dean of the College of Business and Behavioral Sciences in his support and encouragement. Many other individuals were also helpful in providing information and answering questions.

The authors of this report would also like to thank Mr. Peter Hamlin of the Office of Planning and Programming for his assistance in the administration of this project and for his readiness to discuss problems as they arose.

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INTRODUCTION

The Need for Land Use Planning

The past decade has witnessed a rapid growth in the awareness of the many problems related to land use. The increased concern with air and water pollution and with many other environmental problems is evident even to the casual observer. The recognition of the finite nature of man's resources and natural heritage has been compounded by the awareness that many of man's actions have had an injurious effect on his natural environment. The often non-reversible and always costly deterioration of natural vegetation, wildlife and landscape caused by expanding of urban areas, by using more land for transportation, and by growing industrialized areas, has been coupled with a general lack of concern. Such attitudes have become a major concern of many citizens and their political representatives. The many problems resulting from these activities can be best viewed as external or spillover effects.*

An example of a spillover effect is the effect downstream in a river basin of increased urbanization upstream. In this case the changes in run-off characteristics and erosion patterns affect sedimentation and flow in the entire river basin. Alternatively an industrial development which releases pollutants into the river basin may affect not only the health of populations downstream, but also wildlife (land based and aquatic) and vegetation as well. The effects on these is then compounded as they pass through the biological chain of the ecological system. The long-term effects of such an event can have a magnitude far in excess of the initial impacts. These effects often compound to the extent that they negatively alter the quality of life for man. Examples of such cycles are clearly evident in the way Appalachian strip mining has disrupted the landscape and the natural environment, causing substantial injury to the inhabitants of the regions. Further concern is evidenced by the

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*An externality is an economic concept referring to an impact from an action for which the causing activity is not financially accountable; spillover effects are externalities which are experienced by locations and areas other than the side of the causing activity. See Dueker, K., and Talcott, R., *Statewide Land Use Analysis and Information Requirements*, Working Paper No. 13, Institute of Urban and Regional Research, University of Iowa, Iowa City, p. 9.

current debates over waste disposal and the problems associated with it.

This increasing awareness over the past decade of the degree to which the natural environment is being destroyed and altered, and the recognition that there is a need to protect the environment, has led to the attempt by the federal government and by many states to improve land use planning and to generate some guidelines for the development of comprehensive land policies. The Land Use Policy and Planning Assistance Act proposed by Senator Henry Jackson and others (the so-called "Jackson Bill") is a culmination of this interest at the federal level.

In the State of Iowa such interest has been evident and has culminated in a bill (House File No. 1422), submitted by the Committee on Natural Resources, which would provide for a State Land Use Policy. In addition the interest of Governor Robert Ray in a department which would be charged with resource conservation is further evidence of the concern of the state. The Office of Planning and Programming has shown sufficient interest in the topic to let several contracts concerned with the development of important Land Use Policy support systems. Considering these and similar actions at the federal level and those of the elected representatives in Iowa, as well as similar activities in other states, it is clear that a demand exists, and is growing, for policies which will control the deterioration of the environment. Evidence of this interest can be found almost daily in the published statements of public officials, in editorial comments of state and national news media, and in the growing expenditure of public funds, at all levels, on land use and environmental research. Examples of these comments are as follows:

> "Let us see if we can't design the proper use of our land which is a common heritage, and control that use for the benefit of ourselves and future generations. What is required now, with a much larger population and more complex economy and more knowledge about the environment, is stricter control over land use based on 'careful, technical study and planning.'"
>
> Editorial, **Des Moines Register**, April 7, 1974

> "I would *guess* that land encroachment from cities will eat up more farm land in the next 27 years than highways will."
> (emphasis added)
>
> Dr. Marvin Julius, Iowa State University, as quoted in "Highways vs. Farm Land," **Des Moines Register**, September 16, 1973

> "With scarcely any standards or controls now being applied, land today is being developed at the rate of one million acres a year, often for purposes unsuited to the site and with a consequent waste or destruction of areas of critical environmental concern. The objective of the proposed act is to prevent the wasting of a valuable resource by coordinating land use planning with a view to preserving recreational and scenic values."
>
> Editorial, **Des Moines Register**, May 27, 1974

The basic approach to such a policy as viewed by the proposed state and federal bills referred to above seems to be generally agreed upon. This approach consists of developing ways for regulating the spatial patterns of activities and for identifying areas undergoing significant deterioration. Those areas which are in decline, but which have features which are unique and perceived as beneficial to society now and in the future, are referred to as "areas of critical environmental concern." The advantages of having a land use policy and of planning and regulating the impacts of man's activities on the environment are many. The density of activities can be controlled so that the aggregate impact per unit area is kept within certain limits so that it can be absorbed by the natural system. Second, the allocation procedure which results, allows for a more precise identification of the trade offs involved and allows for the utilization of improved measures of program efficiency. Third, historical, unique and aesthetic areas can be better preserved and controlled. Lastly, the problem of accountability, the identification of those activities responsible for the generation of externalities and spillover effects, can be better handled. Another basic advantage in utilizing land use planning as a basic tool in environmental protection is that such planning is a means by which government, at all levels, can control change according to specified social and political priorities, without unduly disturbing the functioning of the "market economy." All that a land use policy does is to set the framework within which alternative locations are specified or restricted according to types of land use.

Land use policy in the State of Iowa must deal with five basic types of land use: agricultural, industrial, mining, residential, and public (see Figs. I - 1 and I - 2). Each of these can be further subdivided as follows:

- Agricultural
  - crops
    - type (corn, wheat, beans, oats, etc.)
    - operation (intensive-extensive, rotating, etc.)
    - scale of operation
  - livestock
    - type (cattle, hogs, poultry)
    - operation (feedlot, grazing, feeder stock, etc.)
    - scale of operation

- Industrial
  - type of product (primary, light manufacturing, heavy manufacturing, transportation, etc.)
  - employment
  - waste output
  - size and scale

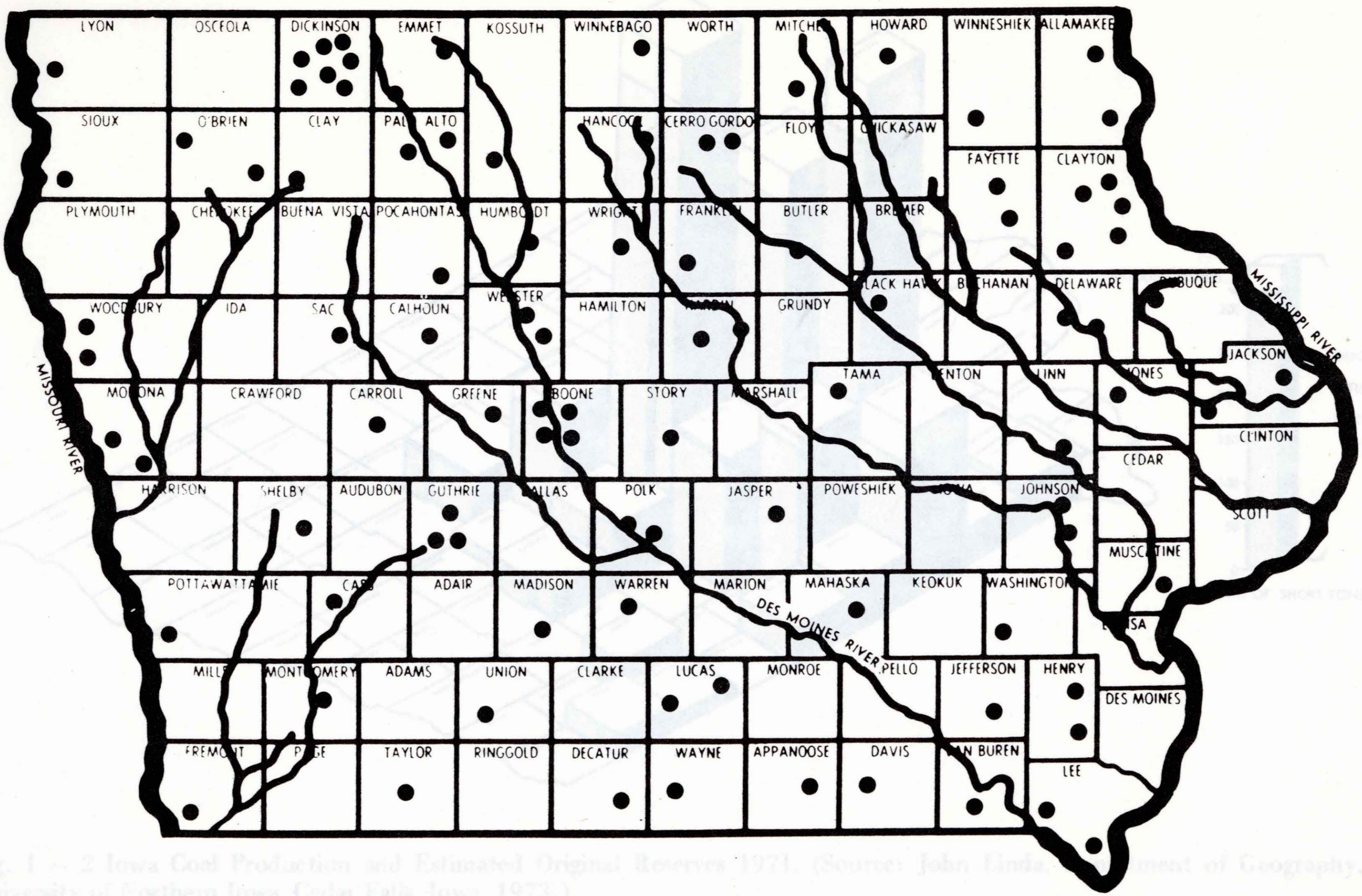


Fig. I — 1 Iowa's State-Owned Recreation Areas. (Source: *1972 Statistical Profile of Iowa*, Iowa Development Commission, p. 24.)

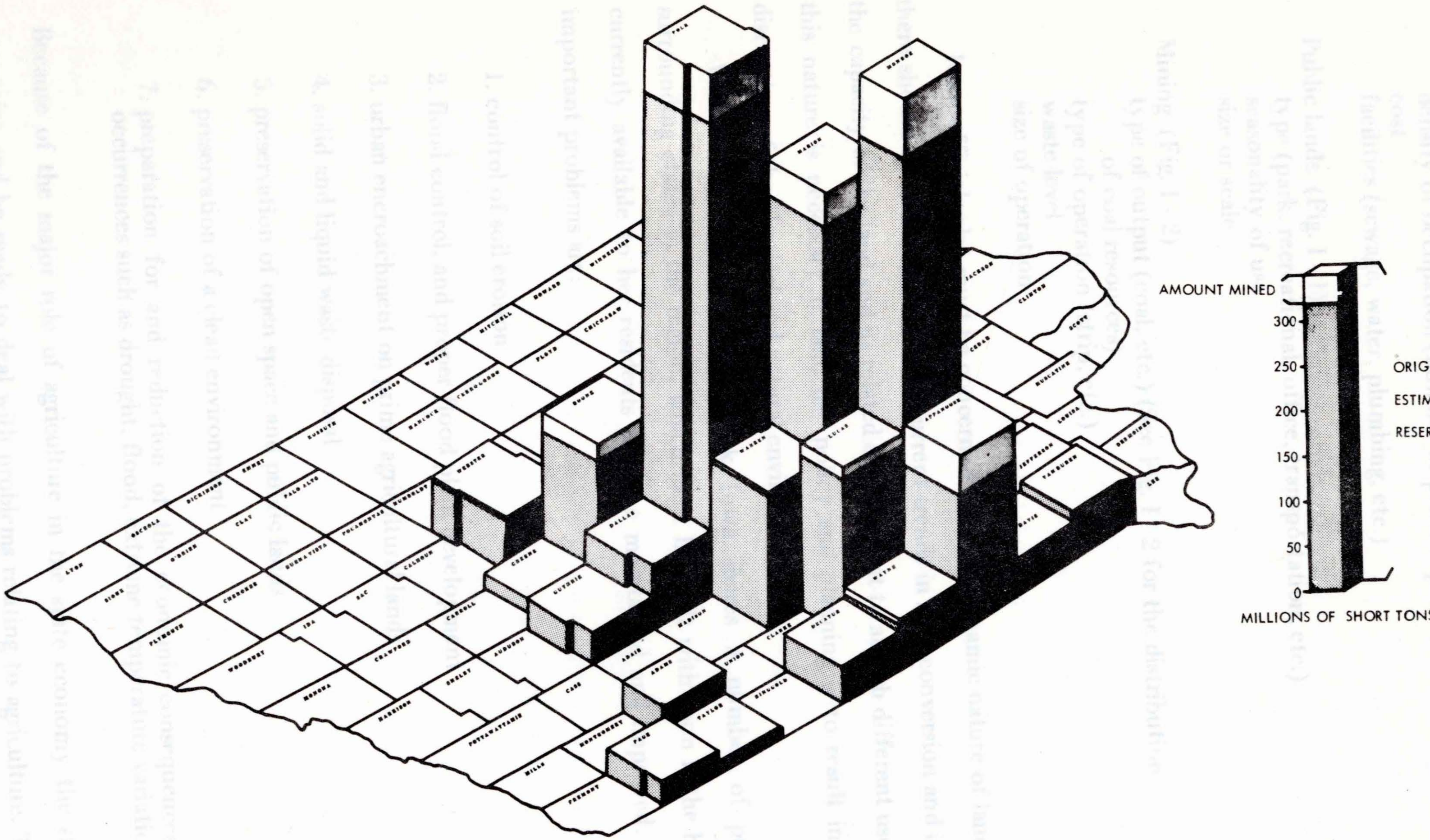


Fig. I – 2 Iowa Coal Production and Estimated Original Reserves 1971. (Source: John Linda, Department of Geography, University of Northern Iowa, Cedar Falls, Iowa, 1973.)

Residential
- type (multi-family, single-family, by size class)
- density of occupation (number of persons per household)
- cost
- facilities (sewage, water, plumbing, etc.)

Public lands (Fig. I - 1)
- type (park, recreational, office, transportation, etc.)
- seasonality of use
- size or scale

Mining (Fig. I - 2)
- type of output (coal, etc.) (See Fig. I - 2 for the distribution of coal resources)
- type of operation (strip, etc.)
- waste level
- size of operation

Iowa officials also must be concerned with the dynamic nature of land use. Specifically there should be information about current trends in land conversion and information about the capacity of the land and its related environment to absorb different uses. Information of this nature is necessary if land use policy and planning is to result in reduction in the disruption of the physical and natural environment.

Within this land use framework Iowa shares a number of problems with the surrounding states in the region, which must be dealt with soon if the high quality of life currently available to her residents is to be maintained and improved. Some of the most important problems are:

1. control of soil erosion
2. flood control, and proper flood plain development
3. urban encroachment on prime agricultural lands
4. solid and liquid waste disposal
5. preservation of open space and public lands
6. preservation of a clean environment
7. preparation for and reduction of the economic consequences of adverse natural occurrences such as drought, flood, extreme temperature variations, etc.

Because of the major role of agriculture in the state economy the state must be able to recognize and be ready to deal with problems relating to agriculture. This requires, among other policies, a well-defined and publicly understood agricultural land use policy. In order to formulate and update policies dealing with these problems the policy makers and their agents must be able to obtain a great deal of relevant information. This required information must be capable of being constantly updated such that the dynamic natural system can be monitored at regular intervals. It must also be in a form that can be integrated and analyzed to produce meaningful descriptions of any area or region within the state. These requirements can be met by a land use information system.

The Purpose of the Current Research

The purpose of the research carried out under Contract No. IGA-1E are explicitly stated in the contract. In general the purpose is to attempt to identify the necessary and desirable characteristics of a statewide land use information system to be developed for the State of Iowa. Second, the major potential users of such a system are to be identified along with the demands those users are likely to exert on such a system. Third, the desirable form and content of the data base of the information system is to be identified with at least preliminary documentation of the sources of the required data being developed. Fourth, alternative approaches to land use information systems are to be investigated and discussed. Lastly, some suggestions and a framework through which alternative proposals for the components of a land use information system for Iowa may be evaluated and judged.

Organization of This Report

This report summarizes the research which was carried out under Contract IGA-1E. It is organized in a way that will enable the reader to focus on those areas in which he has interest and to provide for a better awareness and understanding of what a statewide land use information system is. To accomplish these goals the report is organized in six additional chapters with further information provided in three appendices. Chapter II focuses on the nature and role of land use information systems in a general context. Chapter III considers the specific potential users of a system developed for Iowa and their requirements of the system. Chapter IV discusses in substantial detail the proposed content and characteristics of the data base (the core of the land use information system). Chapter V is concerned with the necessary and desirable capabilities of the analytical subsystem. Chapter VI presents several general alternative approaches for system design (for the entire system as well as for specific subsystems and components) with a special focus on alternative administration structures designed to promote full use of the system. Chapter VII presents the conclusion of the research including a general framework which would improve the evaluation process used in choosing the final design of a land use information system developed specifically for Iowa. The appendices consist of a glossary of terms which are common in the technical writing on information systems, the documentation of data sources, and a selected listing of existing systems and subsystems along with appropriate reference information for each.

CHAPTER II

LAND USE INFORMATION SYSTEMS

Information Systems and Planning

In general an information system is a systematic structure containing specified information or data which can be accessed, modified and returned easily. Simple examples of information systems are the index in a book and the card catalogue system in a library. The increased interest in and research on information systems has led to a slightly narrower use of the term. Specifically the term now carries the connotation of systems analysis and computer technology as well as the original concept of information organization. One major type of information system, developed over the past 15 years, is intended to serve urban and regional policy makers and planners and has been titled Urban and Regional Information Systems (URIS). The rapid rise in interest in this topic has given rise to a new research and policy oriented association--the Urban and Regional Information Systems Association (URISA).

Using the annual proceedings from URISA's meetings as well as a large volume of recent literature it is possible to subdivide this type of information system as follows:

Urban oriented information system

Regionally oriented information system

Special-purpose systems

Administratively and management oriented information systems

Planning and policy oriented information systems

One characteristic of all urban and regional information systems is that much (and sometimes all) of the information being dealt with has a geographic dimension, and the systems are thus designed to retain and utilize the geographic attributes. These systems thus make use of various geocoding, mapping, and spatial classification procedures. The most convenient way to view this type of information system is by looking at it as a collection of components or subsystems operating in a computerized environment as shown in Figure II - 1 below.

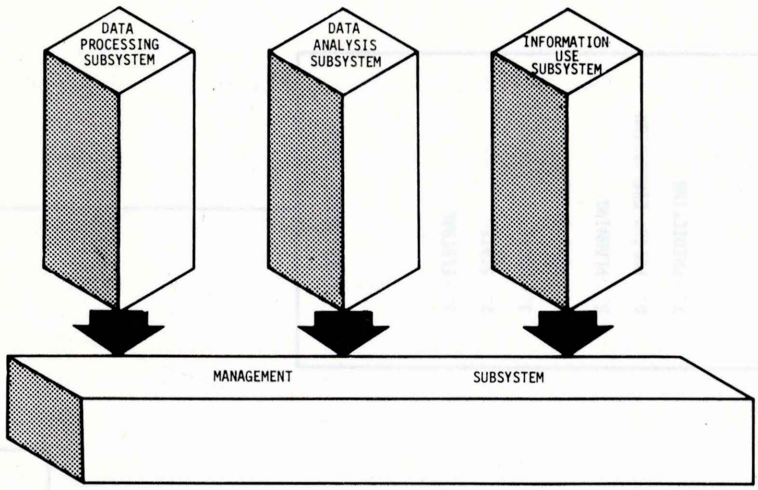


Fig. II–1 Information system. (Source: Dr. Kenneth S. Dueker, ***Statewide Land Information Systems: Design Considerations*****, Iowa City: Institute of Urban and Regional Research, University of Iowa, 1972, p. 5.)**

Such an information system is also divisible into four major components: 1) the data subsystem; 2) the analytical subsystem; 3) the user subsystem; and 4) the management subsystem (see Fig. II - 2). These are all considered as existing (or as being developed) with a given computerized environment. Each of these subsystems must be properly designed and the linkages between them must be appropriate if the system is going to be of significant value to the users. However, the larger the number of uses and the greater their variety the more complex and more costly the remaining subsystems will be. Thus in designing any information system, the first step must be to identify the probable users and the uses they will require the system to accommodate. These uses in turn require information (or data) in the form of output and imply characteristics and capabilities which the analytic subsystem must have. The management subsystem is the component which determines the level of use of the system and the degree to which it will meet the requirements of system users.

Land Use Information Systems

Land use information systems (LUIS) are a special type of urban and regional information systems. Land use information systems are designed to. aid in the policy

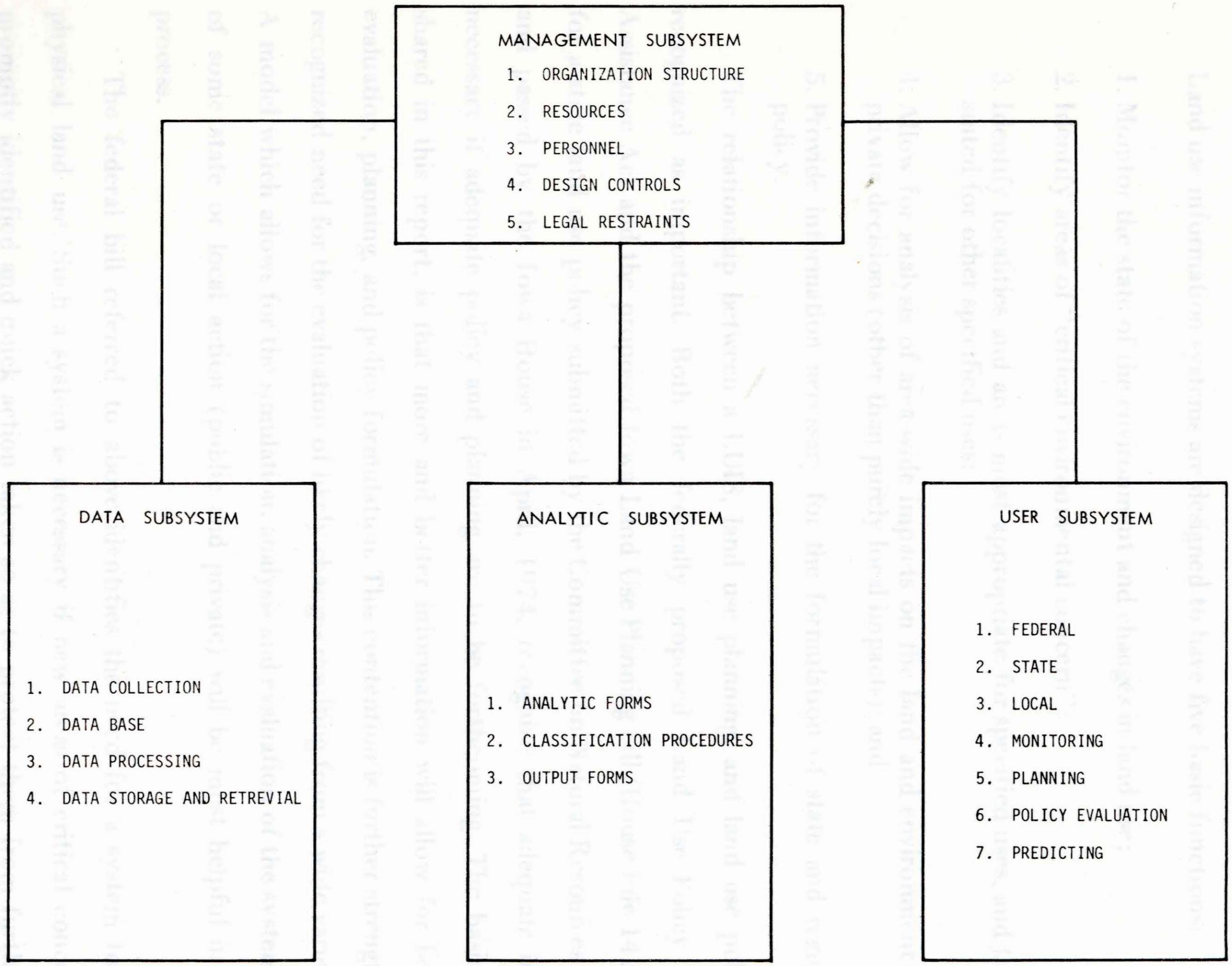


Fig. II – 2 A Land Use Information System

making, planning, and evaluation processes concerned with the environment and the surface of the earth. Such systems are, by definition, geographic in nature. They must be concerned not only with location and areal distribution, but also with relationships among numerous phenomena over space. A simplified model of a land use information system is shown in Figure II - 3.

Land use information systems are designed to have five basic functions:

1. Monitor the state of the environment and changes in land use;
2. Identify areas of "critical environmental concern";
3. Identify localities and areas most appropriate for specified uses, and those areas not suited for other specified uses;
4. Allow for analysis of area-wide impacts on the land and environment of public and private decisions (other than purely local impacts); and
5. Provide information necessary for the formulation of state and regional land use policy.

The relationship between a LUIS, land use planning, and land use policy has been recognized as important. Both the federally proposed Land Use Policy and Planning Assistance Act and the proposed Iowa Land Use Planning bill (House File 1422) to provide for a state land use policy submitted by the Committee on Natural Resources and amended and passed by the Iowa House in April, 1974, recognize that adequate information is necessary if adequate policy and planning are to be forthcoming. The basic assumption, shared in this report, is that more and better information will allow for better analysis, evaluation, planning, and policy formulation. This contention is further strengthened by the recognized need for the evaluation of likely changes resulting from a wide variety of actions. A model which allows for the simulation, analysis and evaluation of the system-wide impact of some state or local action (public and private) will be most helpful in the planning process.

The federal bill referred to above identifies the need for a system to monitor the physical land use. Such a system is necessary if new areas of critical concern are to be promptly identified and quick action taken so as to protect them from further damage. It follows that a LUIS must have the capability for regular, periodic updating of the data base. A monitoring capacity requires that a procedure be incorporated into the system which classifies areas according to the common occurrence of specified phenomena. The criteria which define such an area must be specified.

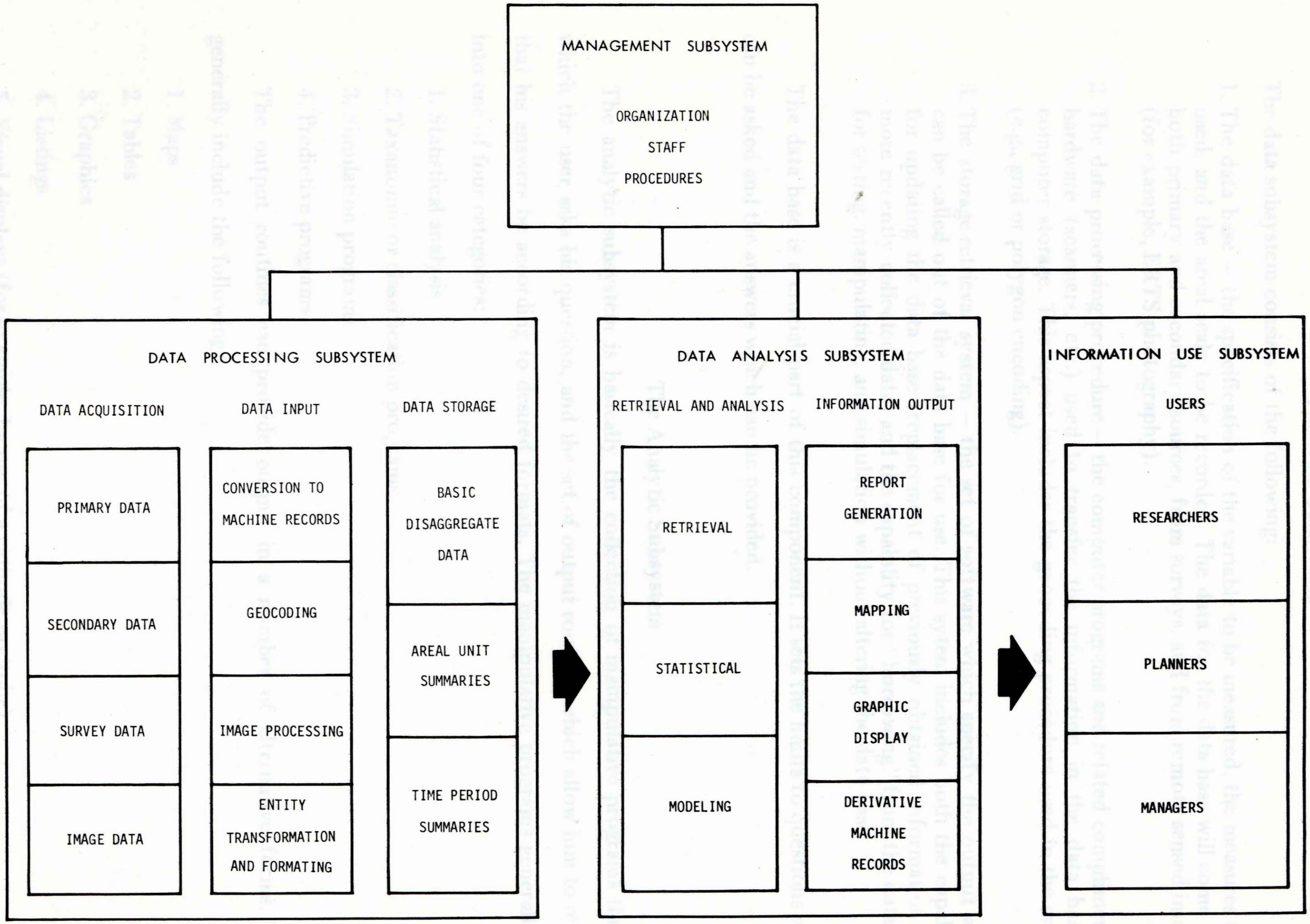


Fig. II – 3 Urban and Regional Information System Elements. (Source: Dr. Kenneth S. Dueker, *Statewide Land Information Systems: Design Considerations*, Iowa City: Institute of Urban and Regional Research, University of Iowa, 1972, p. 5)

Land Use Information System Subsystems

The Data Subsystem

The data subsystem consists of the following:

1. The data base – the specification of the variable to be measured, the measures to be used, and the areal scale to be recorded. The data for the data base will come from both primary and secondary sources, from surveys, and from remote sensed imagery (for example, ERTS photography).

2. The data processing procedure – the computer programs and related complimentary hardware (scanners, etc.) used to transfer the information in the data base to computer storage. This aspect includes the geocoding procedure used in the system (e.g., grid or polygon encoding).

3. The storage-retrieval system – the set of software which specify the output which can be called out of the data base for use. This sytem includes both the capability for updating the data base (replacement of previously obtained information with more recently collected data) and the capability for "borrowing" from the data base for testing, manipulating, and simulation without altering the data base.

The data base is a crucial part of this component. It sets the limits to questions which can be asked and the answers which can be provided.

The Analytic Subsystem

The analytic subsystem is basically the collection of manipulative programs through which the user asks his question, and the set of output routines which allow him to request that his answers be according to desired formats. The manipulative programs generally fall into one of four categories:

1. Statistical analysis
2. Taxanomic or classification programs
3. Simulation programs
4. Predictive programs

The output routines can provide output in a number of alternative forms. These generally include the following:

1. Maps
2. Tables
3. Graphics
4. Listings
5. Visual displays (for example, by use of a cathode ray tube)

It is this subsystem which allows for user-system interaction. The analytic subsystem is the component which is directly used by the planners, policy makers, and other users. It provides the user with meaningful access to the data base.

The User Subsystem

The user subsystem consists of the set of regular system users and their requirements. For a LUIS the users are generally federal, state and local government agencies and their representatives. As is discussed in Chapter III, the requirements of these users vary greatly in detail and purpose. Furthermore, with the projected increase in environmental and land use legislation, the number of users and their needs can be expected to increase. The users can be subdivided by level of government, but they can also be expected to come from other sectors as well. Specifically the users can be classified according to five types:

1. Planners--those attempting to modify the environment for the "public good";
2. Monitors--those identifying the current status and rate of change of various aspects of the environment;
3. Managers--those concerned with managing or conserving environmental features;
4. Academic researchers; and
5. Private users--such as businessmen, non-government citizen groups, etc.

It is this subsystem which, along with technological and economic feasibility, determine the desirable characteristics of the remainder of the LUIS.

The Management Subsystem

This subsystem exists as an umbrella under which the remainder of the system must operate. The management subsystem plays a major role in the design of the system by deciding the user priorities and the resources to be allocated to various stages of development, and by specifying the evaluation procedures which are to be used in testing the various components and subsystems. The management subsystem also plays a most important role in determining the effectiveness of the completed LUIS.

The operating environment and operating structure of the system will have a clear relationship to frequency and quantity of system use. As the state of New York has found out a complex, costly and rigid operating environment can severely reduce the degree to which the system is actually used.

The management subsystem also determines the degree to which the LUIS is up to date and capable of meeting current and expected demands. Thus, this subsystem can be viewed as crucial if the State is to benefit fully from such an expenditure as is involved in the development of a statewide LUIS.

CHAPTER III

POTENTIAL USERS AND USES OF AN IOWA LUIS

Introduction

Before the desirable characteristics of a LUIS designed for Iowa can be discussed and an appropriate evaluative framework developed, it is necessary to understand the demands which are likely to be placed on such a system. Clearly no such discussion can be considered complete since the system has not yet been designed, and the design process is likely to lead to modifications of the list of potential users and their uses. Futhermore unforeseen users and uses may develop between now and the time a LUIS is operational at the state level. This section deals with those likely users (and their respective uses) identified by an examination of legal responsibilities, stated objectives, expressed interest, or proposed legislation. Some of these users and uses are generated by two bills (one federal and one state) not yet transformed into law. Another potential using agency (the State Department of Transportation) has not yet taken form. Nevertheless these developments may be used as evidence pointing to current data interests and analytic needs. Other users are identified by probable benefit as opposed to probable use. In these cases the argument is that the potential user is such because a significant benefit may be gained by the use of a LUIS. The actual use of the system by this group of potential users will depend on many factors: ease of access, ease of use, awareness, etc.

For the purpose of this report, potential governmental users are divided into three categories: federal, state and local. The various potential users and their requirements are discussed for each category.

Potential Federal Users

Federal agencies with a potential use for an Iowa statewide LUIS are focused in five federal departments: Interior (DOI); Agriculture (DOA); Transportation (DOT); Health, Education and Welfare (HEW); Housing and Urban Development (HUD). Other likely users at the federal level are the Environmental Protection Agency (EPA), the Federal Energy Office (FEO) and the Federal Power Commission (FPC).

Within the Department of Interior the following agencies are potential users of an Iowa system:

1. Office of Oil and Gas
2. Office of Coal Research
3. Office of Water Resources Research
4. Bureau of Sport Fisheries and Wildlife
5. National Parks Services
6. Bureau of Mines
7. U.S. Geological Survey
8. Bureau of Indian Affairs
9. Bureau of Land Management
10. Bureau of Outdoor Recreation

Among these agencies the most notable uses of a LUIS would be in the identification of deteriorating micro environments, evaluation of environmental impacts, and in the allocation of federally-owned lands among competing demands. Several of the above agencies are concerned with the identification of potential natural resources and control over their exploitation. The coordination of the various activities of these ten agencies at the state is a difficult and complex problem. An operational statewide LUIS would be a potentially powerful tool for such a coordination effort. This role is implied in the Federal Land Use Policy and Planning Act submitted to the U.S. Congress by Senator Henry Jackson and others. This bill calls for the establishment of an Interagency Advisory Board on Land Use Policy. This Board would be responsible for the necessary coordination of the various agencies' activities and policies.

The ten agencies listed above are concerned with a variety of problems and tasks. Some of the more important activities which would benefit from an operational LUIS are:

1. environmental protection
2. resource exploration
3. economic development of Indian lands
4. expansion of outdoor recreation facilities; and
5. protection and control of federal lands.

The "Jackson Bill" would add to these the identification and protection of "areas of critical environmental concern" regardless of whether or not they conform to areas of federal ownership. The "Jackson Bill" would assign many of the tasks and much of the responsibility for these activities to the various states and local governments. These activities would be largely funded by the federal government and be "reviewed" by the Department of Interior.

Another requirement of the "Jackson Bill" is the establishment, in the Department of the Interior, of a federal land use information and data center. This would be most likely linked to a statewide land use information system for Iowa and other statewide systems with information passing in both directions.

The Department of Agriculture has three agencies, of great importance to Iowa, which would be directly involved with a statewide land use information system. These are:

1. the Soil Conservation Service
2. the Agricultural Research Service
3. the Agricultural Stabilization and Conservation Service

The duties of these agencies imply that they would be major federal users of a statewide land use information system. These duties include:

1. conservation planning (especially the "Great Plains Conservation Program"),
2. land development,
3. watershed planning,
4. flood prevention and erosion control,
5. crop selection and production assistance, and
6. control of agricultural pollution.

These activities clearly require a knowledge of existing land use patterns, soil characteristics, climatic characteristics, and of the hydrologic system. Also required is information about the interactions among these variables and their joint spatial distributions.

The Department of Transportation also has agencies which would be potential users of an Iowa land use information system. The two most important would be the Federal Highway Commission and the Federal Railroad Administration. Information about the physical land characteristics and the distribution of both population and economic activities are desirable if not necessary for the planning activities of these agencies. Both agencies, as well as the Federal Aviation Administration (in planning airport construction and expansion), are required to make environmental assessments of proposals. Furthermore, proposals by these agencies could be analyzed by the other users ahead of implementation.

Health, Education and Welfare at present has no agencies concerned directly with land use or with the environment, but studies by the National Institute of Health (NIH) and its arm, the National Institute of Mental Health (NIMH), have shown increasing concern with effects of humans of air and water pollution, as well as some interest in the relationship between the physical environment and mental health. Should this interest continue to grow these agencies would become potential users of a statewide land use information system.

Housing and Urban Development (HUD) is directly concerned with both urban and rural land use and planning. Through three primary programs--Community Planning and Management, Community Development and Interstate Land Sales Registration as well as through its Research and Development arm--HUD is concerned with the physical characteristics of land and with environmental protection. Through such controls as the Flood Plain Development regulations, this department is attempting to alter and control the current tendency toward haphazard urban growth and urban sprawl. In Iowa it is reasonable to expect that there will be increasing concern by HUD as well as the DOA with the encroachment on prime agricultural land by urban development.

Among the independent agencies, directly under the Office of the President, the EPA, FEO and FPC are the most likely agencies to make use of land use information systems on the state level. The EPA is specifically required to monitor and regulate man-made changes in the environment, including land (or the surface environment), as well as air and water. Testing, modeling and simulation of the areal impacts of specific activities are already a concern of the EPA. The FEO is concerned with the development of energy sources, their conservation, and their extraction under controls which preserve the beneficial characteristics of the physical landscape. The FPC is concerned with environmental protection as well as with the distribution of power. The effects of power lines on animal habitats and behavior are but one aspect of this interest.

All of these federal agencies and departments require reasonably up-to-date information about the landscape, environment, hydrology, and geology of broad areas. However, they also require procedures for integrating this information and analyzing it. Many of the questions they need answered will be concerned with probable effects of specified activities in specific and general geographic areas.

Potential Users at the State Level

The many potential users at the state level include the proposed new Department for Soil Conservation and Land Use, Land Use Policy Commission, Intergovernmental Advisory Board, and County Land Use Policy Commissions, the recently enacted Department of Transportation, as well as many other existing agencies. Among the agencies currently in operation the following are potentially important users or clients of a state land use information system:

1. [redacted] Conservation Commission. This agency is concerned with the acquisition of new parks, preserves, forests, and other conservation areas as well as with the operation, maintenance and improvement of existing state lands.

2. The Department of Soil Conservation (as exists). This agency is concerned with the dissemination of information, watershed development, erosion control, and with making decisions as to the approval of federal conservation and development projects (see Fig. III - 1).

3. The Department of Mines and Minerals. This agency is concerned with the rehabilitation of land affected by surface mining, as well as the safety and licensing of all mines in the state.

4. Iowa Real Estate Commission. This agency is legally responsible for regulating the subdivisions of lands and as such has a potentially major role in determining land use patterns and in implementing land use policy.

5. The Iowa Natural Resources Council. This agency is authorized to regulate and control exploitation of surface and underground water resources, establish flood control programs, and define the requirements and criteria for oil and gas exploration and exploitation.

6. Iowa Development Commission. This agency is concerned with the development of Iowa's agriculture, industry, recreation and travel. Through its role as liaison between industry and agriculture and its role as a public body this agency has the potential for significant activity in the land use field.

7. The Iowa State Highway Commission. This agency (which is in the process of being superseded by the Department of Transportation) is responsible for the primary highway system in Iowa. It is also the state agency concerned with the allocation of interstate highway and other federal highway funds. The Highway Commission has six main functions, of which three are relevant here. These are the projection of future highway needs and resources, the planning and design of such facilities, and the construction of such facilities. As a substantial proportion of funding for roads comes from the federal government the Highway Commission is required to undertake environmental assessments as part of its planning and design process. These environmental impact studies would benefit substantially by the use of a statewide land use information study.

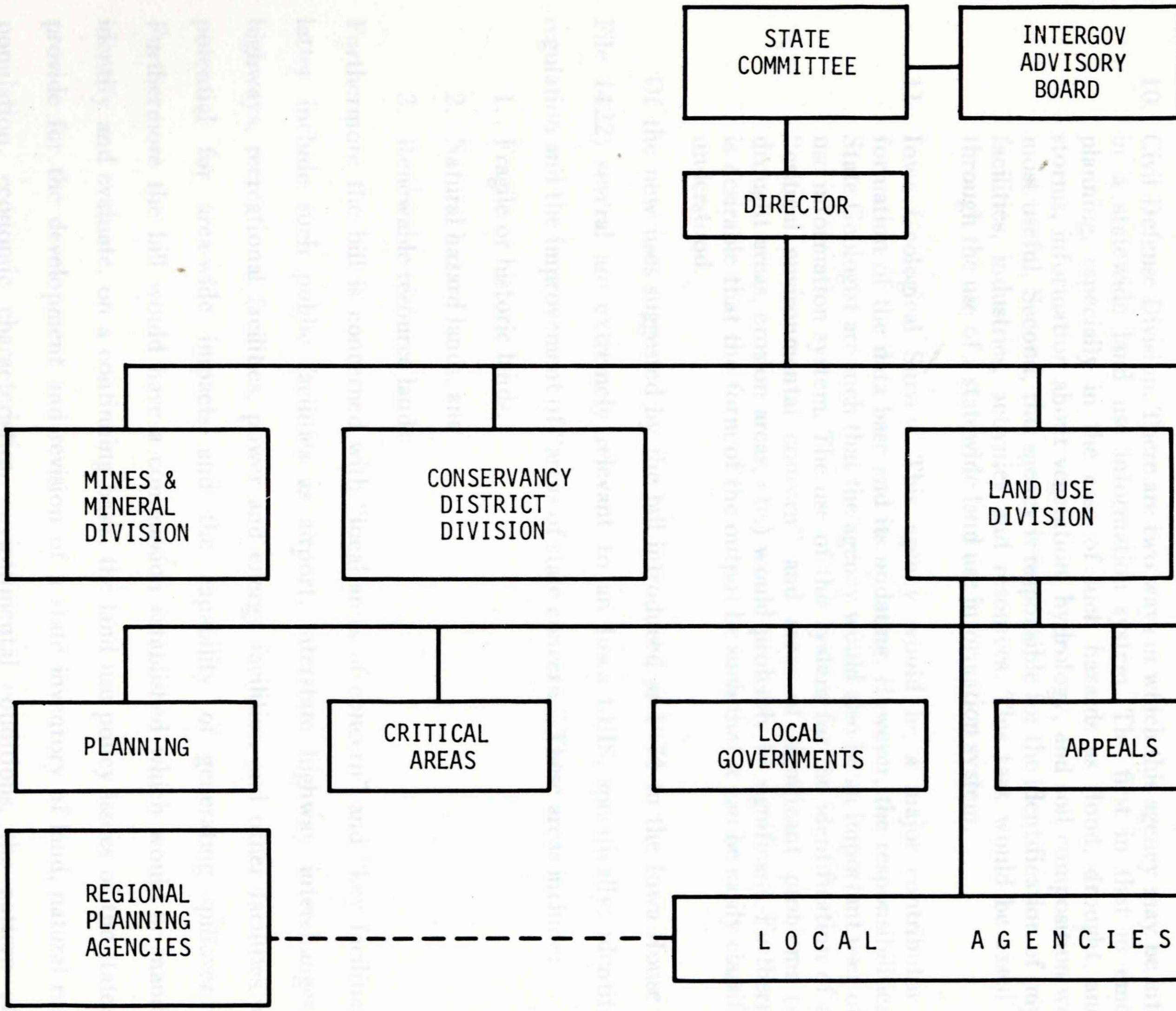


Fig. III — 1 Department of Soil Conservation and Land Use. (Source: House File 1422, A Bill for An Act to provide for a state land use policy, and to create a department of soil conservation and land use, a state land use policy commission, an intergovernmental advisory board, county land use policy commission, and to specify the powers and duties of such agencies. Passed by the 1974 Session of the Sixty-fifth General Assembly, State of Iowa.)

8. The Iowa State Department of Health. This agency along with its policy-making body, the State Board of Health, is concerned with many duties. Of relevance for this report is the environmental engineering service which seeks to assure that Iowans enjoy "a clean, safe and healthy environment." This role includes administration of sanitation programs for water supplies, waste disposal programs, air pollution control, and control of radioactive activities. This body provides personnel for the air pollution control Commission, Water Pollution Control Commission, and other agencies. All of these activities would benefit greatly by the intensive use of a well-designed statewide land use information system.

THIS IS OUTDATED

9. The Department of Revenue. This agency is concerned with, among many duties, the equalization of property taxation and the assessment of utility and railroad properties. For such tasks a statewide land use information system with the capability to classify land by physical characteristics and use characteristics would be most useful.

10. Civil Defense Division. There are two ways in which this agency may be interested in a statewide land use information system. The first in that in emergency planning, especially in the case of such hazards as flood, drought, and wind storms, information about vegetation, hydrology, and soil composition would be most useful. Second, this agency is responsible for the identification of important facilities, industries, activities and resources. This task would be eased greatly through the use of a statewide land use information system.

11. Iowa Geological Survey. This agency would be a major contributor to the formation of the data base and its updating. However, the responsibilities of the State Geologist are such that the agency would also be an important user of a land use information system. The use of this system for the identification of areas of "critical environmental concern" and areas of significant problems (such as drought areas, erosion areas, etc.) would probably be significant. Furthermore, it is desirable that the form of the output be such that it can be easily classified and understood.

Of the new uses suggested by the bill introduced in 1974 to the Iowa House (House File 1422) several are extremely relevant to an Iowa LUIS, specifically: identification, regulation and the improvement of "areas of state concern." These areas include;

1. Fragile or historic lands,
2. Natural hazard lands, and
3. Renewable resource lands

Furthermore the bill is concerned with "local areas of concern" and "key facilities." The latter include such public facilities as airport, interstate highway interchanges, other highways, recreational facilities, power and energy facilities, and other facilities with the potential for area-wide impacts and the capability of generating spillover effects. Furthermore the bill would have a commission established which would be mandated to identify and evaluate, on a continuing basis, the land use policy issues of the state; and to provide for the development and revision of a state inventory of land, natural resources, population, economic characteristics, environmental conditions, the pattern of urban growth, land use suitability information, and projections concerned with all major land use categories. This requirement would include periodic monitoring and updating. In other words, the bill calls on the (to be established) commission to develop and operate a land use information system for Iowa. All of the other specified obligations of this commission would require use of this land use information system if they are to be carried out efficiently and accurately.

Potential Local Users

At the local level there are three basic user classes: a system of regional planning agencies*, the counties themselves, and the cities and metropolitan governments. Each of the above users will be discussed in the context of the use of a land use information system.

An example of a regional planning agency is the Iowa Northland Regional Council of Governments (INRCOG) which serves the Region 7 area (see Fig. III - 2). The purposes for establishing INRCOG were as follows: to provide solutions and recommendations for common problems facing local governments; to foster, promote and achieve the objectives of regional and metropolitan planning as provided and set forth in Chapter 473A, State Code of Iowa; to maintain valid and certified planning programs and review federal and state grant and aid programs for counties, cities and towns within the jurisdiction of this agency.

The organizational structure of INRCOG consists of a Council, an Assembly, and delegated authority groups along with staff support (see Fig. III - 3). The regional assembly is where a land use information system would be beneficial. It could provide information concerning the environment, economic development, land use and many other types of pertinent data to the appropriate committee(s).

At the county level the Board of Supervisors acts as the executive branch of county government. Its purpose is to create ordinances, which could pertain to land use and to "areas of critical environmental concern," zoning, etc. The Zoning Commission (where one exists) serves as a recommending body, whose suggestions must be acted upon by the Board of Supervisors. The purpose of the zoning ordinance is to promote the following: 1) public health; 2) safety, comfort and order; 3) general welfare to conserve and protect natural and man-made environment; 4) social and economic advantages resulting from an orderly,

*Iowa is divided into 16 regional planning agencies.

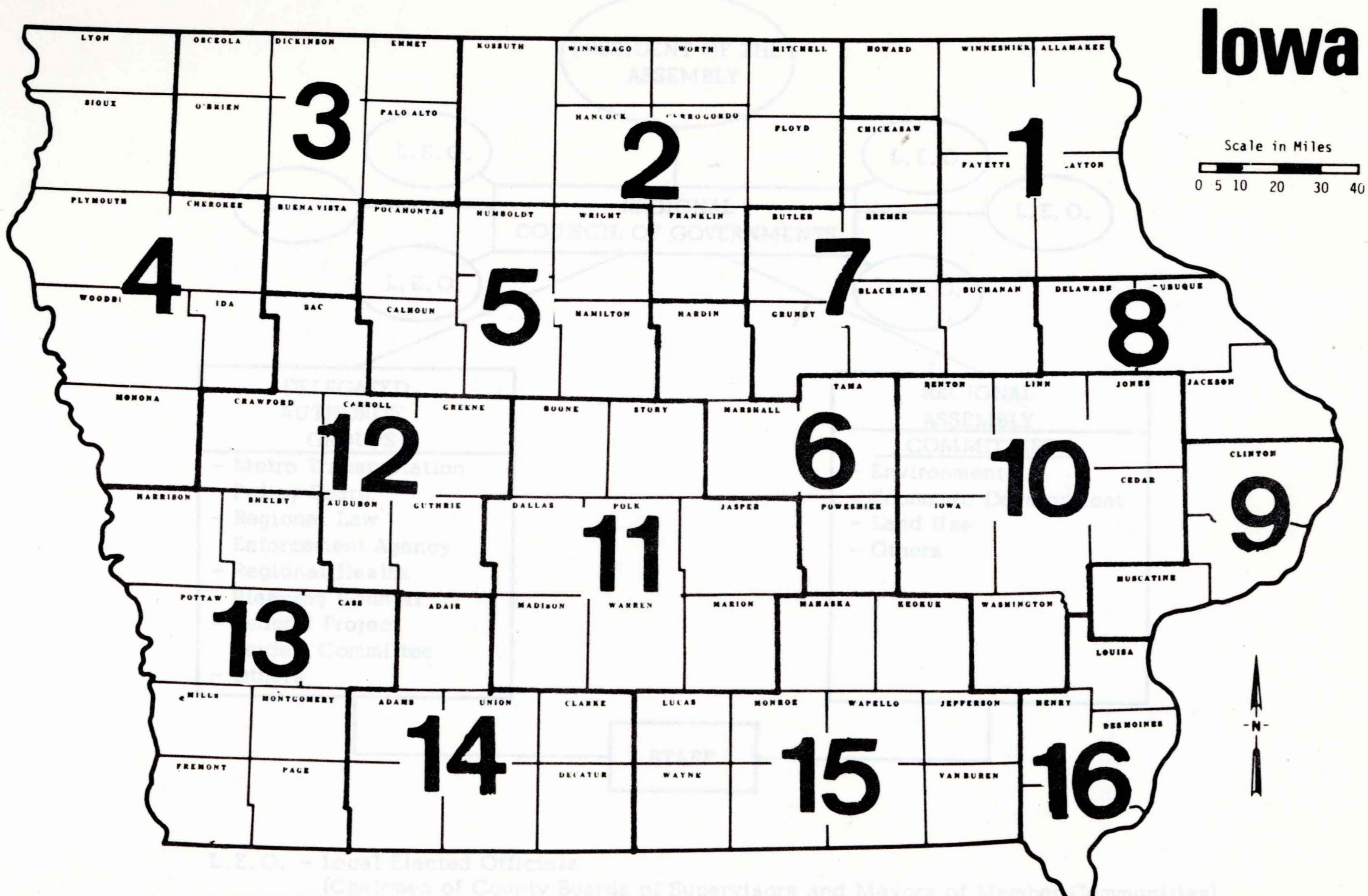
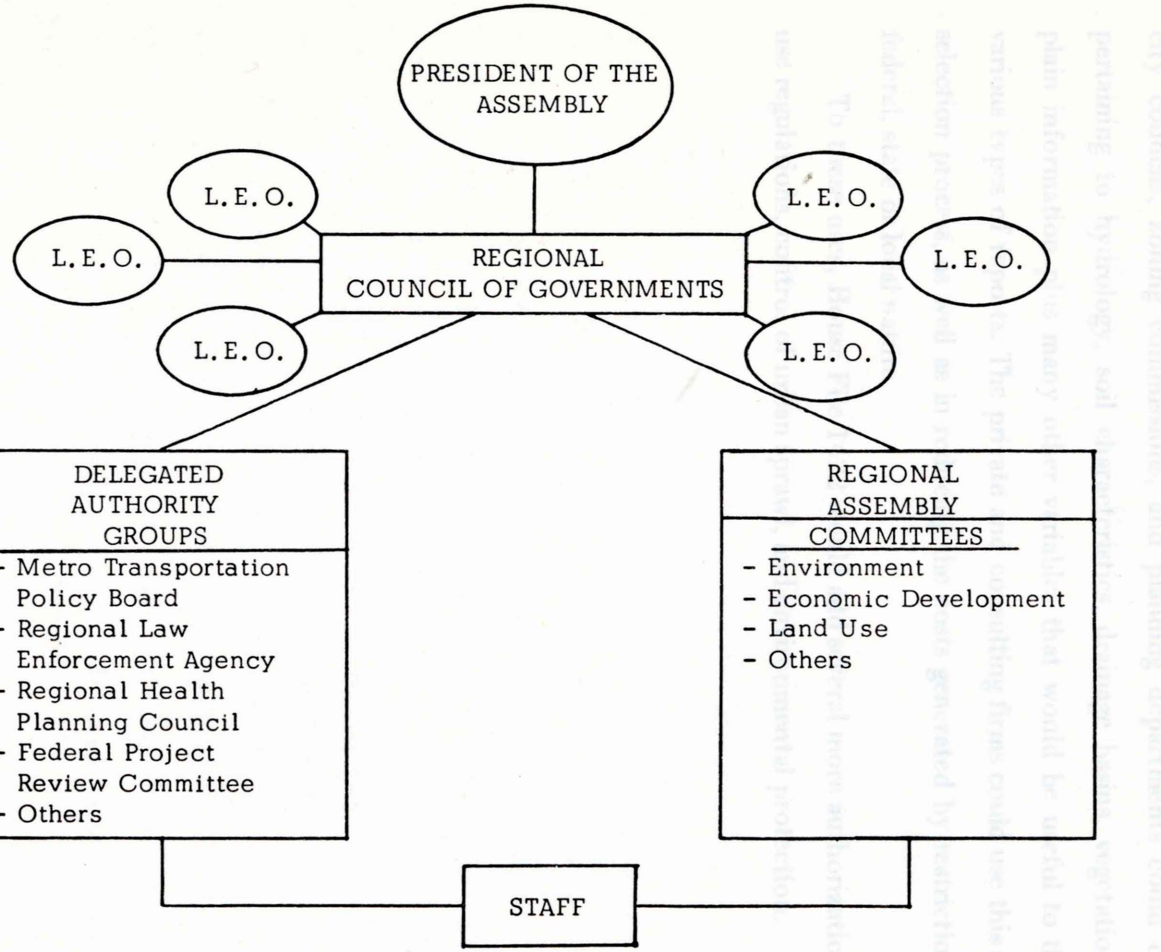


Fig. III – 2 Iowa Multi-County Regions. (Source: *Planning Information Files*, Iowa Northland Regional Council of Governments.)



L.E.O. - Local Elected Officials
(Chairmen of County Boards of Supervisors and Mayors of Member Communities)

Fig. III – 3 Proposed Structure of the Regional Council of Governments. (Source:*Planning Information Files*, Iowa Northland Regional Council of Governments.)

planned use of land resources; and 5) the development of adequate but economical provisions for public improvements. Much of the information needed for making important decisions could be obtained from a land use information system.

At the city or municipal level the following would have a need for such a system: city councils, zoning commissions, planning departments, and private and consulting firms. The city councils, zoning commissions, and planning departments could obtain information pertaining to hydrology, soil characteristics, drainage basins, vegetation cover and flood plain information plus many other variables that would be useful to them in conducting various types of reports. The private and consulting firms could use this system in their site selection process, as well as in reducing the costs generated by restriction on land use of a federal, state or local nature.

To these uses, House File 1422 would add several more authorizations concerning land use regulations, control of urban sprawl, and environmental protection.

CHAPTER IV

THE DATA SUBSYSTEM

The data subsystem, as noted earlier, consists of the actual information or data used in the information system plus any collection, programming and storage designs relating to it. This information (the data base) must be collected from different sources, converted into machine-readable languages, geocoded, and processed and stored in a manner that allows it to be recalled for use. The data subsystem thus includes the collection, translation, coding, storage and retrieval operations as well as the actual data (see Fig. IV - 1). The actual data as it is stored and retrieved is called the data base. Each element of the data base has several characteristics which must be specified in the design of a land use information system. These include the type of geocoding procedure to be used, the areal unit over which the entry is defined, the level of aggregation, the temporal dimensions referred to, the source of the entry values (this is especially needed when more than one potential data source exists), the location of the entry in the storage file or files, and the procedures for data standardization. This section of the report attempts to specify the desirable content of the data base for a land use information system for Iowa. The information is separated into seven categories. For each category the entry may be of one of three types: point, linear, or areal. One other category of information is also discussed, that is, bibliographic or reference material. The latter category is suggested to help counteract the frequent complaint by observers that information systems of the type being discussed here are often too sterile and devoid of human and historical perspectives.

In what follows, each category of information is discussed according to the output which is desirable and the data inputs which are necessary. For each bit of information decisions must be made as to the preferable scale, metric, data type, data availability, and standardization. Appendix C documents more fully the available data sources. To some degree the precise form of the entry will depend on the exact form of storage-retrieval programs. If the information is geocoded and stored on a grid system, the form of the data

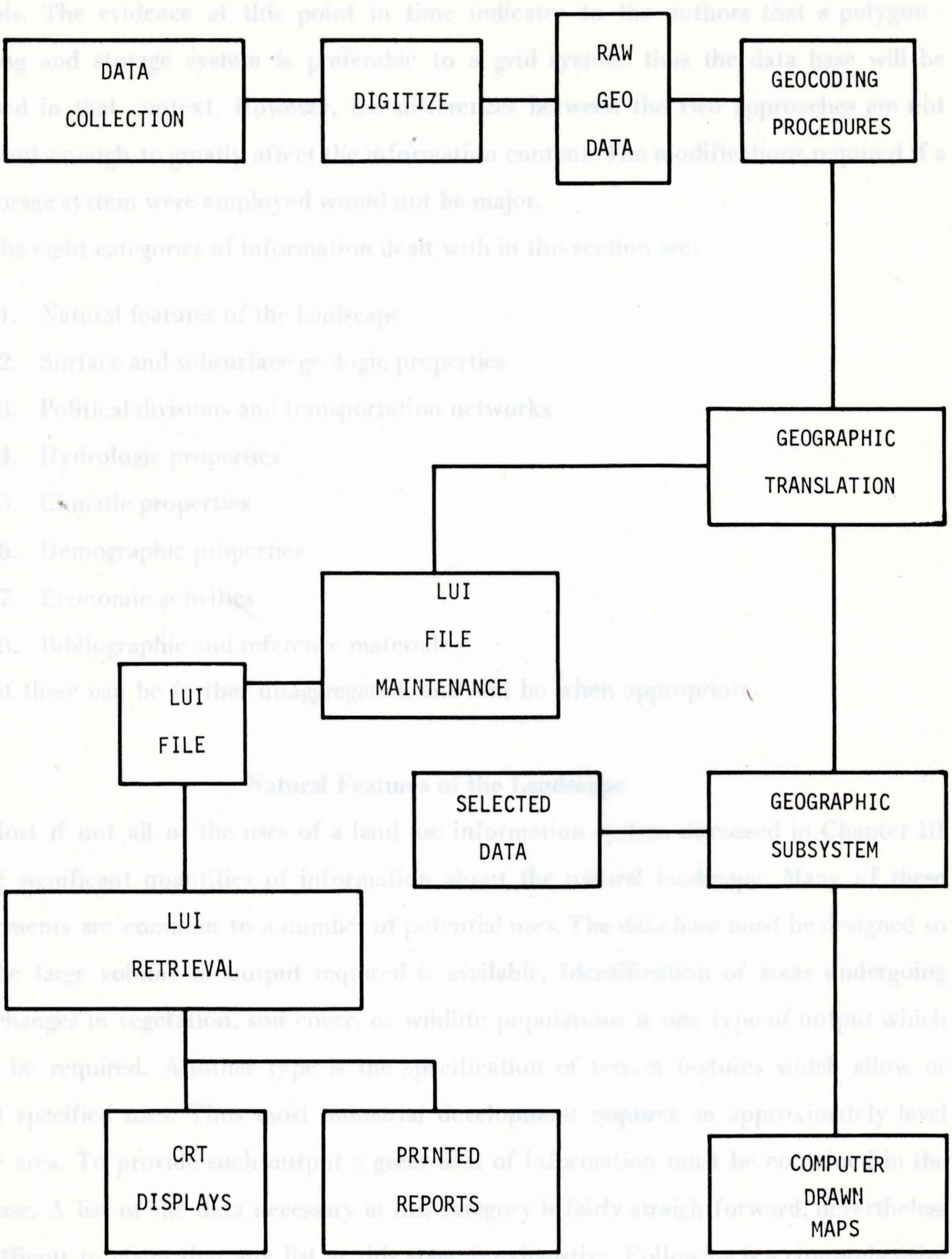


Fig. IV – 1 L.U.I.S. Data Subsystem

entries will be somewhat different than if it is to be stored by one of the existing polygonal methods. The evidence at this point in time indicates to the authors that a polygon encoding and storage system is preferable to a grid system; thus the data base will be discussed in that context. However, the differences between the two approaches are not significant enough to greatly affect the information content. The modifications required if a grid storage system were employed would not be major.

The eight categories of information dealt with in this section are:

1. Natural features of the landscape
2. Surface and subsurface geologic properties
3. Political divisions and transportation networks
4. Hydrologic properties
5. Climatic properties
6. Demographic properties
7. Economic activities
8. Bibliographic and reference materials

Each of these can be further disaggregated, and will be when appropriate.

Natural Features of the Landscape

Most if not all of the uses of a land use information system discussed in Chapter III require significant quantities of information about the natural landscape. Many of these requirements are common to a number of potential uses. The data base must be designed so that the large volume of output required is available. Identification of areas undergoing rapid changes in vegetation, soil cover, or wildlife populations is one type of output which would be required. Another type is the specification of terrain features which allow or restrict specified uses. Thus most industrial development requires an approximately level surface area. To provide such output a great deal of information must be contained in the data base. A list of the data necessary in this category is fairly straightforward, nevertheless it is difficult to claim that any list at this stage is exhaustive. Following is a comprehensive list, but it may have several gaps due to the specialized backgrounds of the authors.

A. Areal Data

1. Elevation. This is the first and one of the easiest geographic variables to measure. It is necessary for a large number of uses. Flood control, erosion patterns and studies in micro-climates are all topics which require information about elevation.

2. Slope. This variable is directly related to elevation. Slope will also be needed in the topics mentioned under elevation. However, slope can be an important factor in deciding appropriate land uses.
3. Soil type. This is an important variable in land use decisions, especially relative to agriculture. Soil types are also important factors in erosion behavior and can be important in analyzing hydrology and water pollution. The most available and appropriate classification procedure is that used in the soil surveys of the department of Agriculture (see Fig. IV - 2).
4. Vegetation cover. This variable refers to natural cover, not to agricultural activities. The identification of type, coverage and mix of vegetation is important in understanding wildlife patterns, erosion, and hydrologic patterns.
5. Wildlife communities. This variable consists of identifying and measuring the populations of the animal species common to each area and the associations among them (as well as their association with varying vegetation systems).

B. Linear Data

1. Boundaries. This data variable consists of those boundaries which are sharp and well defined. Examples include flood plain boundaries and forest boundaries. Frequently, these boundaries would be aligned with physical characteristics made by man (highways, farm boundaries, etc.).
2. Streams and rivers. The location and interconnections between the rivers and streams in the state are important variables to have stored. Further information about these is discussed more completely under hydrology below. The actual location can be most easily found through air photography and other remote sensing sources (see Fig. IV - 3).

C. Point Data

1. Still bodies of water. The location of ponds and lakes are best located as point data, unless they cover a substantial area. For these the geometric center of the body of water would be used as the location. Clearly the distinction between point and area data is one of scale and is often arbitrary.
2. Springs and sink holes. This data item is basically the connection of surface hydrology with subsurface hydrology.
3. Special interest features. These are often specific natural features of the landscape (a unique rock, tree, etc.) which are deemed to be of interest and value. These

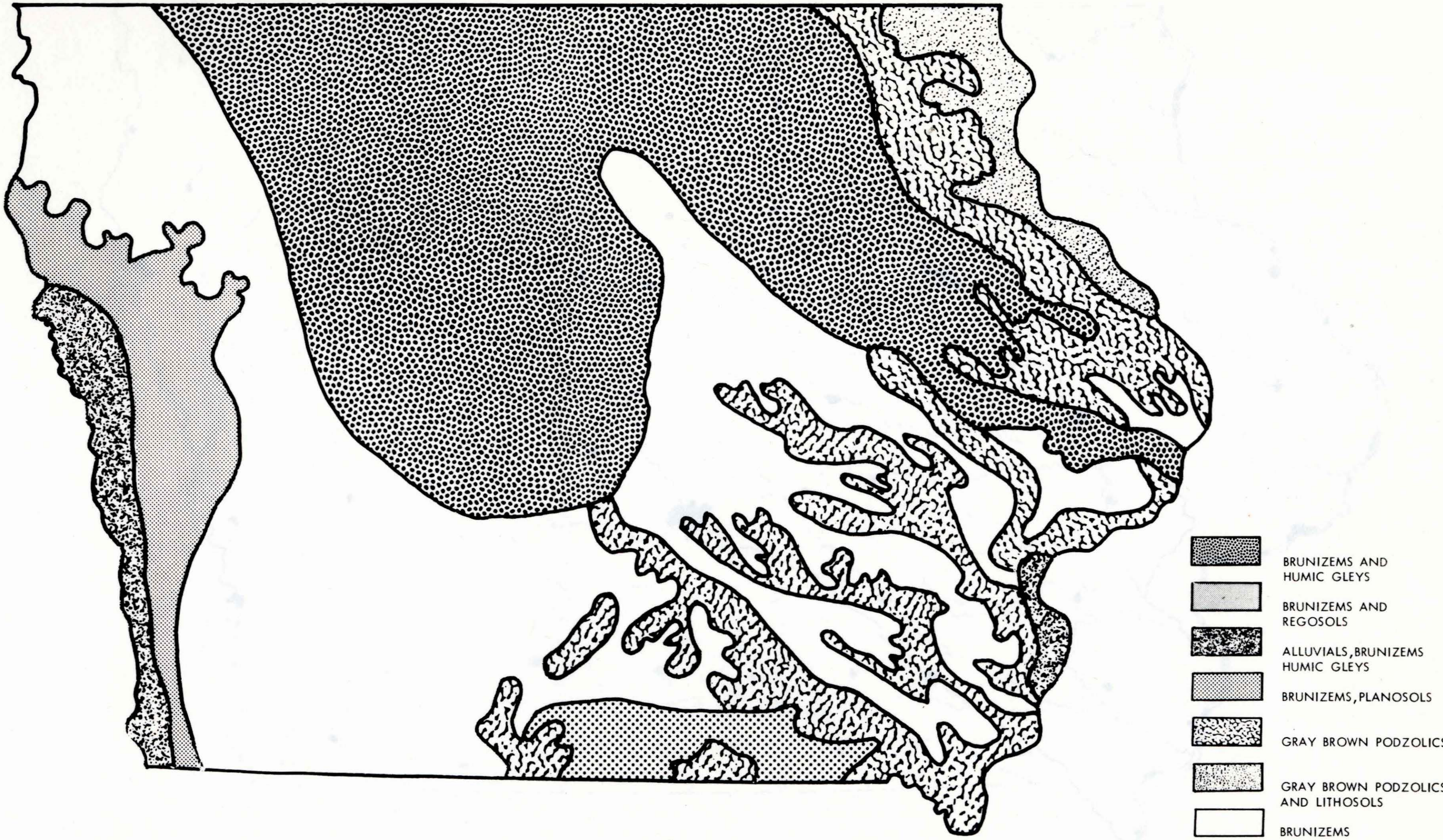


Fig. IV – 2 Major Soil Groups of Iowa. (Source: ***Principle Soils of Iowa -- Their Formation and Properties*****, Ames: Iowa State University of Science and Technology, p. 35.)**

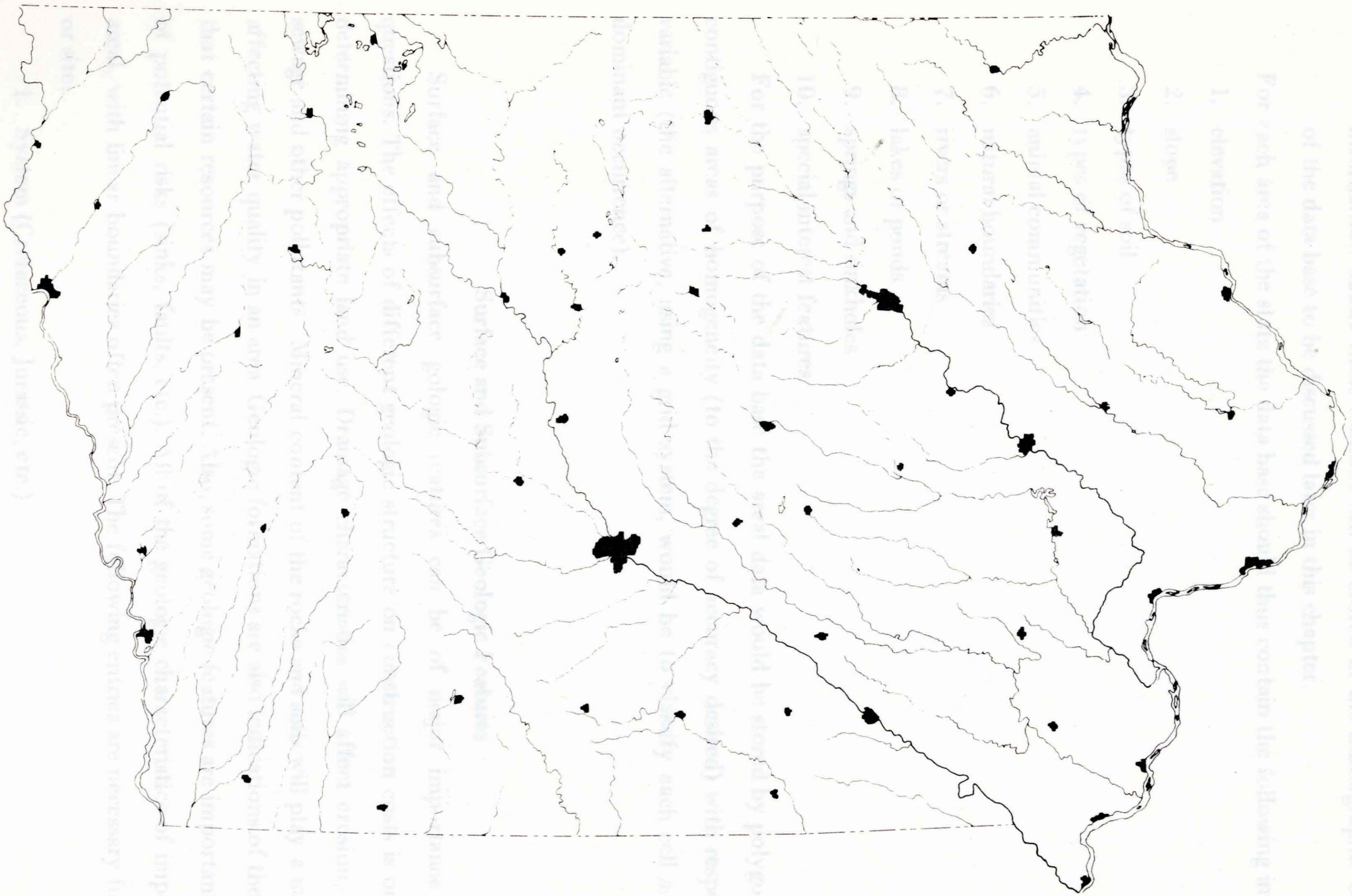


Fig. IV – 3 Drainage System of Iowa. (Source: U.S. Geological Survey, *State of Iowa*) features should be identified, located and included in the data base. More information about these features can be stored in the bibliographic components of the data base to be discussed later in this chapter.

For each area of the state the data base should thus contain the following information:

1. elevation
2. slope
3. types of soil
4. types of vegetation
5. animal communities
6. natural boundaries
7. rivers or streams
8. lakes or ponds
9. springs and sinkholes
10. special-interest features

For the purpose of the data base the areal data would be stored by polygons defining contiguous areas of homogeneity (to the degree of accuracy desired) with respect to each variable (the alternative, using a grid system, would be to classify each cell according to dominant occurrence).

Surface and Subsurface Geologic Features

Surface and subsurface gologic features can be of major importance for many questions. The effects of different geologic structure on construction costs is one factor in determining appropriate land use. Drainage characteristics will affect erosion, seepage of sewage and other pollutants. Mineral content of the rocks and soils will play a major role in affecting water quality in an area. Geologic formations are also indications of the possibility that certain resources may be present. Also, some geologic features are important indicators of potential risks (sinks, faults, etc.). All of the geologic characteristics of importance are areal, with linear boundaries often present. The following entries are necessary for each area or site:

1. System (Cretaceous, Jurassic, etc.)
2. Series (Virgil, Missouri, Des Moines, etc.)
3. Group (Colorado, Dakota, Wabansee, etc.
4. Formation and location (Karst formation, etc.)

5. Material (shale, limestone, sandstone, etc.)
6. Thickness
7. Related hydrologic characteristics (type of aquife or acquiclude)
8. Known mineral resource, if any (limestone, coal, sulphite, clay, etc.)

In addition to these, the data base should also identify areas of shallow bedrock, outcropping, alluvium, residual soils, etc. (see Figs. IV - 4 through IV - 9).

In addition there may be some geologic features (underground caverns, for example) which are unique point phenomena. These too should be contained in the data base.

Political Units and Transportation Networks

The data base should contain all political subdivisions in the state. This includes state, county, township and municipal boundaries. Using a polygonial storage system these are extremely easy to store and retrieve in concert with other information. Small political units (e.g., small towns) can be treated as point data, the remainder are areal data defined by polygonial boundaries. Thus these units are best defined by their boundaries.

The data base should include all segments of the transportation system. With the exception of airports these will be linear entries with interchange nodes identified as points. Airports are best treated as point data. The transportation data should be subdivided into eight categories:

1. air transportation facilities
2. railroad routes
3. interstate highways
4. primary state roads
5. secondary state roads
6. county roads
7. local roads
8. navigable rivers and shipping facilities

For each link in each of these categories the following information should be stored:

1. travel time
2. route capacity
3. any size limitation (i.e., truck, barge or train size restriction)

Of all the components in the data base this is the category which is least accurately measured and most subject to temporal variation. This attribute should be recognized and

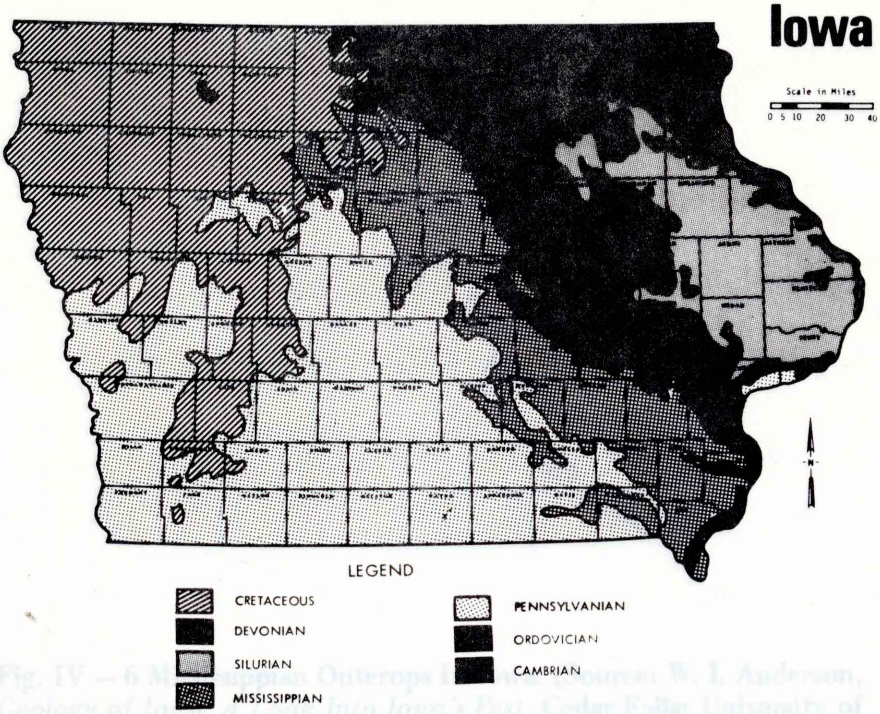


Fig. IV – 4 Bedrock of Iowa. (Source: W. I. Anderson, *Geology of Iowa, A Look Into Iowa's Past*, Cedar Falls: University of Northern Iowa, 1972, p. 13.)

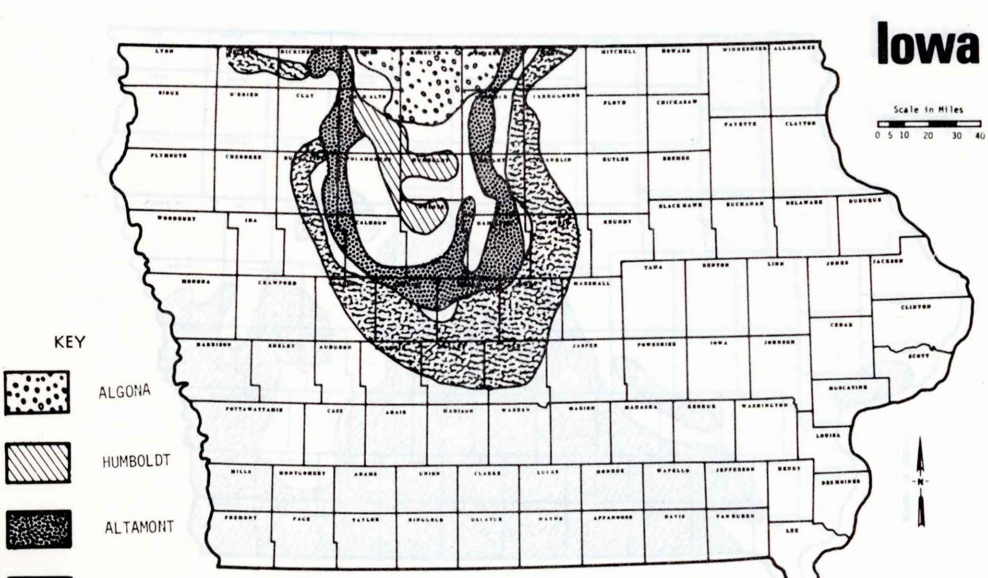


Fig. IV – 5 Major End Moraines of the Cary Drift. (Source: W. I. Anderson, *Geology of Iowa, A Look Into Iowa's Past*, Cedar Falls: University of Northern Iowa, 1972, p. 43.)

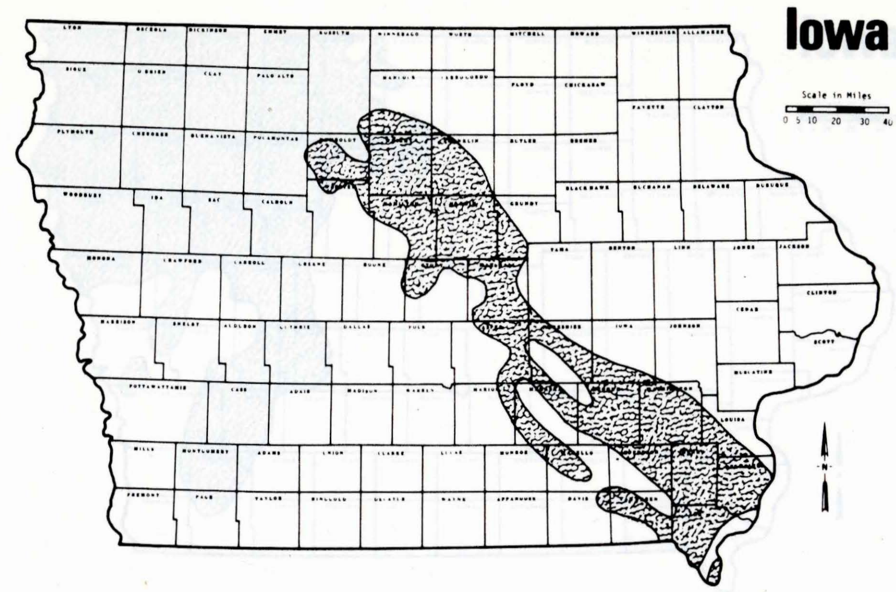


Fig. IV – 6 Mississippian Outcrops In Iowa. (Source: W. I. Anderson, *Geology of Iowa, A Look Into Iowa's Past*, Cedar Falls: University of Northern Iowa, 1972, p. 31.)

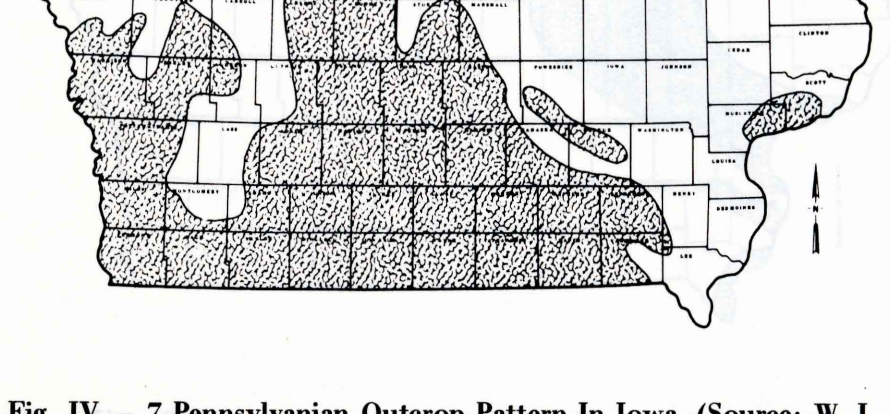


Fig. IV – 7 Pennsylvanian Outcrop Pattern In Iowa. (Source: W. I. Anderson, *Geology of Iowa, A Look Into Iowa's Past*, Cedar Falls: University of Northern Iowa, 1972, p. 33.)

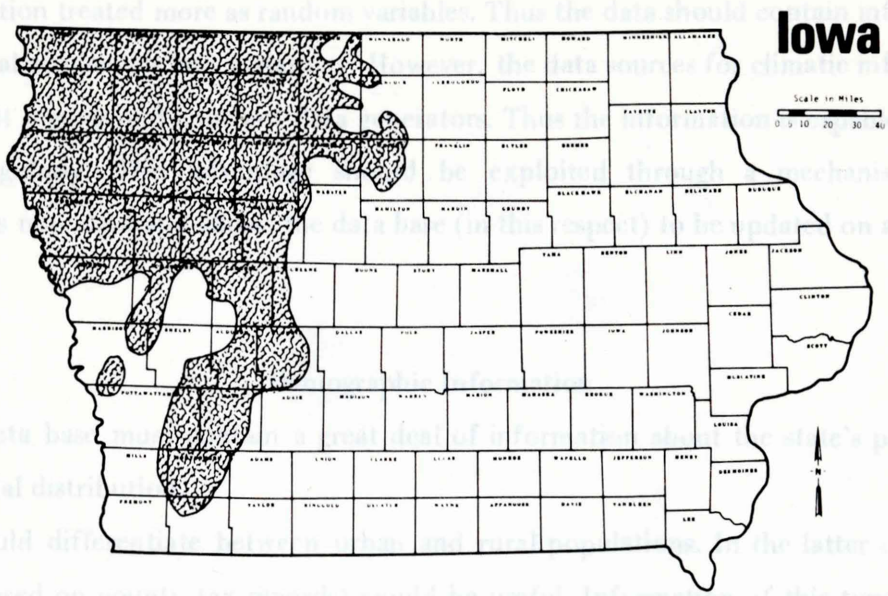


Fig. IV – 8 Cretaceous Outcrop Patterns In Iowa. (Source: W. I. Anderson, *Geology of Iowa, A Look Into Iowa's Past*, Cedar Falls: University of Northern Iowa, 1972, p. 39.)

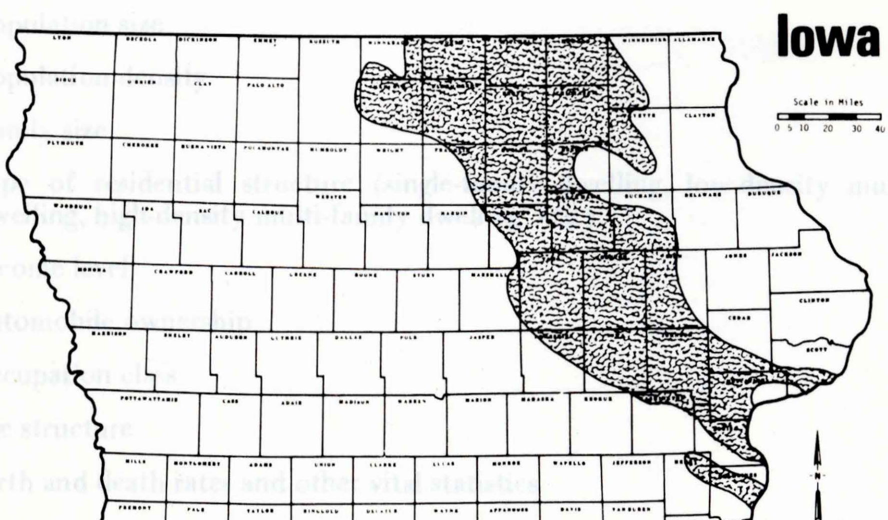


Fig. IV – 9 Devonian Outcrops in Iowa. (Source: W. I. Anderson, *Geology of Iowa, A Look Into Iowa's Past*, Cedar Falls: University of Northern Iowa, 1972, p. 28.)

the information treated more as random variables. Thus the data should contain information about central tendencies and variations. However, the data sources for climatic information are the most regular and constant data generators. Thus the information is capable of being updated regularly. This advantage should be exploited through a mechanism which incorporates new data and allows the data base (in this respect) to be updated on a frequent basis.

Demographic Information

The data base must contain a great deal of information about the state's population and its spatial distribution.

It should differentiate between urban and rural populations. In the latter ownership patterns (based on county tax records) would be useful. Information of this type must be collected and stored in such a way that disclosure laws are fulfilled and personal privacy not violated. To accomplish this task most of the demographic data could be stored in areal form. A major use of demographic information is for identifying current stress on the land and for projecting changes in land use. It can also be used to identify the demands for specific land uses such as outdoor recreation facilities.

The data base should contain the following information, by area, for urbanized areas:

1. population size
2. population density
3. family size
4. type of residential structure (single-family dwelling, low-density multi-family dwelling, high-density multi-family dwelling, etc.);
5. income level
6. automobile ownership
7. occupation class
8. age structure
9. birth and death rates and other vital statistics

Most of the above information is available from the U.S. Census and can be updated and checked through well-designed survey techniques (see Figs. IV - 11 and IV - 12). This information could profitably be supplemented by information about population movement. For example, surveys about residential-employment trips would provide important information for transportation planners. The dynamic nature of urban expansion can be

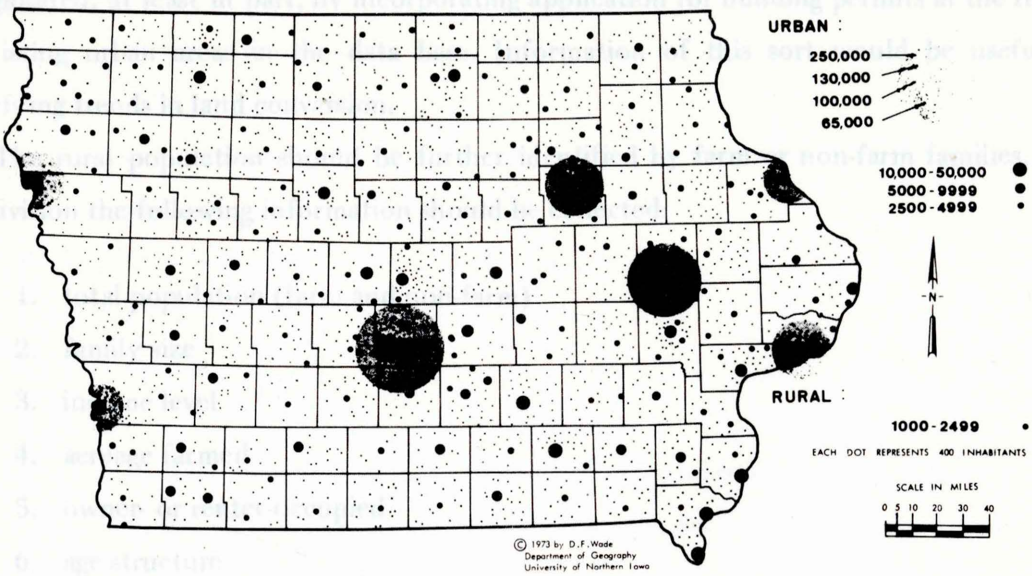


Fig. IV – 11 Population Distribution in Iowa, 1970. (Source: Donald F. Wade, Cedar Falls, Iowa, c 1973.)

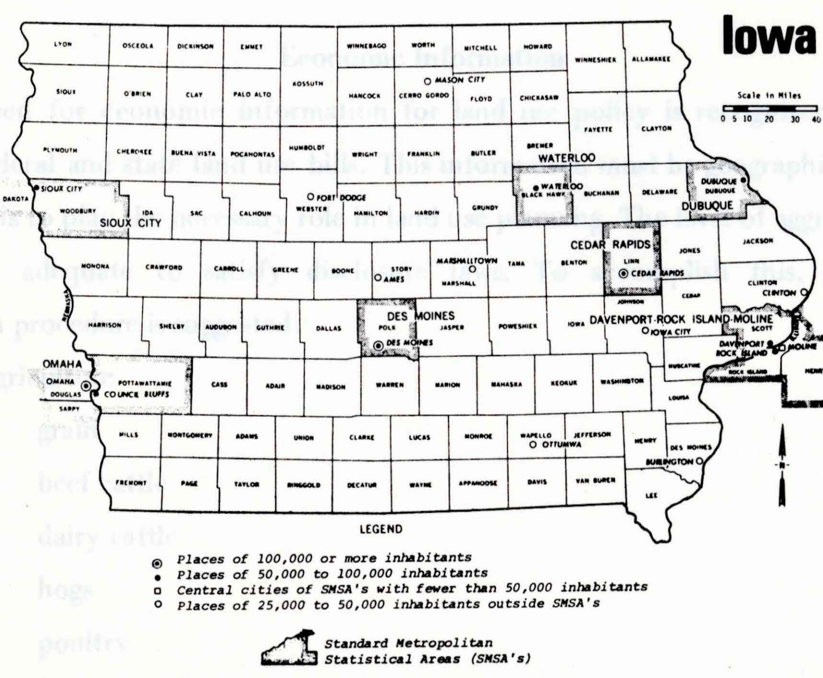


Fig. IV – 12 Counties , Standard Metropolitan Statistical Areas, and Selected Places. (Source: U.S. Bureau of the Census, Census of Population: 1970, Number of Inhabitants, PC(1)-A, Iowa.)

incorporated, at least in part, by incorporating application for building permits at the fringe of existing urban areas in the data base. Information of this sort would be useful in identifying trends in land conversion.

The rural population should be further identified by farm or non-farm families. For this division the following information should be collected:

1. total population (farm and non-farm)
2. family size
3. income level
4. acreage farmed
5. owner- or renter-occupied
6. age structure
7. equipment profiles (for the farming population)

In addition to the above information, rural areas should be mapped by ownership patterns with property lines used to identify privately owned tracts. These cannot be identified by owner due to disclosure rules. This information is currently available from county tax records. This information may be useful in concert with other information in the data base for developing procedures of tax equalization.

Economic Information

The need for economic information for land use policy is recognized by both the proposed federal and state land use bills. This information must be geographic and location specific if it is to play the necessary role in land use planning. The level of aggregation would have to be adequate to satisfy disclosure laws. To accomplish this, the following classification procedure is suggested:

1. Agriculture
   a. grain
   b. beef cattle
   c. dairy cattle
   d. hogs
   e. poultry
   f. pasture
   g. other

2. Industrial
   a. heavy manufacturing
   b. light manufacturing
   c. food processing
   d. utilities
3. Wholesale activities
4. Retail activities
5. Other services
6. Other

Information should be collected so that it can be stored and recalled on areal bases smaller in size than counties. The following information should be collected and included in the data base for each of the above categories.

1. employment
   a. production workers
   b. total
2. square feet (or acreage) production space
3. acreage of site
4. transportation requirements
5. waste generation
6. location

Along with these six variables, it might be desirable to include other input requirements, such as energy needs, water needs, and similar requirements. This information can also be supplemented by use of application for building permits by industrial users.

Bibliographic and Reference Information

This last category of information is a suggested addition to the content found in most existing land use information systems. In this category, lists of publications and studies which deal with social, cultural, economic, physical, environmental, or other factors in Iowa would be stored. They would be indexed by type of information and area(s) of discussion. Thus if a land use planner was dealing with a given county he could also request a bibliographic listing of those articles, books, etc., which could aid him in understanding the area and its population. Much of the information contained in works of this type is important, but it could not be otherwise made available through the land use information system. This type of information has been successfully computerized for many other uses. Its incorporation into a land use information system would be one way for providing more information on the "human dimensions" and on non-quantifiable judgments about regions or features of regions. It would also be useful for providing an historical perspective of an area under scrutiny.

Storage-Retrieval Approaches

An important decision is the selection of the format through which the information discussed above may be stored in the memory and recalled. This matter does not refer to the rather mundane choice between tape, disk or permanent memory storage. Instead it refers to the appropriate type of locator description and encoding approach to be taken. One approach is to divide the state by a meridional grid structure* into a number of cells. This is the general approach taken by the land use analysis laboratory in Ames, as well as that of the New York system. The major problem with this approach is the necessity to assume homogeneity within the a priori specified cells. A further problem exists in developing criteria to allow for continuous linear features which pass through, but do not exhaust, the cells. Any mechanism to do this is subject to significant error. Similarly the simultaneous treatment of point phenomena is subject to significant error. The major alternates, and the one chosen in the California, Minnesota and Wisconsin systems is to utilize a coordinate system and to encode areal phenomena as irregular polygons. This approach is more easily amenable to the simulteaneous and accurate storage of linear data (boundaries, transportation networks, rivers, etc.) and point data.

This approach requires a somewhat more costly and complicated encoding procedure, especially when using areal photographs and other graphic materials. Scanners and automatic encoders are available which can accomplish these tasks at a somewhat higher cost then the scanners and encoders needed under the grid method. The storage system (for either approach) must be such that a user is capable of requesting output for identifiable areas (counties, multi-county areas, river basins, etc.) so that the data will be automatically aggregated to conform to the specified area.

*This type of grid is based on curvilinear divisions corresponding to the curvature of the earth. An alternative, but with greater error, is a straight line grid which ignores the earth's curvature. For small areas the error would be insignificant, but for an area the size of Iowa it would be significant.

A number of alternative encoding approaches are possible in the polygon procedure. The most developed is the approach developed by the Bureau of the Census called the DIME Geocoding System.* This approach allows the complete encoding of any network or linear phenomena or any phenomena which can be approximated by a series of line segments. The DIME procedure allows for the use of powerful editing procedures to be employed which can virtually guarantee a data base free of coding errors.

Each interchange node should be identified according to any intermodal transfer possible (i.e., highway-railroad transfer points).

Hydrologic Information

The location of all water bodies has been discussed earlier under "Natural Landscape," and drainage characteristics under geologic features. The additional information under this category includes:

1. Identification of river basins and stream hierarchies
2. Volume and velocity of flow for each link in the river stream
3. Siltation characteristics and water quality
4. Contribution to volume of ground water from runoff
5. Bank height and flood characteristics
6. Identification and specification of floodplains associated with each river and stream

This information would be necessary in flood control planning, in planning the development of flood plains, in determining the extent and diffusion of water pollution, and many other related uses.

The hydrologic data could also include the location and operating characteristics of any dams, or other existing manmade facilities which affect the natural hydrologic systems.

Climatic Information

The need for climatic information in determining appropriate land uses, planning flood control, examining natural environmental and ecological systems and man's impact on them cannot be overstated. Unfortunately climate is not a fixed or highly predictable natural system. The existing evidence of climatic shifts is but one more complicating factor. Yet the

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*U.S. Bureau of the Census, **Census Use Study, the Dime Geocoding System Report No. 4**, Washington, D.C., 1970 importance of this information for Iowa is clearly evident. Any change in the length of the growing season, or in the average of critical temperatures, precipitation, cloud cover or wind patterns and velocities may have serious economic and land use repercussions for the entire state.

Climatic information is hampered by the relatively few reporting stations and by their geographic distribution (see Fig. IV - 10). Nevertheless the existing data sources can provide some useful information. This information can be generalized through the use of isotherms and similar techniques. The information which should be collected and included in the data base includes:

1. Temperature profile--based on average temperature in temporal sequence; accumulated degree days;

2. Precipitation--by type (snow or rain) and in temporal sequence; and

3. Wind--predominant direction, and variation profile (i.e., the frequency of the occurrence of winds in excess of specified speeds).

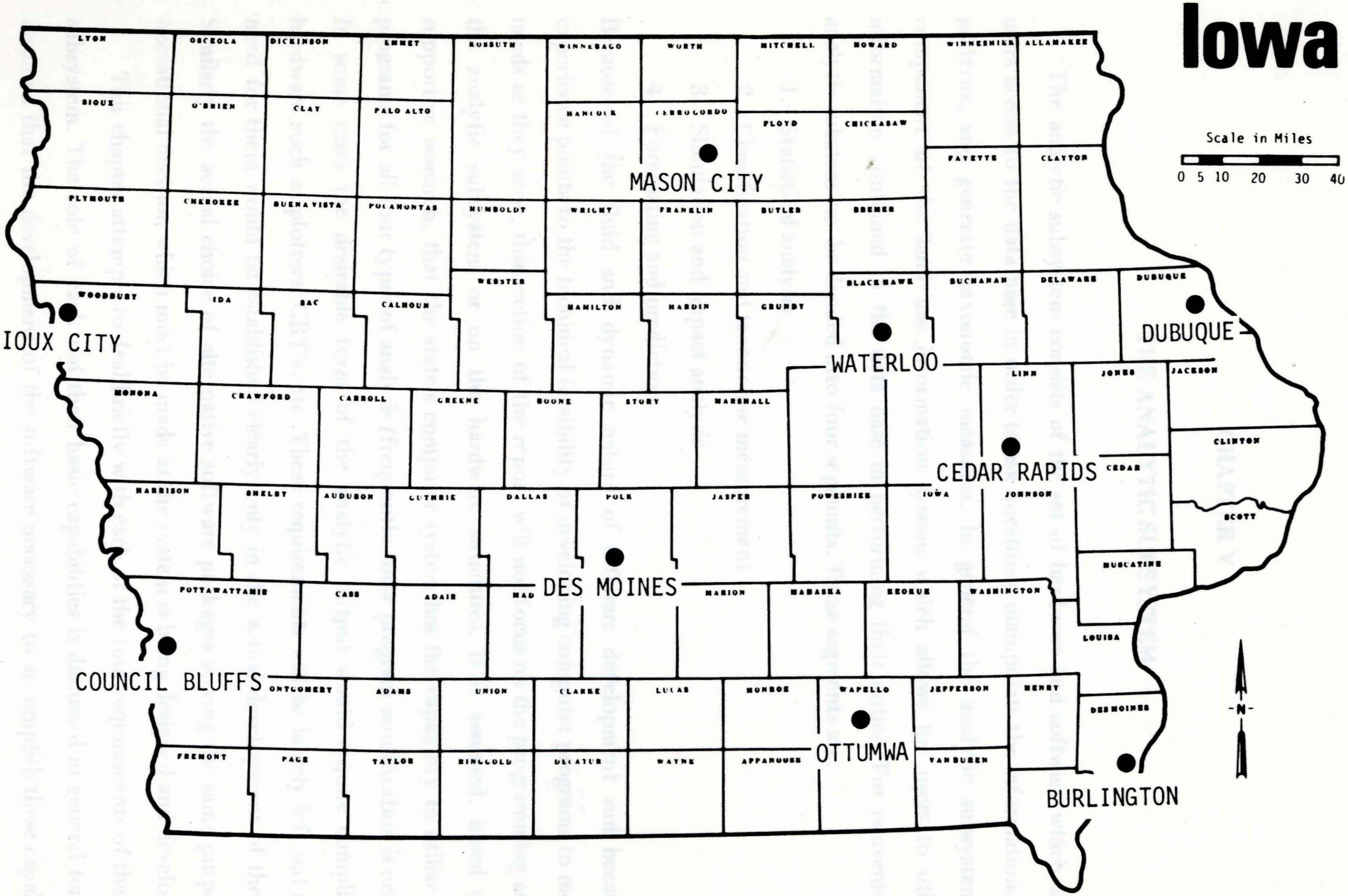

Fig. IV – 10 Aviation Forecast Centers and Areas Plus 12-Hour Terminal Forecast Network. (Source: ***Operations of the National Weather Service*****, Department of Commerce, Oceanic and Atmospheric Administration)**

CHAPTER V

THE ANALYTIC SUBSYSTEM

The analytic subsystem consists of the set of hardware and software which allow the users access to the data base in order to ask questions, manipulate the information, analyze patterns, and generate taxonomic measures. In general the analytic subsystem is the component of the land use information system which allows the users to utilize the information contained in the data base in performing their duties. For convenience the analytic substem can be divided into four segments. These segments are:

1. Statistical analysis
2. Classification and taxonomic measurement
3. Simulation and impact analysis
4. Forecasting and prediction

Because of the fluid and dynamic nature of software development and because past experience points to the technical feasibility of developing computer programs to meet most needs as they arise, this section of the report will not focus on the programming aspects of the analytic subsystem or on the hardware structures. It is assumed, based on some supportive research, that the state's computer system has the capability to utilize existing programs for all four types of analysis (frequently some program modification is necessary). In some cases the desirable form of the analytic output would require complimentary hardware such as plotters, CRT's, etc. These requirements will be largely left out since the need for them would be established clearly only in the actual development of the system. Similarly the actual choice of alternative software packages serving the same purpose is an operational decision which must be made as the system is being designed and developed.

This chapter attempts to deal briefly with each of the four requirements of the analytic subsystem. The role of each and their basic capabilities is discussed in general terms. It is assumed that the development of the software necessary to accomplish these capabilities is simply a matter of manpower and research effort and is both technologically and economically feasible. It is true that most of the software which is indicated in this chapter is currently available in some form.

Statistical Analysis

The statistical arm of the analytic substem is, perhaps, the most important of all four segments. This is because statistical analysis is needed for the other three segments to operate adequately. Classification and taxonomic procedures will require the use of statistical measures and other output from the set of statistical operations. The complimentary function of the set of statistical operations is clearly true for the other function sets as well. The predominate capabilities of this arm of the analytic subsystem are:

1. correlation and regression analysis;
2. factor analysis and principle component analysis;
3. calculation of statistical measures: means, standard deviations, medians, rankings, etc.;
4. temporal and spatial trend analysis;
5. discriminate analysis; and
6. estimation.

Correlation and regression analysis are necessary for several purposes. First, in estimating gaps in the data such methods are often useful. Second, the relationship over time of man's land use and spatial activities to the physical features of the landscape would be important inputs in impact analysis. The use of correlation in taxonomic procedures has been well established in a number of research designs. (See Skokal and Sneath; **Principles of Numerical Taxonomy**). Lastly, correlation and regression can play an important and central role in the forecasting of trends and the projection of future environmental states. Examples of systems in which these methods might be useful or even necessary in dealing with relationships between variables are vegetation with wildlife associations, mineral locations with geologic conditions, soil characteristics with the absorption rates of pollutants, and topography with soil fertility.

Factor analysis and principle components are capable of handling very complex, intercorrelated sets of variables. As such they would be of great potential value in classification procedures. Furthermore, these methods are useful in analyzing and summarizing such complex systems as ecological systems, environmental systems, economic-environmental interfaces, etc.

The need of various statistical summary measures (mean, standard deviation, etc.) is generated by the specific questions users ask. Thus centers of gravity, nearest neighbor measures, and the like, are likely to be as important in the use of a land use information system as the more standard statistical measures. Such measures are very useful in providing graphic and visual output of a descriptive nature. This is a potentially important use of a land use information system, especially in the early period after development. The capability for providing accurate information in an easily understood and simplified form, of what is in fact a complex structure, can be an important educational function. This capability is especially important if the user wishes to improve public awareness of a problem and increase acceptance of the need for specified policy measurers.

Temporal and spatial trend analysis are potentially important analytic methods in forecasting and in impact analysis. They are also useful in identifying areas undergoing significant change and thus can be used to pinpoint areas where a more detailed investigation of conditions should be made and where a greater monitoring effort would be useful. These methods utilize deterministic equations as well as statistical models.

Discriminate analysis is related to regression analysis, but is used to define functional classes of data points by calculating boundaries between them. Thus discriminate analysis is perhaps most useful in classification and taxonomic uses, such as the identification and definition of "areas of critical environmental concern."

The basic, and most common, use of this segment of the analytic subsystem is that of estimation. Rarely will the information in the data base be exhaustive and complete. Thus it is important to be able to fill the holes through estimation. The procedures available to accomplish this range from the simple calculation of means to the use of any or all of the procedures discussed above.

Classification and Taxonomy

A central use of the land use information system specified by both the proposed federal and state bills is the identification of critical environmental areas. Furthermore, in identifying land uses which are most in the public interest, it is necessary to group sites according to their common features. This grouping requires procedures for the classification of land. Such classification can proceed in two basic ways, by a priori criteria, by the use of mathematical procedures developed by numerical taxonomists, or combination of the two. The choice of the approach depends on what is being classified, and for what reasons. For example, the identification of regions or contiguous areas with reasonably homogeneous environments (as is necessary in identifying critical environmental areas) would be best approached by the use of taxonomy. On the other hand determining regions most suitable for agricultural use, industrial use, or residential development, would be more appropriately approached through specified a priori criteria. In other cases a combination of the two general approaches would be most useful.

Simulation and Impact Analysis

Simulation and impact analysis are two related and similar procedures which utilize both stochastic and deterministic models. Simulation is an attempt to reproduce in a model the basic elements of a real system so that the changes that are likely to occur can be identified and estimated. Simulation is amenable to changes in the parameters of the model in a segmented fashion. It can be used for forecasting, projecting, as well as impact analysis. It can also be used to estimate the implication of specified occurrences, such as drought, flood or other climatic changes.

Impact analysis is used here in a more restrictive sense. It is concerned with identifying and estimating the likely effects of specified choice actions. This means that public or private actions, over which there exists some control and which have an element of policy choice, can be evaluated according to their generation of external impacts. For example, the effects of a new highway on wildlife movement, pollution, urban growth, soil erosion, etc., would be estimated through impact analysis. In general impact analysis is the attempt to identify system changes caused by a specified action in a partial analysis (i.e., not including the changes due to other causes). This result can then be compared with the simulated changes in the system in the absence of the specified action. The differences between the results are considered as estimates of the impacts of the specified action.

Forecasting and Prediction

Forecasting and prediction include, but go beyond, simulation and impact analysis. They include such activities as prediction of population change by areal units, projection changes in agricultural behavior, projection of changes in the hydrology (the amounts of subsurface water, the routes of steams and rivers, etc.), projection of future climatic conditions, etc. These procedures often make use of the statistical methods discussed above, but they can also utilize information and findings not contained in the data base. Forecasting and prediction are generally considered as projecting the past into the future. However, this is not a necessary feature. Forecasting and prediction can be based on approaches such as the Delphi Methods, as well as on deterministic and stochastic methods, which can consider other developments without historical precedence.

In general, a well-developed capacity to forecast and anticipate future events and environmental situations is necessary if the policies and plans developed are to be reliable and of significant benefit to the public. This is one of the prime objectives served by a well thought out and carefully designed land use information system.

CHAPTER VI

LAND USE INFORMATION SYSTEM DESIGN ALTERNATIVES

The variety of alternatives available to the developers of a land use information system for Iowa can be overwhelming. This volume is compounded by the rapid expansion in the technical literature and in various states of new procedures, programs and structure for urban and regional information systems. An excellent although somewhat dated discourse of design alternatives is the *Handbook of Methods for Information Systems and Designers*, especially the Basic Handbook and related appendices. These documents, produced by the Synectics Corporation in Allison Park, Pennsylvania, are the bases of the material presented in this chapter. Because of the detail available from that and other sources, as well as because of the dynamic nature of information system developments, the treatment here is general and cursory. Before design alternatives can be seriously investigated it is necessary to develop an evaluative procedure. Two basic procedures have been suggested, one by Kenneth Dueker and the other by the Synectics Corporation. These approaches are discussed briefly in Chapter VII, along with an alternative approach developed in the research for this project.

The system design can be divided into four components: hardware, software, personnel, and operating climate. Besides these components there are several decisions which must be made on a more general level. For example, should the system be static or dynamic, in other words should it include a temporal dimension or not. The choice in this case is clearly based on the cost of the additional capability vs. its benefits. In a statewide broad-based land use information system, the additional cost of adding time is basically related to the cost of surveys and data collection and should be relatively low when compared to the potential value of such information. In fact, several of the user requirements would be difficult to meet without such information.

Hardware Alternatives

There are eight principle classes of hardware which are needed for a land use information system. In each class the developers must decide what approaches to take, how to build the capability of the class, and how to integrate it into the rest of the system. The eight classes are:

1. central data processing components
2. communication components
3. hard copy storage-retrieval components
4. presentation (or output) components
5. measurement components
6. recording components
7. reproduction and copying components
8. special-purpose data conversion components

For the most part the alternatives in these classes are technical and do not substantially alter system performance characteristics. For that reason they are in the sphere of the design technicians. There are, however, several alternatives which do have implications for the operation and use of the system. For example, under the first class the form of mass data storage and transfer method can be an important decision. The use of punched cards, magnetic cards, magnetic tapes, disks, off-line solid storage units, drums, etc., can be of importance in determining the use of the system by potential users. At this point the use of magnetic tapes or disk storage seems to be clearly preferable for ease of access, for flexibility, and multiple use.

The designers face another set of choices in the selection of recording components, reproduction and copying compentents, and in the special-purpose (user-oriented) components. Such techniques as speech recognition and voice output, while attractive, are probably too extravagant for their marginal value and limited use at the present time. The basic rule of design in recording choices is that the alternative which is simplest is usually preferable. The cost of all alternative scanners and other graphic input devices may be expensive, and yet be necessary in a land use information system. Similarly alternative output components, recording components, and reproduction and copying components are likely to be expensive but necessary, and as a result they can be chosen according to comparative cost as well as technical criteria. Clearly some plotters will be necessary. The potential of cathode-ray tube (CRT) displays and camera recorder are great enough to warrant thorough investigation. In these and most of the other choices, besides costs and capability, there are seven criteria which should be evaluated in choosing among the alternatives:

1. Sensitivity--the ability to differentiate noise from intended input and to minimize acceptance or errors.

2. Transduction--the capability to carry and transform the form of the data as required.

3. Capacity--the ability to handle the required amounts and varying rates of data transmission.

4. Compatability--the degree to which each hardware component is integrated effectively into the system.

5. Reliability--the capability of accruing and repetition in the handling of data output.

6. Flexibility--the hardware design must be such that it can be alternatively modified and expanded, without major interruption of the system.

7. Maintainability--the hardware should be designed to faciliate maintenance, especially preventive maintenance.

The other choices in the hardware components can be reduced to the question concerning desirable features of the output vs. the cost of the hardware. This is especially true of the peripheral hardware, such as plotters, CRT's, etc.

Software Choice Alternatives

The development of the software for a land use information system is basically a technical task. The needs are specified by the users (see Chapters III, IV and V). Effective software has the following characteristics:

1. maximizes system efficiency;
2. facilitates system maintenance;
3. directs the hardware in performing specified tasks or jobs; and
4. is consistent with user needs and facilitates use.

Because of the technical nature of these choices they are further left to their proper position in the design of an operational land use information system.

Personnel Design Alternatives

For an operational land use information system in Iowa the personnel and administrative structure should be designed to accomplish the following goals:

1. maximize use by priority users;
2. maximize potential user;
3. minimize waiting time; and
4. minimize costs.

In order to accomplish these goals several possible alternatives must be examined. The ideal of a high degree of on-line interaction between the user and the system, discussed in Chapters I and II, has been found in both California and New York to lead to very complex user instructions. Partly as a result of this complexity, the use rate is very low. An alternative approach worth examination is to have a regular staff of "interfacers." These individuals would be trained to deal with the computerized system and also be trained to interact articulately with users. In this structure, users would only have to be informed about the type of information available in the land use information system and the types of questions it is capable of handling and they could treat the land use information system as a "black box."

Another question which must be dealt with in the design of the personnel structure is the degree of centralization. The alternatives consist of a virtual continuum from one center of system access to on-line access to each county and municipal agency as well as all other users. Initial investigation points toward a regional distribution of access centers. These might be distributed according to the structure of the regional councils of government or by other desirable regional schemes. Each of these centers (four to ten centers are suggested) would have on-line access to the system, and would be staffed by an appropriate number of "interfacers."

The administrative staff of the land use information system must also include personnel capable of preventing illegal use of the system. There is thus a need for some persons trained in both the legal constraints of disclosure and the technical features of the computer system. Furthermore the land use information system staff should include persons engaged in the following tasks:

1. data collection, updating, and modification
2. data translation into machine-readable form

3. system maintenance and operation
4. system planning and modification
5. research and improvement of hardware and software components
6. expanding the awareness of the system by potential users

Operational Climate

The operating climate is the physical and psychological environment within which the users work. There are several requisites that this environment must meet if it is to be of maximum benefit to the state. First, the physical environment must be neat and clean with a clear spatial and organizational structure so that users know who to see and where to go for service. Second, the attitude of the staff must be one of willingness to communicate with users at the user's technical level. Third, the language (spoken and written) which is used to communicate with users must be easily understood and not intimidating. The design of a structure to accomplish these requirements is basically a question of human and organizational engineering.

CHAPTER VII

CONCLUSIONS: AN EVALUATION FRAMEWORK

Introduction

The original purpose of the research discussed in this report was to provide an overview of the nature of land use information systems and to discuss such systems in the context of the needs and problems of the state of Iowa. The need for comprehensive land use planning and policy was briefly pointed out and the relationship of more and improved information to the development of such plans and policies was discussed. It was noted that information of the magnitude required would be wasted unless it was organized in a structure which facilitated its use. This is the primary role of an information system. In discussing the capabilities that a statewide land use information system should have it was necessary to identify major potential users and their needs. This led to a discussion of the information which should be contained in the information system and the methods of analysis which should be available in the system. It has been pointed out that an integral aspect of the design procedure for a statewide land use information system is the existence of an evaluation procedure. Such a procedure is necessary in order to choose between alternative approaches to design problems as well as to choose between broader alternative designs. Because an evaluation procedure plays such a key role in all aspects of the design process it has been left to last. The framework discussed in the following section is a hybrid approach utilizing ideas developed by Kenneth Dueker*, James Altman**, and by Morris Hill***. The first source is concerned with total LUIS evaluation, the second source with evaluation procedures for specific alternatives in the design process, and the last source is concerned with the broader question of evaluation of public programs. Because of the multi-faceted

*K. J. Dueker, **Statewide Land Information Systems: Design Considerations**

J. W. Altman, **Handbook of Methods for Information System Analysis and Designers

***M. Hill, "A Goals Achievement Matrix for Evaluating Alternative Plans" nature of a LUIS and because of the large number of users and objectives, the concept of the Goals-Achievement Matrix developed by Hill is brought into play. In developing any evaluation procedure the following criteria should be utilized:

1. Cost
2. Priorities among users
3. Priorities among objectives
4. Flexibility and growth potential
5. Performance

Within this context an evaluation framework consists of a set of procedures, questions, and relationships which must be applied within a general structure. The following section discusses such a framework in greater detail.

An Evaluation Framework

In developing a framework for evaluating the design alternatives of a LUIS the first step is to specify the objectives of such a system according to their priorities:

Objective set = ($0_1, 0_2, \ldots 0_n) = (0_i)$;

Priority index = $(N_1, \ldots N_n) = (N_i)$

In this step the priority index would consist of a ranking index, with the most important objective receiving a rank of 1, and the least important receiving a rank of n. The identification and ranking of objectives is both a scientific and political problem. The political part is the specification of broad goals such as flood plain development, restriction of urban encroachment on prime agricultural land, etc. The scientific part is the identification of the necessary, desirable, and helpful technical objectives of the system as implied by the politically specified objectives.

At any stage of the design process where alternatives are identified which may be incorporated (e.g., when there is a choice of plotters, classification systems, or geocoding methods) the following measures must be identified for each alternative:

1. cost
2. preference by objective
3. ease of use
4. flexibility
5. integratability

Figure VII - 1 shows a flow diagram depicting the relationship of these measures. Dueker locates an evaluation procedure at four different stages of an information system design (see Fig. VII - 2). His approach is to evaluate the specifications of the data base against objectives and client needs; to evaluate feasibility and cost of alternative hardware components; third to evaluate the system according to legal and political factors; and lastly, a final system evaluation. This approach neglects the important problem of multi-objective evaluation, and also the problem of evaluating flexibility and ease of use. The approach also does not indicate feedback from the evaluation to the preceding stages of system design. Altman and the Synetics Corporation utilize more detailed and frequent evaluations and do include a feedback mechanism. However their approach does not focus adequately on the client nor on the objectives of the entire system. Figure VII - 3 is an example of the procedures suggested by Altman for any given function or design step.

In developing an evaluation framework it is necessary, as indicated by the writers referred to above, to separate the evaluation procedure into several stages. The following are the types of evaluation corresponding to those stages which are suggested for a statewide LUIS:

1. Technical evaluation. The evaluation of system compatability and expense of hardware and software alternatives;

2. Goal related evaluation. The evaluation of any component of the LUIS according to the performance in relation to a specified goal or set of goals;

3. Cost evaluation. The evaluation of the cost of any component against the relevant goal-related evaluations;

4. Use evaluation. The evaluation of user-oriented components (those providing output to or interacting with the users) in relation to their ease of use and degree of simplicity; and

5. Total system evaluation. The evaluation of a complete LUIS design utilizing all of the above evaluation of each independent component of the system and identifying the degree to which the system meets the general (politically determined) system objectives. These results will then be compared to the cost of the system and any other relevant constraints (legal, political, economic, etc.) and the result in an overall evaluation report.

Each or all of these types of evaluation can lead to modifications in the original goals, objectives or specifications of the system or of any component with a second design proceeding from that point.

The first type of evaluation described above is best left to the technical personnel, and need not be of further concern here. The second type of evaluation, the goals related

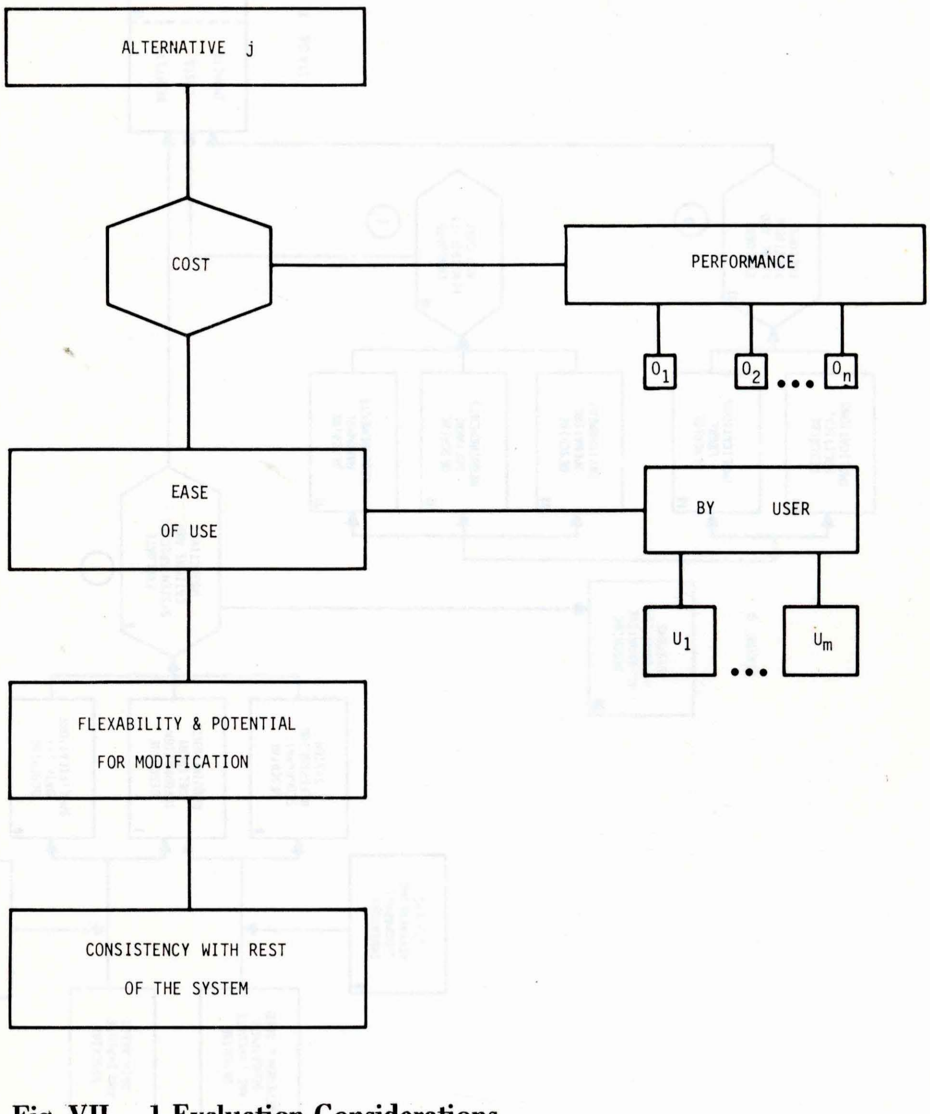

Fig. VII – 1 Evaluation Considerations

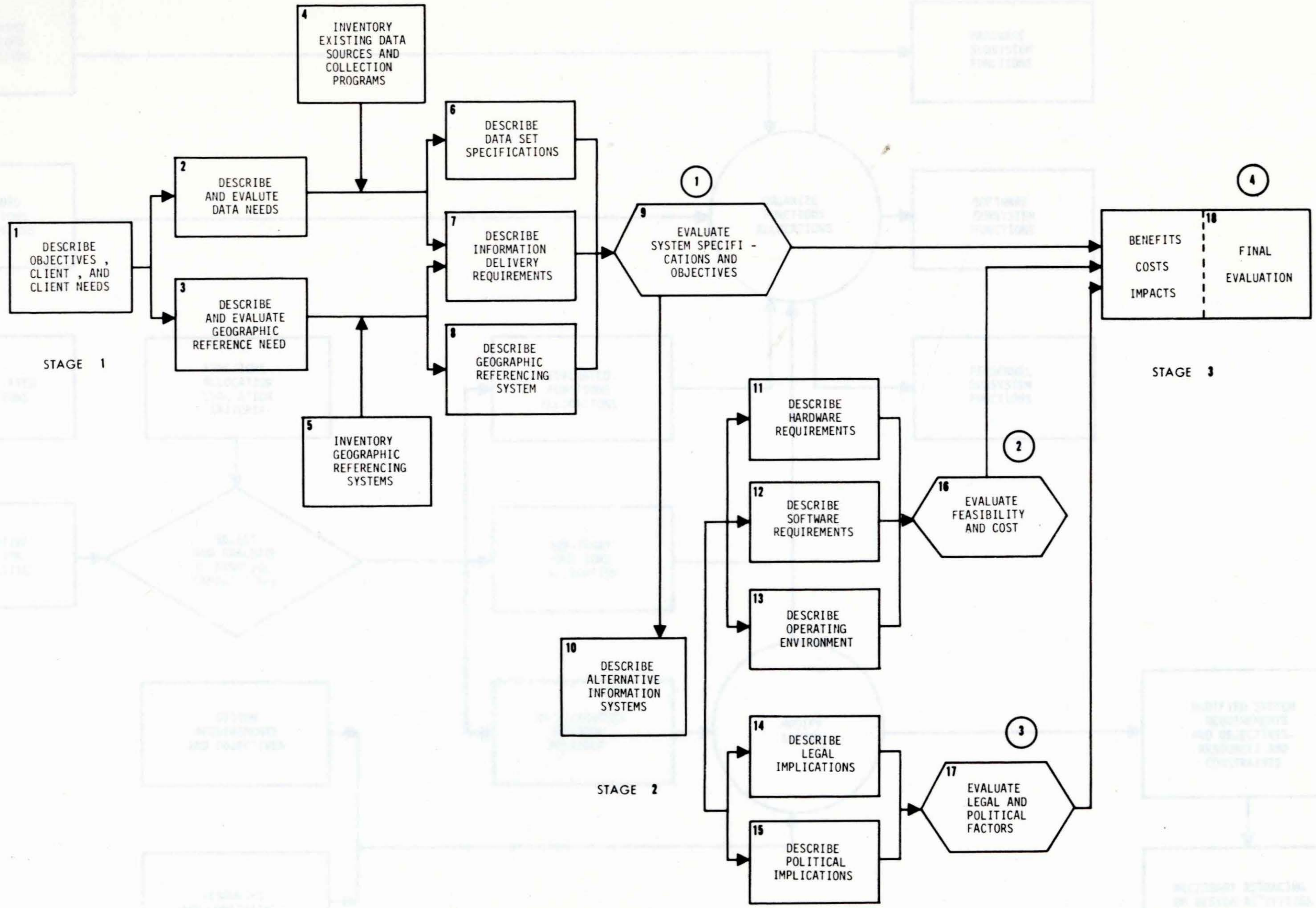

Fig. VII – 2 Information System Design and Evaluation. (Source: Dr. Kenneth S. Dueker, *Statewide Land Information Systems: Design Considerations*, Iowa City: Institute of Urban and Regional Research, University of Iowa, 1972, p. 8.)

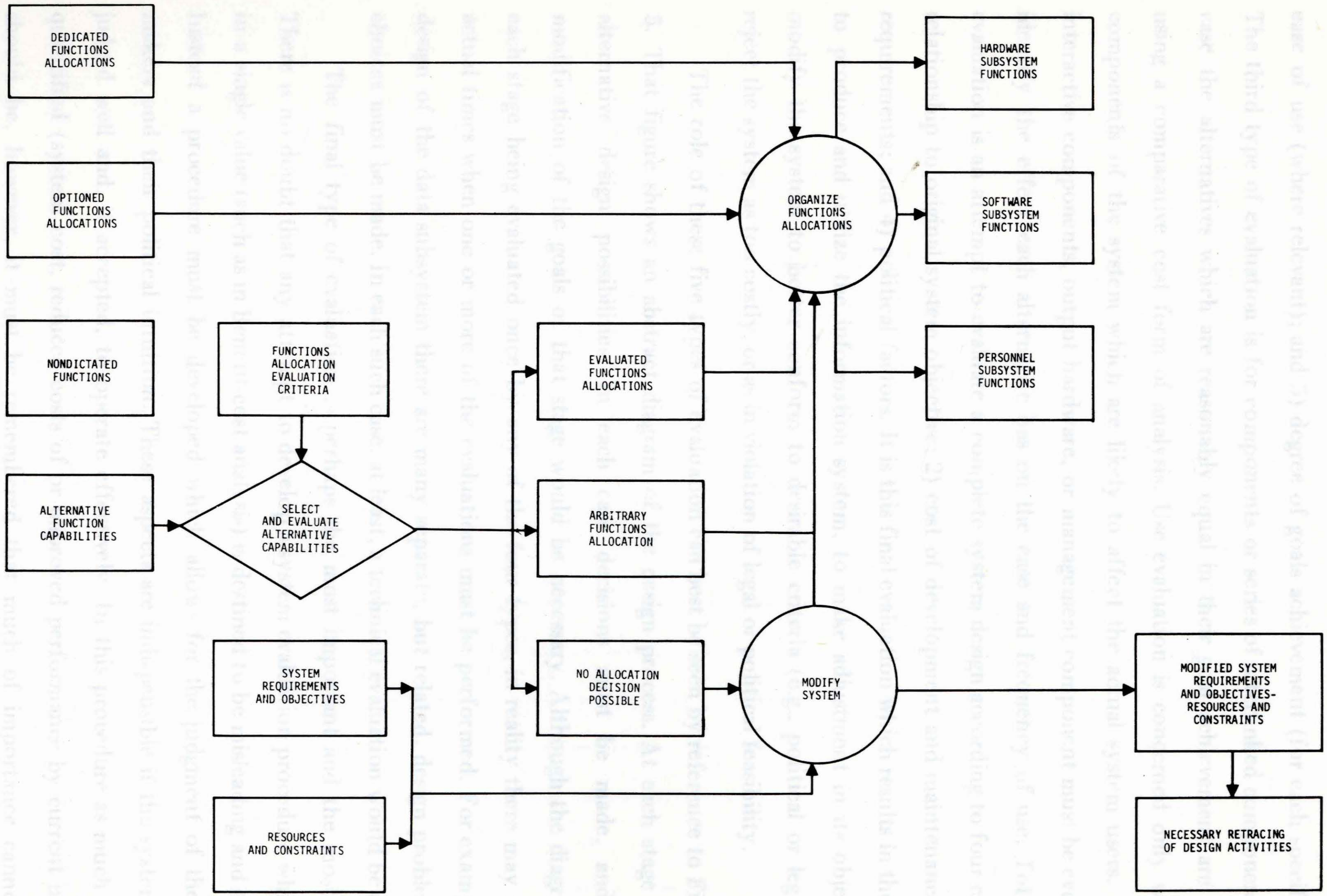

Fig. VII – 3 Allocating Functions and Evaluating Allocations. (Source: James W. Altman, et. al., ***Handbook of Methods for Information Systems Analysts and Designers. Volume I: Basic Handbook and Appendix I,*** **2 Vols., Allison Park: National Technical Information Service, 1971.)**

evaluation, is suggested as a new approach utilizing Hill's Goals-Achievement Matrix. Figure VII - 4 gives an example of the form such an evaluation might take. In this approach each alternative is analyzed according to five criteria: 1) cost; 2) flexibility; 3) integratability; 4) ease of use (where relevant); and 5) degree of goals achievement (for each specified goal). The third type of evaluation is for components or series of interlinked components. In this case the alternatives which are reasonably equal in their goal achievement are evaluated using a comparative cost form of analysis. Use evaluation is concerned only with those components of the system which are likely to affect the actual system users. Thus any interactive components, output hardware, or management component must be evaluated to identify the effect each alternative has on the ease and frequency of use. Total system evaluation is an attempt to evaluate a complete system design according to four criteria: 1) relationship to original system objective; 2) cost of development and maintenance; 3) legal requirements; and 4) political factors. It is this final evaluation which results in the decision to produce and utilize the information system, to make adjustment in its objectives, to modify the system to better conform to desirable criteria (e.g., political or legal), or to reject the system as too costly, or as in violation of legal or political feasibility.

The role of these five types of evaluation can best be seen by reference to Figure VII - 5. That figure shows an abstract diagram of the design process. At each stage there are alternative design possibilities. In each case decisions must be made, and perhaps modification of the goals of that stage would be necessary. Although the diagram shows each stage being evaluated once by any of the four types, in reality there may be several actual times when one or more of the evaluations must be performed. For example, in the design of the data subsystem there are many separate, but related, design problems where choices must be made. In each such case, at least, a technical evaluation would be necessary.

The final type of evaluation is perhaps the most important and the most difficult. There is no doubt that any attempt to develop a system evaluation procedure which results in a single value (such as in Benefit-cost analysis) is destined to be misleading and erroneous. Instead a procedure must be developed which allows for the judgment of the decision makers and their political intuition. These aspects are indispensible if the system is to be judged well and, if accepted, to operate effectively. In this procedure as much as can be quantified (system cost, reduced costs of or improved performance by current users, etc.) should be, however, it must be remembered that much of importance cannot yet be quantified. For this reason the system evaluation should not be such that the decision-maker

	ALTERNATIVE 1	ALTERNATIVE 2	....	ALTERNATIVE n
GOAL 1	COST			
	FLEXIBILITY			
	EASE OF USE			
GOAL 2	INFORMATION			
	% OF OBJECTIVITY MET			
	CONTENT			
GOAL 3	______			
	______			
	______			
⋮				
GOAL n				

Fig. VII – 4 Goal Achievement Matrix

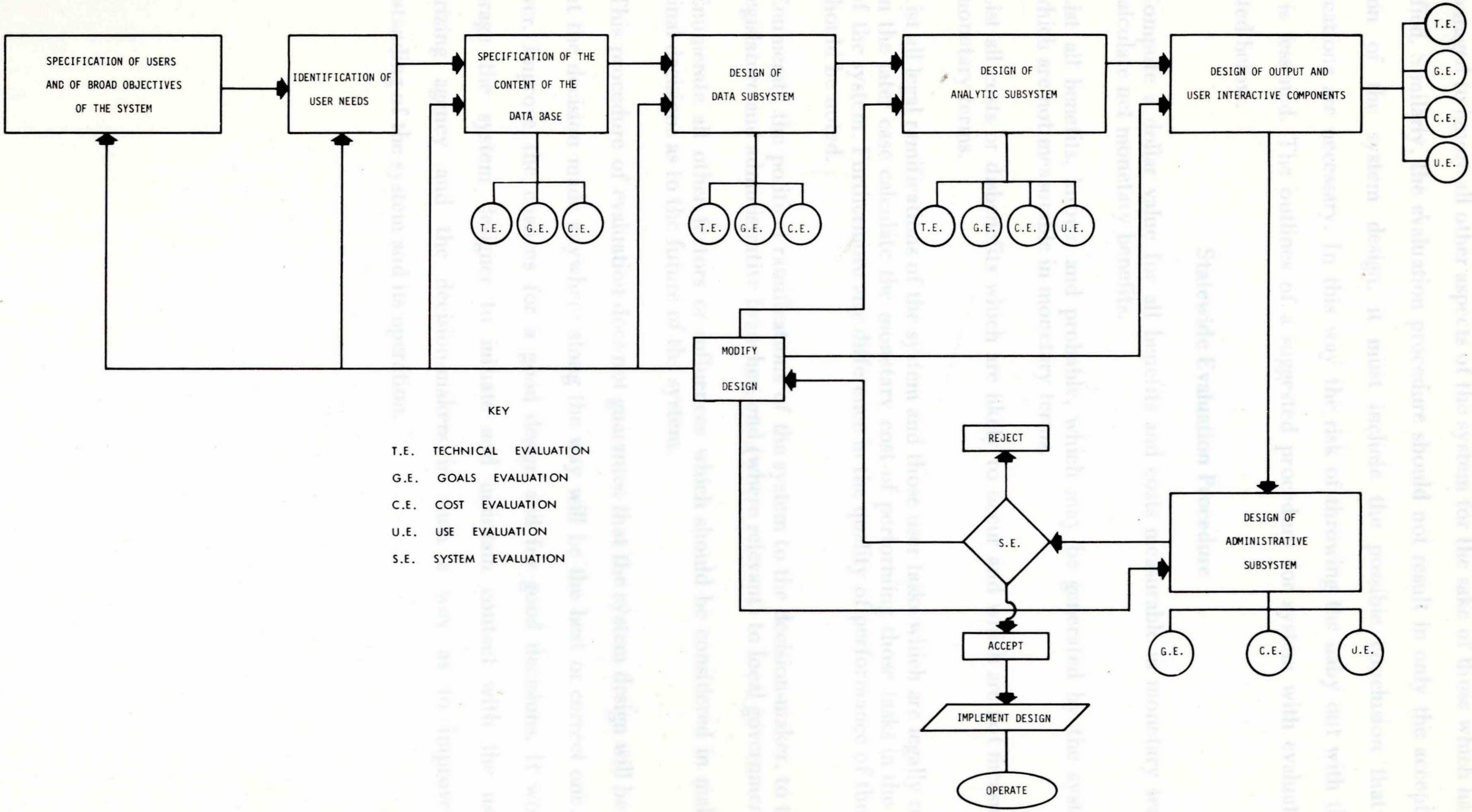

Fig. VII – 5 System Design and Evaluation Process

is encouraged to ignore all other aspects of the system for the sake of those which have been quantified. Similarly, the evaluation procedure should not result in only the acceptance or rejection of the system design, it must include the possible conclusion that design modifications are necessary. In this way the risk of throwing the baby out with the bath water is lessened. The outlines of a suggested procedure for system with evaluation are presented below.

Statewide Evaluation Procedure

I. Compute a dollar value for all benefits and costs measurable in monetary terms and calculate net monetary benefits.

II. List all benefits, known and probable, which may be generated by the system and which are not measurable in monetary terms.

III. List all costs or disbenefits which are likely to occur and which are not measurable in monetary terms.

IV. List all legal ramifications of the system and those user tasks which are legally required. In the later case calculate the monetary cost of performing those tasks in the absence of the system. Furthermore any difference in the quality of performance of those tasks should be noted.

V. Enumerate the political ramifications of the system to the decision-maker, to the state legislature and administrative branches, and (where relevant) to local government.

VI. Enumerate all other factors or influences which should be considered in making the final decisions as to the future of the system.

This procedure of evaluation does not guarantee that the system design will be optimal or that the decision made anywhere along the way will be the best or correct one. It does, however, improve the chances for a good design and for good decisions. It would also encourage the system designer to initiate and maintain contact with the users, the authorizing agency and the decision-makers in such a way as to improve overall understanding of the system and its operation.

APPENDIX A

GLOSSARY

A necessary aspect of communication between persons must be a well-defined vocabulary. Therefore at this time it is beneficial to consider some basic terms and concepts which will be used throughout this report. It is proposed that these concepts be accepted as a basis for all discussion in this report.

Areal data: Data on a particular area or region. An example would be elevation, slope, soil, etc.

Analytic Subsystem: Collection of manipulative programs through which the user asks his question and the set of output continues which allows him to request his answers according to the desired formats.

Data base: The specification of the variable to be measured, the matrices used, and the areal scale of measure.

Data base coordinator: Is responsible for putting entries into the reference files, producing the reports and distributing them, and providing instructions about what should be documented in what detail and in what form.

Data base standardization: Is achieved if data definitions and terminology, units of measurement, data formats, periodicity of reporting, classification and coding schemes, etc., are consistent and compatible within and between data sets.

Data code:* A number, letter, character or any combination thereof used to represent a data item.

Data dictionary: Data items are indexed by subject matter descriptions and permuted descriptor sets. Through the dictionary, the user can locate particular data items in the various records and files.

Data element:* A basic type of information concerning an entity. A data element has a unique meaning and has subcategories (data items) of distinct units or values.

Data Item:* A subunit of descriptive information or value classified under a data element. It consists of the value(s) attached to a data element pertaining to a given entity. Several data items may comprise a data element.

Data processing procedure: The computer programs and related complimentary hardware used to transfer the information in the data base to computer storage.

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*Note that the definitions of data element, data item, and data code are widely accepted standards derived from Department of Defense Directive No. 5000.11, issued December 7, 1964.

Data subsystem: Consists of the following: 1) the data base; 2) the data processing procedure; and 3) the storage-retrieval system.

Encode: Process whereby the raw data is converted in machine language.

Entity: A person, object, event or piece of information.

Entity set: Group of single events (entities) placed into particular groups to form a set. For example a single male worker in a factory would be an entity, while all the males in the factory would be an entity set.

File: A collection of related records treated as a unit.

Geographic reference unit (GRU): A type of land unit of location indicator, or a system for geographic identification. Examples: Street address, Census tract number, or coordinate point.

Hardware: Consists of the information-handling equipment and peripheral devices of the system.

Information System: A systematic structure of information or data which can be accessed, modified and returned easily. Simple examples of information systems are the index in a book and the card catalogue system in a library.

Interfacer: That segment of the system personnel whose duties are to serve as the operators, and translators for the system users.

Linear data: Data that would contain boundaries that are sharply defined, such as flood plains, streams, rivers, etc.

Management subsystem: Determines the resources which are expended on the system development, design, and most importantly the upkeep.

Point data: Data that occupy a specific point on the earth's surface. Example include sink holes, ponds, and unique rock formations.

Record: A group of related facts or data elements treated as a unit.

Software: Consists of the set of instructions which operate the hardware, and may be user-oriented (application programs) or machine-oriented (supervisory programs).

Storage-retrieval system: The set of software which specify the output which can be called out of the data base for use.

User-oriented: Applied to data processing systems with software designed to permit the nonprogrammer user to have direct access to the data base and to personally utilize the various data processing capabilities.

User subsystem: Consists of the set of regular system users and their requirements.

APPENDIX B

DATA SOURCES

A great deal of information exists in published form and is available from a variety of sources. A survey of potential data sources has been undertaken to investigate the sources' usefulness for providing information on the variables that would be needed for a LUIS.* The following criteria were considered in assessing the suitability of any data source:

1. Data Source. What is the data source, its name and author?
2. Scope. What resource(s) does it provide information on?
3. Vintage. What is the date the information was collected?
4. Format. In what form (statistical, card, tape, disk, etc.) is the data?
5. Scale. Is the data uniform in scale and accurate over the format of presentation.
6. Collection methods. How was the data collected?
7. Accessibility. Where is the information located? Is the acquisition of data simply in the context of both time and money.
8. Coverage. What area is covered? Acceptable information is often available only for small areas.
9. Uniformity. Is the classification consistent and is the information specific over the State?

Using this set of considerations, the information available for each variable was analyzed. The data available for each variable discussed in the text, are displayed in Figure B-1.

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*Edward L. Kuhlmey and David R. Laux, **Data and Information Needs and Availability for CRIP, Report Four**, Critical Resource Information Program, Madison, Wisconsin, October 15, 1973. pp. 7-26.

FIGURE B-1

Variable	Existing Source of Relevant Information
Drainage basin	USGS, Hydrologic Atlas Also: D103.47--
Watershed	Drainage basin maps
Specific water body name	USGS topographic sheets (road maps)
Type of water body (i.e., natural, permanent, intermittant, man-made, drainage ditch, irrigation ditch, ephemeral, drainage wetland seepages, impoundment, flowage, reservoir, excavation)	USGS topographic maps
Location	USGS topo maps
Gradient	USGS topo maps
Flood threat	HUD federal insurance administration Flood hazard boundary maps, USGS Army Engineers: Flood plain information
Maximum temperature	State climatologist (now defunct) records Climatological data for Iowa
Proximity to population centers	USGS topo maps
Lakes in Region (number)	USGS topo maps
Surface water inflow and outflow	USGS topo maps USGS hydrologic Atlas
Aquifer Location	USGS Hydrologic Atlas
Aquifer systems communication	Geologic maps
Landform	Aerial photographs, EROS, ERTS, USGS topo maps
Relief and topo character	USGS topo maps, remote sensing (aerial photo)
Soil descriptors	SCS soil surveys ASCS (State Department of Agriculture) (Iowa Natural Resources Council)
Bedrock Depth	SCS Soil Surveys, Reconaissance and association maps, ASCS

FIGURE B-1 (continued)

Variable	Existing Source of Relevant Information
Permeability	SCS soil surveys
Productivity (land capability class)	SCS soil surveys
USCS Classification	SCS soil surveys, ACE
Flood hazard	SCS soil surveys F.P.I.
Drainage characteristics	SCS soil surveys
Depth to ground water table	SCS soil surveys
Texture	SCS soil surveys
Bedrock descriptors (formation, group, member)	Geologic maps
Climatic data a. Temperature b. Pressure c. Precipitation d. Air quality	State Climatologist Records, Climatological Data for Iowa
Major life forms a. fauna b. flora (number and/or percent)	Wildlife population maps Aerial photography Wildlife population maps Field observation
Accessibility	Road maps, USGS topo maps, aerial photo
Percent Slope	Slope maps from USGS topo maps, soil surveys
Density average tree diameter (quadratic mean)	Field observation
Number of community type (of forest, wetlands)	Aerial photo, field work
Number of different crops present	Aerial photography, state Department of Agriculture
Percent of township in openings, 5-10 acres in size (forest open only)	Aerial photography
Developmental (type)	Aerial photo
Agricultural (active, inactive)	Aerial photo

FIGURE B-1 (continued)

Variable	Existing Source of Relevant Information
Urban, agricultural and recreational	
a. Number of people	Census data
b. Number of structures	Aerial photography
c. Size, shape, orientation of structures	Aerial photography
Political designations (county, township, village, city etc.)	USGS topo maps, road maps Political dividion maps (e.g., wardmaps, district maps, etc.)
Value	County assessor's files
Ownership (name, size of holding)	County plat books
Transportation	Iowa Highway Commission Department of Transportation Federal Highway Commission
Population	U.S. Census of Population
Vital Statistics	Vital Statistics of Iowa Iowa State Department of Health
Farm Size Farm Equipment Owner- and Renter Occupied	U.S. Census of Agriculture Iowa Department of Agriculture
Wholesale and Retail Activity	County Business Patterns City and County Data Book U.S. Census of Population
Agricultural Data	U.S. Census of Agriculture ASCS Iowa Department of Agriculture

The nature of the relevant data indicated, and the format and location of the data are discussed for selected data sources.

Detailed Soil Maps (Soil Surveys)

Soil data are mapped and published on aerial photos base at two scales 1:20,000 (1 mile = 3.17 in) and 1:15,840 (1 mile = 4 in). Modern soil surveys are not available for the whole state. (See Fig. B - 2). However, of the counties marked with ⧅ "Intermim" reports exist which describe the soils mapped in the county. Also available are field sheets at the same scale as the detailed soil maps. These are available at the individual county seats. The counties marked with ||||| have available field sheets and interpretation sheets of those areas of the county which have been mapped.

General Description of soils which exist at various scales:

Soil map of the U.S. (1:7,500,000)

Soil map of Iowa (1:250,000)

Soil Association mylar overlay of USGS topo maps (1:250,000)

Further information available from: Soil Conservation Service, 823 Federal Building, Des Moines, IA 50309.

U.S.G.S. Topographic Maps

Topographic maps are available for the entire state at a scale of 1:250,000 (50' contour interval). A complete set of 16 maps would be needed for complete coverage of the state at this scale. Other scales that are available which cover much of state (see Fig. B - 3) are the following:

1:24,000 (1 in. = 2,000 ft), 7½' quadrangle

1:62,500 (1 in. = 1 mile) 15' quadrangle

1:125,000 (1 in. = 2 miles) 30' quadrangle

Topographic maps are on a geodetic latitude-longitude base with 5-minute tick marks included on the margins. Latitude-longitude lines can be drawn on the maps which then can serve as a control base from which control can be transferred to other source documents using a simple grid transfer process. This makes it possible for latitude-longitude locations to be established on aerial photographs and other maps.

Topographic maps are available from:

University Book Store, Iowa State University, Ames, Iowa

Iowa Geological Survey, Geological Survey Bldg., 16 West Jefferson Street, Iowa City, Iowa

U.S. Geological Survey* Distribution Section, Federal Center, Denver, Colorado 80225

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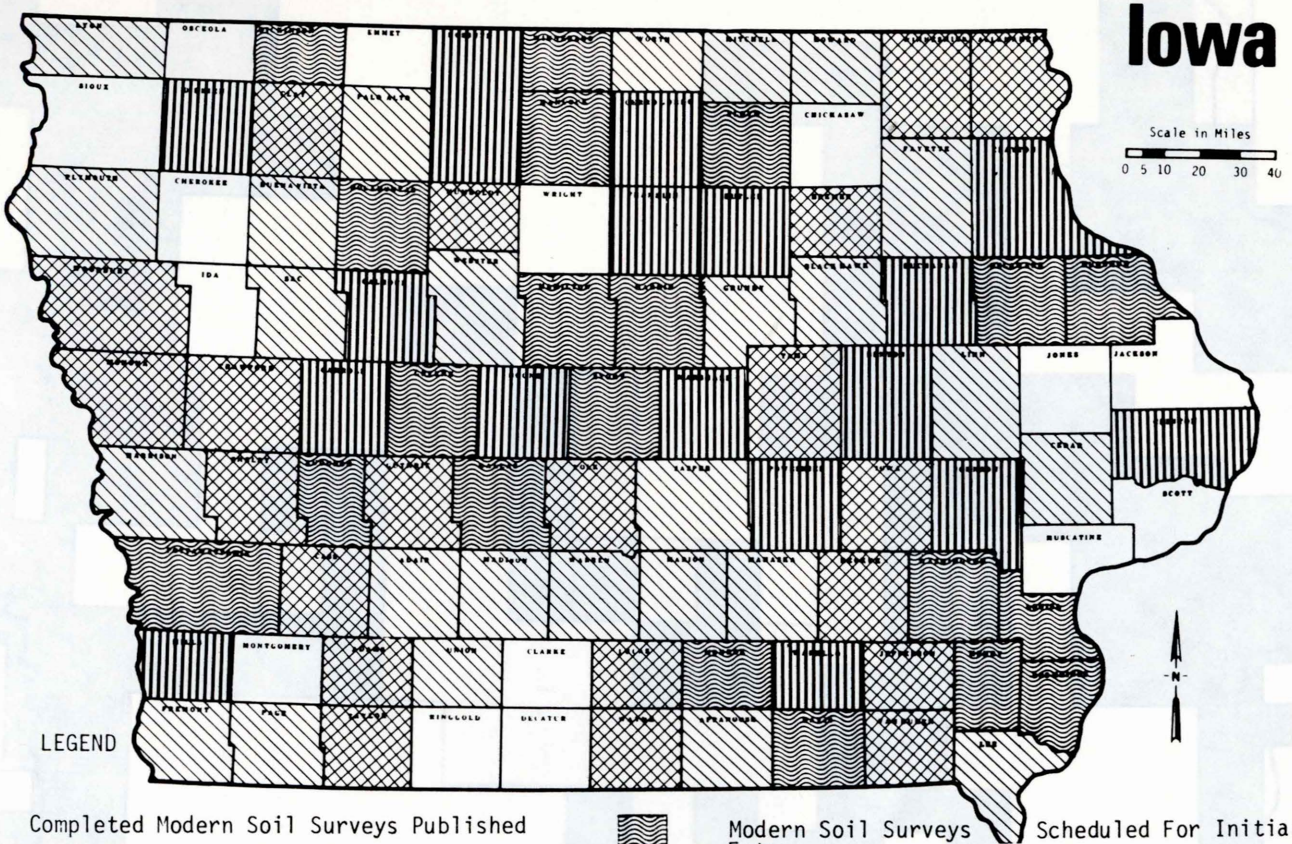
*This address applies only to areas west of the Mississippi River.



Completed Modern Soil Surveys Published

Completed Modern Soil Surveys To Be Published

Modern Soils Surveys In Progress

Modern Soil Surveys Scheduled For Initiation In Future

Modern Soil Surveys To Be Scheduled For Initiation In Future

Fig. B – 2 Status of Soil Surveys, State of Iowa. (Source: 1970 ***National Atlas of the United States of America, and Information from Field Technicians,*** **U.S. Conservation Service.)**

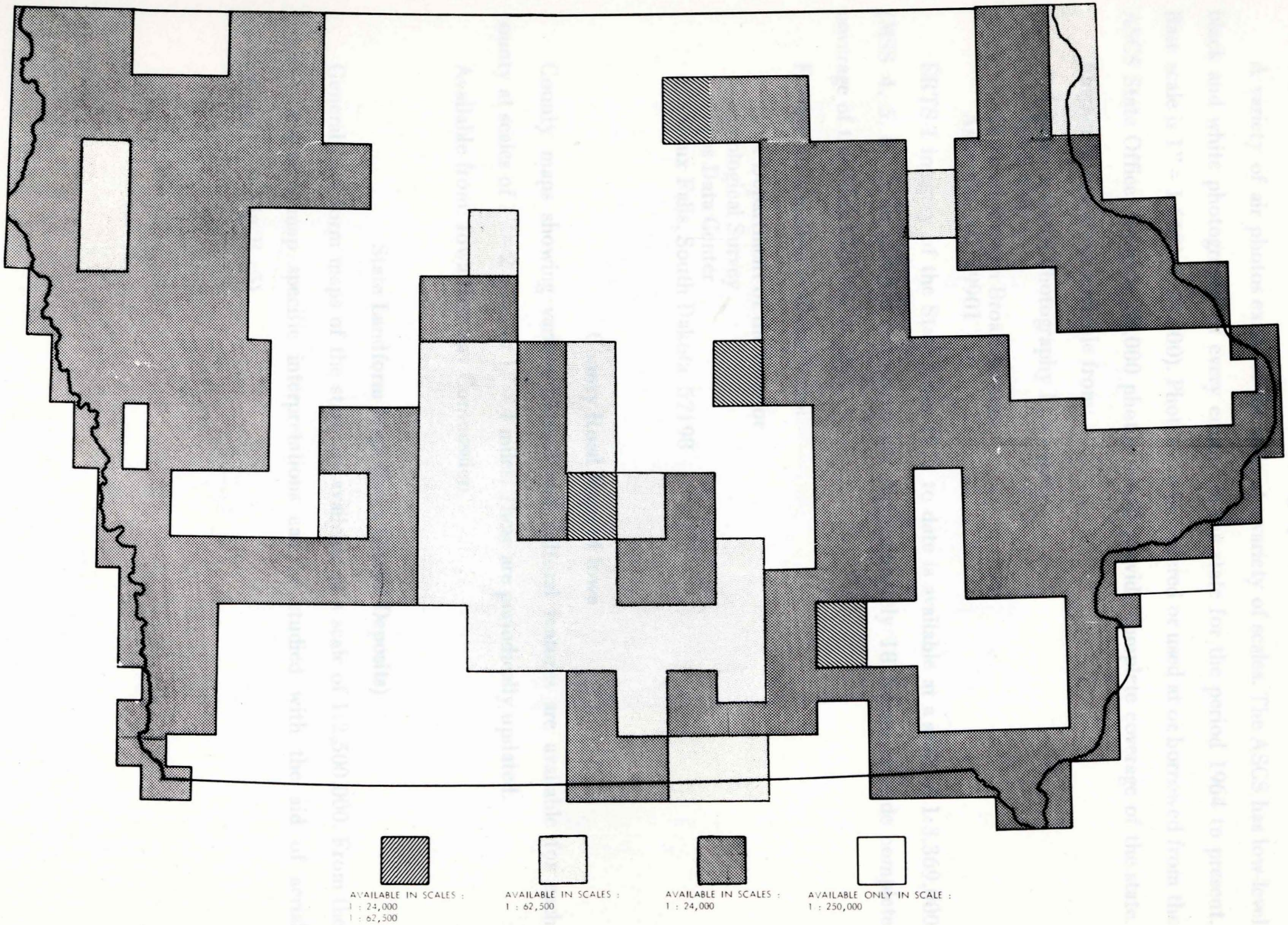


Fig. B – 3 Topographic Coverage of Iowa. (Source: U.S. Geological Survey, March 1973.)

Aerial Photographs

A variety of air photos exist for the state at a variety of scales. The ASCS has low-level black and white photography of every county in the state for the period 1964 to present. Base scale is 1" = 1,667' (1:20,000). Photos can be ordered or used at or borrowed from the ASCS State Office. Roughly 35,000 photos would provide complete coverage of the state.

Further information available from:

Eastern Aerial Photography Laboratory
ASCS-USDA
45 South French Broad Avenue
Asheville, NC 29901

ERTS-1 imagery of the State from 1972 to date is available at a scale of 1:3,369,000 (MSS 4, 5, 6, 7), in positive transparencies. Approximately 18 frames provide complete coverage of the State (See Fig. B - 4).

Further information available from:

U.S. Department of the Interior
Geological Survey
Eros Data Center
Sioux Falls, South Dakota 57198

County Road Maps of Iowa

County maps showing various natural and cultural features are available for each county at scales of 1" = 2 miles or 1" = 4 miles. These are periodically updated.

Available from: Iowa Highway Commission

State Landform Maps (Iowa Glacial Deposits)

General land form maps of the state are available at a scale of 1:2,500,000. From the general landform map specific interpretations can be studied with the aid of aerial photographs (See Fig. B - 5).

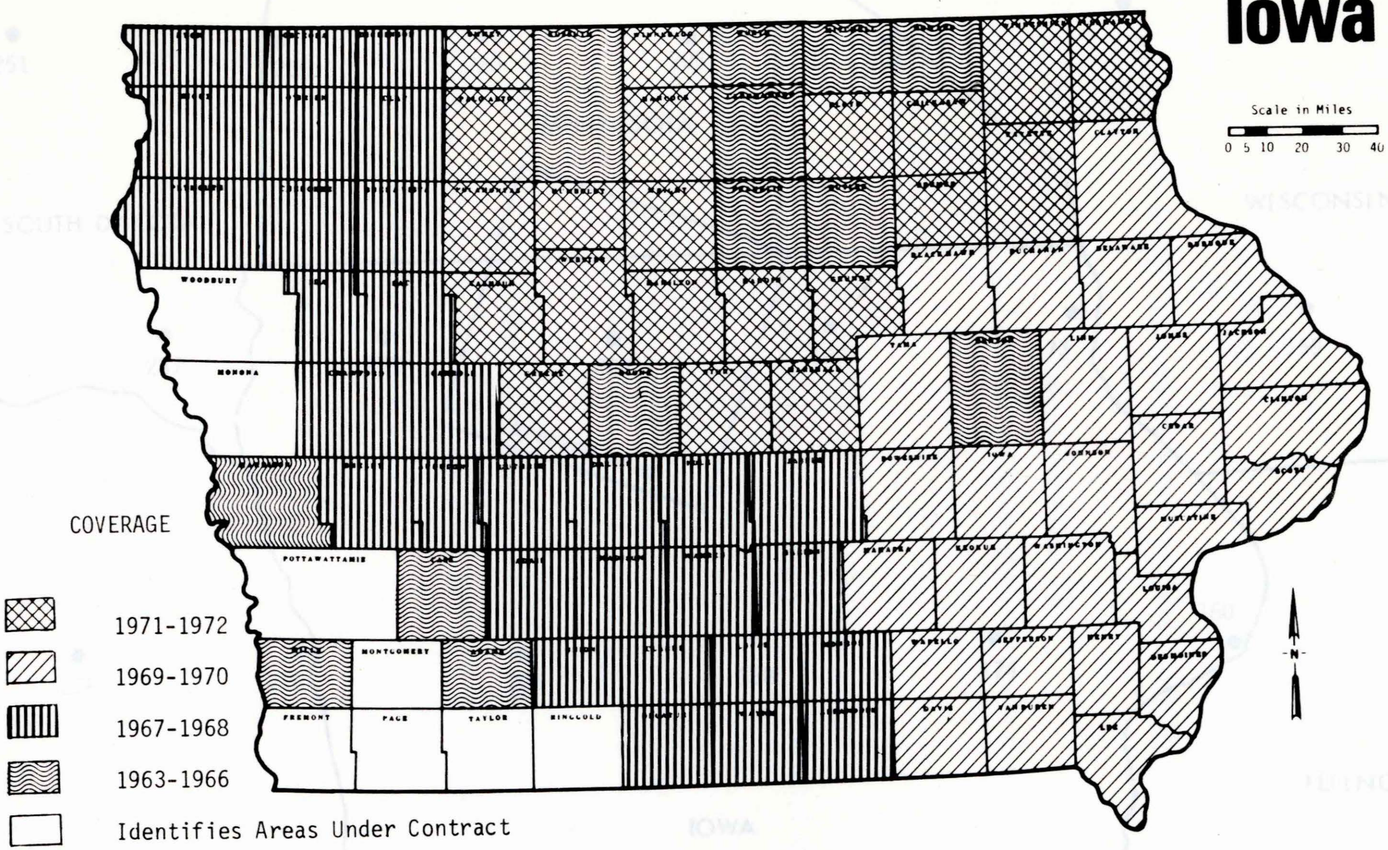


Fig. B – 4 Status of Aerial Photography Coverage of Iowa. (Source: Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture, September 1, 1973.)

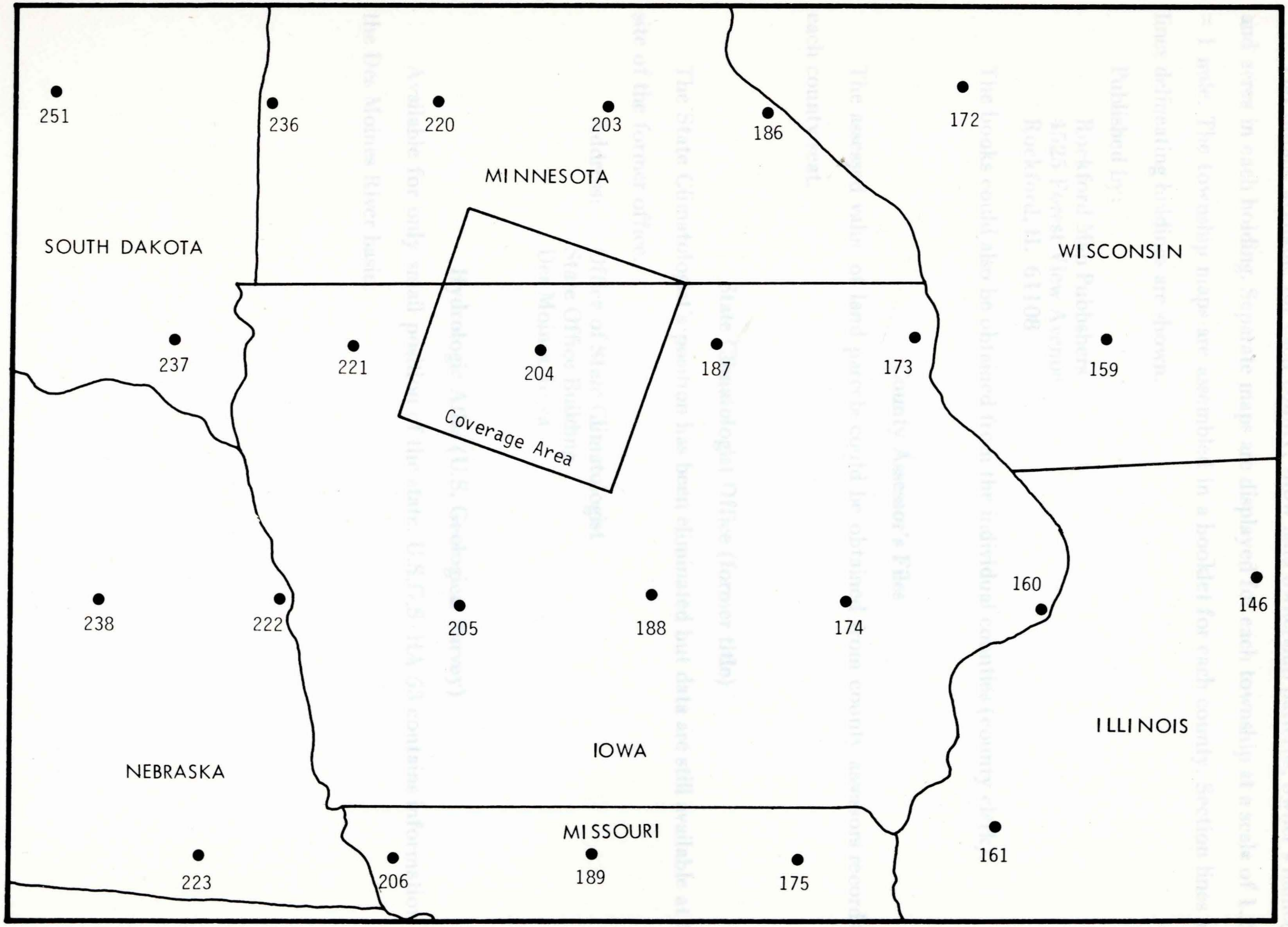


Fig. B – 5 ERTS–1 Coverage of Iowa. (Source: EROS Data Center, Sioux Falls, South Dakota)

County Plat Books

Plat books, available for each county, show land ownership patterns, owner's name(s), and acres in each holding. Separate maps are displayed for each township at a scale of 1.25" = 1 mile. The township maps are assembled in a booklet for each county. Section lines and lines delineating holdings are shown.

Published by:

Rockford Map Publishers
4525 Forest View Avenue
Rockford, IL 61108

The books could also be obtained from the individual counties (county clerk).

County Assessor's Files

The assessed value of land parcels could be obtained from county assessors records in each county seat.

State Climatologist Office (former title)

The State Climatologist's position has been eliminated but data are still available at the site of the former office.

Address: Office of State Climatologist
State Office Building
Des Moines, Iowa

Hydrologic Atlas (U.S. Geological Survey)

Available for only small position of the state. U.S.G.S. HA-53 contains information on the Des Moines River basin.

APPENDIX C

LAND USE INFORMATION SYSTEMS

There have been many proposals to develop information systems over the last decade. Many of these proposals have reached the design and development stage and some have been implemented. However, very few if any have produced significant results or succeeded in meeting their objectives.

Due to recent federal and state legislation concerning land use, the design, development, and implementation of process concerning information systems relevant to land use have accelerated rapidly. Figure C-1 gives a general overview of the states' existing and proposed state land use power. The following is a brief survey of existing systems that could be useful in developing a land use information system for Iowa.

New England (general)

System: NEW ENGLAND NATURAL AREAS PROJECT (NENAP)

Information:

NENAP is a comprehensive listing of land and water features of natural significance in New England.

Information collected for each of close to 5,000 areas includes natural characteristics, location, size, level of significance, extent of present threat to the area, and a description of the area. All of the information is now stored in a computer bank and can be retrieved to meet a variety of needs.

All of the areas inventoried possess one or more of nine major types of significant characteristics: Geology; soils; hydrology; flora; fauna: terrestrial animals; fauna: birds; fauna: aquatic life; archeological and cultural/aesthetic/visual.

Readiness: System in operation since 1970 (an example of output can be seen in Fig. C-2).

Source for further information: Robert M. August, New England Natural Resource Center.

FIGURE C–1

EXISTING AND PROPOSED STATE LAND-USE POWERS

States	Land-use planning	Land-use controls	Costal zone management	Wetlands	Powerplant siting	Surface mining
Alabama	Adopted	Proposed				Enacted.
Alaska	Proposed					
Arizona	Adopted	Proposed	Not applicable			
Arkansas		Under study	do.			Do.
California	Adopted	Proposed	Enacted		Proposed	
Colorado	Adopted	Enacted and proposed	Not applicable			Do.
Connecticut	do.	Under study	Enacted	Enacted	Enacted	
Delaware	do.		do.	do.		
Florida	do.	Enacted	do.	do.	Enacted	
Georgia	do.	Proposed	Enacted	do.		Do.
Hawaii	do.	do.	do.			Do.
Idaho		Proposed	Not applicable			
Illinois		Proposed and under study			Proposed	Do.
Indiana		do.				Do.
Iowa		do.	Not applicable			Do.
Kansas		Proposed	do.			Do.
Kentucky	Proposed		do.			Do.
Louisiana		Enacted	Under study	Enacted		
Maine	Adopted	do.	Enacted			Do.
Maryland	do.	Proposed and under study		Enacted	Enacted	Do.
Massachusetts	do.	do.	Proposed	do.		
Michigan	do.	do.	Enacted	do.		Do.
Minnesota	do.	Enacted	do.		Enacted	Do.
Mississippi			Under study			
Missouri			Not applicable			Do.
Montana	Adopted	Proposed	do.			
Nevada		Under study	do.			
New Hampshire	Proposed	Proposed			Enacted	
New Jersey		do.	Proposed	Proposed		
New Mexico		do.	Not applicable			Do.
New York	Adopted	do.		Enacted		
North Carolina		Under study		do.		Do.
North Dakota		Proposed	Not applicable			Do.
Ohio	Adopted	Enacted				Do.
Oklahoma	Proposed	Proposed	Not applicable			Do.
Oregon	Adopted	Enacted	Proposed and under study		Enacted	Do.
Pennsylvania	Proposed	Proposed			Proposed	Do.
Rhode Island	do.	Under study	Enacted	Enacted	Enacted: for coastal zone	Do.
South Carolina	do.	do.	Under study	Under study		
South Dakota	do.	do.	Not applicable			Do.
Tennessee	Adopted		do.			Do.
Texas	do.	Proposed	Adopted	Proposed, and under study		
Utah	do.	do.	Not applicable			
Vermont	do.	Enacted	do.			
Virginia		Proposed		Enacted		Do.
Washington	Adopted	do.	Enacted	Enacted: for coast zones		Do.
West Virginia	do.		Not applicable			Do.
Wisconsin	do.	Proposed		Enacted		
Wyoming		do.	Not applicable			

Source: **State Land Use Programs,** Summaries of Land Use Regulation in Eight States Prepared by the Environmental Quality Committee of the Young Lawyers' Section, The American Bar Association and a 50-State Survey of State Land Use Controls Prepared by "Land Use Planning Reports." Prepared by Committee on Interior and Insular Affairs United States Senate, pp. 94-95.

FIGURE C–2

Area Number and Name	**MS0098**	**Bartholomew's Cobble**		
Primary Category	103	Cliffs, Palisades, Bluffs, Rims		
Secondary Category	406	Plant Communities Representative of Standard Forest Plant Associations		
Tertiary Category	401	Rare, Remnant or Unique Species of Plants		
One Line Description-	Two Rocky Knolls Rise 80 to 120 Feet Above Surroundings			
County	**Berkshire**		**Quadrangle – Series**	**Ashley Falls 7.5**
Town – City	**Sheffield**		**Inventory Date**	**1971**
Latitude – Longitude	42 3' 0" N 73 20' 0" W.			
Area and Elevation	167 Acres 650 Feet			
Ecological Unit	Forest			
Occurrence	Singularly unique			
Visual Impact	High			
Diversity	Great			
Naturalness Factor	Naturally Permanent			
Significance Level	Local, State, Regional and National			
Surrounding Land	Agriculture Inhabited Area or Road Within 100 Yds.			
Access/Impact	Slight			
Ownership	Private Organization			
Integrity of Area	Safe Indefinitely			

A 167-Acre reservation privately administered as a natural area. Its varied topography includes two rocky knolls that rise 80 to 120 feet above the adjacent, meandering Housatonic River, almost a mile of river shoreline, some 20 acres of level river floodplain, and more than 100 acres of a hillside with a relief of 380 feet. Red Cear, some of which are from 150 to 200 years old, and old-growth Hemlock, White Pine, and hardwoods, open grasslands, and swamp cover the remainder of the area. The reservation is about one mile west of Ashley Falls, Massachusetts and includes a small, 4-acre portion across the state line in Connecticut. It is one of the countries best wildflower gardens and more than 700 plant species have been cataloged. Owned by the trustees of reservations, the area has been recognized as a national natural landmark.

Mr. Paul Favour, Acadia National Park, Bar Harbor, Maine.
Donald Smith, Berkshire County Historical Scoiety, Pittsfield, Ma.
Gordon Abbott, Jr., 224 Adams St., Milton, Ma. 02186.

Source: **Protecting New England's Natural Heritage.** New England Natural Resources Center, November, 1973, p. 26.

System: NEW ENGLAND NATURAL HERITAGE SYSTEM (NENHS)

System Information: The New England Natural Heritage System will consist of natural areas of every characteristics located in every part of the Region.

The System will include an array of land and water features providing representative habitat of terrestrial, aquatic and marine biota as well as opportunities for general education and research into natural phenomena. Systematic recognition, protection and management of natural areas of regional or national significance will characterize the System. Use will be governed by the natural character of each area.

The board of Overseers has the responsibility for policies for creation and management of the System, and is to help focus private and public attention on natural areas in the Region which need protection. Support services will be provided through the regional and state clearinghouses. Regional clearinghouses have the following responsibilities:

--Provide administrative services to the overseers.

--Coordinate state clearinghouse activities.

--Maintain a central data bank for natural areas information.

--Obtain support for the natural areas protection program with emphasis on areas with regional and national significance.

Responsibilities of the state clearinghouses are to:

--Evaluate and rank natural area protection needs.

--Recommend protection needed for specific areas.

--Channel funds and technical services into protection of natural areas.

--Develop and implement management plans for natural areas.

--Maintain and update state natural areas data and facilitate use of such information.

--Educate citizenry on importance of natural areas.

In addition, both the regional and state clearinghouses will help focus governmental responsibilities for the protection of natural areas.

System readiness: This is not operational as yet but is proposed.

Sources for further information: Depositories for natural area inventory information in New England are located in the following states:

Connecticut:

Connecticut Forest and Park Association
Department of Environmental Protection

Maine:

Natural Resources Council of Maine
Maine State Planning Office

Massachusetts:

Trustees of Reservations
Department of Natural Resources--Division of Conservation Services

New Hampshire:

Society of the Protection of New Hampshire Forests

Rhode Island:

Audubon Society of Rhode Island
Department of Administration--Rhode Island Statewide Planning Program

Vermont:

Vermont Natural Resources Council
Vermont State Planning Office

Regional:

New England Natural Resources Center

Colorado

System: DENVER REGIONAL COUNCIL OF GOVERNMENTS (DRCOG), 1970

System Information:

The Denver Regional Council of Governments' projected work program may be divided into five major functional areas of activity:

--Transportation planning
--Regional planning
--Housing
--Environmental systems
--Sub-areas studies

Each of these activities generates a particular set of data requirements. These may be summarized in terms of:

--Cartographic data and maps
--Topographical, geological and physical data
--Land use characteristics
--Employment characteristics
--Regional economic data
--Housing characteristics
--Transportation system characteristics
--Recreational and leisure activities
--Attitudinal and behavioral data

Figure C-3 summarizes the broad requirements of each area of activity for each type of data. Distinction is drawn in the figure between three different levels of spatial detail: "Parcel

DATA ELEMENTS	FUNCTIONAL AREA OF RESPONSIBILITY				
	TRANSPORTATION PLANNING	REGIONAL PLANNING	HOUSING	ENVIRONMENTAL SYSTEMS	SUB-AREA STUDIES
CARTOGRAPHIC DATA & MAPS	◭ ■ ●	◭ ■ ●	◭ ■ ●	◭ ■ ●	◭ ■ ○
TOPOGRAPHICAL, PHYSICAL & GEOLOGICAL DATA	△ □ ◍	△ ▥ ●	◬ ▥ ○	◬ ■ ●	◭ ▥ ○
LAND USE CHARACTERISTICS	◬ ■ ○	◬ ■ ○	◬ ■ ○	◬ ■ ○	◭ ■ ○
POPULATION CHARACTERISTICS	△ ■ ●	△ ■ ●	◬ ■ ●	◬ ■ ●	◭ ■ ○
EMPLOYMENT CHARACTERISTICS	△ ■ ●	△ ■ ●	△ ▥ ◍	◬ ■ ●	◭ ■ ○
REGIONAL ECONOMIC DATA	△ □ ○	△ □ ●	△ □ ●	△ □ ◍	△ □ ○
HOUSING CHARACTERISTICS	△ □ ○	△ ■ ●	◬ ■ ●	◬ ■ ○	◬ ■ ○
TRANSPORTATION SYSTEM CHARACTERISTICS & USE	△ ■ ●	△ ▥ ●	◬ ▥ ◍	△ ▥ ◍	◭ ■ ○
ENVIRONMENTAL SYSTEM CHARACTERISTICS	△ □ ○	△ ▥ ●	◬ ▥ ○	◭ ■ ●	◬ ▥ ○
RECREATIONAL & LEISURE ACTIVITY	△ □ ◍	△ ▥ ◍	△ ▥ ◍	△ ▥ ◍	△ ▥ ○
ATTITUDINAL & BEHAVIORAL DATA	△ □ ◌	△ □ ◌	△ □ ◌	△ □ ○	△ ▥ ○

NOTATION

GEOGRAPHIC LEVEL OF DETAIL

▲ PARCEL DATA
■ TRACT DATA
● REGIONAL DATA

PRIORITY OF DATA REQUIREMENTS

■ REQUIRED IMMEDIATELY
▥ REQUIRED OVER THE SHORT TERM (1-3 YRS.)
⬚ REQUIRED OVER THE LONG TERM (3-5 YRS.)
□ NOT REQUIRED

Fig. C – 3 Summary of DRCOG Data Requirements. (Source: R. O. Worrall, "Information Systems for Regional Agencies: A Pragmatic View," ***URISA*****, 1970, p. 241.)**

Level"; "Tract Level"; and "Regional Level." Distinctions are also drawn between three levels of temporal priority: "Immediate" (required within 1 year from present), "Short-Term" (needed within 1-3 years), and "Long-Term" (needed within 3-5 years).

In response to these requirements a recommended system consisting of six interrelated computer-based file-sets was developed:

--Land use
--Population
--Employment
--Housing
--Transportation
--Environmental systems

Land Use File Set

Contains information on the following:

--Tract-level land use acreages,
--Land value
--Zoning
--Dwelling unit counts
--Structural condition

Initial file development was set at the Census Tract level. Proposed data sources included 1960 DMATS land use data, current land use maps prepared by DRCOG member jurisdictions; proposed 1970 aerial photography and ultimately, automated county assessors' parcel files.

Environmental Systems File Set

The final computer file contains data on regional environmental systems. This file set was designed to include:

--Regional and small-area storm drainage and flood control
--Regional water distribution network
--Regional sanitary sewer system
--Water quality
--Small area water demand and consumption
--Sewer system demand and treatment
--Air quality
--Regional solid waste system

The files were organized at a variety of levels, ranging from generalized regional data to localized air pollution records, broken down by monitoring stations.

Major data sources for the file included local agency records, data assembled in the course of previous and projected DRCOG studies, records of the Colorado State Department of Health, and the output of the regional air pollution monitoring system.

Readiness: (See Fig. C-1)

Source for further information: Denver Regional Council of Government, Denver, Colorado

Minnesota

System(s):

1. Minnesota Land Management Information System (MLMIS)
2. Environmental Planning Programming Language (EPPL)

System Information:

MLMIS collects information at the forty-acre parcel level on a statewide basis, while ELPPL is used for detailed small area studies. Both systems have capabilities for computer mapping and the overlaying of many variables to produce composite maps.

Readiness:

Both systems mentioned above are in operation.

Source for further information:

Les Maki
Environmental Information Manager
State Capitol Square Building
550 Cedar Street
St. Paul, Minnesota 55101

Elements in data base:

A. Soils and geomorphic regions

B. Geology

C. Climate

D. Watershed

E. Land use

1. Residential
2. Manufacturing
3. Transportation
4. Commercial
5. Services
6. Cultural, entertainment, recreational and other
7. Non-urban land use

F. Land cover

1. Forested

2. Grassland
3. Cropland/Cultivated
4. Water
5. Extractive
6. Built-up

G. Zoning

H. Public Ownership

I. Population distribution

J. Minor civil divisions

New York

System: Statewide Information System (SWIS)

System Information:

The data base consists of four geographic levels for which data was available and meaningful in a statewide planning environment. These levels, starting from the largest area to the smallest, are:

1. Statewide data. This kind of information is a measure of the total magnitude of a condition within the state; for example, the state's population, its total land area, etc.

2. County or regional data. In this case we consider regional activity as a specific grouping of counties into some sort of social and economic homogeneity.

3. Minor civil division data (or cities and towns). A great amount of fiscal and vital statistic data is available on each town and city.

4. The lowest level of the hierarchy is that which encompasses the largest number of records covering the smallest geographic area, the square kilometer or a part thereof.

With this unit the Office of Planning Coordination (OPC) has recently completed a Statewide inventory of land use using aerial photographs and photointerpretation techniques.

One unique characteristic of this hierarchial data base is that it is "upward additive." This simply means that the smallest unit must be capable of being accumulated so that data will be compatible with data at the next highest level and so on up the line.

In order to make the most effective use of this data base concept, it was necessary to develop three completely different information processing and analysis systems. The first of these is the County Inquiry System, the second the Minor Civil Division Profile System, and third, Land Use Inventory.

A. County Inquiry System--

--Contains information on numerous items such as transportation, housing, land use and natural resources, etc.

--System maintained by Bureau of Planning Research in the Office of Planning Coordination.

--Designed for use by non-data processing personnel. It can successfully be used by any one after less than four hours of instruction.

--Three terminals in agencies of the state other than the Office of Planning Coordination can access the system. These are Departments of Transportation (DOT), Conservation, and Commerce.

--To join the system, an agency must acquire a terminal renting from $75 to $110 per month, plus $10.50/hr. for computer usage. Depending on the uses of the terminal, an agency could expect to spend between $200 to $300 per month for average access to the county Inquiry and Analysis System.

B. Minor Civil Division (MCD) Information System--

--Contains information on New York's 1600 cities, towns, and incorporated villages.

--Much of the information is from the decennial census of population.

--Able to obtain computer generated community profiles of all 1600 cities and towns.

C. Land Use Inventory*--

--Consists of detailed statistics of one hundred land use classification items on each of the state's 144,000 square kilometers.

--Each cell (square kilometer) coded with over 40 different land uses.

--Able to produce shaded maps.

--Each kilometer is identified with a minor civil division code to allow for interfacing with the OPC information system.

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*A published report that describes the system and its uses is called "Land Use and Natural Resources" and is available from the publication section, Office of Planning Coordination, 488 Broadway, Albany, New York.

Readiness: All systems mentioned above are currently in operation. Source for further information:

Donald Croteau
Assistant Chief
Office of Planning Coordination
Albany, New York

Connecticut

The Department of Environmental Protection is presently in the process of inventorying, mapping and analyzing the state's natural resources, including those of the coastal zone. This effort is designed to develop a data base which can assist local communities in making resource use decisions.

Land Use Contact: Gordon T. Allen, Administrative Assistant to the Governor, Hartford, Connecticut.

Arizona

System: Program Framework for the Collection, Analysis and Use of Resource and Land Information.

System Information:

The program framework is divided into two parts. 1) Resource and Land Information System, and 2) Resource and Land Information Analysis.

The Resource and Land Information System section can be divided into various tasks which consist of the following:

1. Inventory of existing information systems
2. Determination of existing information flows
3. Determination of new information needs
4. Determination of new information sources
5. Analysis of systems alternatives

The Resource and Land Information Analysis is divided into the following tasks:

1. Organization of data
   a. Land resources
   b. Water resources
   c. Air resources

d. Plant resources

e. Wildlife resources

f. Scenic resources

g. Recreation areas

h. Urban areas

2. Division of land into analysis units
3. Identification of extreme conditions
4. Identification of areas needing reclamation
5. Delineation of conservation areas
6. Designation of potential land uses
7. Ranking of land uses

System readiness: System as yet is not operational

Source for further information: Harry Higgins, Director, Arizona Office of Economic Planning and Development Planning Division, Phoenix, Arizona.

Alaska

In the Alaskan government there are three departments which have the responsibility for the management of state land. They are the Department of Natural Resources, Department of Fish and Game, and the Department of Environmental Conservation.

The Alaska Land Act (Act 169-1959) provides for classification of the state's lands according to their highest and most beneficial use, based on area land use plans.

Current activities in the Division of Marine and Coastal Zone Management are aimed at long-term programs designed to define present base level environmental characteristics and to monitor externally and internally induced environmental modifications. Priority topics within these programs include accumulation of a data base for the development of planning and management programs for coastal wetlands, investigation of existing and proposed pupmill sites . . . and definition of the critical oceanographic features of Prince William Sound.

The Sea Grant Program funds the Coastal Resource and Science Service Center in Anchorage, Alaska. The Center is presently engaged in collecting technical information on the ecosystems of the Alaska coastal zone and in providing a coastal resource and science information service to assist with land use and environmental decision-making.

Land Use Contact: Jose Josephson, Co-chairman, Joint Federal-State Land Use Planning Commission, Anchorage, Alaska.

Oklahoma

Land use information system proposed in anticipation of federal and state legislation.

California

California has made a substantial effort toward developing both a general analytic information system and a statewide management information system (TRW-California Region, and TRW-Santa Clara County). Unfortunately because of the high price associated with the system discussed by TRW, and because of its complexity and the failure to present in in simpler, non-technical terms there has been little movement toward implementing the proposed system. This is a clear example of the failure of the system designers to utilize the type of evaluation procedures discussed in the final chapter of this report. As a result, California has the basis for a sophisticated statewide information system, but are unlikely to utilize it.

Memphis Metropolitan Areas

System: Mississippi-Arkansas-Tennessee Council of Governments (MATCOG) Information System. (In development stage--not operational yet).

System Information

A. The system is composed of several subsystems:

  1. Public Service Information System (PSIS)
     --health and welfare services
     --human resource development
     --personal and property safety
  2. Regional Data System
     --data reporting system
     --social reporting system
     --research information system
  3. Data Sources, data inputs, information users

B. Some types of data to be used:

  1. Regional data: people file, economic file, fiscal file, property file, transportation file, public services file, social file.
  2. PSIS: those listed above plus public facilities, physical development, economic development.

C. Inputs: Population, education, environment, economic, human resources, housing, health, public safety, legal, public finance, land use.

The above inputs are only examples of what should be used, not an exhaustive listing. Data files are higher-order, multiple use. (Coupling-interlocking of files, e.g., location of certain income strata with certain potential job opportunities.)

Functions of Regional Data System:

1. Dissemination of data
2. Analysis of specific character of local and/or regional problems

Comment: This system is not a land use information system. However, land use information is included in it.

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