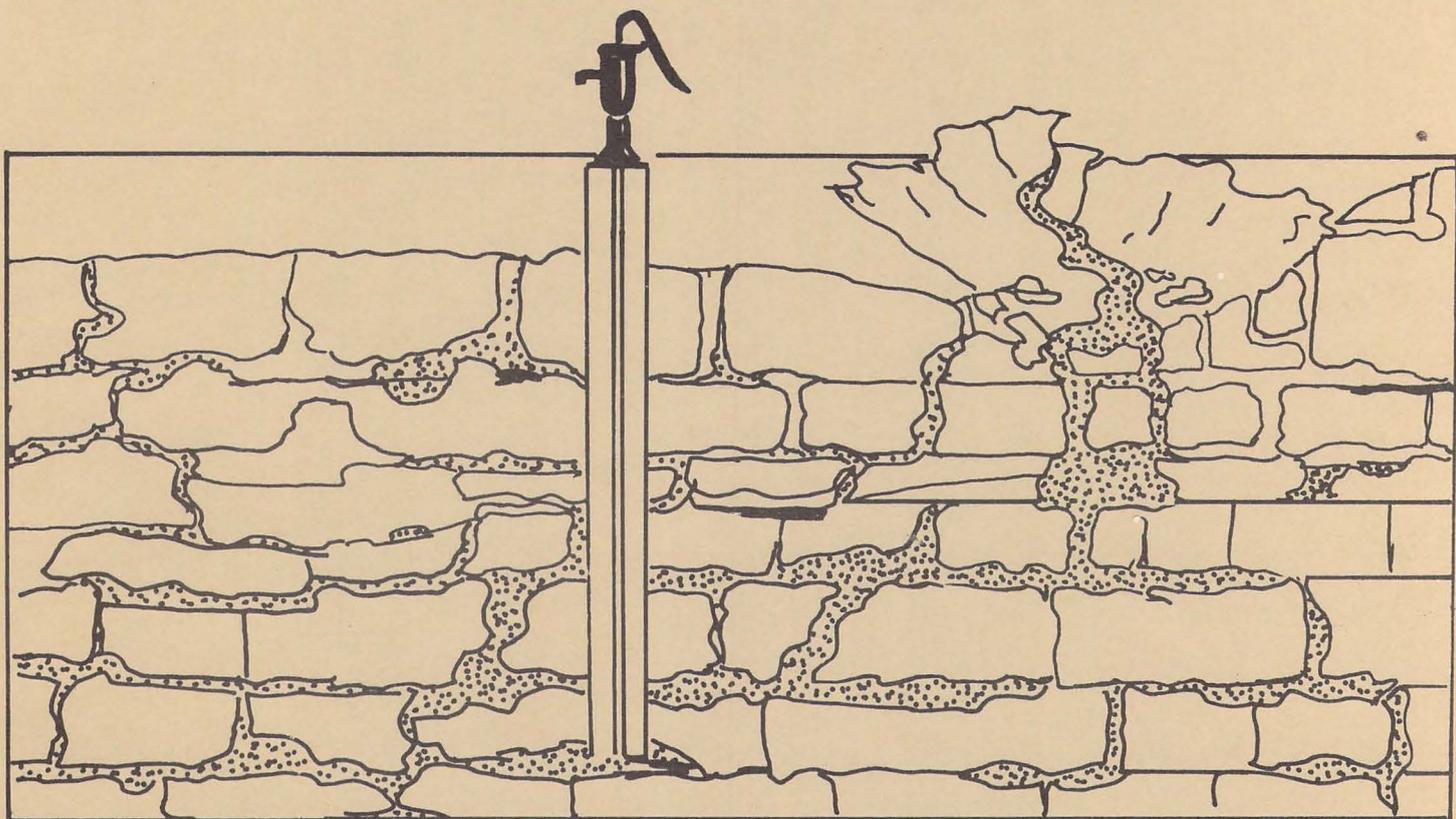


# IOWA GEOLOGICAL SURVEY



ANNUAL REPORT  
1986

**ANNUAL REPORT**

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THIS AGENCY IS NOW PART OF THE IOWA DEPARTMENT OF NATURAL RESOURCES.  
PART OF THE INFORMATION PRESENTED HEREIN REPRESENTS ACTIVITIES WHICH  
HAVE OCCURRED SINCE JULY 1, 1986 WHEN THIS NEW DEPARTMENT WAS CREATED.

**Volume 56**  
**1986**

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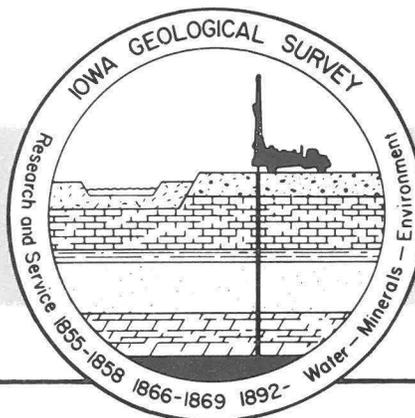
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# Geological Survey Bureau

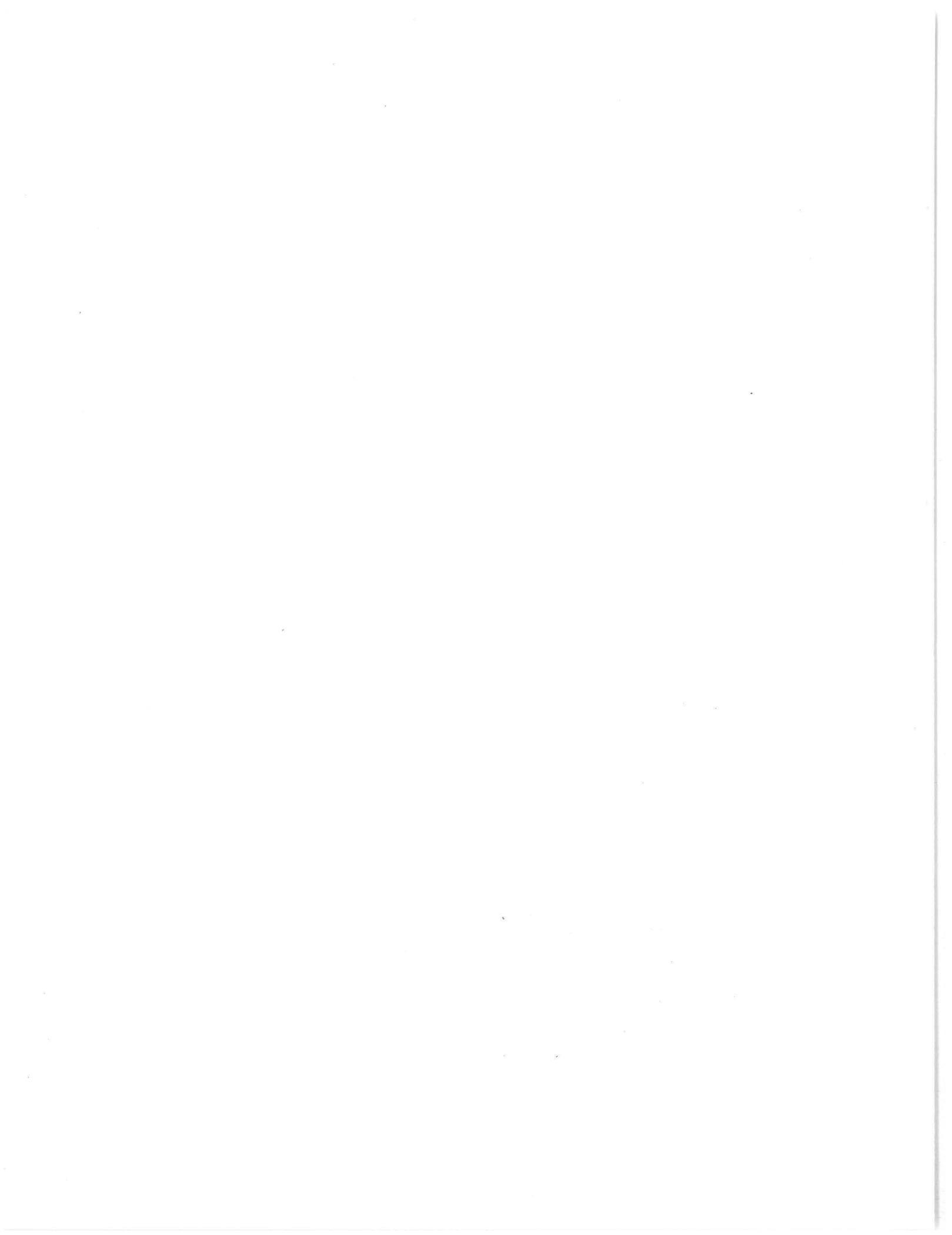


The Iowa Geological Survey was established as a public service and research agency in 1892, following two earlier reconnaissance surveys of Iowa geology commissioned between 1855 and 1859, and again from 1866 to 1869. The Survey was charged with the responsibility "...to make a complete survey of the natural resources of the state in all their economic and scientific aspects..." Today, as the Geological Survey Bureau (GSB) of the Energy and Geological Resources Division, Iowa Department of Natural Resources, GSB has the responsibility to collect, manage, interpret, and report geologic and hydrologic information that is relevant to Iowa's resource development and protection.

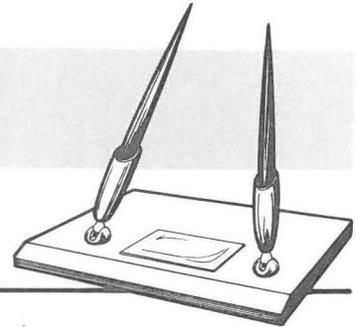
Geological resources, including groundwater, are vital elements in our state's future. Iowa has significant water, mineral, rock, soil, and energy resources, but they are finite; they are distributed unevenly in terms of quantity and quality; and often they are vulnerable to contamination and misuse. Further, there are competing interests for their development and utilization. The State needs a technically qualified source of geologic/hydrologic information to provide balance and credibility in the resolution of many related natural resource issues.

GSB acquires and maintains basic resource data directly through DNR-supported programs and through cooperative agreements and contracts with other state and federal agencies. GSB's staff interprets geologic and hydrologic data in response to both immediate and long-range needs identified in the areas of water supply, environmental protection, and economic development. Assistance to the public is provided through publications, public presentations, and most commonly, by personal response to specific questions raised by public officials, engineers, lawyers, and private citizens.

Through the years, the GSB has acquired invaluable resource information in response to the state's needs. The data bases grow daily; tools for data management and analysis improve regularly; and the staff continues to provide unbiased, reliable information to all. This report provides a summary of GSB's activities during 1986.



# Bureau Management

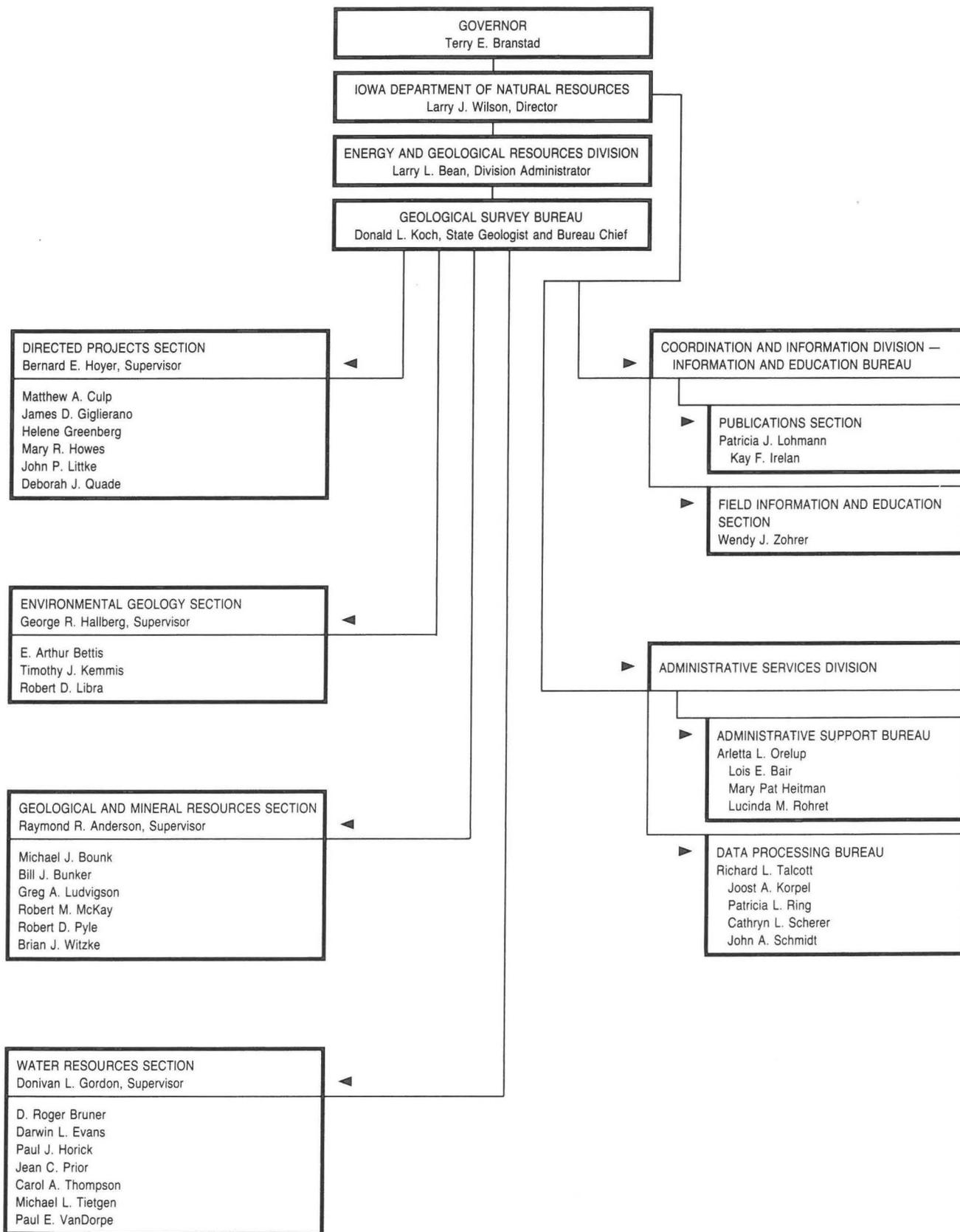


## **STATE GEOLOGIST AND BUREAU CHIEF**

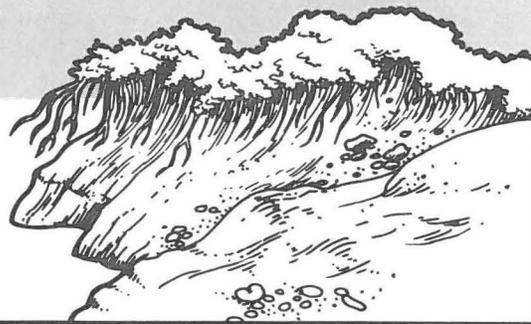
The State Geologist and Bureau Chief is appointed by the Director of the Department of Natural Resources (DNR). It is the State Geologist's responsibility to plan and manage GSB programs so that service and research objectives may be met. The State Geologist represents the DNR on various advisory councils and committees pertaining to natural resource matters.

## **ORGANIZATION AND STAFF**

The GSB consists of four operational sections: Environmental Geology, Geological and Mineral Resources, Water Resources, and Directed Projects. At the conclusion of 1986, GSB had 29 full-time authorized positions, including 24 geologists and geohydrologists. A table of organization is provided on the following page.



# Environmental Geology Section



## ENVIRONMENTAL GEOLOGY

Investigations of groundwater contamination by agricultural chemicals have continued in cooperation with various state and federal agencies. The studies continue to focus on the Big Spring Basin in Clayton County and on Floyd and Mitchell counties. Studies completed in 1986 corroborate previous results and continue to provide necessary information for assessing groundwater protection policy needs. These data indicate that contamination of groundwater from agricultural chemicals is common in the shallower recharge areas of bedrock aquifers, shallow drift aquifers, and alluvial aquifers. A review of data statewide suggests that nonpoint-source agricultural chemical contamination of aquifers may be more severe in western Iowa than in northeastern Iowa.

Increased and excessive nitrogen fertilization and poor nitrogen management have resulted in nitrate concentrations in groundwater which are above accepted health standards. In 1984 over 40 public water supplies exceeded the health standard for nitrates. Studies in northeastern Iowa have shown that in a wet year, an equivalent of over 50 percent of the fertilizer-nitrogen applied may be lost to groundwater and surfacewater; even in a normal year, more than 30 percent may be lost. These data clearly show that the losses are an economic as well as an environmental concern.

Increased pesticide usage on corn and soybeans has resulted in contamination of groundwater by pesticides. Many of the most commonly used herbicides have been detected in groundwater in Iowa; some now occur throughout the year. These pesticides generally appear in very low concentrations (0.1 to 1.0 parts-per-billion) but locally have exceeded 20 parts-per-billion. The continuous record from GSB studies, coupled with information from the University Hygienic Laboratory, indicates that pesticide residues are increasing in groundwater, perhaps analogous to the rise in nitrates of a decade ago. The long-term health effects from such chemicals in drinking water are unknown. These studies have been partially supported by the U.S. Environmental Protection Agency (EPA) during the past year; analytical costs have been partially supported by the DNR's Environmental Protection Division and the University of Iowa Hygienic Laboratory. Evaluation of agricultural drainage wells is the focus of research in Floyd and Mitchell Counties. Through a contract with the U.S. Environmental Protection Agency, GSB collected repetitive water samples from wells constructed to monitor various aquifers. Soils and unconsolidated sediments generally are thicker in Floyd and Mitchell counties as compared with the Big Spring Basin. Consequently, background levels of nitrates and pesticides are slightly below concentrations from wells in the Big Spring Basin. However, concentrations increase dramatically after rainfall and snowmelt events and then return to background levels within two to three weeks.

Elements of a seven-year program for the Big Spring Demonstration project in northeast Clayton County, including project goals, study methods, and participating agencies were described in the 1985 Annual Report. The Big Spring Basin Demonstration Project is designed to demonstrate and document economically viable techniques to protect groundwater from nonpoint-source contamination by agricultural chemicals. Through this project, groundwater protection is expected to occur as more efficient ag-chemical management is documented and farm managers voluntarily employ alternative management practices in their farming operations. The project also includes economic analyses of management practices, a careful evaluation of surfacewater and groundwater quality, and an evaluation of how effective educational programs can be to implement a non-point source groundwater-protection strategy.

### CONSULTATIVE INVESTIGATIONS

GSB has always performed special investigations for Iowa's regulatory bodies, such as the DNR's Environmental Protection Division, the Department of Agriculture and Land Stewardship's Division of Soil Conservation and the Department of Commerce. For investigations that require excessive amounts of time, travel, or other costs, the agencies may share the cost burden, but for the majority, GSB absorbs the cost. These investigations generally cannot be foreseen, and always interrupt the scheduling of other planned projects. Thus, flexibility must be built into GSB's longer-term projects.

#### Toxic and Hazardous-Waste Sites

Staff have provided general information to the Environmental Protection Division and the U.S. EPA on numerous sites involved with the Resource Conservation and Recovery Act and Superfund programs. Site reviews generally include evaluating the general hydrogeologic setting, identifying and detailing the nature of groundwater supplies used in the area, and evaluating monitoring plans.

Staff have also provided more detailed investigations of sites for the Environmental Protection Division (EDP) and county or local health departments and fire marshals involving pesticide dumps and spills, hazardous-waste disposal, and petroleum leaks and spills. These projects have involved investigative field work, review of consultants' reports, testimony at formal proceedings, and oversight of clean-up operations in some cases. In this general area, review of progress and data from the LaBounty arsenic disposal site and review of remedial programs for the Des Moines TCE problems are continuing efforts.

#### Other Water and Land Issues

Staff of the Environmental Geology Section routinely provided review and information on a number of other issues including:

1. Design and analysis of pumping tests for EPD well-permit hearings.
2. Consultation on natural land-boundary disputes.
3. Continuing consultation on Indian land cases along the Missouri River.
4. Review of new rules and regulations proposed by Iowa and federal regulatory agencies.

## Site-Development Potential

As development costs increase, it has become more common to seek preliminary information on alternative sites before expensive on-site investigations are undertaken. Of particular note are requests (primarily from eastern Iowa and the Des Moines area) for information concerning engineering-geologic conditions for foundations and/or potential problems for new commercial/industrial construction. The requests have come directly from commercial/industrial firms, from engineering-consulting firms or architectural firms which represent clients, and from various state and local government agencies involved with commercial development. As GSB expertise in this area has become better known, the number of requests has risen.

Parallel to these inquiries have been information requests regarding general soil-geologic and drainage conditions, the suitability of sites for sewage disposal, water and utility lines, and the possible economic value of soils in various development areas. These requests have come from state, local, and federal agencies, several Iowa municipalities, regional planning agencies, and private firms and individuals.

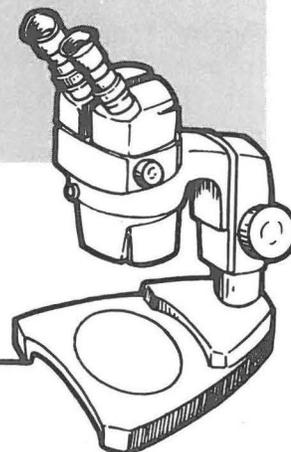
## Cooperative Applied Soils Research

Staff of the Environmental Geology Section direct, coordinate, and/or participate in ongoing cooperative research programs of the Iowa Cooperative Soil Survey (USDA-Soil Conservation Service and Iowa State University Experiment Station and Extension Service) and the Geotechnical Research Group, Department of Civil Engineering, Iowa State University. These programs are designed to assist and improve soil-survey operations and to evaluate engineering properties and problems associated with soil mapping units or geologic units, as appropriate.

As an ongoing part of the cooperative applied soils research, GSB provides geologic data and topographic maps to aid in the initial stages of county soil surveys. Section staff participate in field reviews to assess mapping problems. GSB serves as an ex-officio advisor to the Cooperative Soil Survey Planning Group.



# Geological and Mineral Resources Section



## BASIC GEOLOGIC DATA ACQUISITION AND STUDY

Basic rock data in Iowa are developed from the systematic collection and study of rock chips collected from drilled wells (well cuttings), continuous cores of rock obtained from GSB research programs or industry, and exposures of rock in quarries, along road cuts, or along streams and rivers. By far the largest amount of data are derived from well cuttings. Of the 90 Iowa well drillers contacted in 1986, 22 save samples for the GSB on a regular basis, 31 save samples periodically, and 37 save samples of individual wells at our request. Their cooperation is vital to our understanding the geology of Iowa. Implementation of the new program for registration of drilling contractors by EPD will increase the number of drill sample sets to be processed and studied. The following table provides a summary of research activity during 1986.

### GSB Rock Samples Received, Processed, and Studied in 1986

	<u>Number of wells or sites</u>	<u>Total Feet</u>
Samples received:		
Well cuttings	300	53,000
Rock cores	8	7,000
Well cuttings processed	162	30,000
Samples studied:		
Well cuttings	107	34,000
Rock cores:		
Detailed logs	18	2,873
Reconnaissance logs	2	388
Outcrops studied:		
Detailed measurements	24	1,082
Reconnaissance measurements	6	1,800

The well cuttings, rock cores, and outcrops studied during 1986 add to the information previously compiled. Following are actual counts and estimates of the total rock data available at GSB at the end of 1986.

Rock Samples Received, Processed, and Studied Through 1986

	<u>Number of wells or sites</u>	<u>Total Feet</u>
Samples received:		
Well cuttings	28,346	7,603,000
Rock cores	821	104,920*
Well cuttings processed	27,751	7,330,000
Samples studied:		
Well cuttings	20,587	7,564,000
Rock cores:		
Detailed logs	119	14,898
Reconnaissance logs	259	32,088
Outcrops studied:		
Detailed measurements	2,059	62,582
Reconnaissance measurements	2,011	61,850

\*Most cores are not complete from top to bottom. The number represents the feet of core collected from the 821 holes. The core was recovered from holes which represent about 368,300 feet of section.

The backlog of unstudied wells is large, and new EPD water-well permitting rules will increase our backlog. Following is a tabulation of unstudied well data.

Unstudied Wells (Rock Cuttings)

	<u>Number of Wells</u>	<u>Approx. Footages</u>
Bedrock wells:		
Iowa wells	4,935	750,000
Out-of-state wells	20	6,000
Wells not reaching bedrock:		
Iowa wells	2,760	279,200
Out-of-state wells	<u>26</u>	<u>3,000</u>
TOTAL	7,741	1,032,200

Additionally, about 53,160 feet of core has been collected which is currently unstudied. The study of rock cores is very time consuming, but rich in information. Normally, cores are studied only in direct response to particular problems. Their availability is invaluable, however, because even if they are not fully studied immediately, their curation provides a rich source of information for researching future problems.

## RESEARCH PROJECTS

### Iowa Stratigraphic Study

The Stratigraphic Study is a comprehensive reevaluation of the entire rock sequence in Iowa. It includes a restudy of each geologic system and constitutes the major research effort of the Section. Reports on each geologic system will be completed before the centennial year of the Geological Survey Bureau in 1992.

To conduct this study, previous data are being merged with new data collected in the field. These data are often analyzed in ways which were not available previously. Rock exposures in quarries and along road cuts and streams are being carefully described and sampled. Rock descriptions are being combined with microscopic examination, especially petrographic and micro-paleontological analyses, in order to recorrelate the rocks and aggregate them into more appropriate units. Geophysical logs and geochemical data which were not available earlier are also an integral part of this restudy of Iowa's rock sequence.

The work completed to date on the Stratigraphic Study has been very useful in a number of on-going projects. Maps and cross sections have been widely distributed to exploration geologists in the petroleum industry and were the primary data source used in locating several drilling sites. New stratigraphic interpretations have also been instrumental in groundwater quality and quantity studies presently in progress in northeast and north-central Iowa and will be an integral part of a current groundwater study in southwest Iowa. Additionally, the stratigraphic study benefits such cooperative studies as the U.S. Geological Survey Midcontinent Strategic and Critical Minerals Program, the Decade of North American Geology program, and the Deep Observation and Sampling of the Earth's Continental Crust project.

### Decade of North American Geology (DNAG)

Staff from the Geological and Mineral Resources Section (GMRS) participated in a number of projects related to the Geological Society of America's massive compilation of geological information for a centennial observance, the "Decade of North American Geology." Witzke and Bunker completed a summary of Phanerozoic geology of the central midcontinent (Iowa, Nebraska, Kansas, western Missouri). Additionally, GMRS produced descriptions and stratigraphic sections of seven rock exposures in Iowa, for inclusion in the DNAG guidebook series. The completed sequence of DNAG publications will provide the base for many future geologic studies and exploration projects in North America.

### Midcontinent Strategic and Critical Minerals Programs

In 1986 the Section continued its participation in the Midcontinent Strategic and Critical Minerals Program (MSCMP), a U.S.G.S.-sponsored study of geology and mineral resources in Iowa and portions of eleven surrounding states delineated by latitudes 36°N to 44°N and longitudes 88°W to 100°W. Anderson continued to direct the study of the rocks of the Midcontinent Rift System in Wisconsin, Minnesota, Iowa, Nebraska, and Kansas. He also conducted a meeting of key scientists in Denver and supervised the collection of gravity data for studies of another ancient rock system, the Trans-Hudson Orogenic

Belt, as a part of MSCMP. Additionally, Anderson compiled a map of "Phanerozoic Structural Features in the Northern Midcontinent, USA." The map will be used as a tool to help identify major structural zones and potential mineralization. The Iowa maps and cross sections compiled in 1986 for the MSCMP include:

1. Phanerozoic Structural Features in the Northern Midcontinent, U.S.A.
2. Isopach of Mississippian Carbonates in Iowa.
3. Limestone/Dolomite Isopleth of Mississippian Carbonates in Iowa.
4. Lithostratigraphic Cross Section of the Total Mississippian System Along 41° Latitude in Southern Iowa.
5. Lithostratigraphic Cross Section of the Total Mississippian System Along 42° Latitude in Central Iowa.

#### Fossil Amphibian Site Discovered

A significant fossil amphibian site was discovered by McKay (GMRS) and former GSB geologist M. Patrick McAdams in 1985. The site, an unexpected product of field studies associated with the Stratigraphic Study, contains the preserved remains of the oldest known amphibians in the United States. The site was excavated during the summer of 1986 in cooperation with staff of the Field Museum of Natural History, Chicago with partial funding from the National Geographic Society. Preliminary collections and stratigraphic studies have been completed, and an article describing the site and the fossils has been prepared and submitted to *Science* for publication. Fossil preparation, study and curation is continuing at the Field Museum of Natural History.

### SERVICE

#### Oil and Gas Exploration in Iowa

In 1986 Section staff we responded to about 100 requests for information on oil and gas exploration in Iowa. These requests included technical information for petroleum exploration and service companies, general information to Iowa residents, and interviews with the media. During the year, GMRS was contacted by three major oil companies, 12 independent oil companies, and six consultants and service companies. Geologists from five companies visited our offices for information and to examine samples in our rock library.

The Bombei #1, drilled in Washington County in 1985 by CST Oil and Gas Corp., was developed in 1986. The well produced only about 75 barrels of oil before it was plugged and abandoned. Also in 1985, AMOCO announced plans to drill a deep petroleum exploration test hole in Carroll County in 1986. Sharp declines in the price of crude oil resulted in postponement of the spring startup date, but site preparation was initiated late in 1986 for reactivation of the project in the spring of 1987. The test will be the first exploration of the Midcontinent Rift in Iowa and only the second test well along the rift's 700-mile length. The well is projected to reach a total depth of between 15,000 to 18,000 feet, shattering Iowa's previous well depth record of 5,305 feet. It will cost an estimated \$4 to \$6 million.

#### Service to Iowa's Mineral Industry

In 1986 the Section responded to 25 requests for information from Iowa's stone, clay, gypsum, and sand and gravel producers. These included visits to

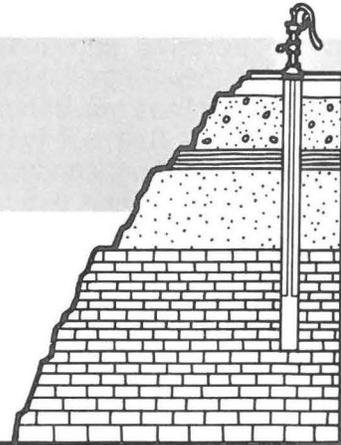
an underground mine in Scott County to provide advice on iron sulfide contamination of their high calcium limestone resources, and to an underground mine in Louisa County to assist in the resolution of problems associated with the presence of numerous pockets of clay in the limestone being produced.

#### Service to the Public

GMRS geologists responded to over 400 requests for geological information in 1986. These requests covered a variety of subjects including latitude/longitude determinations, elevations, resource assessments, rock identifications, oil exploration and leasing, earthquake potential, rock and fossil collection locations, and a variety of other topics. In addition, staff organized and conducted several field trips which explored geologic features of interest with the scientific community and general public, and gave talks on petroleum exploration in Iowa and recent stratigraphic studies.



# Water Resources Section



## SERVICE ACTIVITIES

### Well Forecasts and Advice on Groundwater Problems

During 1986, Section staff responded to over 500 individual requests for advice on the development of new wells or procedures to be followed in correcting specific well problems.

A typical well forecast is a letter report that provides site-specific information on the thickness and sequence of geologic formations to be encountered during drilling, formations that will provide water, the anticipated rates of yield, and the expected quality of water. Depending on the detail and precision required by the request, an individual report may take from four to over eight hours to prepare. Approximately 20% of the Section's staff time was spent on this and related activities. Requests for information come from a variety of sources. Approximately 30 percent of requests come from local, state, or federal government agencies. Individual domestic requests comprise 25 percent, while a variety of commercial sources constitute about 21 percent of all requests.

### County Groundwater Reports

During 1986, Section staff published two new groundwater availability studies for Hamilton and Iowa Counties, bringing the total number of these reports to twenty-one. Each report presents the general geologic setting, depths to potential water-bearing zones, expected water quality of each zone, anticipated yields, a list of drilling contractors serving the area, and a list of agencies that may be contacted for assistance on water-supply questions.

Assistance to the Division of Soil Conservation, Dept. of Agriculture and Land Stewardship; and Coal Mine Operators.

During 1986, numerous written and telephone responses were made to coal miners, state and federal mine regulators, and private parties regarding information and technical assistance on coal occurrence and quality, underground mine maps, and mine-subsidence problems.

Section staff continued to assist in the technical review of coal mine

operators' permit applications and subsidence control plans. Such plans are required for new coal mine operations before permitting. The Section also aids in coordinating other coal-related activities of the Division of Soil Conservation. One activity in this area is the restoration of historic mine maps which is being conducted by the Iowa State Historical Department. This work is funded by the U.S. Office of Surface Mining, administered by the Division of Soil Conservation, and coordinated by GSB staff. Other functions in this area included continued work on the Iowa Mine Lands Data System and the completion of the study of coal mining and subsidence phenomena in Appanoose County. This work is funded by the Iowa Abandoned Mine Lands Inventory program.

## RESEARCH ACTIVITIES

Although a key goal is to assist Iowa's industries, businesses, communities, and citizens in the development of water supplies to meet their needs, there also is an awareness that the state's water resources are limited. Research objectives have been adjusted to consider the budgeting aspects of groundwater management -- how much is available; what rates of withdrawal can be sustained; how much is used, where and for what purposes; and how much additional water can be safely allocated. Because future state water-allocation strategies are being developed, these kinds of information are receiving a high agency priority.

### Municipal Water-Supply Inventory

A comprehensive inventory of the water supplies of the state's regulated municipalities, initiated in 1981, continues to be updated. The project has expanded our knowledge of community water developments and allows the DNR to be more effective and efficient in serving Iowa communities. The data derived, in part, from files maintained by the six field offices of the Environmental Protection Division.

The data compiled include: location and design of wells; geologic source of water; rates of pumping; water use and water quality. These data have been merged with existing GSB data to generate a comprehensive information base. The data have been coded and entered into the Municipal Water-Supply Inventory (MWSI) file, which is currently accessible on INFO on the University of Iowa PRIME computer system. The MWSI is being transferred and implemented on the Integrated Data Management System (IDMS) in Des Moines. This final step will allow MWSI to be used by EPD staff in Des Moines, its six field offices, GSB, and any other user with access to IDMS.

MWSI will be updated on a "daily" basis by Section staff when MWSI is on-line. This will allow current or new information to be available to all users as soon as information is made available. Water quality data will also be added on a real-time basis. Report generation capabilities will be used to tailor the information to each individual request either by geographic area, such as well, community, county, region, or state, or by parameters, such as aquifer, well depth, water use, community population, or treatment.

The MWSI includes information on 814 municipal supplies and 30 rural water associations. Ninety-four percent of the municipal supplies and seventy-three percent of the rural water associations rely at least in part on groundwater. Six percent of the municipal supplies and twenty-seven percent of rural-water associations use surfacewater. There are nearly 2,000 active municipal-supply wells in the state, an average of about 2.6 per community.

About seventy-five percent of the state's population is served by municipal water supplies.

### Alluvial Aquifers Program

The assessment of alluvial aquifers in northwest Iowa, which first began in 1981, has continued throughout 1986. Monthly or bi-monthly water sample collection continued through October, 1986 at 65 wells and 14 surfacewater sites. A total of 964 samples were collected for nitrate analysis: 125 surfacewater and 839 groundwater. Although nitrate levels frequently were found in concentrations  $>5$  mg/l, only seven percent of the samples exceeded the maximum contaminant levels (MCL) for nitrate of 45 mg/l.

Results to date show that nitrate concentrations vary temporally and generally rise in response to increased infiltration associated with precipitation. Vertical stratification of nitrate has been found in each of the alluvial systems. Generally, nitrate levels decrease with depth and the highest concentrations are found in the top 10 feet of the saturated aquifer. Denitrification, the transformation of nitrate to nitrogen gas, has been hypothesized to occur along parts of the Ocheyedan and Des Moines alluvial systems. It apparently does not occur to any great extent along the Little Sioux alluvial system south of Cherokee or in the Rock alluvial system. This may, in part, explain the higher nitrate concentrations observed in these systems.

Nitrate concentrations are highest in the Rock alluvial system. Reasons for this difference in nitrate concentration are related to aquifer thickness, land use, topography, soil type, and chemical transformations of the nitrate.

Seventy-six samples were collected in 1986 for pesticide analysis. Atrazine and metolachlor are the only varieties detected in the monitoring wells. Atrazine, cyanazine, metolachlor, alachlor, and carbofuran have all been detected in surfacewater. Pesticides concentrations have all been below acute toxicity levels.

Four wells were installed near Emmetsburg in Palo Alto Co. in the late fall of 1986. These wells were installed in the till adjoining the Des Moines alluvial system.

Additional money for sampling in 1987 has been provided by the Environmental Protection Division for continued monitoring of northwest Iowa alluvial aquifers.

### Water Resources of Northeast Iowa

A regional water atlas covering eleven northeastern Iowa counties is in preparation. The objective of this project is to summarize the availability, quality, and use of water in an area which includes: Howard, Winneshiek, Allamakee, Chickasaw, Fayette, Clayton, Bremer, Black Hawk, Buchanan, Delaware, and Dubuque counties. This atlas is nearly ready for publication.

### Southwest Iowa Groundwater Study

A four-year cooperative program between GSB and the U.S. Geological Survey, is studying groundwater availability in southwest Iowa. The study area comprises the following counties: Pottawattamie, Cass, Adair, Mills, Montgomery, Adams, Fremont, Page, and Taylor. The first project year, 1985, was devoted to the researching, collating, and evaluation of extant data on the Dakota, buried-channel, and alluvial aquifers of the region. Because the deep rock aquifers of the region are highly mineralized, the previously men-

tioned aquifer systems are the focus of the investigation. Locally, however, the Pennsylvanian system may also be evaluated. Field work, test drilling, and monitoring well installation were conducted during the summer of 1986 and will continue in 1987.

The project is scheduled for completion in 1988. The objectives of the project are to define the occurrence, development potential, and water-quality characteristics of groundwater in the Dakota, buried-channel, and alluvial aquifer systems.

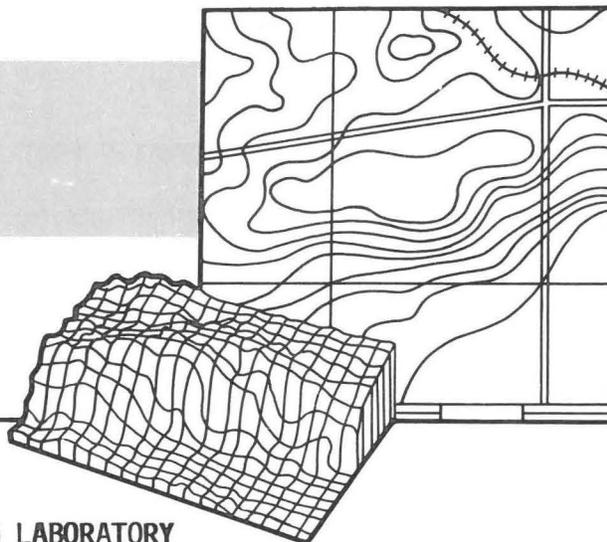
#### Skunk River Basin Project

This investigation is being conducted by GSB under contract with the U.S. Soil Conservation Service (SCS). The work is an element of a comprehensive study of the Skunk River Basin by SCS. GSB has prepared geologic and soil thickness maps for the Skunk River Basin, defined the groundwater resources of the basin, and evaluated trends in groundwater quality that may relate to land management practices in the study area. This investigation is nearly ready for publication.

#### Cedar Valley Aquifer, Charles City

GSB and EPD have concluded a study investigating the hydrology of the Cedar Valley Aquifer in the Charles City area. The study reevaluated the necessity for the current groundwater development restrictions that have been imposed by EPD to protect the aquifer from contamination by the La Bounty hazardous waste site. This study is nearly ready for publication.

## Directed Projects Section



### REMOTE SENSING LABORATORY

A statewide, digital database has been constructed which includes gravity, aeromagnetic, topographic, surficial imagery, and Precambrian surface information at a uniform resolution, scale and format. Manual and automated analyses have begun to investigate and evaluate possible interrelationships among surficial features and geologic structures and rock types buried deeply beneath Iowa soils. Special emphasis is being placed on evaluation of the Midcontinent Gravity Anomaly (MGA) and the basins which flank it on both sides; these features have received recent attention for hydrocarbon exploration. Side-looking radar imagery, acquired in November over the Omaha and Fort Dodge 1:250,000 scale map areas, will be added to the database when it becomes available and will be analyzed together with Thematic Mapper satellite imagery in detailed study areas over the MGA at a later time.

The geographic database at Big Spring was upgraded with the addition of land ownership data, drainage basin data, and Mapper imagery. These are important steps towards effective evaluation of groundwater as a part of the Big Spring Basin Demonstration Project.

### COAL RESOURCES INFORMATION

Coal resource information has been greatly enhanced through participation in the National Coal Resources Data System, a U.S. Geological Survey cooperative program, and the Abandoned Mine Lands Inventory, a program of the Office of Surface Mining administered through the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship. The compilation of extant coal data is nearing completion and the construction of a computerized database, the Iowa Mined Lands Data System, for all the data has advanced significantly.

Existing mine maps have all been restored. Most are currently available for reproduction and all are available for researching via the database. Unmapped mining sites have been fully researched in twelve counties. Coal resource data have been compiled throughout Iowa. These data have been entered into the database except for central and southwest Iowa counties. Coal outcrop mapping in twelve counties and digitizing of all coal reserves remain the major tasks for resource evaluation.

A special study of underground mining and subsidence was concluded in the Centerville area. This report is complete and should be available early in 1987. In addition, as a part of the Abandoned Mine Lands Inventory, four new mine sites were evaluated for the inventory and eleven sites on the national

inventory were reevaluated.

### GROUNDWATER PROTECTION PLANNING

A comprehensive groundwater protection strategy was developed for the Environmental Protection Commission during 1986. Working through the Coordination and Information Division, Iowa's first plan evolved with the cooperation of other state agencies and various private groups. After approval by the Commission in January 1987, the plan will be delivered to the General Assembly and Governor for their consideration and action.

### U. S. GEOLOGICAL SURVEY COOPERATIVE PROGRAMS

#### Topographic Mapping

The cooperative topographic mapping program of the 1:24,000 scale topographic series was completed during 1986. Iowa is now the 25th state for which a complete set of topographic maps at this scale is available.

Significant progress has been made in the production of 1:100,000 scale county topographic maps. Thirty of the county maps have been published and are available from GSB as follows:

Allamakee	Delaware	Louisa
Adair	Fremont	Marion
Appanoose	Howard	Marshall
Audubon	Ida	Osceola
Benton	Iowa	Polk
Black Hawk	Jasper	Poweshiek
Clay	Jefferson	Shelby
Clinton	Johnson	Warren
Davis	Jones	Wayne
Decatur	Linn	Woodbury

#### Water Resources

During the past year, GSB has continued a cooperative program with the Iowa District Office, Water Resources Division, U. S. Geological Survey. The program is intended to collect, analyze, maintain, and publish data and information pertinent to understanding and managing Iowa's water resources.

Results of most data collection programs are maintained on computer files and published annually. Water Resources Data, Iowa Water Year 1986 will contain the data collected from the stream-gaging program, the groundwater monitoring project, and sediment data-collection project. The results of other projects are published at their conclusion. Reports are published either by the U. S. Geological Survey or GSB.

Stream-gaging program: The U.S. Geological Survey maintained 116 continuous-gaging stations on Iowa rivers, 125 crest-stage stations on Iowa rivers, and stage recorders on seven Iowa lakes. These records are vital to assessing our water resources and are especially useful and basic to any engineering studies along Iowa rivers. The U.S. Army Corps of Engineers is the largest contributor to the gaging program which is also supported by the State, municipalities, industries, and other organizations. State money for this purpose is channelled through GSB and is used to support 30 gaging sites as listed in the following table:

Continuous-Gaging Stations Cooperatively Supported: GSB-USGS

Stream	Station Number	Location
Big Cedar Creek	05412870	Varina, Pocahontas Co.
Cedar Creek	05473400	Oakland, Mills Co.
East Br. Iowa River	05449000	Klemme, Hancock Co.
East Fk. Hardin Creek	05483000	Churdan, Greene Co.
Iowa River	05449500	Rowan, Wright Co.
Little Sioux River	06606600	Correctionville, Woodbury Co.
Maquoketa River	05418500	Maquoketa, Jackson Co.
Middle Raccoon River	05483600	Panora, Guthrie Co.
Nodaway River	06817000	Clarinda, Page Co.
North Fk. Maquoketa River	05418450	Fulton, Jackson Co.
North Raccoon River	05482300	Sac City, Sac Co.
North Skunk River	05472500	Sigourney, Keokuk Co.
Ocheyedan River	06605000	Spencer, Clay Co.
Platte River	06818750	Diagonal, Ringgold Co.
Shell Rock River	05462000	Shell Rock, Butler Co.
Skunk River	05474000	Augusta, Des Moines Co.
South Skunk River	05470000	Ames, Story Co.
Tarkio River	06811840	Stanton, Montgomery Co.
Turkey River	05412500	Garber, Clayton Co.
Turkey River	05412500	Spillville, Winneshiek Co.
Wapsipinicon River	05411600	Elma, Howard Co.
Wapsipinicon River	05421000	Independence, Buchanan Co.
Weldon River	06898400	Leon, Decatur Co.
West Nishnabotna River	06807410	Hancock, Pottawattamie Co.
Winnebago River	05459500	Mason City, Cerro Gordo Co.

Continuous-Gaging Stations Cooperatively Supported: GSB-USGS-Corps of Engineers

Stream	Station Number	Location
Boyer River	06609500	Logan, Harrison Co.
East Nishnabotna River	06809500	Red Oak, Montgomery Co.
Floyd River	06600500	James, Plymouth Co.
Little Sioux River	06607500	Turin, Monona Co.
Soldier River	06608500	Pisgah, Harrison Co.

Sediment station program: Fourteen locations on Iowa streams were monitored periodically for sediment load carried by the stream. The stations that GSB cooperatively supports are indicated in the table below:

Sediment Stations Cooperatively Supported: GSB-USGS

Stream	Station Number	Location
Iowa River	05454500	Iowa City, Johnson Co.
Nodaway River	06817000	Clarinda, Page Co.
Ralston Creek	05455000	Iowa City, Johnson Co.
Skunk River	05574000	Augusta, Des Moines Co.

Groundwater monitoring: Approximately 200 groundwater-quality monitoring sites are sampled each year from this program. Sites are selected from different aquifers throughout the state and plans call for repeated water-quality sampling every five or six years.

Iowa River Aquifer: The alluvial aquifer between Coralville Reservoir and Belle Plaine is being monitored to evaluate water quality and resource availability. The results of this study will be published in 1987.

Southwest Iowa Water Supply: An evaluation of groundwater resources in southwest Iowa was begun in 1985. After extant data was compiled and evaluated, a drilling plan was developed for implementation in 1986. Drilling will continue in 1987 with results of the study published in 1988.

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