

Jean C. Prior

ANNUAL REPORT

of the

STATE GEOLOGIST

to the

GEOLOGICAL BOARD



Volume 46
30 June 1975

GEOLOGICAL BOARD

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Iowa
a place to grow

Stanley C. Grant
Director and State Geologist

Orville J Van Eck
Associate State Geologist

Donald L. Koch
Assistant State Geologist

August 14, 1975

TO: Governor Robert D. Ray, Chairman,
and Members of the Geological Board

Gentlemen,

Herewith is the Annual Report of the State Geologist made in accordance with the requirements of the Code of Iowa, Section 305.7 and Section 17.4. It describes the activities and accomplishments of the Iowa Geological Survey for the period of 1 July 1974 to 30 June 1975.

On 31 March 1975, Dr. Samuel J. Tuthill resigned as State Geologist to accept a position with the Federal Government in Washington, D. C. Mr. Orville J Van Eck was appointed Acting State Geologist. Dr. Stanley C. Grant became Director of the Survey and State Geologist on 1 June 1975.

The legal responsibilities of the Iowa Geological Survey are set forth in the Iowa Code, Chapters 305 and 84. Additional appointive responsibilities require that the State Geologist or a Survey staff member serve as a technical or scientific advisor to several State government agencies, boards, and commissions.

Respectfully submitted,



Stanley C. Grant
Director and State Geologist

SCG:wg

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Iowa Geological Survey

ANNUAL REPORT

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1 July 1975

Figure 1 shows the table of organization for the Geological Survey for this date. Figure 2 shows the functional relationships of the Survey. During the past year the Survey has accomplished the following major tasks:

I. GEOLOGICAL SURVEY PUBLICATIONS

1. Hoyer, B.E., Hallberg, G.R., and Taranik, J.V., 1974, Summary of multispectral flood inundation mapping in Iowa: Pub. Info. Circ. No. 7, 57 p.
2. Anderson, R.R., 1975, Guide to aerial imagery in Iowa: Pub. Info. Circ. No. 8.
3. Garvin, P.L., Van Eck, O. J, 1975, Strippable coal reserve study in selected Iowa counties: Prelim. Rept.

II. GEOLOGICAL SURVEY PUBLICATIONS IN FINAL PREPARATION

1. Gilmore J.L., 1975, Gravity survey of Randalia magnetic anomaly: Rept. Inv. 11.
2. Drake, L., Prior, J.C., 1975, Environmental geology atlas of Linn County: Misc. Map Series.
3. Prior, J.C., 1975, Iowa, the land: Ed. Ser. 3.

Figure I. Staff Organization and Responsibility Assignment

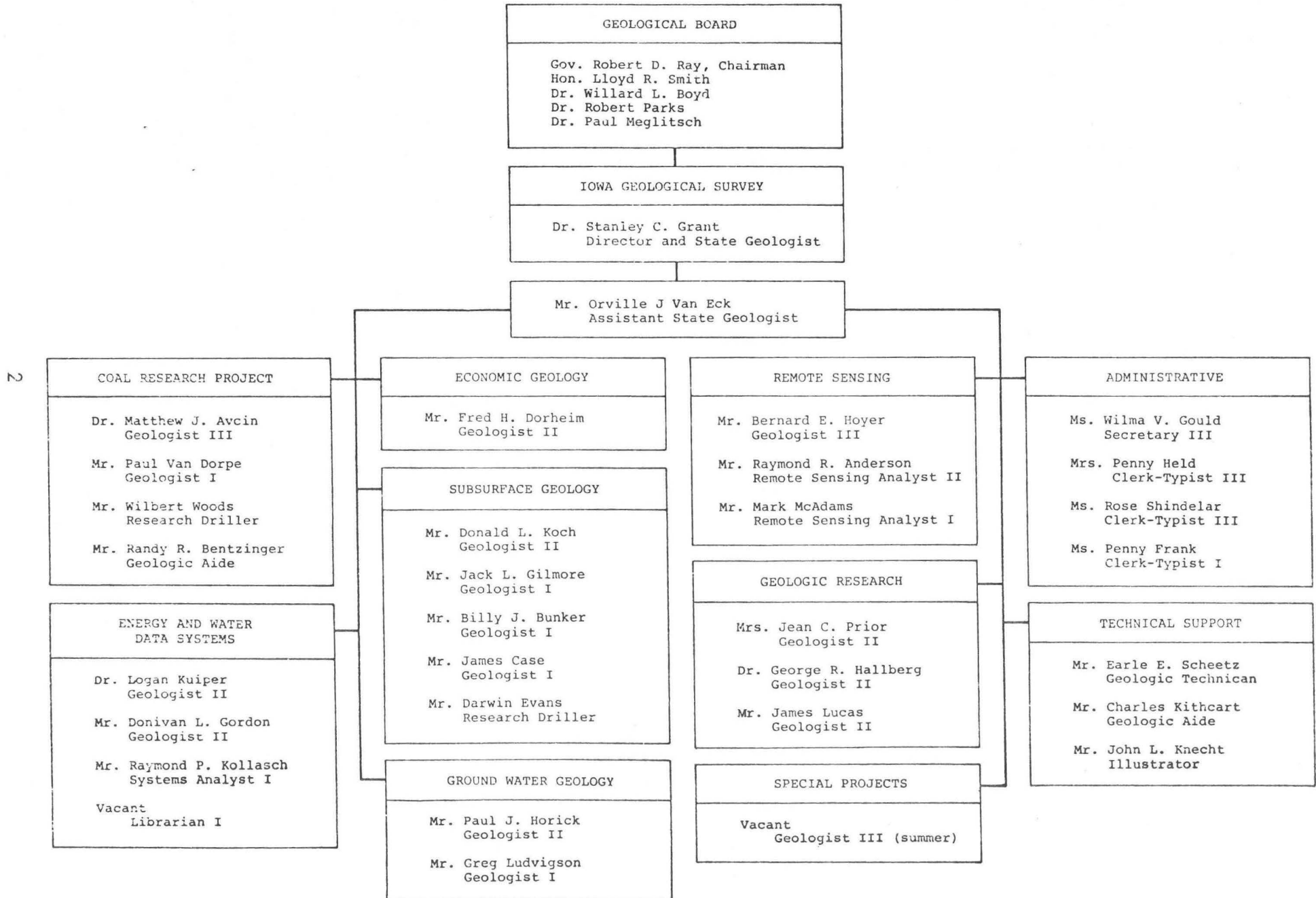


Fig. 2. Functional Relationships of the Iowa Geological Survey

IOWA GEOLOGICAL SURVEY

Research Cooperative Programs

U. S. Geological Survey
 Groundwater (50/50)
 Surface Water (50/50)
 National Aeronautics and
 Space Administration
 U. S. Bureau of Mines
 U. S. Geological Survey
 Geologic Division
 U. S. Department of Agriculture

Consultation, Advisory, and Data-
 Source Services

Iowa Department of Revenue
 Iowa Water Well Drillers
 Local and Regional Planning Commissions
 Iowa Counties and Municipalities
 Iowa Commerce Commission
 Iowa Development Commission
 Office for Planning and Programming
 Iowa State Department of Health
 Dept. of Environmental Quality
 Air Quality Commission
 Solid Waste Management Division
 Water Quality Commission
 Chemical Technology Commission
 Iowa State Hygienic Laboratory
 Iowa Department of Justice
 Iowa Natural Resources Council
 Iowa Department of Soil Conservation
 Iowa Agricultural Experiment Station
 State Archaeologist
 Iowa Highway Commission
 Iowa Department of Agriculture
 Iowa Preserves Board
 Iowa Conservation Commission
 The University of Iowa
 Iowa State University
 University of Northern Iowa
 Iowa Department of Public Instruction
 U. S. Department of Agriculture SCS
 Iowa Citizens
 Private Industry
 Engineering Consultants

Participation in Other
 Agencies

Iowa State Map Advisory Council
 Iowa Conservation Education
 Council
 Iowa City Chamber of Commerce
 Environmental Concerns Committee
 Dept. of Environmental Quality
 Inter-Agency Resources Council
 Dept. of Soil Conservation
 Land Rehabilitation Advisory Board
 Watershed Advisory Board
 Conservancy District Task Force
 U. S. Department of Agriculture
 Iowa-Cedar Rivers Basin
 Coordinating Committee
 Energy Policy Council

III. EXTRINSIC PUBLICATIONS

1. Oros, M.O., Gordon, D.L., et al., 1975, Oil and gas development in North Mid-Continent in 1974: Am. Assoc. Petrol. Geol.
2. Hallberg, G.R., 1974, Geologic profile of Lee County, in Soil Survey of Lee County: Adv. Rept., Pt.1, U.S.D.A. Soil Conservation Service, p. 165-188.
3. Hallberg, G.R., et al., 1974, Quaternary records of Microtus xanthognathus (Leach), the yellow-cheeked vole, from northwestern Arkansas and southwestern Iowa: Jour. Mammol., v. 55, No. 3, p. 640-645.
4. Hoyer, B.E., Hallberg, G.R., in press, The application of remote sensing to flood mapping, in The Manual of Remote Sensing: Am. Soc. Photog.
5. Hallberg, G.R., et al., 1974, The geology and paleopedology of the Cherokee Sewer Site: Jour. Iowa Archaeological Soc., v. 21, chapt. 2, p. 17-50.

The Geological Survey also assumed responsibility for publication of three monographs for the State Archaeologist. The three monographs, titled The Iowa Northern Border Brigade, Physical Affiliations of the Oneota Peoples, and Silver Creek Woodland Sites, Southwestern Wisconsin were published through the Office of the State Printer. This is in contrast to past publications of the State Archaeologist which usually were published by the University Press.

IV. CONSULTATIVE, ADVISORY, AND DATA-SOURCE SERVICES

Well Predictions

Predictions for groundwater resources are made on request for groups or individuals. Most of them are presented in the form of letter reports, but some are telephoned reports. The requests come from a wide range of users which are summarized as follows:

<u>Category</u>	<u>No.</u>
Municipal	48
Industrial	17
Domestic	59
Feedlots	3
Irrigation	8
Recreational	9
Rural Water Districts	4
Other	<u>20</u>
Total	168

Well Logging

Drill cuttings from approximately 50 wells were logged for a total footage of about 24,700 feet. Of this footage, approximately 5,600 feet were examined to determine depths to formation tops only. The remaining samples were logged in detail for each sample interval. Because in most well drilling procedures a sample is collected for each 5-feet of drill penetration, the detailed logging of approximately

19,000 feet of drill samples means a microscopic study of about 3,800 individual samples.

Emphasis is being placed on the logging of deep municipal and industrial wells, and those wells located in special project areas.

Casing Points

Drill cuttings from 10 municipal wells were examined during the drilling of the wells to define casing points for various well contractors and engineers. The average depth of these wells is 1,800 feet. Verification of formation tops by the Geological Survey is relied upon to insure that drilling has reached proper depth for placement of casing in wells.

Oil and Gas Administrator

Under Chapter 84, Code of Iowa, the State Geologist is designated Administrator of Oil and Gas. In this capacity the Geological Survey reviewed and processed 188 applications for drilling permits during the period of 1 July 1974 to 1 July 1975. Specifically, 171 permits were issued to Northern Natural Gas Company in support of the geologic evaluation studies for potential gas storage sites in Guthrie, Boone, Story, and Hamilton Counties. Thirteen permits were issued to Natural Gas Pipeline Company of America for injection/withdrawal wells into various storage zones at their underground storage facilities at Cairo and Columbus City, Louisa County. Four permits were issued for oil and gas tests, one in Montgomery County, and three in Louisa County.

The permits issued during the reporting period, plus the carry-over from the previous reporting period, resulted in the drilling of 328 shallow tests, 12 intermediate tests, and 10 deep tests in storage evaluation programs, 13 injection/withdrawal wells, and 4 oil-test wells.

The cited drilling activity resulted in a requirement for the following field investigations:

- 1) Site investigation of oil and gas test in Montgomery County at request of State Insurance Commission.
- 2) Site investigation for evaluation of well location and degradation potential of discharged saline water from wells to be tested in determining aquifer characteristics and gas-storage potential at the Cairo and Columbus City storage facilities. The investigation was performed at the request of the Iowa Natural Resources Council.
- 3) Site and water-well evaluation of a potential water-well interference problem associated with a shallow-drilling program conducted by Northern Natural Gas Company in Dallas County. The investigation was requested by the Dallas County Gas Storage Association on behalf of a private owner.

Drilling statistics accumulated in the administration of Chapter 84 were reported quarterly to Iowa Natural Resources Council, monthly to the American Petroleum Institute, and periodically to the Petroleum Information Service.

The Geological Survey continues to serve as consultant to the Iowa Commerce Commission in the review of procedures being followed by Northern Natural Gas Company in the abandonment of the Vincent gas-storage facility. The original acreage under lease for this facility when abandonment began in 1971 was 12,373 acres. Recovery of gas from the facility has made it possible to reduce the leased acreage to 2,240 acres. The total gas in place as of 26 March 1975 was 2,875,473 Mcf (thousand cubic feet), a reduction of 75,872 Mcf from the same date one year ago.

Requests for Information

The Survey regularly responds to a large number of requests for geologic and hydrologic information. With the onset of public concern over environmental and energy problems, the number of requests has increased substantially. The manner in which the requests are answered is largely predicated by the nature and scope of the request.

For those requests that are general in nature, one of the publications of the Survey often will fulfill the needs. For those of a more specific or localized nature a special letter report is prepared. These reports are generally interpretive.

In contrast to the requests for interpretive reports, we also are called upon to supply much data. Recognizing this need some time ago, we have worked to develop an automated geologic and hydrologic data bank. These efforts have progressed to the point where we now can

provide such data to well drillers, planning agencies, engineers and so forth, rapidly with comparatively little demand on staff time and at a nominal cost to the user.

Coincident with the public concern about energy and environmental problems has come a greater demand for public addresses by staff members. These have ranged from short presentations to various service groups to seminars devoted to specific subjects. The results have been gratifying in that there seems to have developed among the general public an entirely new appreciation of our earth resources.

Consultative Contacts

The Survey is often called upon to provide consultative services to various state agencies, industries, and individuals. These services frequently require interpretation of data and quite often on-site investigations in various parts of the state. The following tabulation indicates the approximate number of contacts that fall within this category:

<u>Agency or Group</u>	<u>No. of Contacts</u>
Iowa Natural Resources Council	22
Iowa Commerce Commission	7
Department of Environmental Quality	96
Iowa Conservation Commission	33
Iowa State Highway Commission	6
Office for Planning and Programming	2

Iowa Development Commission	4
Iowa Department of Justice	3
State Hygienic Laboratory	7
State Archaeologist	10
Iowa Department of Soil Conservation	7
State Universities and Public Schools	30
Counties and Cities	54
Federal Agencies (U.S.D.A., F.H.A., etc.)	61
Engineering Consultants	66
Water Well Drillers	83
Industry	52
Individual Citizens	<u>139</u>
Total	682

Sanitary Landfills

The Geological Survey established geologic and hydrologic criteria to be included in the rules that govern sanitary landfill siting, under the jurisdiction of the Solid Waste Management Division, Department of Environmental Quality. These criteria are designed to protect the water resources of the state. To assist municipal and county governmental agencies in the selection of sites that will best meet the geologic and hydrologic criteria, the Geological Survey has upon request either furnished extant data, made on-site inspections, or conducted earth-resistivity surveys on potential landfill sites for

all but three counties of the state (fig. 3). In the final rush to meet the 1 July 1975 deadline established by the Department of Environmental Quality for compliance with sanitary landfill regulations for disposal of solid wastes, requests for assistance occupied about 75 percent of the time of one geologist.

To insure compliance with the rules designed to protect water resources, the Geological Survey reviews all plans of proposed sanitary landfills that are submitted to the Department of Environmental Quality.

V. RESEARCH

1. Cold Water Cave

Research studies on Cold Water Cave were ended on 17 January 1975 with the termination of the lease agreement with Mr. Kenneth Flatland. An eighty-page final report was presented at a meeting with Governor Robert D. Ray, representatives of the Iowa Conservation Commission and area legislators on 12 February 1975.

Included in the report were discussions of the potential of the cave to attract visitors and estimates of visitor attendance, and a review of possible developmental construction techniques and estimated costs. Supplemental information on radiometric dating and climatic history is forthcoming.

2. Strippable Coal Reserves

This research was conducted under a grant from the U.S. Bureau of Mines. Because the grant arrangement was not finalized until October,

1974, and work was to be completed before June, 1975, only five counties were included in the study. Those five counties were Lucas, Mahaska, Marion, Monroe, and Wapello because of the amount of information available from which strippable reserve estimates can be made.

Reserve estimates were calculated in the categories of measured-indicated (most accurate) and inferred (less accurate) for coals 28-42 inches thick and greater than 42 inches thick under overburden thicknesses of 0-50, 50-100, and 100-150 feet. The total strippable reserves in the measured-indicated category in the five counties is 332.08 million tons, and in the inferred category it is 811.94 million tons. This is a total of 1144.02 million tons of coal considered to be strippable under guidelines established by the U. S. Bureau of Mines.

A report has been prepared for the Bureau of Mines and the information has been placed on open file at the Geological Survey offices. A more detailed report, complete with maps, is being prepared for later publication.

3. Coal Research Project

The research goals of this project were presented in the 30 June 1974 Annual Report.

Delivery of the drill rig, which is used to obtain subsurface information, was not made until July 1974 so the past year was devoted primarily to getting the drilling phase of the project under way. Various drilling techniques and drilling equipment were evaluated to find the optimum combination of technique and equipment for the drilling conditions

encountered. In spite of the experimentation and the usual problems encountered in the initial stages of a new project, significant progress was made.

Twenty-one holes were drilled with a cumulative drilling footage of 5,848 feet, of which 3,442 feet were in the coal-bearing rocks of the Pennsylvanian System and were core sampled. The remainder of the drilled footage was in the unconsolidated materials overlying the rocks of the Pennsylvanian System.

Twenty of the cores have been described in sufficient detail to discuss the coal recovered. In the 20 cores, a total of 62 coals were encountered, of which 32 were 14 inches or greater in thickness. Coals less than 14 inches thick are not considered in coal reserve estimates in conformity with standard procedures followed by the U.S. Bureau of Mines. The 32 coals 14 inches or greater have a cumulative thickness of 85.08 feet, or an average thickness of approximately 2.66 feet. A further breakdown shows the following distribution:

<u>Thickness category</u>	<u>No. of Coals</u>	<u>Total thickness</u>	<u>Average thickness</u>
14 to 28 inches	17	27.66 feet	1.63 feet
28 to 42 inches	7	20.17 feet	2.88 feet
over 42 inches	8	37.25 feet	4.66 feet

These data can be translated into reserve estimates by using standard procedures. Coal weight is considered to be 1,800 tons per acre foot, measured reserves are considered within a one-quarter mile

radius of the data point, and inferred reserves are considered outside a one-quarter mile radius but within a one-mile radius of the data point. With these constraints, the drilling accomplished thus far permits us to identify the following reserves:

Thickness category (inches)	Measured (tons)	Inferred (tons)	Total (tons)
14-28	6,252,416	93,936,240	100,188,656
28-42	4,566,816	68,502,240	73,069,056
42-	<u>8,432,784</u>	<u>126,491,760</u>	<u>134,924,544</u>
Total	19,252,016	288,930,240	308,182,256

An additional 65,111,040 tons of coal in beds less than 14 inches thick have been identified. Although coals that thin probably will never be mined, they do constitute a potential resource if in situ gasification is ever developed as a viable technology.

The past year was also significant in terms of establishing close ties with researchers and organizations with research interests in Iowa coal. In a cooperative program with the U.S. Geological Survey, the Iowa Geological Survey is furnishing samples for the determination of trace element composition and general quality of Iowa coal. Other programs in cooperation with various university researchers are designed to develop a better understanding of coal occurrence, to develop a tool for identification of a particular coal, to determine which trace elements are concentrated by the plants that make up the coal, and to determine

the ceramic suitability of the clay minerals contained in the rocks associated with Iowa coals. Each of these research efforts is considered significant to the development of the coal resources of Iowa.

4. State Water Model

One of the severest problems encountered in the management of groundwater resources is the prediction of the amount of groundwater available and how much can be withdrawn at a sustained rate from any particular aquifer. To overcome these problems, two mathematical models have been constructed.

The first is a generalized state model which will provide maximum sustainable withdrawal rates and the amount of water in storage for the various aquifers. It is a simple and generalized model. The second is a detailed digital water model. This model divides the state into more than 1,000 different elements. At each element, drawdown, flow rate and flow direction of groundwater are calculated. A model similar to the latter, but using more sophisticated mathematical procedures, is under construction. Both of the models must be solved on the computer.

It is expected that this approach will be a tremendous aid in the solution of many of the groundwater management problems in Iowa. It will be an integral tool in the Water Availability Study for the Comprehensive State Water Plan.

VI. COOPERATIVE RESEARCH

To implement geologic and hydrologic research in Iowa, the Geological Survey uses the authority granted in Section 305.8, Code of Iowa, to cooperate with federal agencies in cost-sharing programs.

During the current reporting period, the survey continued a 50/50 cost-sharing cooperative program with the Water Resources Division of the U. S. Geological Survey. The objectives of the program are threefold: (1) to inventory the groundwater resource, which involves an overall appraisal of groundwater occurrence and quality in an aquifer- or basin-wide organization of information; (2) to maintain surveillance of the groundwater resources which involves maintaining a network of observation wells to determine water-level and chemical quality changes; and (3) to maintain a system for collection and compilation of basic records of daily stage and flow rate of streams, and the concentration and total load of sediments carried by streams. The data gathered in these programs form the foundation for good water-management policies and comprehensive planning.

In addition to the broad program objectives, the Iowa Geological Survey is actively cooperating in the following research projects:

1. Hydrology of Carbonate Aquifers of the Eastern Iowa Groundwater District.

The research objectives for this project were outlined in the 30 June 1973 Annual Report.

Twenty-eight research wells were drilled during the past year.

Three of those wells were completed as production wells for pumping tests. Core drilling was completed on another hole which will be completed for test pumping. Two other test holes that previously were not completed because of drilling difficulties were finished as production wells. The remainder of the test holes were drilled to establish reliable parameters for stratigraphic correlation of Pleistocene sediments.

A tabulation of samples recovered for specific purposes follows:

<u>Type of Sample</u>	<u>Sample Use</u>	<u>Footage Drilled</u>
1. Cuttings from unconsolidated sediments (Pleistocene deposits).	Lithologies and stratigraphic control.	3,150
2. Cores of unconsolidated sediments.	Porosity and permeability tests.	65
3. Rock cuttings.	Stratigraphic control, structural mapping.	940
4. 2 1/8" dia. rock core.	Porosity and permeability tests, quantitative chemistry; Petrology and diagenesis.	<u>1,245</u>
	Total	5,400

Thin sections were prepared from 115 samples of rock core. These are being studied with a petrographic microscope to determine diagenetic features that may affect variations in water chemistry and that may also control the rate and direction of groundwater flow.

A suite of geophysical logs is run on each test hole. These logs include caliper, natural gamma, gamma-gamma, neutron, conductivity, self-potential, resistivity, temperature, and flow-meter logs. The logs provide additional information on in situ porosity-permeability relationships, lithologies, and water-bearing zones. They also define the zones that are to be isolated for production tests and from which water samples will be collected for mineral analyses. Recorders have been placed on five wells to monitor fluctuations of water levels in the various aquifers penetrated.

2. Jordan Aquifer Research

The Jordan aquifer constitutes the most widespread source of relatively large yields of good to moderate quality groundwater in Iowa. It is the source of supply for many municipalities and industries in the state. As a result, the capabilities of the aquifer to meet the withdrawal demands are being severely taxed in some areas. This is evidenced by significant losses in pressure head at a number of points in the state. For example, at Ottumwa the pressure head has decreased 100 feet in 70 years, at Grinnell 100 feet in 80 years, and at Mason City 140-200 feet in 57 years. In an artesian aquifer such as the Jordan, these affects have to be widespread.

To determine just how widespread and significant the head loss is, we are conducting inventories on all wells in the state that produce

water from the Jordan aquifer. The inventory includes measurement of the depth to the non-pumping water level to determine what head loss has occurred. We are also gathering well production records to determine how much water has been pumped from the aquifer at that point. From these data we will be able to not only define the historic loss of pressure head in the aquifer but also to predict future loss.

The information is to be presented in a Water Atlas. Also to be included are maps depicting variations in water quality in the aquifer.

3. Cooperative Applied Soils Research

During the past several years representatives of the Iowa Soil Survey Program from the U. S. Soil Conservation Service, the State Soil Survey staff of Iowa State University Experiment Station, the Iowa and U. S. Geological Surveys, and members of the Soils Engineering Group at Iowa State University have discussed and initiated a cooperative integrated program of research and information exchange. These efforts have grown into an active program, especially during the past year.

The purpose of the program is to form an integrated research team applying the different kinds of available expertise to the mutual problems of the represented groups. Each of the represented disciplines utilize many of the same techniques in the analysis of materials to solve their individual problems. These data can and should be jointly collected and used.

Each of the groups involved have various resources and facilities to contribute. For maximum effectiveness, there must be a core of people involved from each of the disciplines for two reasons: (1) To translate the results and utility of the combined data to specialists in their field; and (2) To make the overall program and its resultant data credible to specialists and others outside the cooperative group who will be the critical users.

Hopefully, the end product of these efforts is information on the physical limitations of the land and water resources of the state which has not been available before. It is expected that this information will aid in the wise and judicious use of Iowa's resources, which are a part of the charge of all of the participating groups.

As part of this effort the Iowa Geological Survey is providing basic geologic data to aid in the initial stages of the County Soil Survey, such as:

1. The thickness of unconsolidated material and the topography of the bedrock;
2. The distribution and lithology of rock outcrops;
3. Flood hazard maps;
4. The general nature and distribution of geologic materials, which may include providing computer printouts of well logs, or typical well logs for different areas of the county;

5. The participation of Geological Survey staff in soil survey field reviews, which is educational for all involved.

In addition, the Geological Survey is carrying on the following specific studies as part of this cooperative research effort:

1. Comparison and correlation of particular soil series with large magnitude floods. This analysis has been very successful to date. It appears that soil series can be quantified enough to allow the extrapolation of flood hazard areas with soil survey information. This potentially presents a very useful planning tool.
2. The stratigraphic, mineralogic, and hydrologic analysis of unconsolidated materials in eastern Iowa. The Iowa-U.S. Geological Survey Carbonate Aquifer Program involves detailed test drilling to analyze the nature of the unconsolidated materials. Part of this study will include the relationship of soils and parent materials, and their relationship to groundwater recharge and availability in eastern Iowa.
3. Detailed soil-geomorphic, stratigraphic studies to model soil-landscape relationships in O'Brien, Cedar, Linn, Benton, Buchanan, and Muscatine Counties.
4. Cooperative evaluation of the use of remote sensing in soil survey.

5. Water-table, soil moisture, and hydrologic properties in relation to other physical properties of soil.
6. Characterization of the clay mineralogy of the loess.
7. Continuing evaluation of the geochronology of soils and parent materials.

VII. COMPREHENSIVE STATE WATER PLAN

The Geological Survey has played an active role in formulating plans for the development of the comprehensive state water plan. A Survey representative worked with the technical coordinating committee to establish guidelines for the water plan study, framework report, and the budget required.

An advisory committee to the Iowa Water Resources Data System (IWARDS) was established to begin formulating guidelines for determining the scope of the data system. Subcommittees were established to determine guidelines and set standards for data quality control; to study and report on various hardware configurations for the system, their software requirements, and costs; and finally, a subcommittee to draft guidelines for the functions of the advisory committee.

After a fairly exhaustive survey of the resources data systems of other states, a decision was reached to attempt to utilize the data management systems of either Louisiana, New Mexico, or possibly Texas. There is a twofold advantage in this approach. First, each of these systems was developed largely with federal monies and their software may be obtained at very minimal cost. Second, the systems could be adapted to the hardware configuration of the State

Multicomputer Complex in Des Moines. This is important because the most economical hardware-communications configuration, without sacrificing efficiency, was determined to be the utilization of the extant Des Moines complex, with System Central (at the Geological Survey) maintaining the data bank via a remote batch station connected to the Des Moines system through a telephone medium. An operating budget for the system was developed on this premise.

Two water-plan task force groups organized under the coordinating committee and led by the Geological Survey are continuing their work assignment. Both groups have produced initial reports which were submitted to the coordinating committee and the planning section of the Iowa Natural Resources Council for review. The report by the task force on data base outlined the data requirements for the water plan study and the implementation of the State Comprehensive Water Plan. The report by the task force on water resources availability pictorially identified the nature of Iowa's surface- and groundwater resources via various maps.

The report on water resources availability was submitted to the coordinating committee and other task force groups for comment in relation to the task of producing the detailed report for the framework study. Work is continuing on the design and scope of the detailed water availability study.

VIII. MIDWESTERN GOVERNORS' CONFERENCE TASK FORCE ON MIDWEST ENERGY REQUIREMENTS AND ENVIRONMENTAL PROTECTION

In August, 1972, the Midwestern Governors' Conference under the Chairmanship of Governor Robert D. Ray established the Task Force on Energy Requirements and Environmental Protection. The task force serves as advisory body and as a forum for information exchange in the fields of natural resources, energy and environmental protection to the Governors of the 15 included states. The Iowa task force delegation is composed of the State Geologist, the Director of the Energy Policy Council and the Chairman of the Iowa Commerce Commission. Dr. Samuel J. Tuthill, former State Geologist, was task force chairman from its beginning in 1972 until August, 1974.

During Dr. Tuthill's tenure as chairman, members of the Geological Survey provided staff support in the form of organization and arrangements for meetings, secretarial assistance, and compilation and editing of evaluation reports and yearly summary reports for presentation to the Midwestern Governors' Conference. Policy positions and recommendations have been made in such areas as Midwest and National energy policy and state-federal relationships for dealing with fuel shortages. Specific reports have dealt with coal research and demonstration projects, state responses to fuel shortages, use of alcohol for fuel, evaluation of FEA petroleum allocation regulations, and evaluation of Midwest energy sources. Current task force attention is being given to Arctic natural gas pipelines, natural gas curtailments and deregulation, coordination of energy data-gathering methods, and strip mine legislation.

IX. REMOTE SENSING LABORATORY

The 1974-75 fiscal year was marked by a large amount of cooperative work with state and federal agencies involved with regulatory and/or research functions that utilize natural resource and landuse data. In addition, the year was marked by a large volume of data collection which will constitute a great amount of study into the next fiscal year.

A summary of the new research and newly acquired data underscores these statements on cooperation in data collection. The Remote Sensing Laboratory (RSL) was directly involved in the acquisition of photography of about 800 miles of rivers in Iowa and some adjacent states in support of the regulatory functions of the Iowa Conservation Commission and the U. S. Army Corps of Engineers, Rock Island District. RSL also participated with the Iowa Department of Environmental Quality in helping them conduct their regulatory authority over feedlot construction and management in northwestern Iowa. Extensive cooperative programs for research and development were conducted with the Iowa Conservation Commission on migratory geese inventories and forest disease. Archaeological site identification by aerial photography was done with the office of the State Archaeologist. New research on evaluating hydrogeology, water quality, and reclamation of strip mines was started with the cooperation of the U. S. Geological Survey, Water Resources Division, and support from the Iowa Department of Soil Conservation and the State Hygienic Laboratory. Most extensive was the imagery acquired in cooperation

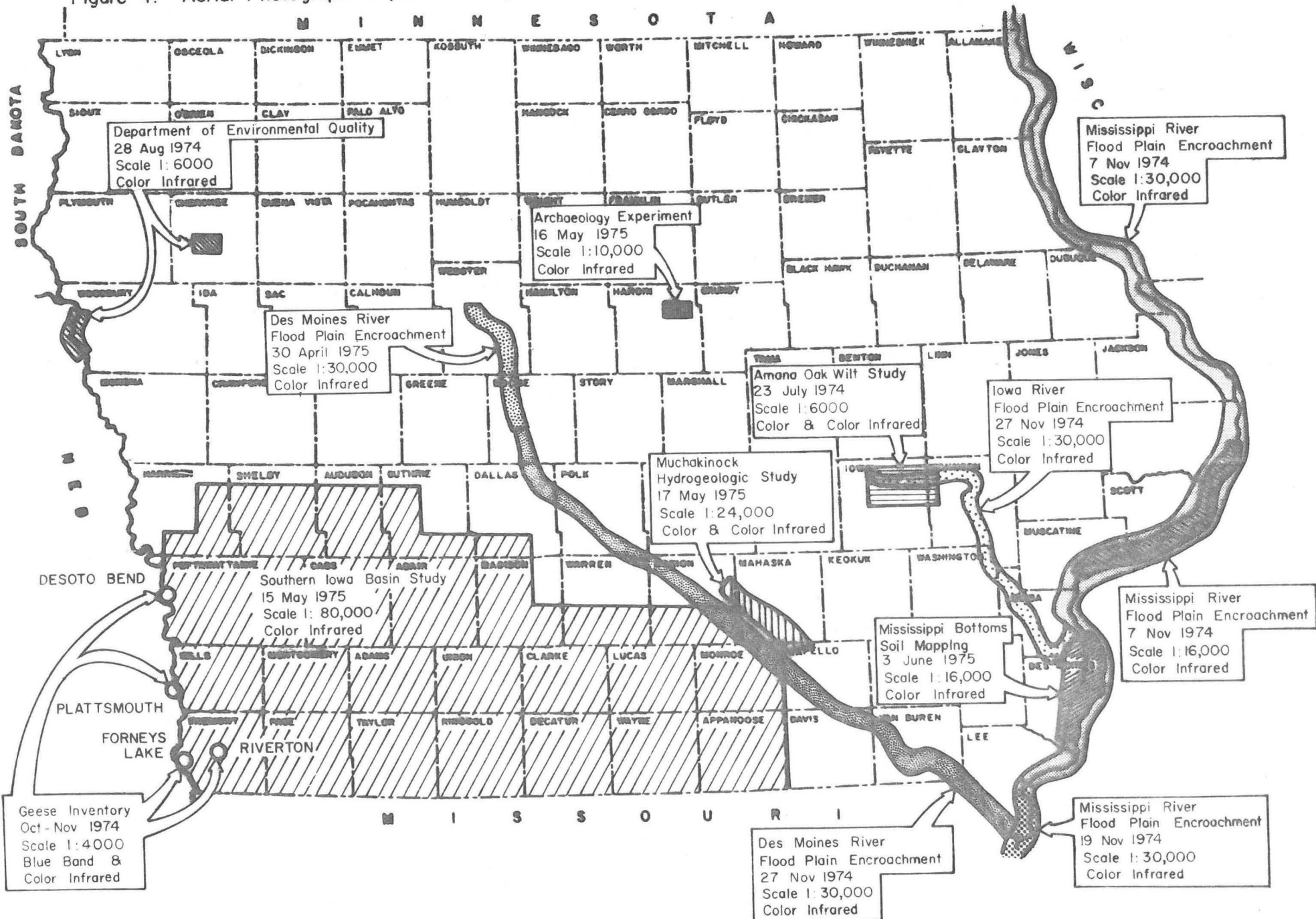
with the U. S. Soil Conservation Service. About one-seventh of Iowa's total area was photographed with high-altitude imagery in support of their Southern Iowa River Basin Study. In addition, imagery was acquired to assist in the extremely difficult task of soil mapping on the Mississippi River flood bottom in two counties. A summary of aerial imagery obtained in the past year is presented in fig. 4.

Other work continued from previous years includes efforts on evaluating photographic techniques for soil mapping, the environmental inventory of 11 counties in southern Iowa, and flood mapping technique development. These programs were conducted with the cooperation of the Soil Conservation Service, the Environmental Protection Agency, and the U. S. Geological Survey and Corps of Engineers, respectively.

Data acquisition and cooperative planning have been the major activities in the past year. However, some conclusions and reports have been produced. Two IGS reports of RSL activities were published: Summary of Multispectral Flood Inundation Mapping in Iowa, Public Information Circular No. 7; and Guide to Aerial Imagery of Iowa, Public Information Circular No. 8 were both published. The latter was a direct result of a service performed for the Map Advisory Council. However, published results are not the only important ones. The imagery obtained along Iowa rivers to detect non-permitted encroachment onto floodplains proved very valuable to both the Iowa Conservation Commission and the Corps of Engineers.

Those agencies plan to continue using the technique. In another project

Figure 4. Aerial Photograph Acquired Through *The Remote Sensing Lab*, July 1974 - June 1975.



photography obtained by RSL was used to help convince the operators of a private feedlot of the wisdom in having an engineering firm modify the feedlot tile system in order to bring the feedlot into compliance with the permit to operate. This saved the Department of Environmental Quality and the State of Iowa the time and expense of possible legal action.

Three contracts were entered into during the past year. NASA, Goddard, awarded IGSRSL contract number NAS5-20832 for the purpose of producing enhanced satellite images of the Iowa landscape in cooperation with the Jet Propulsion Laboratory, California Institute of Technology. The project is to run for 16 months from February, 1975.

The Soil Conservation Service awarded IGSRSL a contract for reimbursible services of up to \$28,000. The purpose of the contract was to obtain high-altitude color-infrared photography suitable for the evaluation of landuse data and the evaluation of conservation practices. The service was contracted and completed prior to June 30, 1975.

A contract for up to \$2,000 in reimbursible services was written by the U. S. Army Corps of Engineers, Rock Island District. This contract was for the purpose of continuing flood inundation mapping technique development. Of particular interest is the relationship of interpreted boundary elevations to gaging elevation records.

In addition, service contracts were instituted for the first time through the Department of General Services for flying aerial photography and buying aerial film. A service contract for film processing was considered, but no contract was entered into during 1974-75.

Important personnel changes were made within the remote sensing program during this past fiscal year. On January 2, 1975, Dr. James Taranik, Chief of Remote Sensing, left the Iowa Geological Survey and was succeeded by Mr. Bernard Hoyer. Two other new staff members were added in the last year. Mr. James Lucas joined the staff in February, 1975, on a grant from NASA, and Mr. Mark McAdams joined the staff in June, 1975. They joined Mr. Raymond Anderson, who was already engaged full time in the activities of the laboratory.

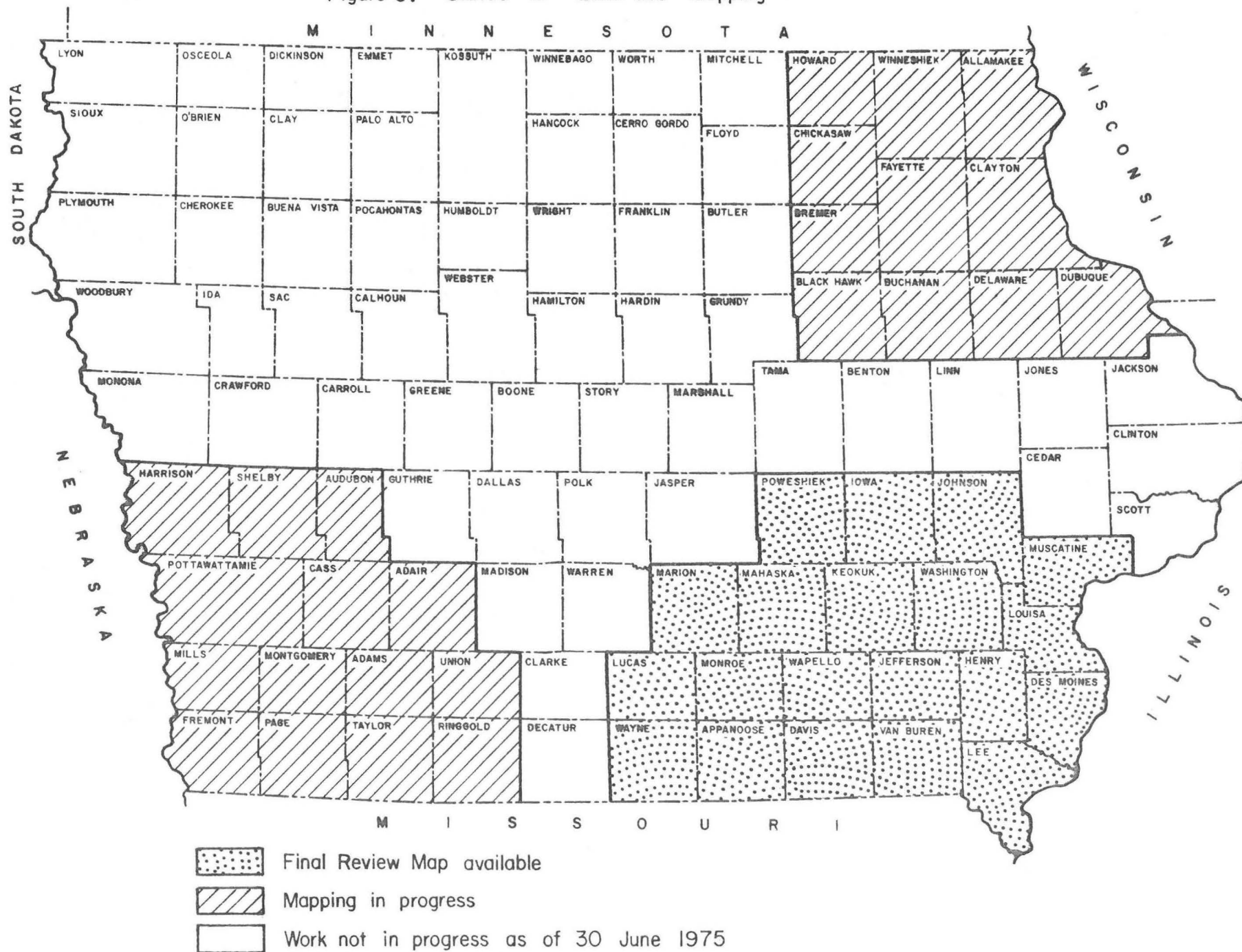
1. Projects of the Remote Sensing Laboratory

A. Southern Iowa High-Altitude Imagery. High altitude, 1:80,000 scale, color-infrared imagery was obtained in May, 1975, over about 7,000 square miles of southern Iowa. The purpose of this imagery was to assess landuse patterns and the distribution of conservation practices within watersheds in southern Iowa. The imagery was requested and paid for by the U. S. Soil Conservation Service for its Southern Iowa Rivers Basin Project. The color-infrared film was chosen for its unique interpretation qualities which allow rapid recognition of the distribution of forest, pasture, row crops, water, surface mines, and urban landuses. Conservation practices such as strip cropping and terracing is also readily interpreted. The current imagery should allow an accurate appraisal of the surface cover throughout the entire study area. The imagery also allows the state of Iowa a unique opportunity to obtain detailed, up-to-date landuse information for about one-eighth of the entire area of the state.

B. Statewide Landuse Map. The Remote Sensing Laboratory is attempting to complete landuse maps for the entire state. Work copies are being produced at a scale of 1:250,000, although final publication in fiscal 1975-76 may be at a scale of 1:500,000. To date, 20 counties have been mapped and are ready for review, 25 counties are in various work stages, and 54 counties have yet to be mapped. Completion of work copies ready for review is scheduled for early fiscal 1975-76 with publication in the latter stages of the same fiscal year. Figure 5 indicates the status of mapping to date. These maps are being constructed from several available small scale imagery sources including satellite and recent high-altitude aircraft imagery.

C. Development of Enhanced LANDSAT Imagery for Landuse Classification in Iowa. The NASA contract referred to earlier was awarded IGS in the amount of \$28,775 for the purpose of using satellite images as a basis for computer-derived landuse maps in Iowa. The Jet Propulsion Laboratory at the California Institute of Technology and the EROS Data Center are cooperating with IGSRSL on the project. All computer enhancement is being conducted on their computer facilities. In the study, LANDSAT multiband computer compatible tapes are manipulated in the computer to enhance the digital information and reduce it to images in which each classified landuse is represented by a unique color. Four enhancement techniques have been attempted and partially evaluated. Results are encouraging to date, but final results will be forthcoming in the 1975-76 fiscal year.

Figure 5. Status of Land-use Mapping



D. Flood Inundation Mapping. Plans have been established to continue studying aerial techniques for flood mapping. The Corps of Engineers, Rock Island District, and the U. S. Geological Survey have agreed to continue support of this activity. Plans include studying the exact vertical relationship of the interpreted flood boundary to the gaging records. To achieve this goal, detailed valley profiles, topographic mapping, low-altitude photography and soil series correlation are planned along with the acquisition of higher altitude color-infrared imagery. Flooding at Ames in late June, 1975, on Squaw Creek and the Skunk River may prove suitable for further development of this technique. Imagery was obtained during the crest on June 27th and will be compared with imagery obtained four days after the flood crest. Ground observations were made by U.S.G.S., Corps of Engineers, Iowa State University Agronomy Department, and I.G.S. personnel. Mapping and results will be published in fiscal year 1975-76.

E. Floodplain Encroachment Inventory. The Remote Sensing Laboratory helped plan and coordinate the acquisition of aerial imagery along several Iowa rivers for the purpose of regulating unlawful encroachment onto floodplains. The Iowa Conservation Commission and the U. S. Army Corps of Engineers, Rock Island District, who have responsibility for this regulation, together with RSL, obtained imagery along the Mississippi, Des Moines, Iowa, Galena, and Rock Rivers. This color-infrared imagery

was primarily obtained in the fall, 1974, at a scale of 1:30,000, with small segments obtained in the spring, 1975. The imagery provided information that each agency felt was manageable and of sufficient detail to ease their respective regulatory tasks. Both regulatory agencies feel the imagery was very useful and each is interested in conducting similar encroachment surveys in the future.

F. Water Quality Study of Muchakinock Creek Basin. Cooperative work with the U.S. Geological Survey began in April, 1975, to assess water quality in a basin that has had extensive strip and underground coal mining. Photography was obtained of the entire Muchakinock Creek basin to assess current land cover, extent of surface mining, and present location of strip mine ponds. Multiband photography was obtained in conjunction with water sampling at selected sites to determine what techniques might be feasible to inventory acid mine waters.

G. Migratory Geese Inventory. Cooperative study with the Iowa Conservation Commission may lead to an operational inventory of migratory geese in Iowa utilizing aerial photography. Based on previous experimentation, color-infrared and blue-band, black-and-white imagery was obtained over selected locations along the Missouri River during the fall, 1974, at scales up to 1:4,000. It was determined that a census of geese could be accomplished with either film using conventional human interpretation methods. Machine processing is planned for this same imagery to determine if it can produce an accurate inventory more quickly.

H. Inventory of Oak Wilt in Amana Colonies. A cooperative effort to study the extent of oak wilt (Ceratoyosis facacerum) in the Amana Society forestland began in August, 1974. This study is being coordinated with the U. S. Forest Service, Iowa Conservation Commission, and the Amana Society. Color and color-infrared photography was obtained at a scale of 1:6,000 to determine the best film for diseased tree identification. In conjunction with aerial imagery, ground surveys were conducted to identify infested trees. Both films proved satisfactory for detecting the diseased trees. More detailed ground sampling is necessary, however, to statistically determine the accuracy of the aerial interpretation. The bulk of the study should conclude during the 1975-76 fiscal year. However, observations on the spread of the disease will continue with annual photography over selected diseased areas.

I. Archaeology. Black-and-white and color-infrared photography was obtained in May, 1975, over about 13 square miles in Hardin County near Steamboat Rock. This area has been surveyed previously because of corridor studies for proposed highway construction. Previous IGSRSL attempts at utilizing aerial photography for locating archaeological sites in Iowa have met with little success. It is expected that the detailed survey may improve results this time. Personnel from the State Archaeologist's office will help assess the effectiveness of this photography.

J. Evaluation of Several Film Types for Soil Mapping. The U. S. Soil Conservation Service and the ISU Agricultural Extension Service are cooperating with RSL in evaluating the relative merits of color, color-

infrared, and black-and-white photography for soil mapping. The test is being conducted by the soils team mapping Johnson County. Some test areas have been studied and each film type has shown some inadequacies for soil mapping. However, superior soil moisture detecting capabilities of color-infrared film have been clearly demonstrated. Final evaluation will be made with major input from the Johnson County soil mapping team.

Color-infrared imagery was obtained in June, 1975, over the Mississippi River valley in Des Moines and Louisa Counties. The complexity of bottomland soils and the sensitivity of color-infrared film to moisture variations led the Soil Conservation Service to request this imagery. The imagery will be used to aid soil mapping programs in those counties.

K. Environmental Studies. Two cooperative studies have been undertaken with the Iowa Department of Environmental Quality and the U. S. Environmental Protection Agency.

In August, 1974, color-infrared photography was obtained at an enclosed feedlot in northwest Iowa. Violations of their permit to operate were suspected. The imagery clearly indicated apparent permit violations in the construction and management of the tile system. The imagery is now being utilized by a consulting engineering firm to bring the feedlot into compliance with the feedlot's original permit.

E.P.A. has acquired imagery over an 11-county region in south-central Iowa. The inventorying of feedlots, junkyards, strip mines, outfalls, and waste treatment facilities has been completed for Monroe, Wapello, and Lucas Counties. Similar imagery and interpretive work was scheduled for May, 1975, for 12 counties in northwest Iowa, but airplane scheduling difficulties on the part of E.P.A. and NASA have, at least temporarily, stalled this activity.

L. Consultation with Other Governmental Agencies and Private Companies. As part of our duty to provide information and assistance to governmental agencies and the private sector of Iowa, the Remote Sensing Laboratory receives requests for information on how to utilize remote sensing for some particular application.

Planning agencies have requested help on acquiring current landuse data, handling the data, and displaying this data. During the past year, we have cooperated to some extent with East Central Intergovernmental Association, Bi-State Metropolitan Planning Commission, Mid-Iowa Development Association Region Planning Commission (MIDAS), Siouxland Interstate Metropolitan Planning Council, Central Iowa Regional Association of Local Governments, Area XV Regional Planning Commission, Linn County Regional Planning Commission, and the Johnson County Regional Planning Commission. Our cooperation with MIDAS includes cooperative effort by the Agricultural Extension Service of Iowa State University.

Private companies have requested information on locating tile systems in fields and locating sand and gravel deposits.

The State of Missouri has sent a forester to the Remote Sensing Laboratory to utilize equipment that we have and to request information on useful techniques for forestry applications of remote sensing.