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IOWA WATER RESOURCES DATA:
COLLECTION PROGRAMS AND DATA SOURCES

*Iowa
Water Plan '78
NRC -
Management Study
New Report
NRC*

PREPARED BY
IOWA GEOLOGICAL SURVEY
WATER PLAN DIVISION
1978

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INTRODUCTION

The purpose of this survey is to identify and describe the state and federal programs for the collection of data on the water resources of Iowa and the data holdings of the collecting agencies. The survey is limited to the measurement, inventory, and monitoring programs currently operated on a routine basis. Since the programs, collection networks, and data holdings are described as they currently exist, some of the information in this report will necessarily be outdated in the future as programs are modified and new data become available. Historical changes, for example, in locations of collection sites or discontinued programs, are not documented. Special purpose, short-term data collection activities have generated considerable data about the water resources of the state, but no attempt has been made to survey these special projects. Many of the special projects and research reports are referenced in the "Bibliography of Iowa Water Resources" in the IWARDS Data Catalog (Iowa Water Resources Data System, Iowa Geological Survey, 1977).

The survey is organized in 5 sections, each covering a general category of water resources data: climate, surface water, ground water, water quality, and basin characteristics. The section on basin characteristics covers a variety of data types related to water resources, including soil types, soil moisture, drainage, topography, and available aerial photography, cartographic data, and maps.

In each section, the governmental agencies are identified and their programs for data collection are described. Characteristics of specific types of data under the general categories are given along with frequency of measurement and methods of data recording, storage, and distribution. Maps or

listings of the locations of data collection sites and of areas with available data coverage have been compiled for most programs. The last part of each section, titled "Sources of Data," is an annotated listing of published and unpublished sources of data, and brief descriptions of existing computer data management systems from which certain data may be obtained. An accompanying table summarizes the information about collecting agencies, programs, data types and their availability for each section.

This report would not have been possible without the cooperation and assistance of the many state and federal agencies involved in the collection of water resources data. Information about data collection programs was obtained through questionnaires and subsequent interviews with personnel in charge of programs and data holdings at the various agencies. The initial draft of the report was distributed for review in April 1978. The additions and comments received are reflected in this final report. The report was written by Jayne Harbaugh and by Donovan L. Gordon, who compiled information on ground water data and provided editorial assistance.

AGENCIES INCLUDED IN SURVEY

State Agencies:

- Conservation Needs Committee
- Cooperative Extension Service in Agriculture and Home Economics
- Drainage Districts
- Iowa Agriculture and Home Economics Experiment Station
- Iowa Department of Agriculture (IDA)
- Iowa Department of Environmental Quality (DEQ)
- Iowa Department of Soil Conservation
- Iowa Department of Transportation (IDOT)
- Iowa Geological Survey (IGS)
- Iowa Natural Resources Council (INRC)
- Iowa State Conservation Commission (ICC)
- Iowa State Department of Health (IDH)
- Iowa State University, Department of Agronomy, Climatology and Meteorology Section
- State Hygienic Laboratory (SHL)
- State Soil Conservation Committee

Federal Agencies:

- Earth Resources Observatory Systems Data Center (EROS)
- Federal Aviation Administration (FAA)
- Federal Insurance Administration (FIA)
- National Aeronautics and Space Administration (NASA)
- National Cartographic Information Center (NCIC)
- National Oceanic and Atmospheric Administration (NOAA)
 - National Climatic Center (NCC)
 - National Environmental Satellite Service (NESS)
 - National Weather Service (NWS)
- U.S. Agricultural Stabilization and Conservation Service (ASCS)
- U.S. Army Corps of Engineers (ACE)
- U.S. Bureau of the Census
- U.S. Environmental Protection Agency (EPA)
- U.S. Geological Survey (USGS)
- U.S. Soil Conservation Service (SCS)

CLIMATIC DATA

I. Agencies and Programs

A. National Oceanic and Atmospheric Administration (NOAA)

NOAA is the federal agency most active in collection of climatic data. There are 3 operational branches of NOAA directly involved:

1. National Weather Service (NWS) is responsible for data acquisition, mainly through weather station operations. Continuous or daily data on precipitation, temperature, evaporation, and weather conditions are collected through routine station operations. The NWS is also responsible for making flood forecasts in the United States. (See "Surface Water Data"). In Iowa, special rainfall data are immediately reported by station operators during severe storms and are also collected through dense networks of special rain gages in 15 designated "flash flood" basins.

2. National Climatic Center (NCC), a division of NOAA Environmental Data Service, is responsible for data storage, analysis, and dissemination through published data reports and copy services for unpublished data.

3. National Environmental Satellite Service (NESS) is responsible for operation of weather observatory satellites and the images obtained.

B. U.S. Army Corps of Engineers (ACE)

The ACE operates 32 precipitation and temperature gages in conjunction with reservoir and navigation projects in Iowa. Data

collected at about half of the gages are cooperatively shared with the NWS and the NCC for publication.

C. Federal Aviation Administration (FAA)

The FAA maintains weather observatory equipment at 4 FAA airports in Iowa: Burlington, Cedar Rapids, Mason City, and Ottumwa. Since the FAA provides the NWS copies of the data for storage and distribution through the NCC, the FAA stations are included in the NWS data collection networks in this report.

D. Iowa Natural Resources Council (INRC)

The INRC began a rain gaging program in 1975 to supplement precipitation data collection of the NWS. Up to 4 volunteers in each county record rainfall amounts from inexpensive rain gages provided by the INRC.

E. Iowa Department of Agriculture (IDA)

The IDA presently supports a Weather Division headed by the State Climatologist. This position functioned for several years under the NWS until 1974 when federal support was eliminated. It was reinstated in 1976 under state funding. The State Climatologist is responsible for archiving climatic data and making assessments of weather trends, summaries, and other public service assistance. Although no climatic data collection programs are directed, the State Climatologist, through cooperation with the NWS, maintains the most complete collection of climatic records in Iowa. Precipitation and temperature data and maps are reported through the "Iowa Crops and Weather" issued weekly from April through December and monthly from December through March.

II. Data Collection Networks

A. National Weather Service

There are 397 stations (gages) currently operated at 242 locations in Iowa (usually more than 1 type of gage at a location) from which the NWS receives data. Four of the locations are National Weather Service Offices (Des Moines, Dubuque, Sioux City, and Waterloo) and 4 are Federal Aviation Administration stations (Burlington, Cedar Rapids, Mason City, and Ottumwa). The other locations make up the cooperative substation network in which private citizens and organizations maintain observational equipment and record data for the NWS, all on a voluntary basis and many for small remittance. The NWS provides standard equipment and pays expenses for data reporting. The Des Moines Weather Service Forecast Office (WSFO) is responsible for NWS activities in Iowa. All weather station data are sent to the Des Moines WSFO from where they are forwarded to the NCC. Figures 1 and 2 show the locations of the NWS stations.

1. Precipitation

There are 138 nonrecording stations at which 24-hour amounts of precipitation are recorded. Continuous records of precipitation are obtained at 74 recording stations, 8 of which are equipped with telemeters for immediate transmission of data to the Des Moines WSFO.

In addition to routine data collection, special rainfall data are obtained to assist in making flood forecasts. Station operators make special reports to the Des Moines WSFO of rainfall amounts greater than 2.00 inches that occur in less than

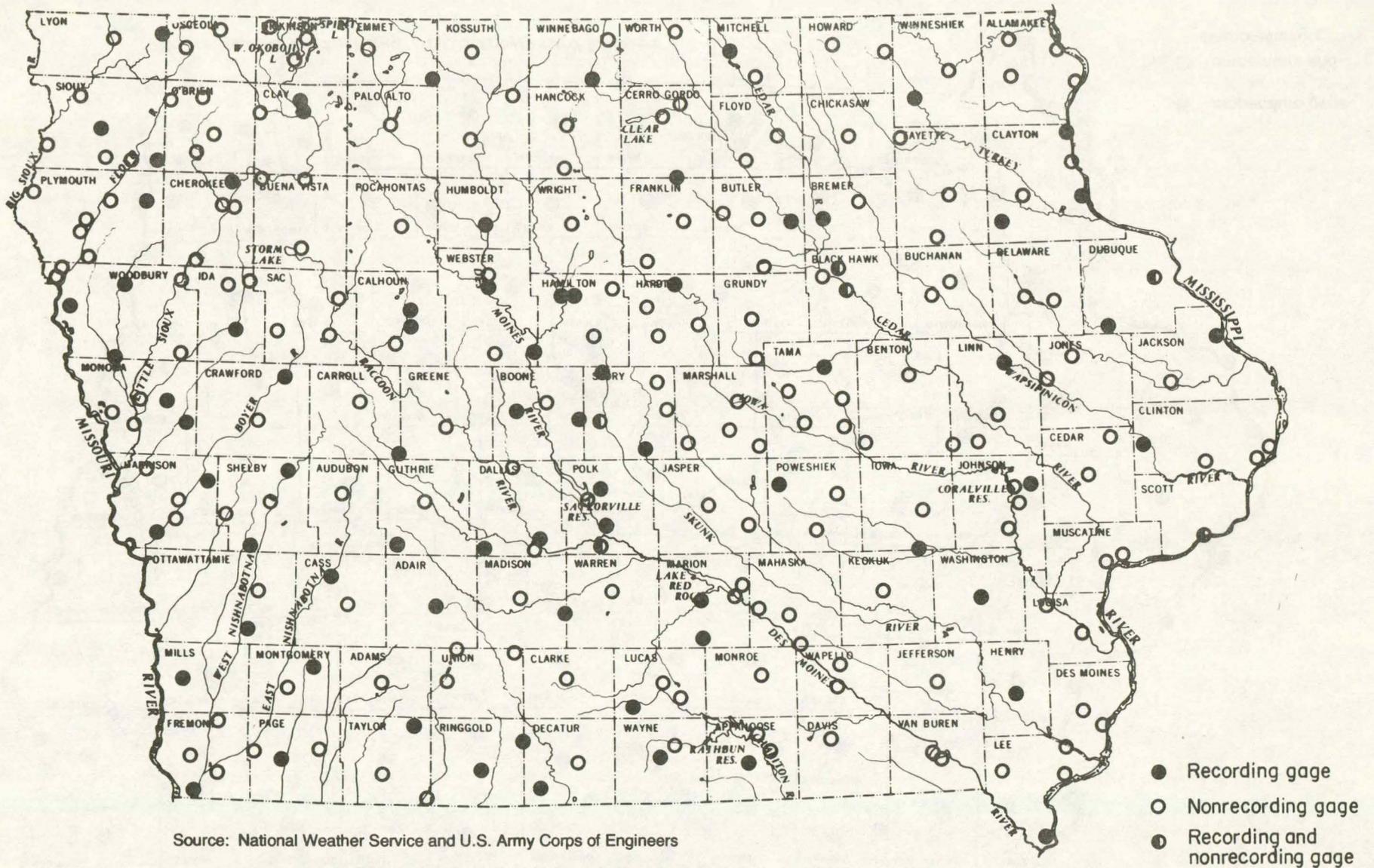


Figure 1. Locations of Precipitation Stations (1977)

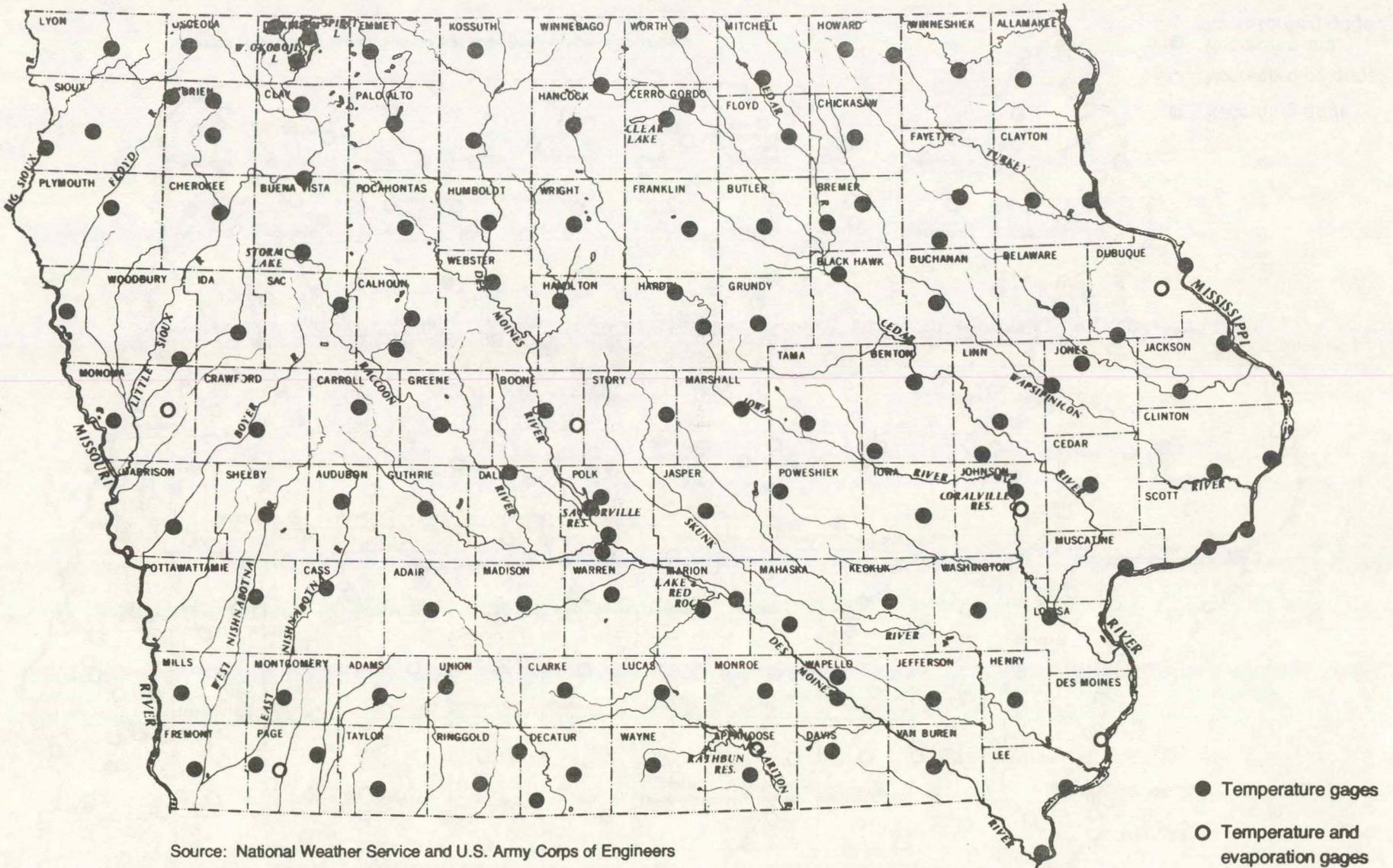


Figure 2. Locations of Temperature and Evaporation Stations (1977)

the normal 24-hour recording period. Special networks of simple rain gages have also been established throughout 15 "flash flood" basins in Iowa. The basins are located in or near urban areas and have histories of flash flooding. Local observers immediately report rainfall amounts from these gages to the Des Moines WSFO. (The flood forecasting programs of the NWS are further described in the "Surface Water Data" section of this report.)

2. Temperature

There are 124 stations where daily minimum and maximum air temperatures are measured. Hourly temperature data are also recorded at 8 of these stations (the 4 NWS stations and the 4 FAA stations).

3. Evaporation

Daily pan evaporation data are collected at 7 NWS stations during the period from April or May through October.

4. Weather Conditions

Detailed data on local weather conditions, such as type of weather, wind, and sky cover, are collected at the 4 NWS stations and the 4 FAA stations.

B. Army Corps of Engineers

1. Precipitation

The ACE operates 14 nonrecording and 7 recording precipitation gages in Iowa (fig. 1). Data for 7 of the nonrecording gages and for 3 of the recording gages are included in the NCC climatic data bulletins.

2. Temperature

Daily measurements of minimum and maximum air temperature are collected by the ACE at 11 stations (fig. 2). Data for 7 stations are included in the NCC climatic data bulletins.

C. Iowa Natural Resources Council

The INRC intends to establish a network of 4 rain gages in each county. Currently, 236 volunteers are participating in the program (fig. 3). The INRC provides inexpensive rain gages and pays reporting costs.

III. Data Types and Availability

A. Precipitation

1. Continuous Data

Continuous records of precipitation amounts are obtained at stations equipped with recording rain gages. Daily and hourly totals and maximum totals for hour and quarter-hour durations are compiled from continuous records and published in the NCC "Hourly Precipitation" bulletin. Daily totals for some recording stations are also published in the NCC "Climatological Data" bulletin along with nonrecording station data. Hourly totals are reported in the NCC "Local Climatological Data" bulletin for 5 stations: Burlington (FAA), Des Moines, Dubuque, Sioux City, and Waterloo. Unpublished data for the FAA stations at Cedar Rapids, Mason City, and Ottumwa are available from the NCC. Unpublished data collected by the ACE are held at the ACE District Office in Rock Island, IL.

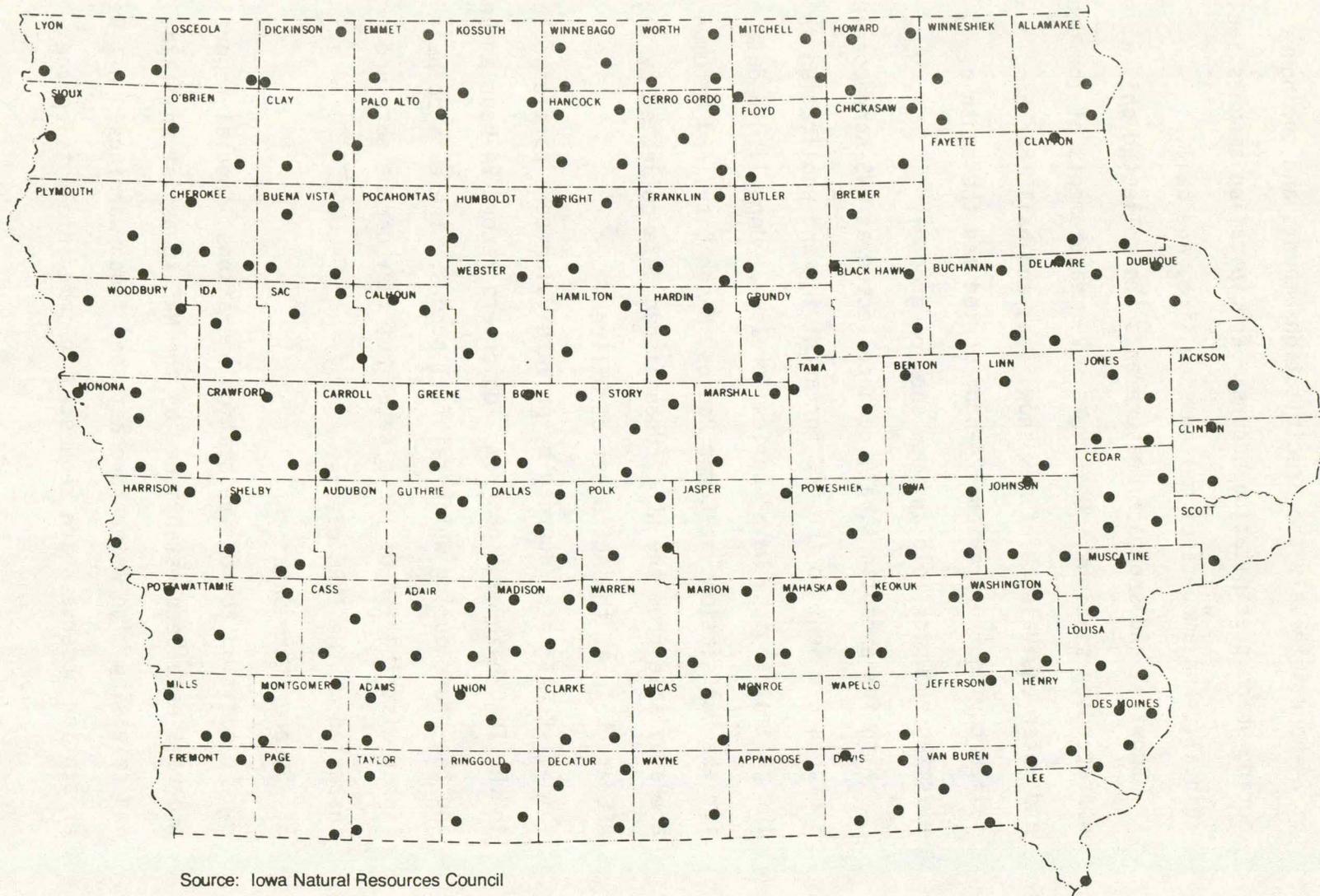


Figure 3. Locations of Iowa Natural Resources Council Rain Gages (1977)

2. Daily Data

At the nonrecording stations, local observers manually record at 24-hour intervals the precipitation amounts and the hours during which precipitation occurs. Precipitation amounts include rainfall, and amounts of melted snow, ice, and hail.

Snowfall and snowpack measurements are collected only at the nonrecording stations. Observers make measurements of the depth and water equivalence of new snow, ice, and hail that has fallen during the previous 24-hour period and the depth of existing snowpack (old and new snow on ground).

With few exceptions, all data collected at NWS nonrecording stations are sent to the NCC for archiving and publication in the "Climatological Data" series for Iowa. Unpublished data for the FAA stations at Cedar Rapids, Mason City, and Ottumwa are available from the NCC. Unpublished data collected by the ACE are held at the ACE District Offices.

Daily data are recorded by private volunteers participating in the INRC rain gage program. Observers record 24-hour amounts and the hours during which rainfall occurs. There is no published distribution of these data, but they can be obtained or inspected at the INRC office.

3. Severe Storm Data

In addition to routine station operations, special reporting programs have been established by the NWS to assist in making and releasing high water forecasts and flood warnings. All weather station observers are requested to immediately telephone

the Des Moines WSFO and report rainfall amounts in excess of 2.00 inches that occur in less than 24 hours.

Also, rainfall data are collected during storm events at the special rain gages established in designated flash flood basins. The data collected in conjunction with flood forecasts are not routinely published but are on file at the Des Moines WSFO. If related to severe storms or excessive flooding, general accounts of the storm rainfall may be published in the "Storm Data" bulletin of the NCC.

Following the occurrence of severe storms, "bucket surveys" and local interviews may be made to determine the extent and severity of storms. These data are not published but are held by the collecting agencies, principally the Des Moines WSFO and the INRC. The Des Moines WSFO holds these data for not more than 5 years.

B. Temperature

1. Hourly Data

Hourly air temperature observations are made at the 8 NWS and FAA stations. Only the observations at three-hour intervals are published in the "Local Climatological Data" bulletin for 5 stations: Burlington, Des Moines, Dubuque, Sioux City, and Waterloo. Daily minimum and maximum extremes for these stations are also published in the "Climatological Data" series for Iowa. Complete hourly records for all 8 stations are available from the NCC.

2. Daily Data

Daily observations at temperature stations are taken from minimum-maximum thermometers. Temperature extremes are recorded

by observers every 24 hours. The NCC publishes these daily minimum, maximum, and monthly average values in the "Climatological Data" series. Unpublished data collected by the ACE are held at the ACE District Offices.

3. Related Data

Data and summary statistics about heating and cooling degree days, dew point, and departures from normal temperatures are available for the 5 stations for which data are published in the "Local Climatological Data" series. Additional statistics on temperature extremes, seasonal and monthly heating degree days, freeze data, and departures from normals are summarized for temperature stations in the July and annual issues of the "Climatological Data" series.

C. Evaporation

1. Pan Evaporation Data

Measurements of water evaporation are currently obtained by the NWS at seven stations. Daily measurements of water evaporated from standard Class A pans are obtained from April or May through October. Related data collected at each station are daily minimum and maximum temperature extremes of the water in pans and pan wind movement measured by a continuous anemometer recorder located six to eight inches above the pan.

Evaporation and related data are regularly published in the "Climatological Data" bulletin. Monthly issues contain daily values for evaporation, water temperature extremes, and mean wind speed. Both monthly and annual reports give monthly total wind and evaporation values and monthly water temperature extremes.

D. Weather Conditions and Storms

1. Local Weather Conditions

Detailed observations are routinely made at the 8 NWS and FAA stations. In addition to precipitation and temperature, several variables are recorded that are not observed at other stations, including prevailing weather, wind speed and direction, sky cover, sunshine, visibility, ceiling, and relative humidity. The data are published in the "Local Climatological Data" for stations at Burlington, Des Moines, Dubuque, Sioux City, and Waterloo. Data for FAA stations at Cedar Rapids, Mason City, and Ottumwa are available from the NCC.

2. Radar Images

The radar installation at the Des Moines WSFO gives areal coverage for all of Iowa and about half of the neighboring states and is used to monitor statewide weather conditions, particularly the severity and movement of storms. The radar image, or echo, shows the location, base, and height of storm cells and storm intensity. A screen camera produces a permanent photograph of the radar image normally every five minutes. If precipitation is shown on the radar, photographs are taken once every 5 minutes, and during severe weather, once every 1½ minutes. Similar radar and camera installations that provide coverage of portions of Iowa are operated at Huron, SD, Minneapolis, MN, Neenah, WI, Marsailles, IL, Kansas City, MO, and St. Louis, MO. The photographs are sent to the NCC for archiving and public distribution. Radar images can also be reproduced and transmitted from the

Des Moines WSFO to other users who have the necessary tele-copier equipment. Other radar installations without screen camera are operated at Waterloo, IA, Omaha, NB, Sioux Falls, SD, Rochester, MN, and Moline, IL.

3. Satellite Images

The National Environmental Satellite Service (NESS) of NOAA operates several weather observatory satellites to collect data on daily weather phenomena. Copies of current satellite images covering Iowa are received at the Des Moines WSFO every 30 minutes from the NESS Satellite Field Service Station, Kansas City, MO. Copies are kept on file for a short time at the Des Moines WSFO. Copies of all satellite images are available from the NCC.

4. Weather Maps

Maps published by the NCC show the spatial distribution, development, and movement of weather phenomena. The "Daily Weather Maps, Weekly Series" include surface weather map, 500-millibar chart, highest and lowest temperature chart, and precipitation chart for each day. The "Synoptic Series" is issued in two parts. The first is a series of daily synoptic weather maps and the second contains data tabulations of synoptic surface and upper air reports.

Many other special purpose maps are compiled by the NWS, especially for short-term weather forecasting. However, the maps are generally for agency use and not published. The NWS and the Des Moines WSFO may be contacted for information about the types and availability of other types of weather maps.

5. Storms and Unusual Weather

Data describing severe storms, unusual weather, and resulting personal and property damage are compiled and published monthly in the "Storm Data" bulletin of the NCC. Data are compiled from radar and satellite sources and weather station reports. Additional data may be gathered after a severe storm through local interviews, bucket surveys, and local news reports.

E. Upper Air Conditions

1. Upper Air Data

Weather balloons are released twice daily, at 6:00 a.m. and p.m., from Huron, SD, Omaha, NE, and Marsailles, Springfield, and Peoria, IL, for the collection of upper air radiosonde and rawinsonde data. Data transmission from the balloons provides plotted traces of upper air temperature, relative humidity, air pressure, and wind with elevation and balloon path. These data can be obtained from the NCC. Much of the data are published in the "Synoptic Series" of weather maps.

IV. Sources of Data

Major sources of climatological data described below are also indexed in Table 1 according to type of data.

A. Published Data Sources

1. "Climatological Data - Iowa"

Published by the National Climatic Center as monthly and annual issues for each state.

Contents: basic climatological data collected at most NWS stations; monthly issue: daily precipitation, temperature, snowfall and snow on ground, evaporation and wind, and station index chart and map; annual issue: monthly and annual average values and departures from normals.

Previous Titles and Sources:

Climatological Service Bulletin, 1906-1909

Monthly Weather Review, 1909-1914

2. "Local Climatological Data"

Published monthly and annually by the National Climatic Center for individual stations: Burlington FAA/COOP, Des Moines WSFO, Dubuque WSO, Sioux City WSO, Waterloo WSO.

Contents: basic climatological data; monthly issue: daily precipitation, temperature, wind, sunshine, sky cover; hourly precipitation; 3-hourly ceiling, visibility, sky cover, weather, temperature, humidity, dew point, and wind; annual issue: monthly and annual averages and extremes for year, normals, and summary data for period of record.

Previous Titles and Sources:

Monthly Meteorological Summary, 1897-1948

Local Meteorological Summary, 1949-1952

Local Climatological Data with Comparative Data, 1952-1966

3. "Hourly Precipitation Data - Iowa"

Published by the National Climatic Center for each state on monthly and annual basis and includes data from stations equipped with automatic recording gages.

Contents: monthly issue: daily and hourly precipitation amounts, monthly maximum amounts for hour and quarter-hour periods, and station index information; annual issue: monthly and annual totals and maximums.

Previous Titles and Sources:

Hydrologic Bulletin, 1940-1948

Climatological Bulletin, 1948-1951

4. "Storm Data"

Published monthly by the National Climatic Center for the United States.

Contents: chronological listing by state of storms and unusual weather phenomena with date and time of occurrence,

length and width of storm path, number of persons killed and injured, estimated damage, and narrative of associated details.

Previous Titles and Sources:

Monthly Weather Review, 1921-1949

Report of the Chief of the Weather Bureau, 1929-1935

U. S. Meteorological Yearbook, 1936-1949

Climatological Data, National Summary, Monthly, 1950-1959

5. "Daily Weather Maps, Weekly Series"

Published weekly for Northern Hemisphere by the National Climatic Center. Surface weather map is for coterminous U. S. only.

Contents: maps of synoptic surface weather, 500-millibar surface, minimum and maximum temperature, and precipitation for each day of previous week.

Previous Titles and Sources:

Daily Weather Maps, 1871-1968

6. "Synoptic Series, Part I Northern Hemisphere Sea Level Charts and 500-Millibar Charts, Part II Northern Hemisphere Data Tabulations"

Published by the National Climatic Center. Part I is issued monthly. Part II is issued daily and since 1964 only in microfilm and microfiche form.

Contents: Part I: daily synoptic weather maps; Part II: daily surface and upper air data tables.

Previous Titles and Sources:

Published under same title since 1940 with data from 1899.

7. "Selective Guide to Climatic Data Sources"

Publication No. 411 issued in 1969 in Key to Meteorological Records Documentation Series of the National Climatic Center.

Contents: describes publications having climatological data tables and maps and references several publications not listed here.

8. "Iowa Crops and Weather"

Publication of Iowa Department of Agriculture, NOAA-National Weather Service, and U. S. Department of Agriculture Statistical Reporting Service. Weather data is compiled by the State Climatologist. Issued weekly from April to December and monthly from December through March. Contents: narrative summary of weather and effects on agriculture for previous week; current conditions of crops and livestock; maps of precipitation and soil moisture; data charts of averages and departures from normals for temperature, precipitation, and growing degree days for the 9 crop reporting districts.

B. Unpublished Data Sources

1. For a few stations, climatological data have been collected but not published in bulletins of the NCC. These data are archived by the State Climatologist and at the NCC.
2. Original data forms and recorder charts are submitted by NWS station observers to the Des Moines WSFO and later archived by the State Climatologist or the NCC. These contain some detailed data not included in publications.
3. Precipitation data acquired by the Iowa Natural Resources Council are kept in manual files at the INRC office in Des Moines, IA.
4. Special data associated with storms, unusual weather, and flood forecasts are kept at the Des Moines WSFO. These include telephone reports of 2.00-inch precipitation events, rainfall reports from flash flood basins, bucket surveys and local interviews, and storm and flood warnings issued by NWS.
5. Photographic copies of radar images observed at the Des Moines WSFO and similar radar stations in surrounding states are sent to the NCC for archiving and public distribution. Copies are also transmitted from the Des Moines WSFO to several public information agencies via telecopier.
6. Inquiries concerning weather satellite imagery and interpretive data should be made to the National Environmental Satellite Center of NOAA. Selected images covering Iowa are filed at Des Moines WSFO.
7. Data collected by the ACE at some stations are forwarded to the NCC for publication. Data collected at the other stations are unpublished and kept on file at the ACE district offices: data from 4 recording precipitation stations, 7 nonrecording precipitation stations, and 4 temperature stations.

C. Computer Storage and Retrieval

1. The NCC maintains all submitted data in a computer storage system. Copies of data on punched cards, tape, disc, or printed output can be obtained at nominal costs.
2. The Iowa Geological Survey has obtained from NCC a computer tape file of historical climatic records for Iowa through 1974 and copies of the data can be provided upon request.
3. The Iowa Department of Environmental Quality has obtained from NCC a computer file of climatic records for Iowa for the period 1965 through 1976.

TABLE 1. SUMMARY OF CLIMATIC DATA COLLECTION

<u>Data Type</u>	<u>Recording Frequency</u>	<u>Collecting Agency</u>	<u>Stations¹ in 1977</u>	<u>Published²</u>	<u>Unpublished²</u>	<u>Computer² Storage</u>
Precipitation	Continuous, Hourly	NWS	74 recording stations	A2, A3	B1, B2	C1, C2
	Continuous, Hourly	ACE	7 recording stations	A3	B7	
	Daily	NWS	138 non-recording stations	A1, A2, A8	B1, B2	C1, C2, C3
	Daily	ACE	14 non-recording stations	A1	B7	
	Daily	INRC	236 non-recording stations		B3	
	Storm Event	NWS	243 precipitation stations	A4	B4	C1
	Storm Event	NWS	15 flash flood basins	A4	B4	C1
Snowfall, Snowpack	Daily	NWS	138 non-recording stations	A1, A8	B1, B2	C1, C2, C3
Temperature	Hourly	NWS	5 stations	A2	B1, B2	C1, C2
	Daily	NWS	124 stations	A1	B1, B2	C1, C2, C3
	Daily	ACE	11 stations	A1	B7	

<u>Data Type</u>	<u>Recording Frequency</u>	<u>Collecting Agency</u>	<u>Stations¹ in 1977</u>	<u>Published²</u>	<u>Unpublished²</u>	<u>Computer² Storage</u>
Evaporation	Daily	NWS	7 stations	A1	B1, B2	C1, C2
Local Weather Conditions	Hourly	NWS	8 stations	A2, A5, A6	B1, B2	C1, C2
Radar Images	Continuous	NWS	7 stations with camera, 5 stations without camera		B5	
Satellite Images	Continuous	NESS	synoptic coverage		B6	
Storm Character and Damage	Storm Event	NWS		A4, A5, A6	B1, B4, B5, B6	C1
Weather Maps	Daily	NWS	synoptic coverage	A5, A6, A8		
Upper Air Conditions	Twice Daily	NWS	5 stations	A5, A6	B1	C1

¹Number of stations does not include stations discontinued before 1977 for which data are available.

²Codes refer to items described in IV Sources of Data.

SURFACE WATER DATA

The data collection programs described in this section are related to the quantity characteristics of surface water resources. Information about surface water quality is found in the "Water Quality Data" section of this report.

I. Agencies and Programs

A. U.S. Geological Survey (USGS)

The USGS is the principal collector of data on the occurrence and quantity of surface water in Iowa. The Iowa District Office of the USGS, Water Resources Division, is responsible for operation and coordination of the various data collection programs. Funding and cooperative support are provided by direct USGS appropriations, transferred funds and data sharing with the U.S. Army Corps of Engineers, and through cooperative cost-sharing arrangements with state and local governments. The major programs involve collection of daily stage and discharge records at complete-record stream gaging stations and records of low flows and crest stages and discharges at partial-record stations. A program for recording lake levels had been operated since 1933 but most stations were discontinued by 1975 because of lack of funds; 2 lake stations are now in operation. Other surface water data are acquired during special investigations of flood events and regional inventories of water resources. During the period 1972-1976, the USGS prepared 326 maps of flood-prone areas in Iowa showing the boundaries of the 100-year flood or the outstanding flood of record. This mapping program has been discontinued until more funds are made available.

Two computer systems are maintained by the USGS for the storage and retrieval of data. The National Water Data Storage and Retrieval System (WATSTORE) is used for the storage, processing, and dissemination of data collected by the USGS. Requests for WATSTORE data can be made to the Iowa District Office. The National Water Data Exchange System (NAWDEX) is a data referral service organized to assist in locating and requesting water data held by public and private organizations and to provide direct access to WATSTORE and STORET (the data management system of the U.S. Environmental Protection Agency). NAWDEX services can be obtained through the District Office of the USGS and the Iowa Geological Survey.

B. U.S. Army Corps of Engineers (ACE)

The ACE has provided streamflow information since the late 1800's when the first river stage recordings were made on the Mississippi and Missouri Rivers to aid navigation. The ACE currently operates an independent network of gaging stations in addition to cooperatively supporting the USGS program. Continuous or daily stage and discharge records are obtained at the stations located on major rivers, reservoirs, and lock and dam structures. The network has been established to meet the special data needs of the assigned missions and projects of the ACE, particularly navigation and operation of flood control reservoirs.

The ACE also maintains data on the design and operations of the 4 ACE reservoirs (Coralville, Rathbun, Red Rock, and Saylorville), the lock and dam structures on the Mississippi, and the Missouri River waterway. An inventory of private and public dams

in Iowa has been completed by the ACE; this includes all dams with at least 50 acre-feet of storage or 25 feet in height.

C. National Weather Service (NWS)

The NWS is responsible for making flood forecasts throughout the nation. The Kansas City River Forecast Center prepares flood forecasts for major rivers in the Upper Mississippi and the Missouri River Basins based on weather and river stage data provided by the state forecast offices. Forecasts are transmitted to the state offices where they are reviewed and modified if necessary, and then released to the public as flood warnings. The Des Moines Weather Service Forecast Office (WSFO) is responsible for providing data and releasing forecasts for the interior rivers of Iowa; NWS offices at Omaha and Chicago are responsible for the Iowa reaches of the Missouri and Mississippi Rivers, respectively.

An additional flood forecasting program has been established for 15 small "flash flood" basins in Iowa that are located in or near urban areas and have histories of severe flash flooding. The forecasts are prepared by the Des Moines WSFO and are transmitted to local public officials and news media as flood warnings.

D. U.S. Soil Conservation Service

The SCS provides technical assistance to local units for watershed protection projects and maintains support information on the design and operation of project reservoirs. An inventory of all dams and reservoirs with which the SCS has been involved has recently been completed. The SCS also compiles data on reservoir inflow, stage, area, and capacity for reservoir sedimentation surveys

conducted by the Sedimentation Laboratory of the U.S. Department of Agriculture.

E. Federal Insurance Administration (FIA)

The FIA, Department of Housing and Urban Development, is responsible for administering the National Flood Insurance Program. The FIA contracts for local flood insurance studies which are used to establish actuarial rate zones on the basis of flood plain characteristics, flood history, flood inundation boundaries, and expected frequency of floods.

F. State - USGS Cooperative Programs

The cooperative programs provide considerable support for USGS data collection activities. The cost-sharing arrangements with various state agencies and some local governments provide about 45% of the annual funding required for operation of USGS stream stations.

1. Funds for the support of the continuous gaging stations are provided in part by the Iowa Agriculture and Home Economics Experiment Station, Iowa Department of Transportation, Iowa Geological Survey, Iowa Institute of Hydraulic Research, Iowa Natural Resources Council, and several local governmental units.
2. The Iowa Natural Resources Council has provided funds to support the operation of low-flow partial-record stations since the stations were established in 1957.
3. The Iowa Department of Transportation, Highway Division, has provided funds to support the operation of crest-stage partial-record stations since the stations were established in 1950 and 1967.

G. Iowa Natural Resources Council (INRC)

The INRC maintains a file of flood high-water marks; water elevations are surveyed after major flood events or obtained from local residents. As the liaison between communities and the FIA, the INRC keeps information on local flood plain management, flood control measures, and flood insurance studies generated for the National Flood Insurance Program. Design plans and related information on all dams in Iowa with a storage capacity of at least 18 acre-feet are also held on file. As required by the state's water permit system, the INRC maintains data on the permitted water withdrawal and storage allocations and on the total water withdrawals reported by permit holders. This includes data for both surface and ground water sources.

II. Data Collection Networks

A. Gaging Stations

These are recording installations sited on streams, lakes, and reservoirs which measure water stage, or water surface elevation. Daily discharge values are computed from the stage records. In Iowa, there are currently 128 gaging stations operated by the USGS and 16 operated by the ACE (fig. 4).

B. Partial-record Stations

These are stations where specific kinds of data are collected only periodically or a few times during a year.

1. A network of 424 low-flow partial-record stations is operated by the USGS to obtain instantaneous discharge measurements during periods of low streamflow (fig. 5).

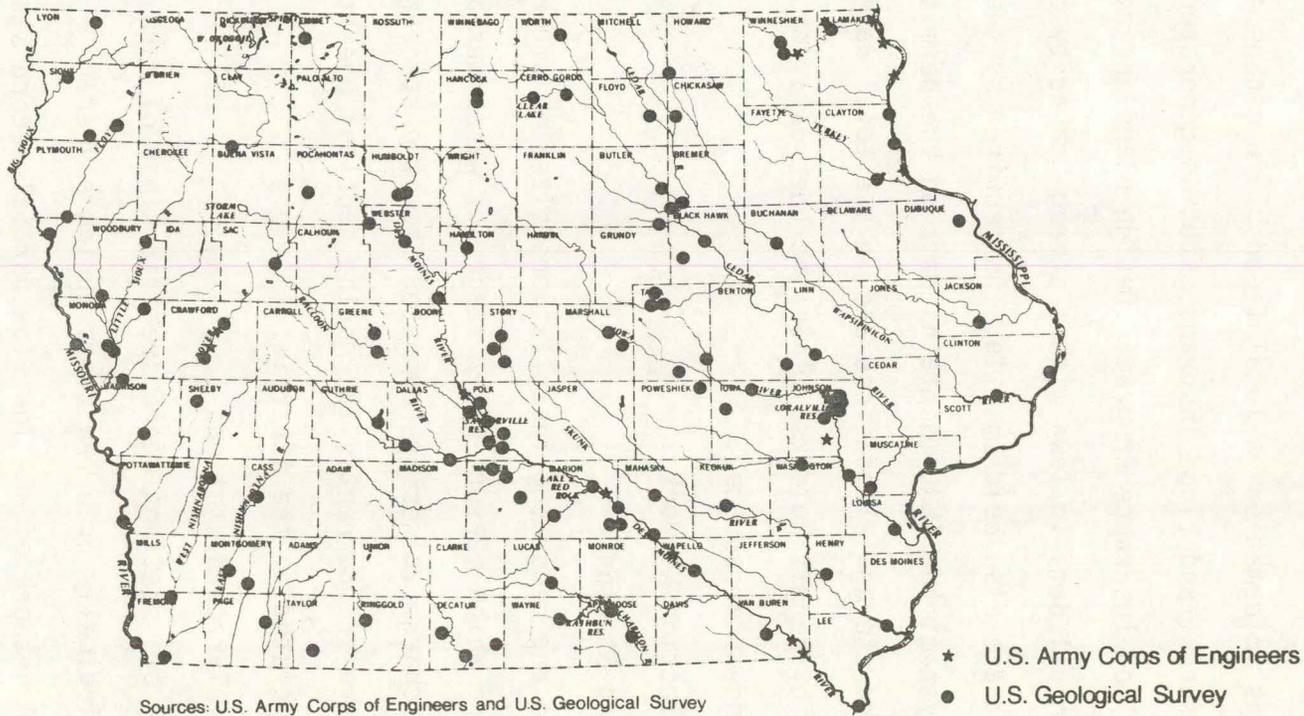


Figure 4. Locations of Stream Gaging Stations (1977)

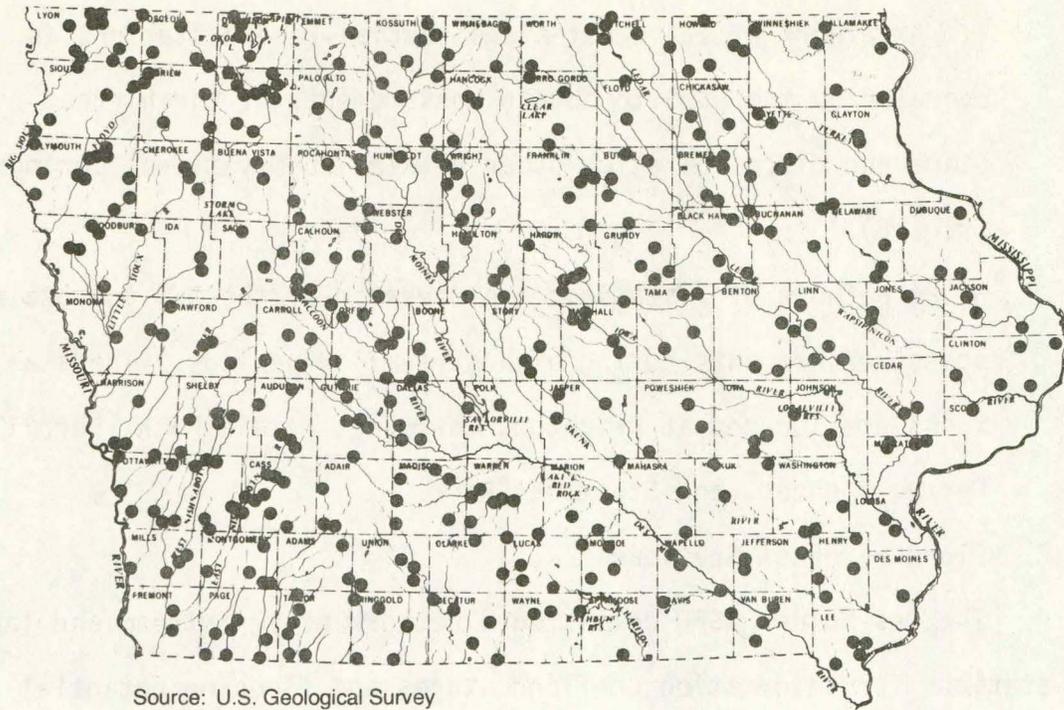


Figure 5. Locations of Low-flow Partial-record Stations (1977)

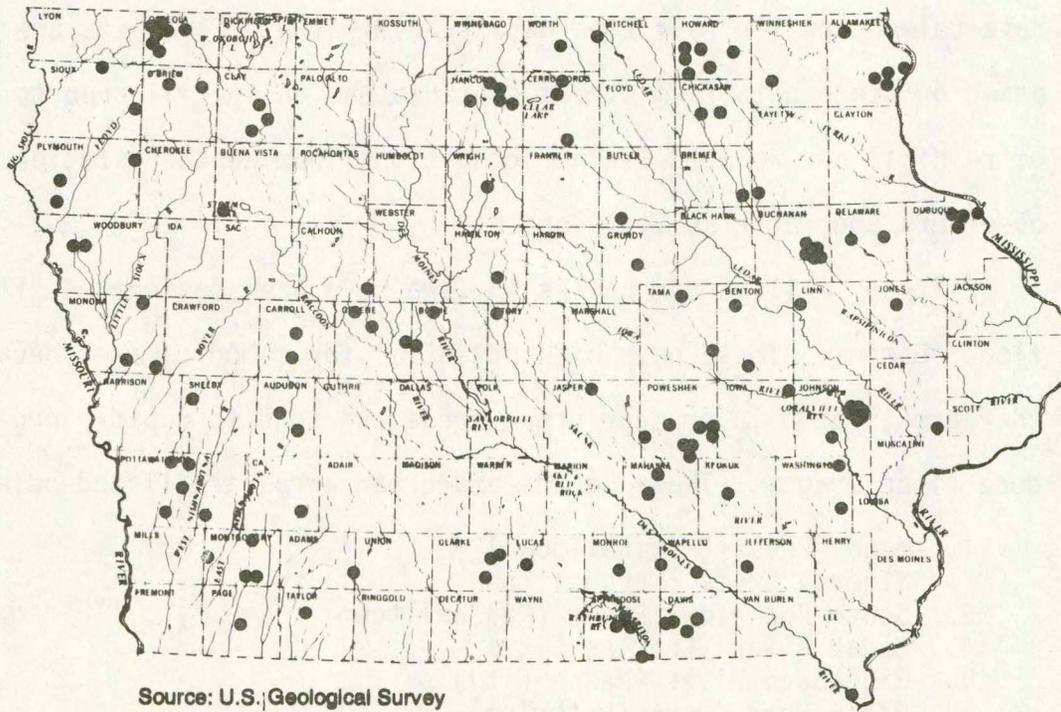


Figure 6. Locations of Crest-stage Partial-record Stations (1977)

2. A network of 134 crest-stage partial-record stations is operated by the USGS to obtain measurements of the highest stage and discharge which occur between observational periods (fig. 6).

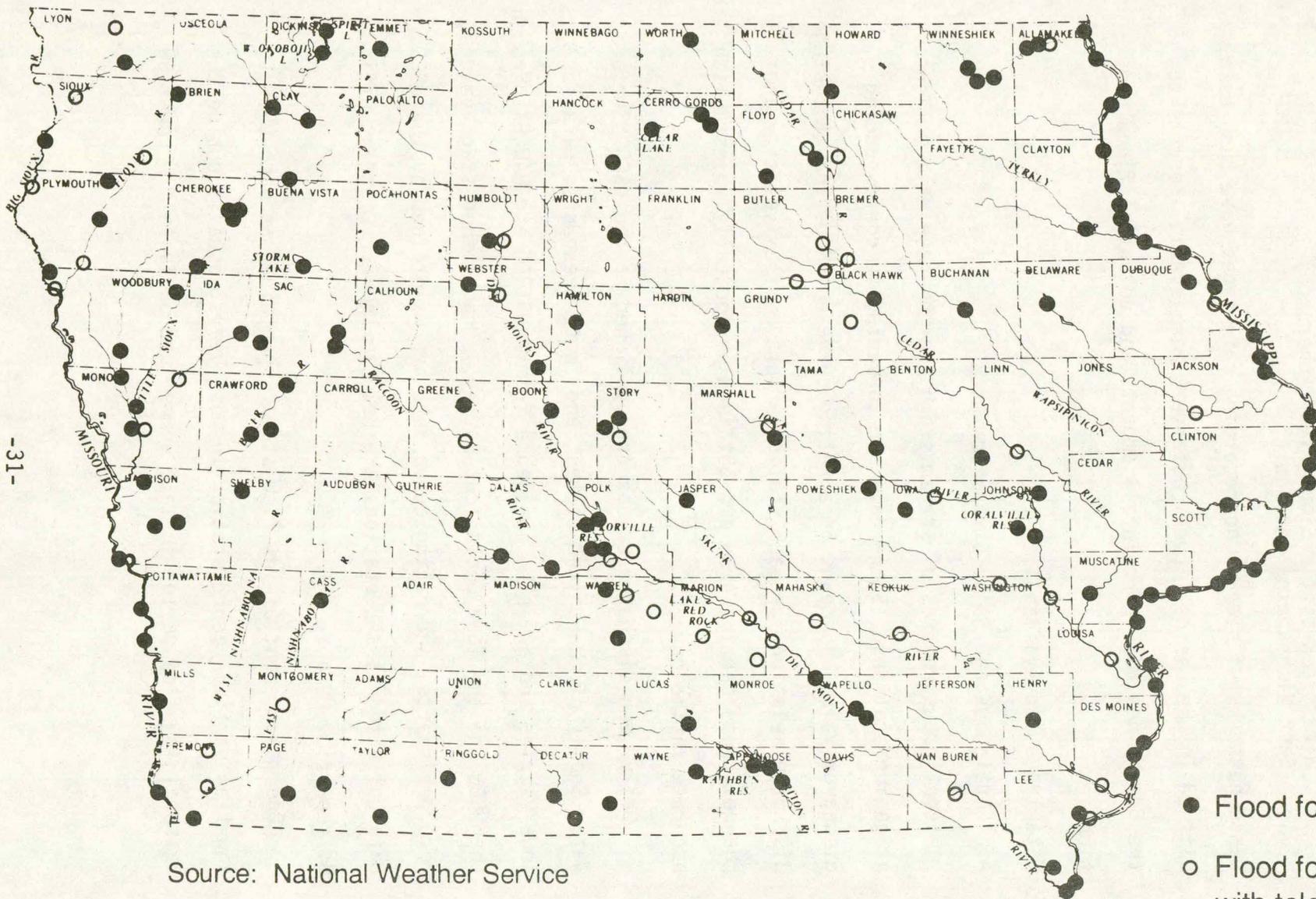
3. A network of 7 stations are operated by the NWS to obtain stage measurements during high streamflow periods. The stations are located at Brighton, Cherokee, Marble Rock, Merrill, Perry, Spencer, and Steamboat Rock.

C. Flood Forecast Stations

The Des Moines WSFO relies on a network of 174 stream and lake stations for information on flood stages and flooding potential (fig. 7). The network is comprised of the 7 stage stations of the NWS and selected gaging and partial-record stations maintained by the ACE and the USGS. Of the 174 stations, 41 are equipped with data telemeters for real time data transmission. Forecasts are based on stage data from stream stations and on special reports of rainfall and related weather conditions from weather station observers and radar surveillance.

Fifteen small stream basins in Iowa have been designated "flash flood" basins. These have high potential for flood damages because they are located in or near urban areas and tend to rapidly produce flood stages. These basins and urban areas are listed below.

1. Honey Creek (Marshalltown)
2. Minerva Creek (Marshalltown)
3. South Fork Iowa River (Marshalltown)
4. Cedar River (Charles City)
5. Winnebago River (Mason City)
6. Black Hawk Creek (Waterloo)
7. Prairie Creek (Cedar Rapids)
8. Squaw Creek (Ames)



Source: National Weather Service

- Flood forecast stations
- Flood forecast stations with telemetry equipment

Figure 7. Locations of National Weather Service Flood Forecast Stations (1977)

9. Lizard Creek (Fort Dodge)
10. Walnut Creek (Des Moines)
11. Fourmile Creek (Des Moines)
12. Dry Creek (Hawarden)
13. Perry Creek (Sioux City)
14. Mill Creek-Little Sioux River (Cherokee)
15. East Nishnabotna (Atlantic)

Dense networks of simple, nonrecording rain gages have been established in the basins. Local observers make special reports to the Des Moines WSFO of rainfall amounts and potential flood conditions.

III. Data Types and Availability

A. Continuous and Daily Streamflow Data

Continuous records of stream stage are the base data collected at gaging stations. Stage data are converted to corresponding discharge values by means of a rating curve which defines the stage-discharge relation for each station. Data on flow velocity and channel cross section area are obtained periodically to establish accurate rating curves.

Daily mean discharge values are published in the USGS "Surface Water Supply of the United States" and "Water Resources Data for Iowa" series and are also available from WATSTORE and NAWDEX through the USGS and the Iowa Geological Survey. Unpublished stage values, recorder charts, and rating curve data are maintained by the USGS. Data collected at ACE stations are held in the ACE District Offices.

B. Low-flow Data

One measurement of low-flow stage is obtained at each USGS low-flow partial-record station in most years, usually during the seasonal low-flow period in late summer and early fall. Low-flow

data are also available from continuous records collected at USGS and ACE gaging stations. Since streamflows are monitored continuously, a more complete record of low-flow characteristics throughout a year is provided.

Data for low-flow partial-record and gaging stations are published in the USGS series "Surface Water Supply of the United States" and "Water Resources Data for Iowa." Stage values, rating curves, and other unpublished station data are held by the USGS. The District Offices of the ACE hold data obtained at ACE stations. Low-flow data are also available from NAWDEX through the USGS and the Iowa Geological Survey.

C. Peak-flow Data

Peak stages and corresponding instantaneous discharge data are obtained at USGS crest-stage partial-record stations. Crest-gage equipment registers the peak stage that occurs between periodic inspections of the gage and, therefore, the date of the crest stages is not always certain. A close estimate is obtained by comparison with nearby continuous gaging records, weather reports, and local inquiry. Peak-flow data are also obtained at gaging stations. The continuous data records from gaging records give more accurately the time of occurrence and the time sequence and magnitude of high flows less than the peak.

Stage measurements are obtained at the 7 NWS stations during periods of high streamflow. Measurements are taken by local observers as frequently as needed (e.g., hourly) for short-term predictions of flood stages.

Annual maximum discharge values at USGS crest-stage partial-record stations and data from gaging stations are published in USGS series "Surface Water Supply of the United States" and "Water Resources Data for Iowa." Unpublished data on peaks less than the annual maximum that occur at partial-record stations are held by the USGS. The District Offices of the ACE hold data obtained at ACE gaging stations. The National Climatic Center holds all stage data collected at the 7 NWS stream stations and publishes annual peak stages in the "River Forecast Points and Miscellaneous Information." Peak-flow data can also be obtained from WATSTORE and NAWDEX through the USGS and the Iowa Geological Survey.

D. Flood Forecasts and Warnings

Short-term flood forecasts made by the NWS are usually estimated flood stage elevation and time of arrival for specific locations. In some cases, forecasts are in terms of major or minor flooding, or proportion bankfull rather than specific stage values. The forecasts are issued to appropriate public officials and news media to inform the public of flood hazards.

Permanent records of all forecasts and warnings are kept by the NCC, although there is no published compilation of the river forecasts and flash flood forecasts. Information about the availability of these data can be obtained from the Des Moines WSFO.

E. Flood Flows

A variety of data and interpretive reports have been compiled about past flood events, though usually not through a systematic, periodic data collection program. Iowa Natural Resources Council

has limited data on flood high-water marks obtained from field surveys of elevations and observations of local residents. The USGS and the ACE may gather information on water surface profiles, flow velocities, and damage after severe floods, principally through field investigations, news accounts, and local inquiries. Most of these data are held in unprocessed data files in the agencies, though some are available in agency reports. River basins for which the USGS has prepared reports of flood histories or of specific floods are identified in figure 8.

F. Flood Hazard Areas

The USGS, ACE, and FIA produce maps and reports depicting the extent of flood hazards in specific areas.

1. The USGS issues a series of maps of flood-prone areas based on the standard 7½-minute topographic map. Delineated on the maps are areas inundated by the 100-year flood or the outstanding flood of record. Maps for about 75% of the 444 designated flood-prone areas in Iowa are completed and available from the USGS District Office (fig. 9).

2. The ACE publishes a series of Flood Plain Information reports (FPI) for specific river reaches and urban areas where recurrent flooding is a serious problem (fig. 10). An FPI report contains narrative descriptions of past and expected future floods and profiles on topographic maps of inundated areas for selected flood frequencies. Similar information may also be contained in special agency reports of specific flood control projects.

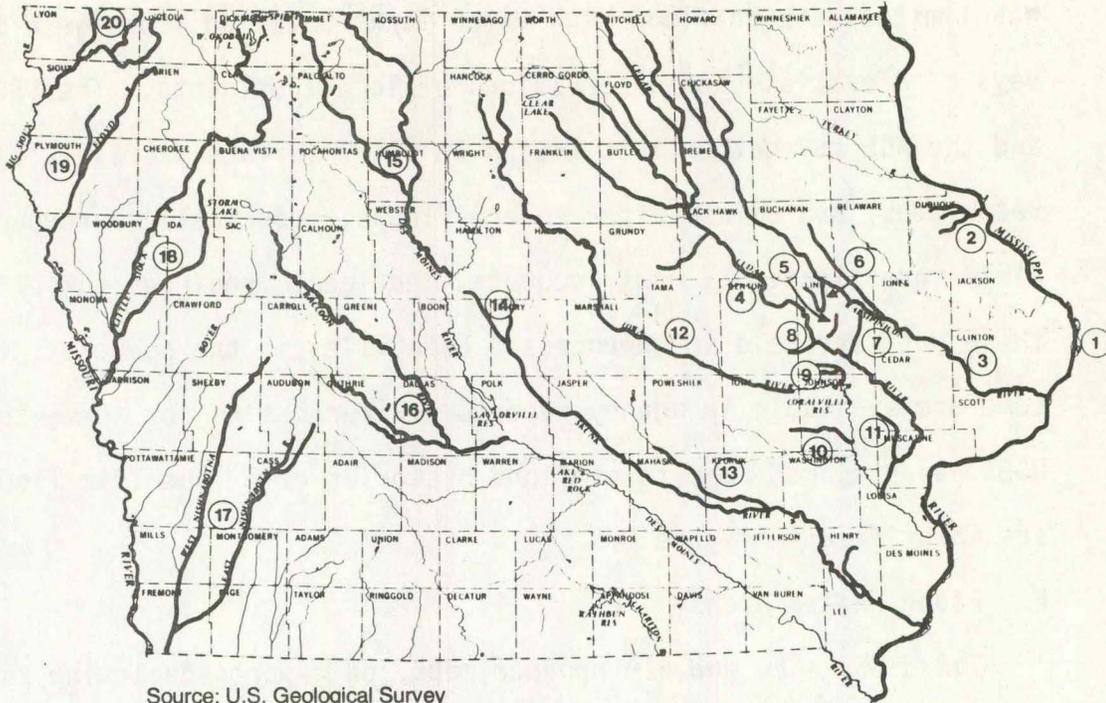


Figure 8. U.S. Geological Survey Flood Reports (1977)

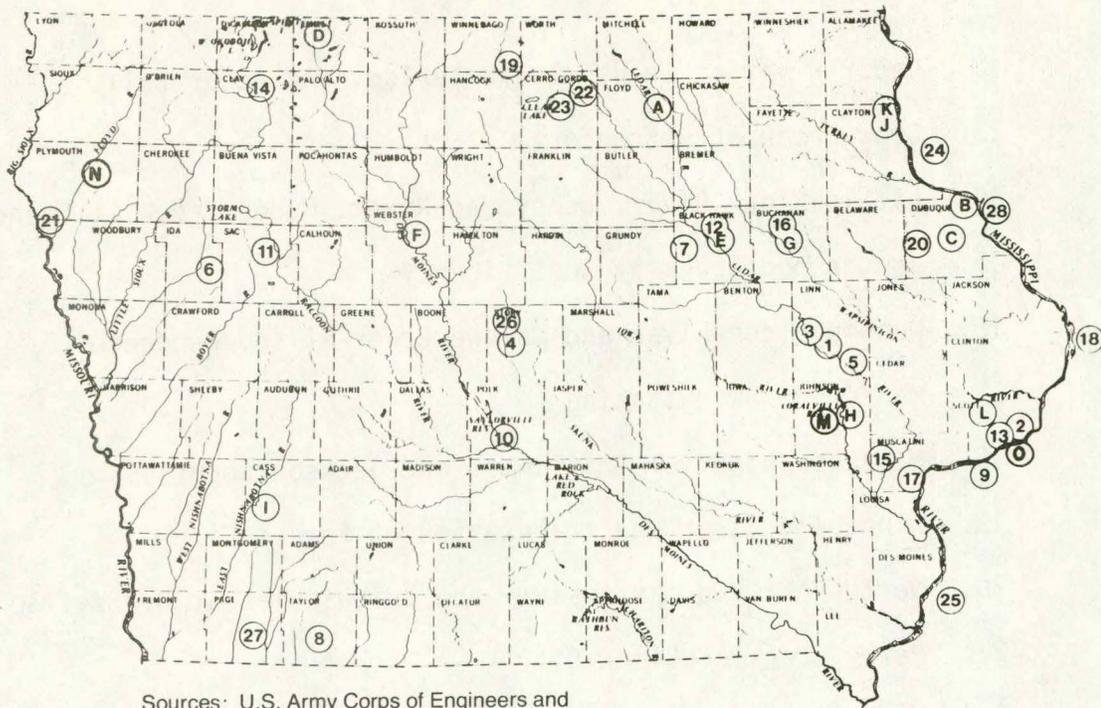
Map No.	Map No.
1 Mississippi River	11 Wapsinonoc Creek
2 Little Maquoketa River Basin	12 Iowa River Basin
3 Wapsipinicon River Basin	13 Skunk River Basin*
4 Cedar River Basin	14 City of Ames
5 Squaw Creek	15 Upper Des Moines River Basin
6 Otter Creek	16 Racoon River Basin*
7 Big Creek	17 Nishnabotna River Basin*
8 Morgan Creek	18 Little Sioux River Basin
9 Hoosier Creek	19 Floyd River Basin*
10 Old Mans Creek	20 Rock River Basin

*In progress

3. The FIA contracts for flood insurance studies for several communities in order to establish actuarial rate zones for flood insurance and provide detailed flood plain information for land use regulations required by the National Flood Insurance Program. Fifteen studies have been completed (fig. 10) and about 40 are in progress. Copies of the insurance studies and the FIA Flood Boundary and Floodway maps are available in limited numbers from the program's State Coordinator with the INRC. Copies of the Flood Insurance Rate maps are distributed by the National Flood Insurance Program, Bethesda, MD.

G. Lakes and Reservoirs

Data on storage contents are available for few lakes and reservoirs in Iowa. The ACE holds data on stage and contents of the 4 federally-owned reservoirs and stage of the locks and dams on the Mississippi River. Data records on reservoir stage-area-contents, water inflow, and losses of storage capacity are compiled by the SCS and the ACE and published every 5 years by the U.S. Department of Agriculture in the series "Summary of Reservoir Sediment Deposition Surveys Made in the United States." The USGS gaging stations on lakes were officially discontinued by 1975, except for the station on Clear Lake. The station on Blackhawk Lake was reestablished in early 1978. Historical records of daily stage and contents of the 4 ACE reservoirs and of daily stages at USGS lake stations are published in "Surface Water Supply of the United States" and "Water Resources Data for Iowa."



Sources: U.S. Army Corps of Engineers and
Employers Mutual Casualty Company

Figure 10. Flood Plain Information Reports and Flood Insurance Studies (1977)

Flood Plain Information Reports

1. Indian and Dry Creeks at Cedar Rapids
2. Duck Creek at Davenport and Bettendorf
3. Prairie Creek at Cedar Rapids
4. Skunk River and Squaw Creek at Ames
5. Cedar River in Linn County
6. Badger Creek, Odebolt Creek, and Maple River at Ida Grove
7. Black Hawk Creek in Black Hawk County
8. East Fork Hundred and Two River at Bedford
9. Mississippi River in Scott and Muscatine Counties
10. Des Moines River at Des Moines
11. North Raccoon River at Sac City

Flood Plain Information Reports (cont'd)

12. Cedar River at Evansdale, Waterloo, and Cedar Falls
13. Crow Creek at Bettendorf
14. Little Sioux River, Ocheyedan River, Muddy Creek at Spencer
15. Wapsinonoc Creek at West Liberty
16. Wapsipinicon River and Malone Creek at Independence
17. Mad Creek at Muscatine
18. Mississippi River in Clinton and Jackson Counties
19. Winnebago River and tributaries at Forest City
20. North Fork Maquoketa River and tributaries at Dyersville
21. Perry Creek at Sioux City
22. Winnebago River at Mason City
23. Willow Creek and tributaries at Mason City
24. Mississippi River in Clayton, Dubuque, and Jackson Counties
25. Mississippi River in Lee, Des Moines, and Louisa Counties
26. Skunk River north of Ames
27. Nodaway River and North Branch at Clarinda
28. Catfish Creek at Dubuque

Flood Insurance Studies

- | | |
|----------------|-----------------|
| A Charles City | I Lewis |
| B Dubuque | J McGregor |
| C Epworth | K Marquette |
| D Estherville | L Scott County |
| E Evansdale | M Coralville |
| F Fort Dodge | N Le Mars |
| G Independence | O Panorama Park |
| H Iowa City | |

Information on design and operation of dams and reservoirs is available for most structures in Iowa. The ACE Rock Island District has compiled an inventory of dams and reservoirs that store more than 50 acre-feet of water or are at least 25 feet in height. A similar inventory has recently been completed by the SCS; this includes all reservoir projects for which the SCS has provided assistance. The INRC keeps copies of design plans and related information for all dams and reservoirs that are designed to store at least 18 acre-feet of water.

H. Water Withdrawals

Diversion and withdrawal of water from surface and ground water sources are controlled under the state's water use permit system. The INRC keeps records of maximum withdrawal and storage amounts allowed by each permit and on the total amounts that are actually withdrawn or stored as reported by the permit holders.

IV. Sources of Data

Major sources of water quantity data are described below and indexed in Table 2 according to type of data.

A. Published Data Sources

1. "Surface Water Supply of the United States"
Published in U.S. Geological Survey series of Water-Supply Papers on an annual basis from 1901 through 1960 and every 5 years since 1961. Iowa is included in 2 basin reports: part 5 Hudson Bay and Upper Mississippi River Basins and part 6 Missouri River Basins.
Contents: gaging stations: daily mean, monthly, and annual stream discharge, runoff, lake stage, and reservoir contents; description of station and previous records; low-flow partial-record stations: instantaneous discharge; crest-stage partial-record stations: annual maximum instantaneous discharge and stage.
2. "Water Resources Data for Iowa"
Published annually since 1961 on a state-boundary basis by the U.S. Geological Survey.
Contents: same as USGS Water-Supply Papers entitled "Surface Water Supply of the United States."
3. "Surface Water Resources of Iowa"
Published by Iowa Geological Survey in Water-Supply Bulletin series. Various bulletins cover periods of years from 1873 through 1960.
Contents: daily mean, monthly, and annual stream discharge, runoff, lake stages, and reservoir contents; description of station and previous records for gaging stations.
4. "Compilation of Records of Surface Waters of the United States"
Published by the U.S. Geological Survey in the series of Water-Supply Papers. Two issues are available: one for records through September, 1950, and the second for records from October, 1950 through September, 1960. Iowa is included in 2 basin reports: part 5 Hudson Bay and Upper Mississippi River Basins and part 6 Missouri River Basins.
Contents: monthly and annual stream discharge records collected at gaging stations.
5. "Summary of Reservoir Sediment Deposition Surveys Made in the United States through 1970, with Supplement"
Published every 5 years since 1955 by the U.S. Department of Agriculture. Most recent issue is USDA Miscellaneous Publication No. 1266 and contains all data published in previous issues. Reprints of supplement data for specific reservoirs are available from USDA Sedimentation Laboratory, Oxford, MS.

Contents: Summary: drainage area, sediment source area, reservoir capacity, ratio of actual capacity to annual inflow, and volume and weight of annual sediment accumulation per source area; Supplement: original field survey forms with more detailed data on reservoir, watershed, and sediment characteristics.

6. "Flood Plain Information Reports"
Compiled by U.S. Army Corps of Engineers for selected river basins, river reaches, and urban areas since 1964. Contents: review of flood history, estimates of possible future floods (100-yr flood and Standard Project Flood), maps of flood areas, profiles, cross sections, flow velocities, and durations.
7. "Flood Prone Area Maps"
Prepared by Iowa District Office, U.S. Geological Survey during 1972-76. Of the 444 designated areas in Iowa, 326 have completed map coverage. Contents: boundaries for the 100-year flood are delineated on standard 7½-minute topographic maps.
8. "Flood Insurance Study"
Prepared for the Federal Insurance Administration and used to establish actuarial rate zones applied in the National Flood Insurance Program. Contents: descriptions of flood problems, flood plain development, estimates of future flood profiles and velocities, planimetric maps of flood plain and 100- and 500-year flood boundaries.
9. "Daily River Stages"
Published each year by the National Climatic Center since the late 1900's until 1971. Contents: daily river stages at gaging stations operated by various governmental agencies, flood stage, highest stages for year and period of record.
10. "River Forecast Points and Miscellaneous Information"
Published annually by the National Climatic Center since 1971. Replaced the "Daily River Stages" series. Contents: highest annual stages observed at National Weather Service river stations.

B. Unpublished Data Sources

1. The Iowa District Office of the U.S. Geological Survey maintains streamflow records for several gaging and partial-record stations that are not published in the data reports.

These include stage and discharge values less than the annual maximum for crest-stage partial-record stations. Other unpublished data are stage records, rating curves, flow velocity and area measurements, and general station site information to supplement stage and discharge measurements. In addition, several statistical summaries of streamflows and reports of flood studies have been compiled as intra-agency reports.

2. The U.S. Army Corps of Engineers has no publication series for streamflow and reservoir content records. Gaging station data which are not shared with the USGS can be obtained from the ACE district offices. Several agency reports concerning ACE reservoir design and operations, flood control, navigation, and channelization projects in Iowa are also available. An inventory of all dams with at least 50 acre-feet of storage or a height of 25 feet has been completed by the Rock Island District.
3. Flood forecasts issued by the National Weather Service forecast offices at Des Moines, Omaha, and Chicago are forwarded to local officials and news media for public dissemination. Records of the forecasts and of the river stage and climatic data on which the forecasts are based are held by the National Climatic Center.
4. The Soil Conservation Service prepares field data on water and land resource problems and plans for improvement works for small watershed projects. The data and planning reports describe the watershed, problems such as flooding, erosion, and water supply, the design and operation of structures and their environmental effects.
5. The Iowa Natural Resources Council holds some information related to surface waters. Several measurements of high-water marks associated with flood events are on file as well as information on dams and reservoirs with at least 18 acre-feet of storage capacity. INRC assists the FIA in administration of the National Flood Insurance Program and can provide information about status in the program and characteristics of floods and flood plains of communities.

C. Computer Storage and Retrieval

1. The U.S. Geological Survey has developed a large-scale computer system, the National Water Data Storage and Retrieval System, or WATSTORE, for the storage, processing, and dissemination of water data. Data are entered into and retrieved from WATSTORE through the USGS District Office in

Iowa City. All surface water data obtained through routine collection programs are entered into WATSTORE: stage and discharge records of regular gaging stations and crest-stage partial-record stations, and the location and physical characteristics of station sites. Summary statistics, such as daily maximum and minimum values, are stored for some stations. In addition to surface water quantity data, records from water quality and ground water stations are stored in WATSTORE.

The USGS can provide a variety of data displays and analyses through WATSTORE:

- a. data in machine-readable form: punched cards, tape, and disc copies of raw and processed data
- b. computer-printed tables: a variety of formats to list data and index tables
- c. computer-printed graphics: displays of data such as histograms, frequency curves, maps and point plots
- d. digital plotting: preparation of data for peripheral, off-line printers
- e. statistical analyses: large number of programs for data processing and multivariate analyses.

A minimal fee is charged to cover computer costs and, once a request is completed, results are usually available within 24 hours. Requests for data retrieval and analyses should be made to the U.S. Geological Survey District Office.

2. The U.S. Geological Survey provides an information and referral service through the National Water Data Exchange, or NAWDEX. NAWDEX consists of two computerized data base files: the Water Data Sources Directory identifies participating organizations that collect water data and the Master Water Data Index File contains point-source locations for which data are available, types of data collected, period of record, and collecting organization. Upon request, users are assisted in identifying available data, where they can be obtained, and how they may be requested. NAWDEX referral services can be used through the USGS District Office and the Iowa Geological Survey. The referral services are free, but some participating organizations may charge requesters for some services such as extracting and copying data.

3. The Army Corps of Engineers maintains most streamflow and reservoir data on an agency computer system. Data tabulations and summaries are made periodically for use by the agency and are not released through regular publications. The appropriate office of the 4 ACE districts covering Iowa should be contacted for data retrieval assistance.
4. The Iowa Natural Resources Council maintains computer files on all water withdrawal and storage permits under the Iowa Water Rights Law. The files contain information on permit holders, beneficial uses for which permits are granted, source of water, permitted rates of withdrawal and amount of annual allocation.

TABLE 2. SUMMARY OF SURFACE WATER DATA COLLECTION

<u>Data Type</u>	<u>Recording Frequency</u>	<u>Collecting Agency</u>	<u>Stations¹ in 1977</u>	<u>Published²</u>	<u>Unpublished²</u>	<u>Computer² Storage</u>
<u>Streams</u>						
Streamflow	Continuous, Daily	USGS	128 gaging stations	A1, A2, A3, A4, A9	B1	C1, C2
	Continuous, Daily	ACE	16 gaging stations	A9	B2	C2, C3
Low Flow	Periodic	USGS	424 partial-record stations	A1, A2	B1	C1, C2
Crest Stage	Periodic	USGS	134 partial-record	A1, A2	B1	C1, C2
		NWS	7 stage stations	A9, A10	B3	
		INRC			B5	
Flood Forecasts		NWS	174 stations		B3	
		NWS	15 flash flood basins		B3	
Flood Events		USGS			B1	
		ACE			B2	
Flood-Hazard Areas		USGS	326 maps	A7		
		ACE	29 FPI	A6		
		FIA	15 flood insurance studies	A8		

<u>Data Type</u>	<u>Recording Frequency</u>	<u>Collecting Agency</u>	<u>Stations¹ in 1977</u>	<u>Published²</u>	<u>Unpublished²</u>	<u>Computer² Storage</u>
<u>Lakes and Reservoirs</u>						
Contents		ACE	4 reservoirs	A4	B2	
		SCS	5 reservoirs	A4	B4	
Dam-Reservoir Design		ACE			B2	
		SCS			B4	
		INRC			B5	
<u>Water Use</u>						
Water Withdrawals		INRC	7,650 permits		B5	C4

¹Number of stations does not include stations discontinued before 1977 for which data are available.

²Codes refer to items described in IV Sources of Data.

GROUND WATER DATA

The data collection programs described in this section are related to the quantity characteristics of ground water resources. Information about ground water quality is found in the "Water Quality Data" section of this report.

I. Agencies and Programs

A. U.S. Geological Survey (USGS)

The USGS, Water Resources Division is the principal federal agency engaged in the collection of ground water data. All USGS ground water data collection programs in Iowa are accomplished in cooperation with the Iowa Geological Survey (IGS) and are designed to satisfy three primary objectives: (a) to appraise the occurrence, availability, and quality of the state's ground water resources; (b) to monitor changes in quality and ground water levels; (c) to determine the impact of ground water development in relation to the total water resource system in Iowa.

1. Ground Water Levels

Since the 1930's the USGS has systematically recorded information on water levels, and fluctuations thereof, from observation wells throughout the state. This program in Iowa, part of a national network of observations wells, is intended to provide a sampling and historical record of changes in water levels in Iowa's, and the nation's, most important aquifers. The network in Iowa is currently comprised of 35 observation wells.

2. Water Use Inventories

Since 1950, the USGS has provided inventory information on water use in Iowa for national water use inventories. These reports have

been compiled for successive five-year periods beginning with 1950. These national inventories provide estimates of water withdrawals from both surface and ground water sources, by individual state, according to several different use classifications. Other water use inventories are conducted by the USGS in the course of developing specific county and regional studies of water availability.

3. Hydrologic and Development Data

The USGS acquires and archives several types of hydrologic data related to ground water. Generally, such data are obtained either through specifically designed data collection and research programs or through voluntary agreements with developers. Typical items are:

- a. data from pumping tests
- b. downhole (well) geophysics
- c. water quality
- d. aquifer performance
- e. well development and production information.

4. National Water Data Storage and Retrieval System (WATSTORE)

WATSTORE is the computer data management system used by the USGS for the storage, processing, and dissemination of ground water and surface water data. The System 2000 data base management system under WATSTORE is used for handling ground water data. With the cooperation of the IGS, about 20% of the ground water data for Iowa held by the USGS and the IGS has been coded and entered into System 2000. The system will accommodate encoding of over 200 data items for each well. The general types of data coded are:

- a. well site characteristics
- b. geologic data (lithology, depth, thickness)

- c. well dimensions
- d. pumping and nonpumping water levels
- e. pumping rates and water use
- f. construction and development methods
- g. well casing, lift, and pump characteristics
- h. water quality.

Data are entered into and retrieved from WATSTORE through the Iowa District Office of the USGS. Water quality data are routinely transferred from WATSTORE to STORET, the data management system of the U.S. Environmental Protection Agency. Direct retrieval of WATSTORE data is also available through NAWDEX.

5. National Water Data Exchange (NAWDEX)

NAWDEX is the water data referral service operated by the USGS. Water data holdings of participating federal and nonfederal organizations are indexed in two computerized files: the Water Data Sources Directory of organizations collecting water data and the Master Water Data Index files with data types, collecting points, and periods of records. Users are assisted in identifying what data are available, where they can be obtained, and how they can be requested. Direct access to WATSTORE and STORET are also provided through NAWDEX. The two Local Assistance Centers through which requests can be made are the Iowa District Office of the USGS and the IGS.

B. U.S. Environmental Protection Agency (EPA)

Although not a primary data collector, the EPA works cooperatively with the Iowa Department of Environmental Quality to collect data on surface water quality, a limited amount of data on ground water quality, and other related environmental information. EPA programs for data

collection, storage, and retrieval are described in the section "Water Quality Data" of this report.

C. U.S. Army Corps of Engineers (ACE)

The ACE maintains a recording well at Lone Tree where a continuous record of ground water levels has been collected since 1957. In addition to this long-term project, the ACE intermittently collects water level data in conjunction with specific projects and to monitor ground water conditions at ACE reservoirs.

D. Iowa Geological Survey (IGS)

The IGS is the state's primary consultant on ground water. Since its establishment in 1855, the IGS has collected a wide variety of information about water and other natural resources. This information has come from specific IGS programs, independent research, cooperation with the USGS, and through cooperation with private citizens, other state agencies, mining companies, and well drillers.

1. Well Logging Program

The well logging program, initiated in the early 1930's, is the primary program for the collection of ground water data. Information on well design and samples of drill cuttings and rock cores are voluntarily submitted to the IGS by many independent water well drillers in the state. Information obtained through the microscopic examination of drill cuttings and related information submitted by well drillers are used to construct a detailed geologic "strip" log for each well. A strip log usually includes:

- a. well owner
- b. well driller
- c. well location and elevation

- d. dates of well drilling and completion
- e. person logging well and date logged
- f. record of geologic formations, depths, thicknesses, rock types
- g. major water-bearing formation(s)
- h. total depth of well
- i. casing schedule
- j. pumping and non-pumping water levels
- k. yield in gallons per minute if known.

2. Water Quality Data

The IGS maintains records of ground water quality obtained for public and private water supply systems. Data on public water wells are routinely collected and forwarded to the IGS by the State Hygienic Laboratory which performs the water quality analyses. Data on private wells are voluntarily submitted to the IGS by private well owners.

3. Hydrologic and Development Data

The IGS collects and archives many other kinds of information relative to the testing, performance, and development of water wells. The majority of this information comes voluntarily from well drillers and private or industrial developers. However, a considerable amount of information is generated directly by IGS and IGS-USGS programs. The principal information categories include:

- a. pumping tests and determinations of
 - i. specific yield
 - ii. storage coefficients
 - iii. transmissibility
- b. aquifer performance and yield
- c. hydrologic boundary conditions

- d. water levels
- e. geophysics (bore hold and surface)
- f. well design
- g. water quality.

E. IGS-USGS Cooperative Research

Since the early 1930's, the IGS and the USGS have been involved in a variety of cooperative investigations and ground water research programs. In general the programs have been designed to define the occurrence, extent, hydrologic relations, water quality characteristics, and performance of ground water aquifers in the state. Examples are given by figures 11, 12, and 13. A considerable amount of new information has been generated through these programs which include the drilling and monitoring of test wells, the evaluation of geologic conditions and structure, and the determination of hydrologic variables.

F. Iowa Natural Resources Council (INRC)

The INRC keeps records on permitted surface and ground water withdrawals as an adjunct of the Water Permit System of the 1957 Iowa Water Rights Law. The INRC annually tabulates the total water withdrawals reported by each permit holder. The earliest entries in these files date back to 1958. The INRC also maintains computerized data files which relate to the specifications of water withdrawal and storage permits issued by the State Water Commissioner.

G. Iowa Department of Environmental Quality (DEQ)

The DEQ maintains files on construction permits for municipal ground water wells. These files date back to 1928 and include design specifications for individual wells pursuant to permitting, sketch geologic logs, casing and development schedules.

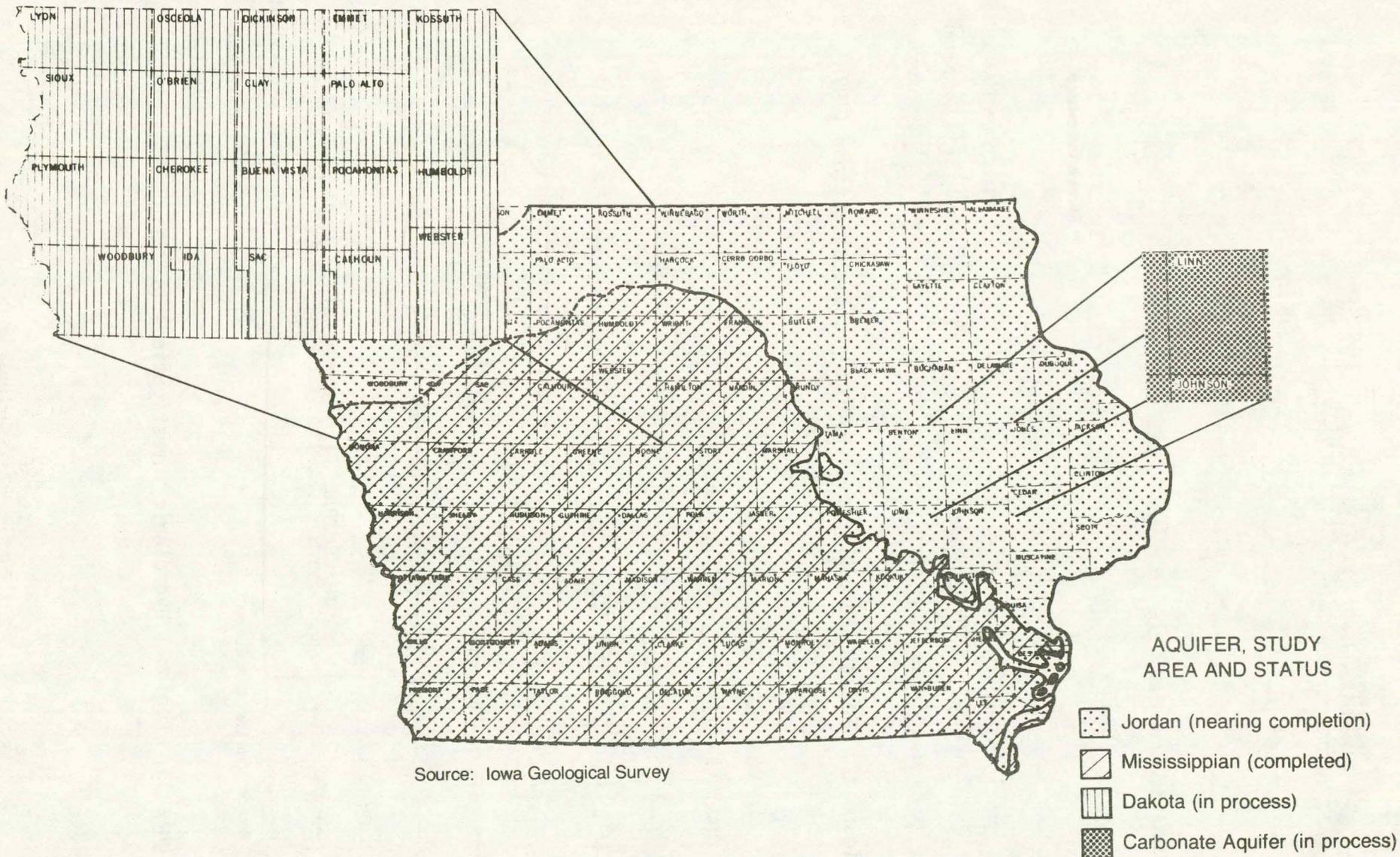


Figure 11. Aquifer Evaluation Studies (1978)

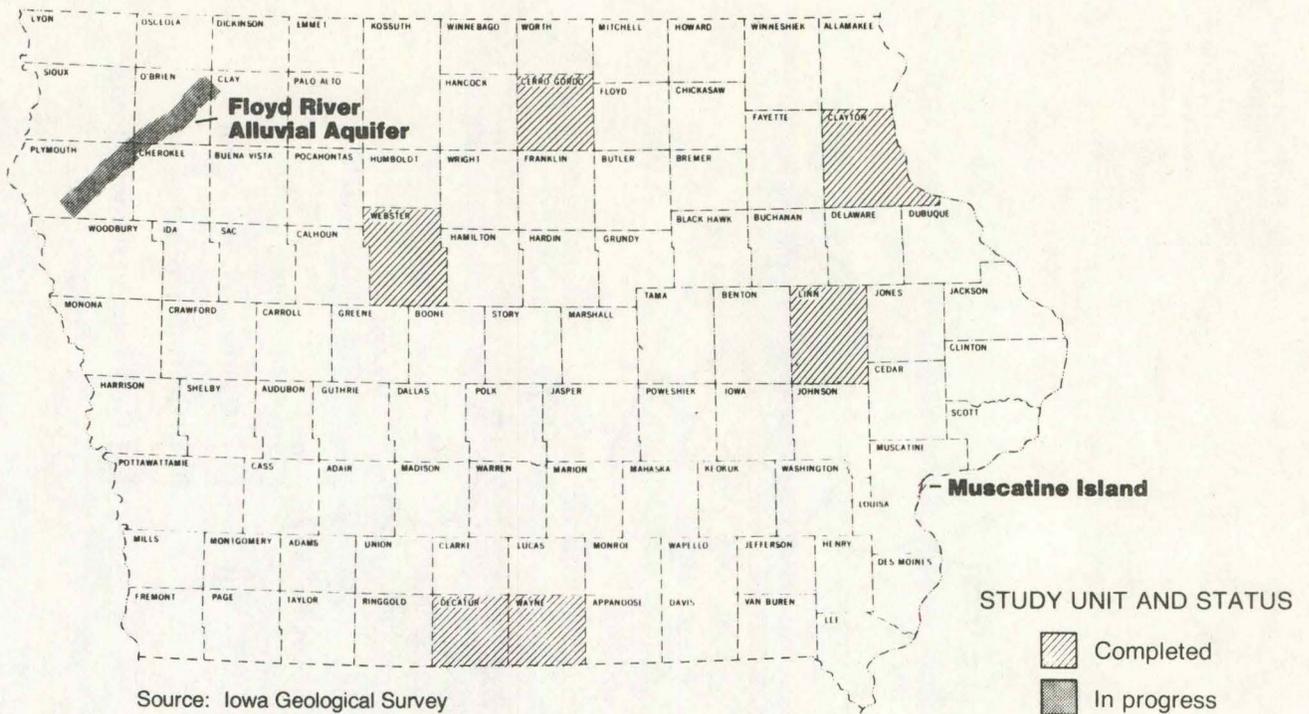


Figure 12. County and Subregional Hydrologic Investigations (1978)

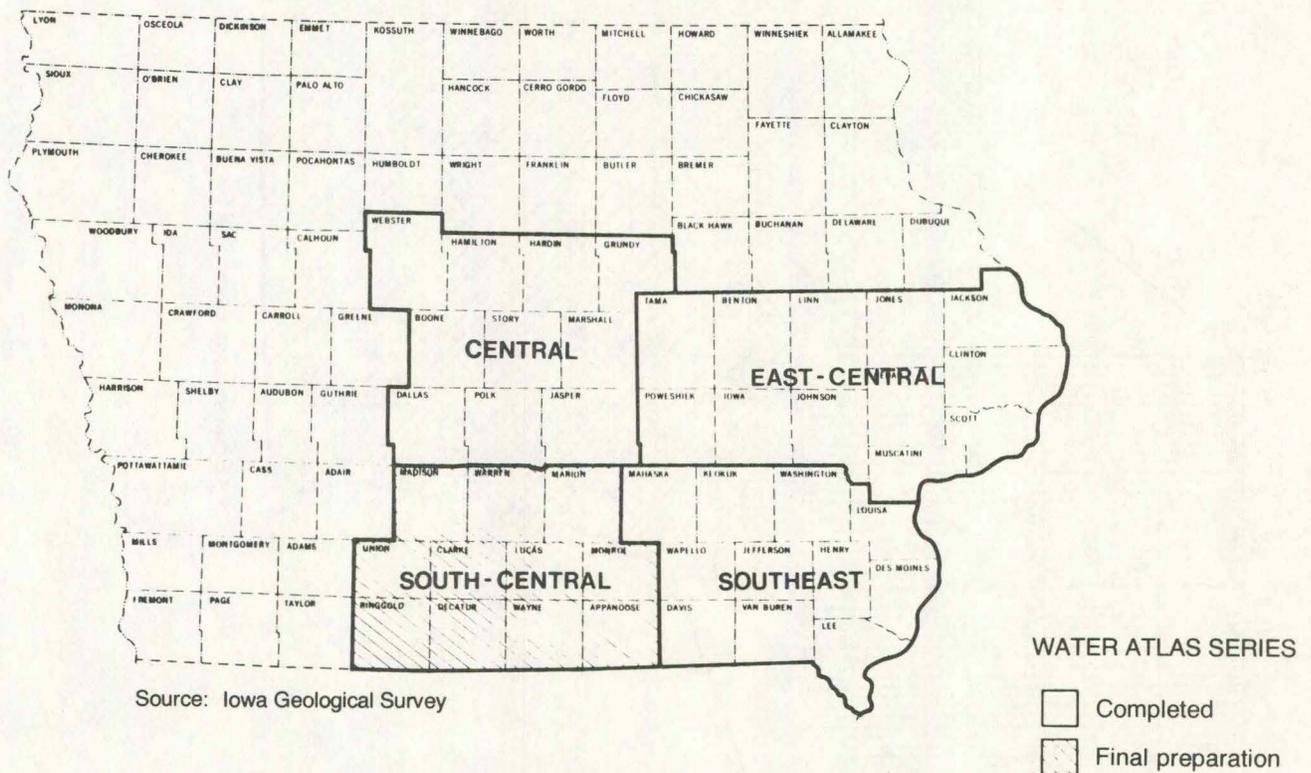


Figure 13. Regional Hydrologic Investigations (1978)

The DEQ also collects and files data on all water supply systems serving municipalities and rural water districts in Iowa. Data are obtained through annual sanitary surveys and monthly operation reports of water treatment facilities, and analyses of the quality of raw and finished water supplies. These data collection programs are discussed in greater detail in the section "Water Quality Data" of this report.

H. Iowa State Department of Health (IDH)

The IDH conducts annual surveys of water supply systems at 260 mobile home parks and 24 migrant labor camps in Iowa. Data are obtained on water quality, supply wells, and local hydrogeologic conditions, including well depth, casings, pump type, pit design, water levels, and the type and thickness of geologic materials encountered in wells. The IDH also assists well owners who wish to perform similar surveys of private water supply systems. However, collection of data from these surveys depends on the voluntary reporting of private owners.

II. Data Types and Availability

A. Ground Water Levels

1. Observation Wells

The USGS network of observation wells currently provides records of water level conditions and fluctuations in several different aquifers at 35 locations in the state (fig. 14). Continuous records are available from 8 wells equipped with automatic recorders. Water levels in the other 27 wells are measured manually at least once a year. However, the frequency and time of year at which measurements are taken in nonrecording wells have varied over the years.

Data from the USGS national network of observation wells are published in 2 series: "Ground-Water Levels of the United States"

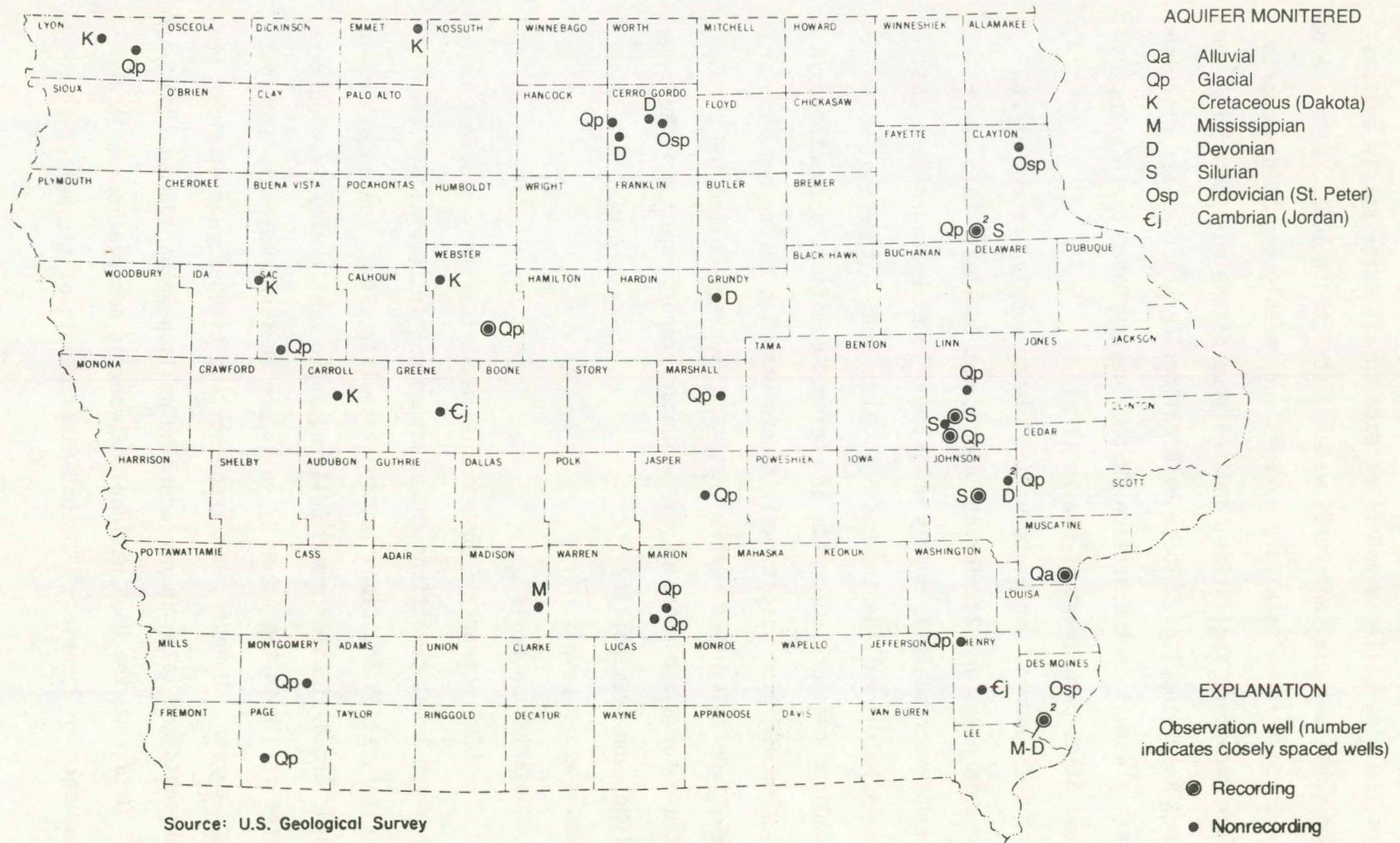


Figure 14. Locations of U.S. Geological Survey Observation Wells (1977)

(in Water-Supply Papers issued annually from 1935 through 1956 and about every 5 years thereafter) and "Water Resources Data for Iowa" (first annual issue with ground water data was released in 1975 and included data since 1972). Data for recording wells are published for only every fifth day. Unpublished data are held at the Iowa District Office of the USGS. The published data and a portion of the unpublished data are available from WATSTORE.

A continuous record of water levels in the observation well at Lone Tree is obtained by the ACE. These data as well as other short-term data records collected for special projects are on file at the ACE District Offices.

2. Strip Log Files

A majority of the well logs maintained in the IGS strip log files record two kinds of water level data: static water level (non-pumping) and the pumping water level. Although these data are current only at the time of development of a well, they do provide a historical record of water level conditions and may be used as a reasonable index of regional water levels within aquifers. The data are available for public examination at the IGS.

3. Aquifer Studies

For special aquifer studies the IGS and the USGS systematically inventory water level conditions for wells upon which the studies are based. The data on water levels reflect the most current regional water level conditions in aquifers and are usually presented as piezometric (water level) maps in the studies. Maps of this nature are available in several IGS-USGS Bulletins, Water Supply Papers, Water Atlases, and Map Series, or as unpublished work maps.

4. Water Supply Surveys

The IDH holds data on ground water levels that are obtained through annual surveys of 284 public water supply systems at mobile home parks and migrant labor camps. The data are not published but may be inspected or requested from the IDH.

B. Hydrogeologic Data

1. Strip Log Files

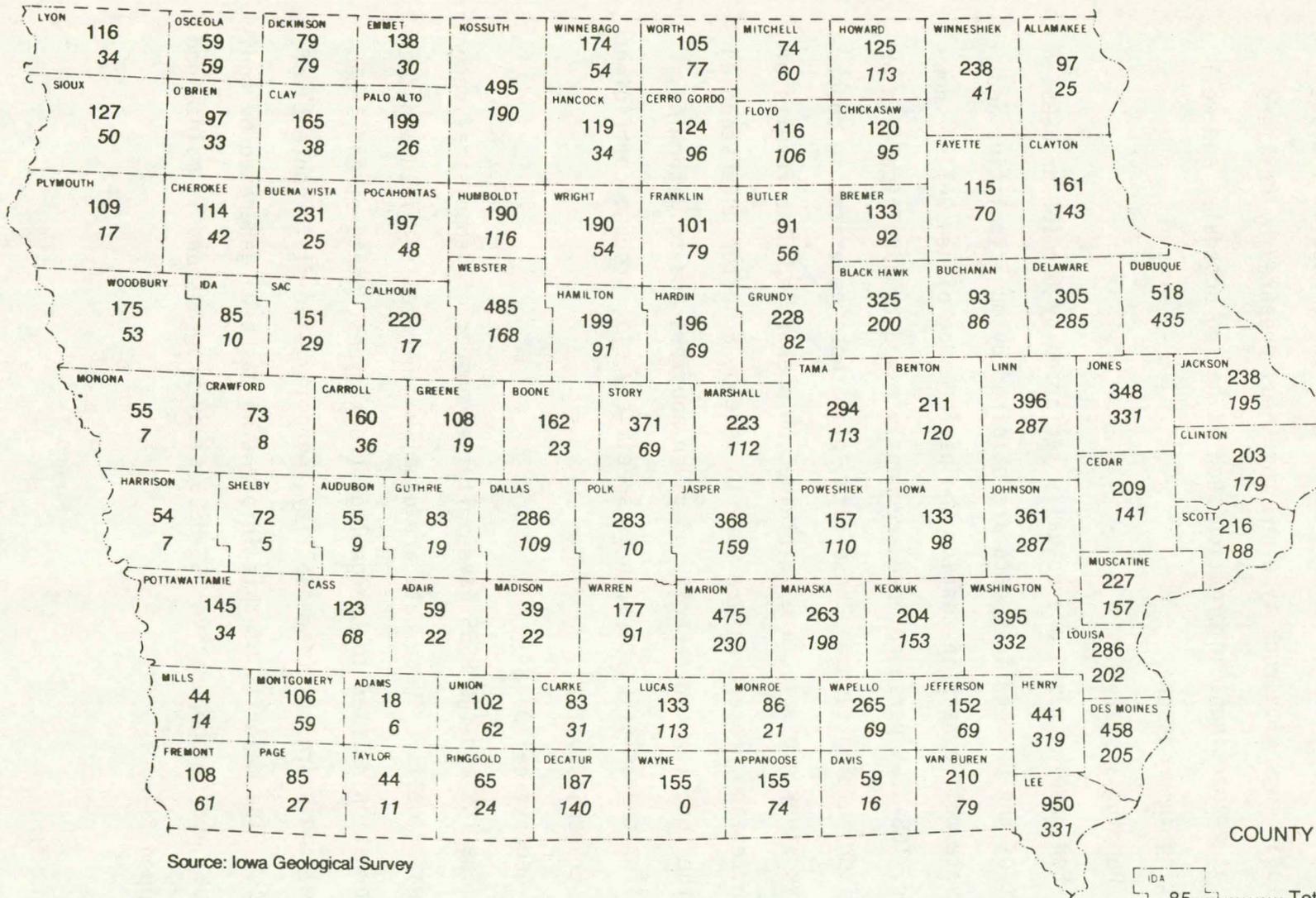
The strip log files maintained by the IGS represent the backbone of the state's information system on subsurface geology. The files contain records on approximately 20,000 individual water wells. These logs also include entries that give basic information on water levels, yield, well casing, etc. The geologic information (formation thickness, sequence, rock type, etc.) for about half of these logs has been coded for entering data into WATSTORE (fig. 15).

In addition to these computer files IGS-USGS are cooperating to code ground water quality data for wells that correspond with those of the strip log file. This work is presently about 50% complete.

The DEQ maintains sketch geologic logs of municipal wells in conjunction with water supply construction permits. The files include information on well design, casing, and development procedures.

2. Section Books

In addition to the strip log files, records of surface exposures are maintained in "section books" by the IGS. Surficial rock exposures are recorded in terms of location, thickness, rock type, and geologic sequence. Section books are used as reference data and as an aid in evaluating subsurface geologic conditions not readily observable in well cuttings and core samples.



Source: Iowa Geological Survey

COUNTY

IDA
 85 Total wells logged
 10 Logged wells on magnetic tape

STATE

Total wells logged 18,797
 Logged wells on magnetic tape 9,388

Figure 15. Status of Well Strip Logging Program (1976)

3. Driller's Log Books

The IGS files driller's log books that are usually submitted along with the samples of well cuttings. These records include geologic logs with rock type and thickness prepared by drillers and other pertinent information such as casing schedules and well testing information.

4. Pumping Tests

Few pumping tests are actually performed by the IGS or USGS. Most of the pumping test data are obtained by municipalities and private well owners in testing the performance of new wells. However, IGS-USGS personnel are frequently asked to participate in or monitor pumping tests. These data, plus those generated in cooperative study projects, are maintained on open file. The results of such testing procedures are used to develop a better understanding of the function and capacity of given aquifers and to determine aquifer characteristics such as specific yield, storage coefficients, and transmissivity.

5. Geophysical Data

The IGS and the USGS have a limited number of geophysical records on water wells. These data are usually generated to yield additional information related to the geology (rock types, texture, and structure) and hydrology (permeability, porosity, and fluid content) of wells. The majority of this information has been generated by individual and/or cooperative IGS-USGS study programs and is maintained in open file.

6. Interpreted Data

Most of the "raw" data held by the IGS and USGS have been compiled in interpretive reports, publications, maps, charts, and tables. A majority of these are available, at nominal cost, from the IGS and are listed in the IGS Publications List. In addition, other similar items are on file at the IGS as open file reports and as in-house working materials.

III. Sources of Data

Major sources of ground water data are described below and indexed in Table 3.

A. Published Data Sources

1. "Ground Water Levels in the United States"
Published by the U.S. Geological Survey on an annual basis from 1935 through 1956 and thereafter for the periods 1957-61, 1962-66, 1967-71, and 1972-74. Data for Iowa is found in part 3 North-Central States. Contents: measurements of water levels in recording and nonrecording observation wells; only data for every fifth day are published for recording wells.
2. "Water Resources Data for Iowa"
Published annually by the U.S. Geological Survey since 1961 for each state. Ground water data were first included in the series in 1975. The 1975 issue contains data for the period 1972-75. Contents: measurements of water levels in recording and nonrecording observation wells; only data for every fifth day are published for recording wells.
3. "Estimated Water Use in the United States"
Published every 5 years since 1950 by the U.S. Geological Survey in the USGS series of Circulars. Contents: estimates of amounts of ground and surface water withdrawn, delivered, and consumed for public supplies, rural supplies, irrigation, self-supplied industries, and hydroelectric power generation in each state.
4. "Iowa Public Water Supply Data"
Published by the Iowa Department of Health, Division of Health Engineering in 1964. These data are now the responsibility of the Iowa Department of Environmental Quality. Contents: municipal ground and surface water supply data, including population served in 1960, date collection facility installed, well depth, chief aquifer, type of water treatment, and chemical quality of raw ground and surface water and of treated supplies.
5. "Water Atlas Series"
Published by the Iowa Geological Survey since 1965. Contents: surface and ground water resources of particular regions; reports are available for Decatur County, Wayne County, and for multi-county regions in central, east-central, south-central, and southeast Iowa.

6. "Iowa Geological Survey Annual Report"
Prepared by the Iowa Geological Survey since 1858. Several reports deal with geology, ground water resources, and water wells in Iowa, including 3 major compilations: Underground Water Resources of Iowa (AR-21, 1910-1911), Deep Wells of Iowa (AR-33, 1927), and Deep Wells of Iowa (AR-36, 1930-1933).
Contents: hydrogeology, inventories of ground water resources, water levels, aquifer production, water quality, and water use.
7. "Water Supply Bulletins"
Published by the Iowa Geological Survey since 1942. Five of the bulletins are reports on the geology and ground water resources of particular areas.
Contents: county or local hydrogeology, inventory of ground water resources, water levels, supply potential, ground water quality, and water use; bulletins are available for Webster, Clayton, Cerro Gordo, and Linn counties and for Muscatine Island.
8. "Miscellaneous Map Series"
Published by the Iowa Geological Survey since 1971. Issues on specific aquifers include 3 map sheets and text.
Contents: hydrogeology, water quality, well capacities and yields, and water withdrawals; the series includes the Mississippian aquifer (Series No. 3) and the Jordan aquifer (Series No. 6, near completion).

B. Unpublished Data Sources

1. The U.S. Geological Survey holds several types of data related to ground water aquifers, water levels, wells and water quality. These include continuous recorder charts of water levels in recording observation wells and unpublished readings from nonrecording wells. Data obtained through pumping tests, water use inventories, and regional water resources studies are held on file. Several work maps and reports have been prepared which summarize some of these data holdings. Many of the unpublished data are held jointly with the Iowa Geological Survey.
2. The Iowa Geological Survey maintains several files of raw and interpreted data on geology, aquifer characteristics, water levels, well design and production and ground water quality. These files include the coded and uncoded strip logs, drillers log books, section books, geophysical logs, water quality reports, and county files of correspondence with well developers on well design and forecasts, pumping tests, and inventory of water supply and quality conditions. An extensive library of rock core and drill cutting samples submitted by drillers is also maintained. Several unpublished work maps have been prepared which summarize

regional water levels, aquifer characteristics, and water quality conditions. Much of these unpublished data are held jointly with the U.S. Geological Survey.

3. The Iowa State Department of Health holds data on hydrogeologic conditions, well design, and water quality at mobile home parks and migrant labor camps. A limited amount of similar data voluntarily submitted by private well owners are also on file.
4. The U.S. Army Corps of Engineers keeps data on water levels collected at the continuous recording well at Lone Tree as well as short-term records from nonrecording wells near ACE reservoirs and other special projects.
5. The Iowa Natural Resources Council holds data on ground and surface water withdrawal and storage permits issued under the Iowa Water Rights Law. These include the maximum allocations allowed by the State Water Commissioner and the total amounts actually withdrawn or stored as reported by each permit holder.
6. The Iowa Department of Environmental Quality maintains records of the quantity and quality of water withdrawn for municipal, rural water districts, state-owned facilities, and some other public water supply systems. The data covers both ground and surface water sources. Records of permits for construction of municipal wells contain information on geology, well design, and production.

C. Computer Storage and Retrieval

1. The U.S. Geological Survey has developed a large-scale computer system, the National Water Data Storage and Retrieval System, or WATSTORE, for the storage, processing, and dissemination of water data. Ground water data are managed in the System 2000 under WATSTORE. Data held by the U.S. Geological Survey and the Iowa Geological Survey on water wells in Iowa are currently being coded and entered into System 2000. Data may be retrieved through the Iowa District Office of the USGS. Direct access to WATSTORE data is also available from NAWDEX, the National Water Data Exchange, through the USGS and the IGS.

A variety of data displays and analyses are available from WATSTORE:

- a. data in machine - readable form; punched cards, tape, and disc copies of raw and processed data
- b. computer - printed tables: a variety of formats to list data and index tables

- c. computer - printed graphics: displays of data such as histograms, frequency curves, maps, and point plots
- d. digital plotting: preparation of data for peripheral, off-line printers
- e. statistical analyses: large number of programs for data processing and multivariate analyses.

Requests for data retrieval and analyses should be made to the Iowa District Office of USGS. A minimal fee is charged to cover computer costs and, once a request is completed, results are usually available within 24 hours.

- 2. The U.S. Geological Survey provides an information and referral service through the National Water Data Exchange, or NAWDEX. NAWDEX consists of two computerized data base files: the Water Data Sources Directory identifying participating organizations that collect water data and the Master Water Data Index File containing point-source locations for which data are available, types of data collected, period of record, and collecting organization. Upon request, users are assisted in identifying available data, where they can be obtained, and how they should be requested.

The NAWDEX system can also provide access to two existing data systems: WATSTORE and STORET. Any data can be retrieved directly through NAWDEX from these systems.

NAWDEX referral and retrieval services can be obtained from the Iowa District Office of the USGS and from the Iowa Geological Survey. The referral services are free, but some participating organizations may charge requesters for some services such as extracting and copying data.

- 3. The U.S. Environmental Protection Agency maintains the computerized data management system STORET for the storage, processing, and retrieval of water quality and related environmental data. Ground and surface water quality data in WATSTORE are also duplicated in STORET.

A number of water quality reports can be generated through STORET:

- a. station description reports: list of locations in Iowa where water quality data are collected and recorded in STORET
- b. inventory report: summary of data available at any station or series of stations with a brief statistical data summary

- c. value report: itemized values of data collected at any station with option of sorting by collecting agency, any data type, or river basin
- d. statistical evaluations: several programs with plotting options for data analysis and display.

STORET data can be obtained through the Iowa Department of Environmental Quality, the local STORET assistance center. The Iowa Geological Survey and the U.S. Geological Survey can also obtain STORET data for requesters through the NAWDEX referral system.

- 4. The Iowa Natural Resources Council maintains computer files on all water withdrawal and storage permits under the Iowa Water Rights Law. The files contain information on permit holders, beneficial uses for which permits are granted, source of water, permitted rates of withdrawal and amount of annual allocation.
- 5. The Iowa Department of Environmental Quality maintains computer files on all public water supplies through use of the Model State Information System (MSIS) which was developed by the U.S. Environmental Protection Agency. The MSIS files contain information on each public water supply system, including water source (surface or ground water), water treatment facility, water use, and treated water quality.

Table 3. SUMMARY OF GROUND WATER DATA COLLECTION

<u>Data Type</u>	<u>Recording Frequency</u>	<u>Collecting Agency</u>	<u>Stations¹ in 1977</u>	<u>Program Began</u>	<u>Published²</u>	<u>Unpublished²</u>	<u>Computer² Storage</u>
Water Wells	Continuous update	IGS, USGS	about 20,000 coded wells	1930		B1, B2	C1, C2
	Annual	IDH	284 public supply systems			B3	
	Continuous update	DEQ	public supply systems	1928		B6	C5
Water Levels	Continuous	USGS	8 wells	1935	A1, A2	B1	C1, C2
	Periodic	USGS	27 wells	1935	A1, A2	B1	C1, C2
	Continuous	ACE	1 well	1957		B4	
	Irregular	ACE				B4	
Water With-drawals	Every 5 years	USGS	state and national water inventories	1950	A3	B1	
	Continuous update	INRC	7,650 permits	1957		B5	C4
Regional Hydrogeology	Continuous update	IGS, USGS			A5, A6 A7, A8	B1, B2, B3	C1, C2

Table 3. SUMMARY OF GROUND WATER DATA COLLECTION (continued)

<u>Data Type</u>	<u>Recording Frequency</u>	<u>Collecting Agency</u>	<u>Stations¹ in 1977</u>	<u>Program Began</u>	<u>Published²</u>	<u>Unpublished²</u>	<u>Computer² Storage</u>
Water Quality	Daily	DEQ	public treatment facilities		A4	B6	C2, C3, C5
	Annual	IDH	284 public supply systems			B3	

¹Number of stations does not include those discontinued before 1977 for which data are available.

²Codes refer to items described in III Sources of Data.

WATER QUALITY DATA

This section describes on-going federal and state programs for the collection of surface and ground water quality data. The first part deals with programs related to general environmental monitoring; that is, the ambient quality of water resources. The programs described in part II focus on the quality of water supplies and in part III, waste water discharges. Because of the number and diversity of water quality indicators, the information on data collection networks, types of data, and their availability is discussed for each agency and program rather than presented under separate headings.

I. Environmental Monitoring

A. U.S. Army Corps of Engineers (ACE)

1. Sediment Data

The ACE has collected sediment data at selected sites in Iowa since the 1930's. At present, daily suspended sediment samples are taken at 17 sites (fig. 16). Historical records are available for a large number of special study and discontinued stations. Samples are analyzed to determine sediment concentrations and discharges, and in some cases, particle sizes. Instantaneous stream discharge occurring at the time samples are taken is also recorded.

The ACE also records information relevant to sediment accumulation in the ACE reservoirs in Iowa and in pools adjacent to locks and dams on the Mississippi River. This information is collected principally through bottom sediment sampling and profile measurements.

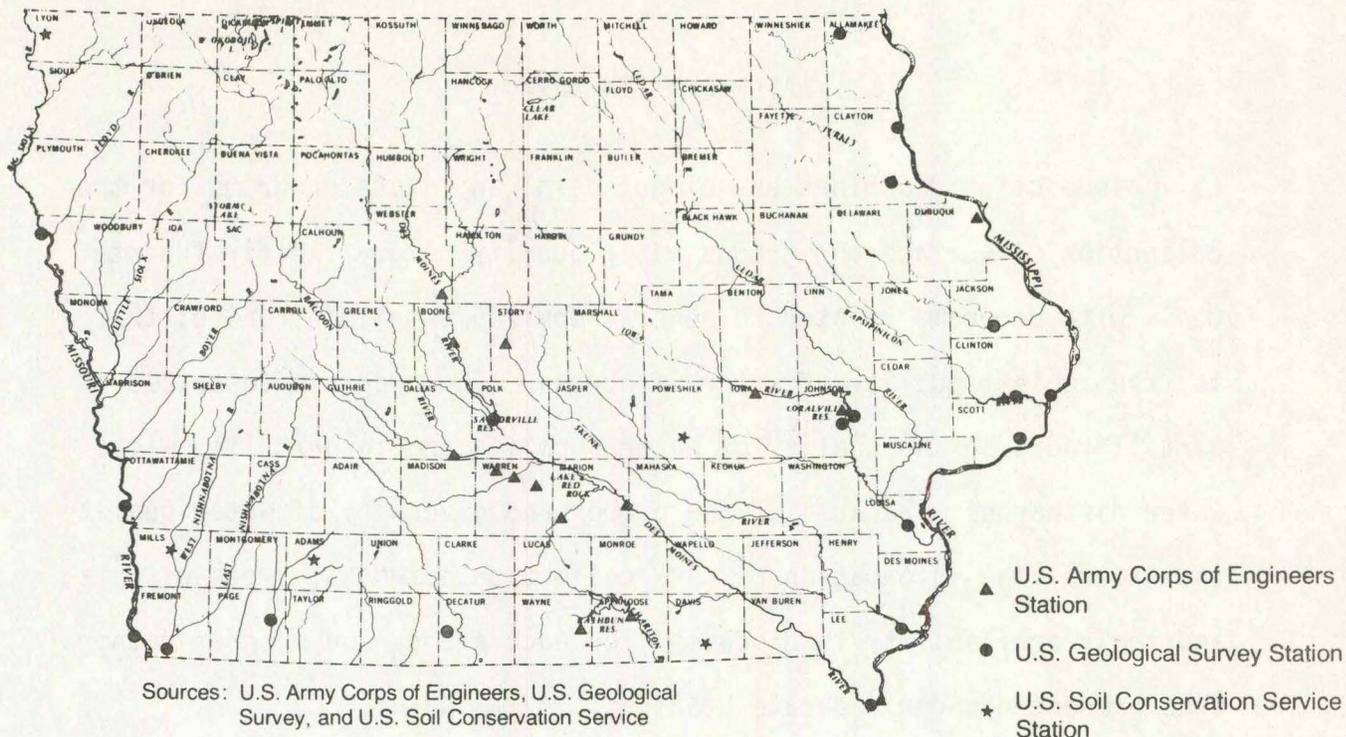


Figure 16. Locations of Sediment Sampling Stations (1977)

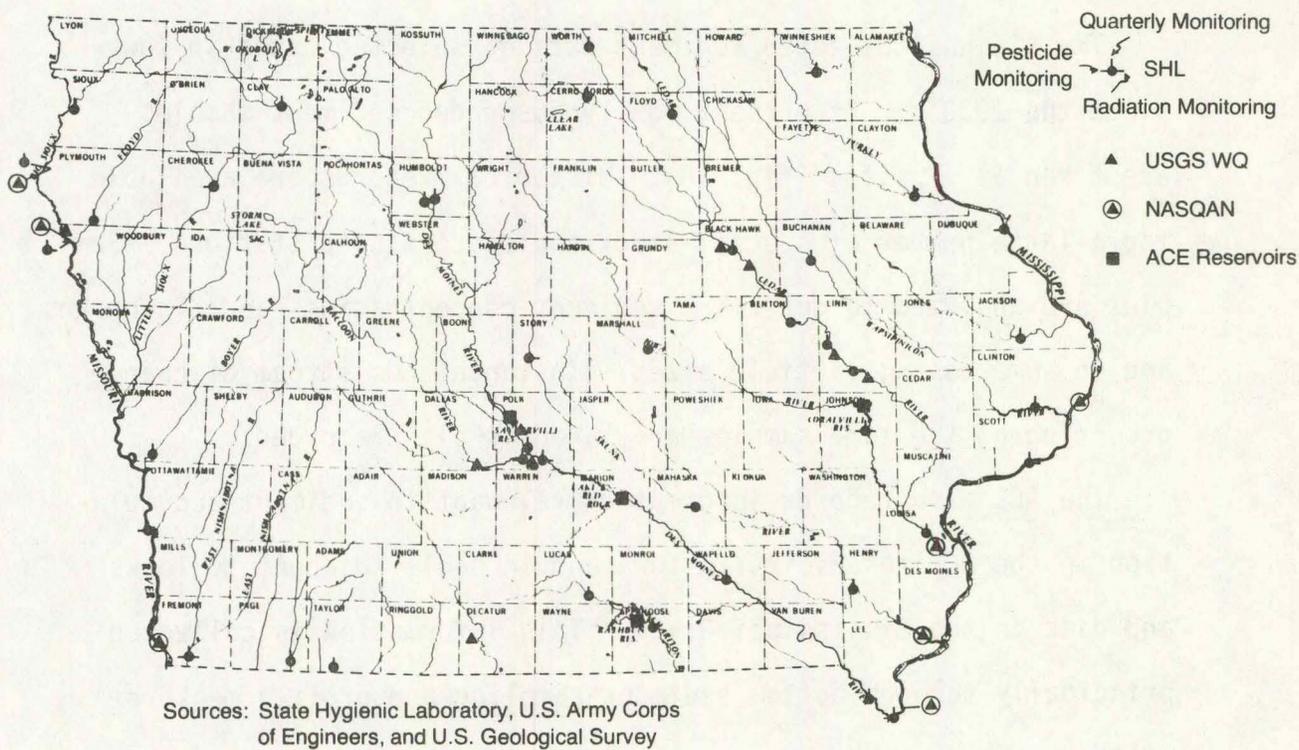


Figure 17. Locations of Surface Water Quality Stations (1977)

2. Reservoir Water Quality Studies

The ACE has acquired water quality data associated with the pre- and post-impoundment conditions at the four ACE reservoirs in Iowa: Coralville, Saylorville, Red Rock, and Rathbun (fig. 17). The objectives of data collection are to determine the quality of water in the reservoirs and the rivers above and below the reservoirs and the effects of reservoir operations on water quality. Post-impoundment studies for Coralville have been conducted since 1964 by the University of Iowa under a research contract with the ACE Rock Island District. Similar contract studies have been conducted by the Iowa State University on the pre- and post-impoundment water quality at Saylorville since 1967 and at Red Rock since 1972. Post-impoundment studies at Rathbun are conducted by the ACE Kansas City District. Routine samples are collected throughout the year (usually on a weekly, biweekly, or monthly schedule) at several locations in and adjacent to the impoundments: 4 locations at Coralville, 2 at Saylorville, 4 at Red Rock, and 25 at Rathbun. The quality indexes monitored vary among reservoirs but usually include about 20 indexes of biological, bacterial, solids, oxygen demand, general organic and inorganic chemical, and physical characteristics.

3. Data Availability

ACE sediment data may be obtained from the appropriate offices of the ACE districts representing Iowa. Reservoir sedimentation data are published by the U.S. Department of Agriculture in the "Summary of Reservoir Sediment Deposition Surveys Made in the United States". Historical records through 1973 of stream and reservoir sediment have also been compiled in "Fluvial Sediment Data for Iowa:

Suspended Sediment Concentrations, Loads, and Sizes; Bed Material Sizes; and Reservoir Siltation" published by the Iowa Geological Survey.

Reservoir water quality data are available from the Rock Island and Kansas City District Offices of the ACE. Monthly and annual summary reports of data collected under contract studies are prepared for the ACE and are available from the Colleges of Engineering at the universities and from the ACE. Most of the water quality data are also available from STORET, the data storage and retrieval system of the U.S. Environmental Protection Agency.

B. U.S. Environmental Protection Agency (EPA)

In conjunction with state and local governments, the EPA conducts a variety of pollution control programs through standards setting, enforcement, and special, temporary water quality monitoring activities. The EPA does not operate any continuous data collection programs or stations in Iowa, although EPA financially supports several surface water quality stations operated by the U.S. Geological Survey. The EPA also gathers considerable water quality data from several collecting agencies for entry into the STORET data system.

1. STORET

STORET is the computerized data management system maintained by the EPA for the storage and retrieval of water quality and other environmental data. Currently there are about 700,000 water quality values collected at some 2,000 locations in Iowa on file in STORET. These data have been collected by several state and federal organizations through their special studies and continuous monitoring programs, such as EPA, ACE, U.S. Geological Survey, Iowa Department

of Environmental Quality, and State Hygienic Laboratory. Most data have been collected in the last 10 years, though some date back to the 1930's. Some 1,800 unique water quality indexes have been defined by the EPA for storing data types. Most of the permanent water quality stations in Iowa have records of up to 50 different indexes. At other locations less than 10 data types are usually recorded.

2. Data Availability

The Iowa Department of Environmental Quality (DEQ) is the principal agency responsible for entering water quality data for Iowa into STORET. All data stored in STORET can be retrieved directly by the DEQ. Direct access to STORET is also provided through NAWDEX, the water data referral service of the U.S. Geological Survey. The U.S. Geological Survey and the Iowa Geological Survey can directly obtain STORET data through NAWDEX for others.

C. U.S. Geological Survey (USGS)

The USGS has collected surface water quality data in Iowa on a systematic basis since 1943. A few records were acquired before this date by special arrangement. Currently, the USGS programs are supported in part through cooperative arrangements with the EPA, which provides funds for several water quality stations operated by the USGS on interior streams and with the Iowa Geological Survey and ACE, which finance or report data for a number of USGS stream sediment stations.

1. Water Quality Stations

The USGS collects surface water quality data at 10 stations (fig. 17). Samples are taken monthly or less often and are analyzed for various physical, chemical, and microbiological characteristics; i.e.,

temperature, pH, turbidity, specific conductance, dissolved solids, dissolved oxygen, chemical oxygen demand, carbon dioxide, coliform, and major chemical ions such as calcium, magnesium, sodium, potassium, carbonate, sulfate, nitrate, and chloride. Instantaneous stream discharge is also recorded at the time of sampling.

2. NASQAN Stations

More comprehensive quality analyses are available from 7 USGS stations in Iowa in the National Stream Quality Accounting Network (NASQAN) (fig. 17). Samples are analyzed for over 40 physical, biological, and chemical characteristics, including special analyses of pesticide residues, radioisotopes, trace metals, and phytoplankton. Some data are analyzed daily and others on a less frequent, periodic schedule. Data for the NASQAN station on the Big Sioux River are collected and published by the South Dakota District Office of the USGS.

3. Partial-record Water Quality Stations

Periodic and intermittent samples are taken at partial-record water quality stations, most of which are also low-flow partial-record stations. Specific conductance, pH, and temperature are determined at partial-record stations whenever discharge measurements are made.

4. Sediment Sampling Stations

Suspended sediment samples are acquired by the USGS at 19 stations (fig. 16). In addition to these routine samplings, several random samples are collected at selected stream gaging stations when velocity-discharge measurements are made. The collected samples are analyzed to determine sediment concentrations, discharge,

and particle size. Instantaneous stream discharge at the time of sediment sampling is also recorded.

Stream bed material is sampled periodically at most suspended sediment stations. Particle size distributions are determined from the bed samples.

5. National Water Data Exchange (NAWDEX)

NAWDEX is the water data referral service organized by the USGS. The water data holdings of participating federal and nonfederal organizations are indexed in two computerized files: the Water Data Sources Directory of organizations collecting water data and the Master Water Data Index files with data types, locations of collecting points, and periods of records. Users of NAWDEX are assisted in identifying available data, where they can be obtained, and how they can be requested. NAWDEX can presently provide referral services for 5 participating organizations collecting water quality data in Iowa: Iowa Department of Environmental Quality, State Hygienic Laboratory, ACE, EPA, and USGS. In addition to referral services, direct access is available through NAWDEX to WATSTORE (the data storage and retrieval system of the USGS) and STORET (the water quality storage and retrieval system of EPA). The two NAWDEX Local Assistance Centers through which requests can be made are the Iowa Geological Survey and the Iowa District Office of the USGS.

6. Data Availability

Surface water quality and sediment data can be obtained from the Iowa District Office of the USGS. Most of the data are published in two USGS report series. The Water-Supply Papers, "Quality of Surface Waters of the United States", were published annually from 1941 to

1964 and every 5 years since then. Since 1964, the data have been published annually in a series "Water Resources Data for Iowa". In addition to these 2 series, data collected before 1941 are also available in the Water Supply Bulletin No. 5, "Quality of Surface Waters of Iowa, 1886-1954" published by the Iowa Geological Survey. Published historical records of sediment data from the USGS, ACE, and SCS have been recently compiled in a separate report, "Fluvial Sediment Data for Iowa: Suspended-Sediment Concentrations, Loads, and Sizes; Bed-Material Sizes; and Reservoir Siltation."

Water quality data are also entered into the USGS data storage and retrieval system, WATSTORE. Requests for data retrieval can be made through the Iowa District Office of the USGS. Water quality data in WATSTORE is also duplicated in STORET. WATSTORE and STORET data can also be retrieved through NAWDEX by the USGS and by the Iowa Geological Survey.

D. U.S. Soil Conservation Service (SCS)

1. Sediment Data

The SCS collects sediment data through surveys of sediment accumulation in storage reservoirs and ponds. The survey sites are small watershed protection and flood control projects administered by the SCS. The survey data include sediment source area, specific weight of sediment, storage capacity of reservoir, ratio of actual storage volume to annual inflow, and the volume and weight of annual sediment accumulation per source area. The earliest data recorded are from 1903, but most surveys have been conducted since the 1940's. Since 1970, the SCS has reduced the number of survey sites to 5 (fig. 16), one with a record of 12 previous surveys and four with one survey each.

2. Data Availability

Sedimentation survey data have been published by the U.S. Department of Agriculture every five years since 1957. The most recent issue in the series, "Summary of Reservoir Sediment Deposition Surveys Made in the United States through 1970", contains all historical data for 55 sites in Iowa published in earlier issues. In addition to the summary report, a supplement is prepared for limited distribution. The supplement contains the data forms used for field surveys and provides more detailed data than the summary. Reprints of the data forms for specific reservoirs can be obtained from the U.S. Department of Agriculture, Sedimentation Laboratory, Oxford, MO. Summary data through 1970 is also reprinted in "Fluvial Sediment Data for Iowa: Suspended-Sediment Concentrations, Loads, and Sizes; Bed-Material Sizes; and Reservoir Siltation."

E. Iowa State Conservation Commission (ICC)

1. Lake Water Quality Monitoring

The ICC is conducting a long-term water quality monitoring program at the 72-acre Red Haw Lake in Lucas County. The program was begun in July, 1973, and is scheduled to terminate in 1980. Some earlier data are available. Monthly water samples are analyzed for turbidity, temperature, specific conductance, alkalinity, phosphates, nitrates, dissolved oxygen at 1-meter intervals to 15-meter depth, and primary production (carbon assimilation).

Some water quality data has been collected for other lakes through short-term, special monitoring programs and other long-term programs which have since been discontinued.

2. Data Availability

There is no regular publication of the data but they may be requested from the ICC.

F. State Hygienic Laboratory (SHL)

1. Quarterly Monitoring Program

The Limnology Division of the SHL has monitored stream quality at 36 fixed stations since 1972 (fig. 17). Water samples are collected every 3 months and are analyzed for at least 45 quality indexes: general chemistry (including conductance, pH, nitrogen and phosphorus series, dissolved oxygen, oxygen demand, residues, turbidity, and chlorophyll a), complete mineral analysis (major chemical ions and trace metals), and coliform bacteria.

2. Pesticide Monitoring Program

This program was begun in 1968 to assess the levels of insecticides and herbicides in Iowa rivers. Water samples from 11 permanent stream stations are collected and analyzed each month by the SHL (Fig. 17). Concentrations of chlorinated hydrocarbons, organophosphates, herbicides, and polychlorinated biphenyls (PCB) are determined for each sample.

3. Radiation Monitoring Program

Radiation monitoring of surface waters has been conducted by the SHL since 1960. Currently there are 10 permanent stream stations where samples are obtained: 2 on a quarterly schedule, 3 monthly, and 5 weekly (fig. 17). Several of the stream stations are located near nuclear power plants in order to monitor the presence of radioactivity. Others are not in close proximity to plants and serve as controls. Analyses are made for gross-alpha and gross-beta activity,

tritium, and radium 226.

4. River Reach Surveys

Detailed water pollution investigations of rivers and impoundments are conducted by the SHL, frequently in conjunction with special needs or projects of other agencies. The data obtained vary with the survey objectives; e.g., to evaluate the effects of waste water discharges, to determine violations of the Iowa Water Quality Standards, or to locate major pollution sources. Many of the surveys are follow-up studies to assess changes, if any, in water quality as compared to previous surveys. Data are generally obtained from complete water chemistry analyses, diurnal dissolved oxygen monitoring, fecal coliform enumerations, and use of benthic organisms as water quality indicators. Usually 10 to 15 surveys are conducted each year.

5. Raw Water Supply Analyses

Data on ambient water quality are obtained by the SHL through analyses of raw (untreated) water supplies. Water samples are collected by the DEQ from municipalities, rural water districts, state-owned facilities, some other public supply systems, or are submitted by private individuals or organizations. For public water supplies, ground water sources are routinely sampled at water treatment plants once every 3 years and surface water sources every year. The samples are tested for potability (bacteria, nitrate, iron, and hardness), mineral content (up to 45 quality parameters, principally chemical ions and heavy trace metals), and radioisotopes (gross alpha and gross beta-gamma activity).

6. Data Availability

The SHL keeps complete records of water quality sampling and laboratory analyses performed. Data acquired through the monitoring and survey programs are also forwarded to the DEQ where they are entered into STORET. Data can be retrieved from STORET through the DEQ and from NAWDEX through the IGS and the USGS. Technical reports of river reach surveys are submitted to the Iowa Water Quality Commission and are available to the public on request. The reports contain tabulations of all water quality data collected, discussion of survey findings, and recommendations for further action. Copies of test results for raw water samples are sent to the respective water treatment facility from which the sample was obtained and to the DEQ and the Iowa Geological Survey. For samples from private sources, results are returned to the submitter.

G. Iowa Department of Environmental Quality (DEQ)

1. Water Supply Quality

The DEQ currently collects and files data on the quality of raw water supplies for all systems serving municipalities, rural water districts, state-owned facilities, and some other public water systems. Water treatment facilities submit monthly operation reports to the DEQ which contain daily records of volume and quality of raw water withdrawn from surface or ground water sources as well as quantity and quality of finished (treated) water. (See II. Water Supply Monitoring).

The DEQ also conducts annual sanitary surveys of water treatment facilities in order to inspect treatment procedures and equipment

and to detect defects in reporting and plant operations. Samples of raw and finished water are also taken for analysis.

Data on raw water quality at public water supply systems are also routinely forwarded to the DEQ by the SHL. The DEQ collects the water samples from public water treatment facilities; the SHL performs the laboratory analyses and distributes the test results.

2. Data Availability

The DEQ maintains the raw water quality data in manual data files and in the Model State Information System (MSIS) computer files. MSIS was developed by the U.S. Environmental Protection Agency and implemented by the DEQ for storage and retrieval of data on public water supply systems. There is one published compilation of data, "Iowa Public Water Supply Data", prepared in 1964 by the Division of Public Health Engineering, Iowa State Department of Health before the DEQ was created.

H. Iowa Geological Survey (IGS) and U.S. Geological Survey (USGS)

1. Cooperative Water Quality Program

Data on the quality of raw and finished water supplies of municipalities and other public systems are routinely forwarded by the SHL to the IGS and USGS. These data (complete mineral analyses) form the principal source of information about the quality of water in subsurface aquifers. The IGS and the USGS also irregularly obtain quality analyses of ground water samples in conjunction with special studies. Some private well owners have voluntarily submitted to the IGS water quality analyses which they have had performed. Through the cooperative efforts of the IGS and the USGS, manually filed data on ground water quality, well characteristics, and pumping operations

are being transferred to WATSTORE. The SHL also forwards data on the quality of surface waters, collected primarily through surface water supply analyses, Quarterly Monitoring, and River Reach Studies. These data are maintained in manual files or are entered into WATSTORE along with other surface water quality data collected by the USGS.

2. Data Availability

Requests for water quality data can be made to the IGS or the Iowa District Office of the USGS. In addition to data in manual files and in WATSTORE, several special reports, water resources atlases, and ground water maps which include compiled information on ground water quality have been prepared by the IGS and the USGS.

II. Water Supply Monitoring

A. Iowa Department of Agriculture (IDA)

1. Water Supply Potability Program

The Food Products Control Section of the IDA is responsible for potability inspections of water supplies of public food establishments such as restaurants, of locker plants, and of other food processing facilities. Water samples are usually tested for bacteria, nitrates, and nitrites. Water supplies obtained from municipal water systems are not monitored.

2. Data Availability

The IDA should be contacted directly in order to obtain data. The data are not published and are currently maintained in manual files.

B. Iowa Department of Environmental Quality (DEQ)

1. Water Supply Quality

Data on the quality of finished potable water supplies are collected by the DEQ at most water treatment facilities in Iowa. Treatment facilities submit monthly operation reports to the DEQ which record daily or periodic measurements of chemical, mineral, radiological, and bacterial characteristics of treated water supplies. Data are currently obtained from all municipalities and rural water districts (over 800 sites) and from other private and public sources. The DEQ also conducts annual sanitary surveys of water treatment facilities. Water samples are obtained at various stages of treatment in order to evaluate plant equipment and treatment procedures. The DEQ also requires regular testing of finished water from municipal systems. Water samples are sent by the municipalities to the SHL which tests for bacteria, nitrate, iron, and hardness. The laboratory results are forwarded to the DEQ which evaluates the data and makes recommendations for modifying plant operations if necessary.

2. Water Supply Facilities Information

Considerable data are maintained by the DEQ on the facilities and operation of water treatment plants. The facilities inventory is an up-to-date index of plants in operation including location, population served, design characteristics, types of treatment, and supply sources. Similar information is also included in administrative records of state and federal grant allocations for plant construction. In addition, the monthly operation reports include data on daily water withdrawals by source, the daily maximum, minimum and average production, quantities of finished water delivered to domestic,

commercial, and industrial users, the number of service connections, and number of metered connections.

3. Data Availability

Water supply quality data can be requested directly from the DEQ. Data on municipal supplies were published in 1964 by the Division of Public Health Engineering, Iowa State Department of Health, in "Iowa Public Water Supply Data". DEQ has assumed responsibility for these data since then. The data are currently maintained in manual files and in the MSIS computer storage system for water supply data.

C. Iowa State Department of Health (IDH)

1. Mobile Home Park Water Supply Program

The 260 mobile home parks with water supply systems are surveyed once a year. Samples of drinking water supplies are analyzed for bacteria and nitrate content and for hardness and iron if above normal concentrations of these 2 constituents are suspected. In addition to water sampling, the annual sanitary surveys provide data on water supply wells and local hydrogeologic conditions to aid well owners in obtaining safe water supplies. Data are recorded on depth of well, casings, type of pump, pit design, ground water levels, and the type and thickness of the geologic materials encountered in wells.

2. Migrant Labor Camp Water Supply Program

There are 24 migrant labor camps in Iowa at which annual sanitary surveys are conducted. The same survey and water sample data are collected as at mobile home parks.

3. Data Availability

There are no published compilations of the data but they may be requested directly from the IDH.

D. State Hygienic Laboratory (SHL)

1. Potability Analysis Program

The SHL performs potability analyses on about 40,000 drinking water samples a year. Laboratory tests are usually performed for coliform bacteria, nitrate, iron, and hardness. About 30,000 of the samples each year are from municipalities, for regular sampling from municipal distribution systems is required by the DEQ. The number of samples required depends upon the population served. For example, the city of Des Moines submits at least 140 samples a month; Iowa City, at least 64 samples a month. The minimum is 2 per month for municipalities with populations of 1000 or fewer.

About 10,000 water samples are submitted each year by private individuals. There is no regular sampling associated with private water supplies.

2. Data Availability

Laboratory data are kept on file by the SHL, and copies are returned to the municipality or individual who submitted the sample. Test results for public (municipal) supplies are forwarded to the DEQ and those for private supply systems are forwarded to the Iowa State Department of Health.

III. Waste Water Monitoring

A. Iowa Department of Environmental Quality

1. Waste Water Quality - Compliance Monitoring

Every waste water facility in Iowa must obtain a permit to discharge effluent into receiving streams. This includes municipalities, industries, and public and private facilities serving at least 15 people. Associated with each permit is a compliance schedule

defining the effluent quality limits and timetable of compliance with effluent standards to be met by the facility. DEQ personnel intermittently inspect plants, sample waste water at various stages of treatment for analysis, evaluate plant efficiency, and determine adherence to compliance schedules.

2. Waste Water Quality - Operation Reports

Under the discharge permit system, the DEQ requires monthly operation reports from waste water facilities. These are considered a form of self-monitoring, since facility personnel are responsible for sampling and laboratory analyses. The reports contain daily data on the quality and quantity of raw sewage coming into the plant, quality at various treatment stages, and the quality of treated effluent discharge. The quality indicators usually determined are BOD (biological oxygen demand), suspended solids, and ammonia nitrogen. Other determinations, such as pH, DO, coliform, and chlorine residue, may be required, depending on the type of plant and treatment methods.

3. Waste Water Facilities Information

The DEQ also maintains data on waste water facility design and operations. The waste water facilities inventory contains information on location, population served, plant design, type of treatment, and the receiving stream. Additional information may be found in administrative records of grant allocations, construction and operation permits, compliance histories, and operator certifications.

4. Data Availability

Waste water data obtained from compliance monitoring and operations reports may be requested directly from the DEQ. The data are maintained on the MONITER system, the computer storage system developed

by the DEQ solely for management of waste water data. Information about construction and operation permits, compliance schedules and histories, and other descriptive information about treatment facilities inventory and grant information are available through the DEQ from STORET.

B. State Hygienic Laboratory (SHL)

1. Effluent Quality Analysis Program (EQAP)

EQAP is a service program provided by the SHL to the DEQ to enable it to monitor the performance and general effluent discharge of all municipal and selected industrial waste treatment facilities. Of the 685 effluent dischargers with permits, 538 are required by the DEQ to participate in EQAP. Every month a sampling kit is automatically sent to each treatment facility. All returned samples are tested for biological oxygen demand (BOD) and selected samples are also tested for ammonia and phosphorus content. Other quality parameters, such as trace metals, are analyzed only upon special requests.

2. Data Availability

The test results are kept on file at the SHL and copies are mailed to each respective water treatment facility. The data are also reported to the DEQ where they are maintained on the MONITER computer data system.

IV. Sources of Data

Major sources of water quality data are described below and indexed in Table 4.

A. Published Data Sources

1. "Quality of Surface Waters of the United States"
Published in U.S. Geological Survey series of Water-Supply Papers on an annual basis from 1941 through 1964 and every 5 years since 1964. Iowa is included in 2 basin reports: part 5 Hudson Bay and Upper Mississippi River Basins and part 6 Missouri River Basin.
Contents: chemical, biological, microbiological, temperature, and sediment data collected by USGS at daily and partial record and NASQAN stations.
2. "Water Resources Data for Iowa"
Published annually since 1961 on a state-boundary basis by the U.S. Geological Survey.
Contents: same data types and format as A.1.
3. "Water Resources Data for South Dakota"
Published annually by the U.S. Geological Survey on a state-boundary basis since 1961.
Contents: same data types and format as A.1.; contains data for NASQAN station on Big Sioux River at Akron, IA.
4. "Fluvial Sediment Data for Iowa: Suspended - Sediment Concentrations, Loads and Sizes; Bed - Material Sizes; and Reservoir Siltation"
Prepared by the U.S. Geological Survey and published in 1977 by the Iowa Geological Survey as Technical Information Series No. 6.
Contents: compilation of stream suspended sediment and bed material data which have been collected and previously published by the U.S. Geological Survey, U.S. Army Corps of Engineers, and U.S. Soil Conservation Service; contains reservoir sediment data published in A.5.
5. "Summary of Reservoir Sediment Deposition Surveys Made in the United States through 1970, with Supplement"
Published every 5 years since 1955 by the U.S. Department of Agriculture. Most recent issue is USDA Miscellaneous Publication No. 1266 and contains all data published in previous issues. Reprints of supplement data for specific reservoirs are available from USDA Sedimentation Laboratory, Oxford, MS.

Contents: Summary: drainage area, sediment source area, reservoir capacity, ratio of actual capacity to annual inflow, and volume and weight of annual sediment accumulation per source area; Supplement: original field survey forms with more detailed data on reservoir, watershed, and sediment characteristics.

6. "Quality of Surface Waters of Iowa, 1886-1954"
Published by the Iowa Geological Survey in 1955 as Water-Supply Bulletin No. 5.
Contents: records of chemical analysis, temperature, and suspended sediment of surface waters collected in Iowa by state and federal agencies through 1954.
7. "Iowa Public Water Supply Data"
Published by the Iowa Department of Health, Division of Public Health Engineering in 1964. These data are now the responsibility of the Iowa Department of Environmental Quality.
Contents: municipal surface and ground water supply data, including population served in 1960, date collection facility installed, well depth, chief aquifer, type of water treatment, and chemical quality of raw surface and ground water and of treated water supplies.
8. "State Hygienic Laboratory Technical Report"
Principal publication series for State Hygienic Laboratory data, including their reports of water quality surveys of specific streams and river reaches.
Contents: summary of survey results, recommendations, and listing of water quality data collected during survey.

B. Unpublished Data Sources

1. The U.S. Army Corps of Engineers does not routinely publish sediment and other water quality data. Reservoir sediment data collected since 1970 may be available. Several monthly and annual intra-agency reports of reservoir water quality data for Coralville, Saylorville, and Red Rock reservoirs have been prepared under contract for the ACE and by the ACE for Rathbun. Reports and other unpublished data can be requested from the ACE District Offices.
2. The U.S. Geological Survey holds some surface and ground water quality data which are not included in the regular publications. These include the irregular water temperature measurements made at stream gaging stations, miscellaneous sediment analyses, and other data collected for special studies.

3. The State Hygienic Laboratory holds records of all water quality tests performed by the Laboratory. Copies of the test results are returned to the water sample submitter. Most of the data are also forwarded to other agencies for their use.
4. The Iowa Department of Environmental Quality holds water quality data on raw and treated water supplies, waste water effluents, and information about water supply and waste water facilities. The data are stored in manual files and in the STORET, MSIS, or MONITER computer systems, depending on the type of data. Data are also forwarded by the State Hygienic Laboratory on samples from public supply systems (raw and treated water), from waste treatment facilities participating in EQAP, and from all of the environmental monitoring programs of the Laboratory.
5. The Iowa Geological Survey and the U.S. Geological Survey routinely receive mineral analysis data from the State Hygienic Laboratory. The data are for raw and treated surface and ground water. They are held in manual files and are being entered into WATSTORE.
6. The Iowa State Conservation Commission collects water quality data at Red Haw Lake in Lucas County. These data as well as others obtained from special and discontinued programs are held by the agency.
7. The U.S. Soil Conservation Service has collected some reservoir sediment survey data since the last compilation was prepared with data through 1970. The next compilation in the series described in A. 5. will include data through 1975.
8. The Iowa Department of Agriculture maintains in manual files water quality data (mainly potability) for food processing facilities.
9. The Iowa State Department of Health holds data on the potability and hydrogeology of public water supply systems at mobile home parks and migrant labor camps and similar data on private supply systems voluntarily submitted by private individuals. The State Hygienic Laboratory also routinely forwards copies of potability tests performed for private individuals.

C. Computer Storage Retrieval

1. The U.S. Environmental Protection Agency maintains the computerized data system STORET. This is to store, process, and retrieve water quality data gathered throughout the country. Several state and federal agencies in Iowa routinely

furnish water quality data to STORET, including DEQ, SHL, ACE, USGS, and EPA. DEQ has recently added about 500,000 data values to STORET which had been collected through special studies conducted by other agencies, universities, and consulting firms. Presently, there are over 700,000 data values collected at some 2,000 locations in Iowa in STORET. Most of the data has been collected since 1965, though some date back to the 1940's. Water quality data maintained by the U.S. Geological Survey in the WATSTORE system are periodically added to STORET. A number of surface water quality data reports can be generated through STORET:

- a. station description reports: list of locations in Iowa where water quality data are collected and recorded in STORET
- b. inventory report: summary of data available at any station or series of station with a brief statistical data summary
- c. value report: itemized values of data collected at any station with option of sorting by collecting agency, any data type, or river basin
- d. statistical evaluations: several programs with plotting options for data analysis and display.

EPA and DEQ also use STORET to store data and generate reports on water supply and waste water facility inventories and grant allocations.

STORET data can be obtained through the Iowa Department of Environmental Quality, the local STORET assistance center. The Iowa Geological Survey and the U.S. Geological Survey can also obtain STORET data for requesters through NAWDEX referral system.

2. The U.S. Geological Survey has developed a large-scale computer system, the National Water Data Storage and Retrieval System, or WATSTORE, for the storage, processing, and dissemination of water data. All water quality data obtained through routine collection programs are entered into WATSTORE, as are data from surface water quantity and ground water programs. Data for Iowa are entered into and retrieved from WATSTORE through the District Office of the USGS in Iowa City. The water quality data are also periodically added to STORET.

A variety of data displays and analyses are available from WATSTORE:

- a. data in machine-readable form: punched cards, tape, and disc copies of raw and processed data
- b. computer-printed tables: a variety of formats to list data and index tables
- c. computer-printed graphics: displays of data such as histograms, frequency curves, maps, and point plots
- d. digital plotting: preparation of data for peripheral, off-line printers
- e. statistical analyses: large number of programs for data processing and multivariate analyses.

Requests for data retrieval and analyses should be made to the Iowa District Office of USGS. A minimal fee is charged to cover computer costs and, once a request is completed, results are usually available within 24 hours.

3. The U.S. Geological Survey provides an information and referral service through the National Water Data Exchange, or NAWDEX. NAWDEX consists of two computerized data base files: the Water Data Sources Directory identifying participating organizations that collect water data and the Master Water Data Index File containing point-source locations for which data are available, types of data collected, period of record, and collecting organization. Upon request, users are assisted in identifying available data, where they can be obtained, and how they should be requested.

The NAWDEX system can also provide access to two existing data systems, WATSTORE and STORET. Any data can be retrieved directly through NAWDEX from these systems.

NAWDEX referral and retrieval services can be obtained from the Iowa District Office of the U.S. Geological Survey and from the Iowa Geological Survey. The referral services are free, but some participating organizations may charge requesters for some services such as extracting and copying data.

4. The Iowa Department of Environmental Quality maintains computer files on all public water supplies through use of the Model State Information System (MSIS) which was developed by the U.S. Environmental Protection Agency. The MSIS files contain information on each public water supply system, including water source (surface and ground water), water treatment facility, water use, and treated water quality.

5. MONITER is the computer data storage and retrieval system developed by the Iowa Department of Environmental Quality for handling data related to waste water quality and treatment facilities. The system presently contains over 150,000 data items, with about 8,000 items added each month. The waste water quality data are obtained from compliance monitoring inspections, monthly operation reports, and monthly EQAP reports. Other information concerning construction and operation permits, compliance schedules and histories, and type of treatment facilities are also maintained on MONITER.

Several types of reports generated through the MONITER system can be requested from the Iowa Department of Environmental Quality. The five general types are:

- a. facilities report: a listing of all facilities, with data on location, population, ownership, treatment type, and design characteristics
- b. value reports: a listing and statistical summary of any parameter or group of parameters, with data sorted by source, location, treatment type, receiving stream, or other characteristics
- c. status reports: records of planning, inspection, and grant activities related to enforcement functions
- d. violation reports: data on violations of effluent limitations and of compliance schedules
- e. facility history report: listing all data for a single facility.

TABLE 4. SUMMARY OF WATER QUALITY DATA COLLECTION

<u>Data Type</u>	<u>Collecting Agency</u>	<u>Collection¹ Sites in 1977</u>	<u>Published²</u>	<u>Unpublished²</u>	<u>Computer² Storage</u>
<u>Environmental Monitoring</u>					
Chemical Quality	USGS	10 daily stations (SW)	A1, A2, A6	B2	C1, C2, C3
	USGS	326 partial-record stations (SW)	A1, A2	B2	C1, C2, C3
	USGS	7 NASQAN stations (SW)	A1, A2, A3		C1, C2, C3
	ACE	4 reservoirs (SW)		B1	C1, C3
	SHL	36 quarterly monitoring stations (SW)		B3, B4, B5	C1, C2, C3
	SHL	river reach studies (SW)	A8	B3, B4, B5	C1, C2
	DEQ	public water supply systems (SW & GW)	A7	B3, B4, B5	C1, C2, C4
	ICC	1 lake (SW)		B6	
Bacteriological and Biological Quality	USGS	9 daily stations (SW)	A1, A2	B2	C1, C2, C3
	USGS	7 NASQAN stations (SW)	A1, A2, A3		C1, C2, C3
	ACE	4 reservoirs (SW)		B1	C1, C3

<u>Data Type</u>	<u>Collecting Agency</u>	<u>Collection¹ Sites in 1977</u>	<u>Published²</u>	<u>Unpublished²</u>	<u>Computer² Storage</u>
	SHL	36 quarterly monitoring stations (SW)		B3, B4, B5	C1, C2, C3
	SHL	river reach studies	A8	B3, B4, B5	C1, C2
	SHL, DEQ	public water supply systems (SW & GW)	A7	B3, B4, B5	C1, C2, C4
Pesticides	USGS	7 NASQAN stations (SW)	A1, A2, A3		C1, C2, C3
	SHL	11 pesticide monitoring stations (SW)		B3, B4	C1, C3
Radiochemicals	USGS	7 NASQAN stations (SW)	A1, A2, A3		C1, C2, C3
	SHL	10 radiation monitoring stations (SW)		B3, B4	C1, C3
Stream Sediment	ACE	17 stations (SW)	A4, A6	B1	C1, C3
	USGS	19 stations (SW)	A1, A2, A3, A4, A6	B2	C1, C2, C3
	USGS	random sampling at gaging stations (SW)		B2	C1, C2, C3
Reservoir Sedimentation	ACE	4 reservoirs, 10 locks and dams (SW)	A4, A5	B1	
	SCS	5 reservoirs (SW)	A4, A5	B7	

<u>Data Type</u>	<u>Collecting Agency</u>	<u>Collection¹ Sites in 1977</u>	<u>Published²</u>	<u>Unpublished²</u>	<u>Computer² Storage</u>
<u>Water Supply Quality</u>					
Potability	IDA	food processing establishments		B8	
	DEQ	public water treatment facilities	A7	B3, B4, B5	C1, C2, C4
	IDH	260 mobile home parks 24 migrant labor camps		B9	
	SHL	private water supplies		B3, B9	
<u>Wastewater Quality</u>					
Raw Sewage Quality	DEQ	public and private treatment facilities		B4	C5
Effluent Discharge Quality	DEQ	public and private treatment facilities		B4	C5
	SHL	538 public and private treatment facilities in EQAP		B3, B4	C5

¹Number of collection sites does not include those discontinued before 1977 for which data are available.

(SW) denotes surface water

(GW) denotes ground water

²Codes refer to items described in IV Sources of Data.

BASIN CHARACTERISTICS DATA

I. Drainage Basins and Wetlands

A. Drainage Basins and Stream Channels

The Iowa District Office of the U.S. Geological Survey (USGS) holds several types of data related to drainage basin and stream channel characteristics. The data compiled for basin areas upstream from USGS stream gaging stations include:

1. drainage area
2. main channel length
3. channel slope
4. percent of land in lakes and ponds
5. percent of land in forest cover
6. average depth of loess cover
7. soil index
8. annual precipitation, annual snowfall, and 2-year 24-hour rainfall amounts
9. mean minimum January and maximum July temperatures.

The types of data available for each gaging site are elevation and cross-sectional area (channel width and depth). The basin-wide and gaging site data are stored in the USGS data management system WATSTORE and are available from the Iowa District Office of the USGS. Most of the data on channel widths and depths are stored in manual files in the District Office.

The most extensive published source of data on drainage basin areas is the "Drainage Areas of Iowa Streams" prepared by the USGS and the Iowa State Highway Commission through the Iowa Highway Research Board. It was first published in 1957 and reprinted in 1974

with revision of some stream names. The publication gives drainage areas for all interior streams with basins larger than 5 square miles. A total of 8106 area measurements, above the mouths of streams and at several intermediate points along the reaches of larger streams, are listed in tables for each county. In addition to the tabulated measurements, county maps show the names and locations of streams and the points above which the stream basins were measured.

The drainage area data are currently being revised and expanded by the USGS. Drainage areas are being measured for all basins larger than 2 square miles that were not included in the published edition. New data being added are the lengths and slopes of stream segments between area measurement sites. These data are being compiled from 7½-minute topographic maps and are kept on file at the Iowa District Office of the USGS.

The Iowa Geological Survey has prepared a general land use map of the state, "Land-use in Iowa: 1976." The map was compiled principally from available satellite and high-altitude aircraft photography and was printed at a scale of 1:500,000. Nine land use categories show various features of urban areas, water bodies, and land used for agriculture, transportation, mineral extraction, and forest.

Two other published sources of information on land cover and use are the "Census of Agriculture" and the "Iowa Conservation Needs Inventory." Both contain state and county estimates of land in urban and rural uses, including the number of acres in various crops, pasture, range, forest, and acres of farmland irrigated and artificially drained.

B. Surface Water Features

The Iowa State Conservation Commission maintains a listing of surface water features, "Interior Iowa Waters Inventory." This was first prepared in 1971 and updated in 1977. For each county the Inventory includes:

1. length and area of warm water and of cold water streams
2. area of natural lakes and of artificial lakes
3. area of natural marshes and of artificial marshes
4. area of reservoirs
5. number and approximate area of farm ponds.

The data are tabulated for individual water bodies and as county totals.

Three agencies currently hold data on most dams and reservoirs in Iowa. The U.S. Army Corps of Engineers, Rock Island District, has compiled an inventory of dams and reservoirs that store more than 50 acre-feet of water or are at least 25 feet in height. A similar inventory has recently been completed by the U.S. Soil Conservation Service; this includes all reservoir projects for which the SCS has provided assistance. The Iowa Natural Resources Council keeps copies of design plans and related information for all dams and reservoirs that store at least 18 acre-feet of water.

C. Artificial Drainage

A large number of drainage districts were organized in Iowa after enactment of the first state drainage law in 1906, and extensive surface and subsurface (tile) drainage systems have since been constructed. The primary sources of data concerning drainage works are records of the drainage districts kept on file by county auditors. Each district

is required to file with the county auditor maps, profiles, engineering reports, and other documents describing affected lands and the location and character of each drainage work. However, records for districts in some counties are quite incomplete and some data are of poor quality.

The U.S. Soil Conservation Service (SCS) has completed an inventory of tile outlet structures for the Iowa-Cedar River basin. Data included in the report are the number, location, and area of drainage districts with tile drains of various capacities. The reports can be obtained from the state SCS office. Copies of the maps of drainage districts in the Iowa-Cedar River basin are also on file and available for inspection. The SCS plans to conduct similar drainage inventories in other major river basins in Iowa. The Des Moines River Basin is scheduled for the near future.

Other published sources of data on land drainage are the "Census of Agriculture" and the "Iowa Conservation Needs Inventory." The census report is issued by the U.S. Bureau of the Census every five years and contains estimates of the area of drained land in each county, as well as other land use information. The "Conservation Needs Inventory" gives estimated acres in each county and major watershed that require drainage, based on the potential for agricultural production. Information on soil and water conservation needs was first developed between 1958 and 1960. It was later updated through a county-by-county inventory in 1966-1967 and published in 1970.

Data on soil drainage conditions in the state may be found in county soil surveys. Soil types with poor drainage characteristics

are identified and a general account of the extent of wetlands and of tile and ditch drainage in the county are given.

II. Soils

A. Soil Surveys

County-wide soil surveys are prepared under the National Cooperative Soil Survey program, a joint effort of the U.S. Department of Agriculture and state agencies. The Iowa Cooperative Soil Survey program was formalized among five state and federal agencies in 1967:

1. Cooperative Extension Service (Iowa State University)
2. Iowa Agriculture and Home Economics Experiment Station
3. Iowa Department of Soil Conservation
4. State Soil Conservation Committee
5. U.S. Soil Conservation Service.

The first county-wide soil surveys for Iowa were published in 1904. Older surveys are available for nearly all counties in Iowa. Soil surveys conducted after 1954 are considered "modern" surveys, because they are based on improved analytical methods and knowledge of soil properties and contain more detailed information and classification of soil types than older surveys. A few more than half of the counties in Iowa have modern surveys published or nearing final publication (fig. 18).

The apparent slow progress in completing the surveys is a function of the time and cost arrangements required for each county survey. It normally takes 12 worker-years to complete the field work, soils mapping, and initial manuscript preparation for a 16-township county. The present cost of field, laboratory, and office work is roughly \$240,000 (\$15,000 per township) of which the county, state,

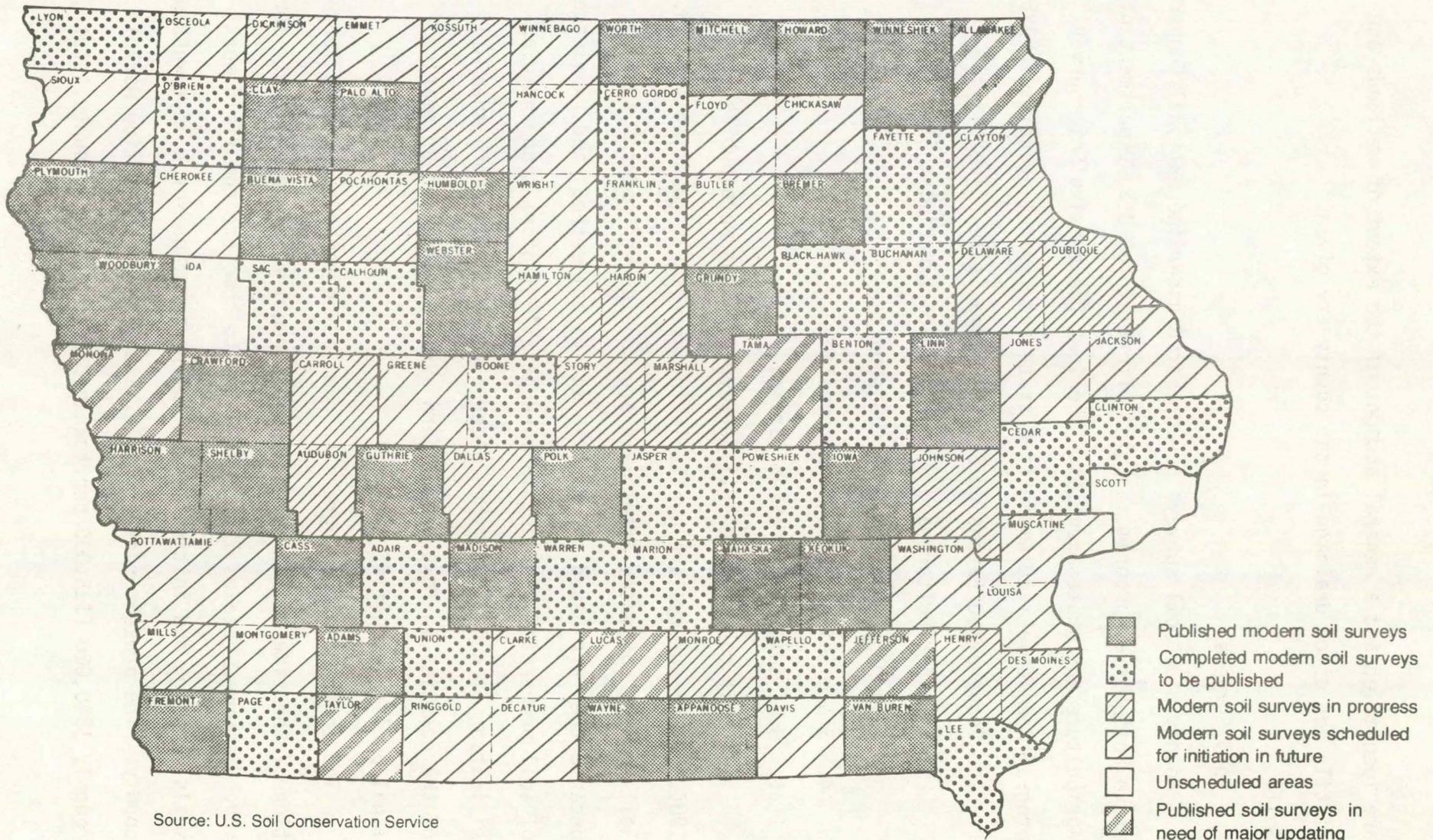


Figure 18. Status of County Soil Surveys (1977)

and federal government each pay one-third. The additional cost of publication (about \$75,000) is paid by the U.S. Soil Conservation Service. A county must approve its cost share proportion before it can be scheduled for a modern soil survey.

Each modern soil survey contains maps and descriptions of the soil associations, series, and phases found in each county. Since 1957, the soil maps have been printed on a mosaic base of aerial photographs. The scale of the photo-maps is usually between 1:15,840 and 1:24,000. The descriptions include physical, chemical, and engineering properties as well as soil use capabilities and management problems. Additional information is obtained from laboratory analysis of soil samples and field measurements of:

1. parent material
2. depth to seasonal high water table
3. moisture density: maximum dry density and optimum density
4. textural analysis (grain-sized fractions)
5. liquid limit
6. plasticity index
7. permeability
8. available water capacity
9. chemical reaction
10. shrink-swell potential.

Based on these measurements and on field observations, soil use interpretations for water and related land resources development and management are made. The type of interpretations made naturally depends upon the characteristics of the county, but most modern surveys in Iowa provide interpretations for each soil group or soil

phase for the following:

1. land-capability interpretations: how soils can be used and managed for most kinds of agriculture, based on limitations of soils, risks of damage under ordinary use, and the ways soils respond to treatment
2. soil-woodland interpretations: main characteristics of soils, existing conditions, and hazards affecting woodland production based principally on soil and climatic potentials for providing proper amounts of moisture for tree growth
3. soil-wildlife and recreation interpretations: e.g., identification of marsh areas suitable for wetland wildlife habitat; soils with water-holding capabilities suitable for ponds
4. engineering interpretations: derived mainly from laboratory and field testing and including:
 - a. suitability of soil as source of topsoil, sand, gravel, roadfill
 - b. soil features affecting foundations, farm ponds and reservoirs, embankments, agricultural drainage, irrigation, terraces and diversions, and grassed waterways.

The soil surveys also provide general information about local areas. The type of information included varies with the nature of the county, but the three common sections in the more recent surveys are:

1. General Nature of the County: topics vary but usually include climate, topography, drainage conditions, agriculture,

water supply, transportation, markets, recreational facilities, and wildlife.

2. Formation and Classification of the Soils: a non-technical discussion of soil-formation processes and their use as a basis for soil-type classification; the 5 basic factors in soil formation (parent material, climate, plant and animal life, relief, and time) are related to local conditions and soil types.
3. Environmental Factors Affecting Soil Use: includes explanations and local examples of the limitations on proper soil use imposed by climate, relief, drainage, vegetation, and agriculture and other settlement activities.

Once the soil surveys are published, copies are distributed within the county and to various government offices and libraries. Copies may be requested from the agencies in the Iowa Cooperative Soil Survey program and from local SCS Area Offices.

During the period between completion of field work and publication, soil survey data and interpretations are available in advance reports. These consist of two parts: part 1, county descriptions, the soils legend, and soil use interpretations; part 2, soil maps showing the location and extent of soil types with slope and erosion classes. Advance reports contain more detailed data than those summarized in published surveys. The reports for a particular county have only a limited distribution; a few copies are held at the state offices of the cooperating agencies and approximately 60 copies are distributed within the county.

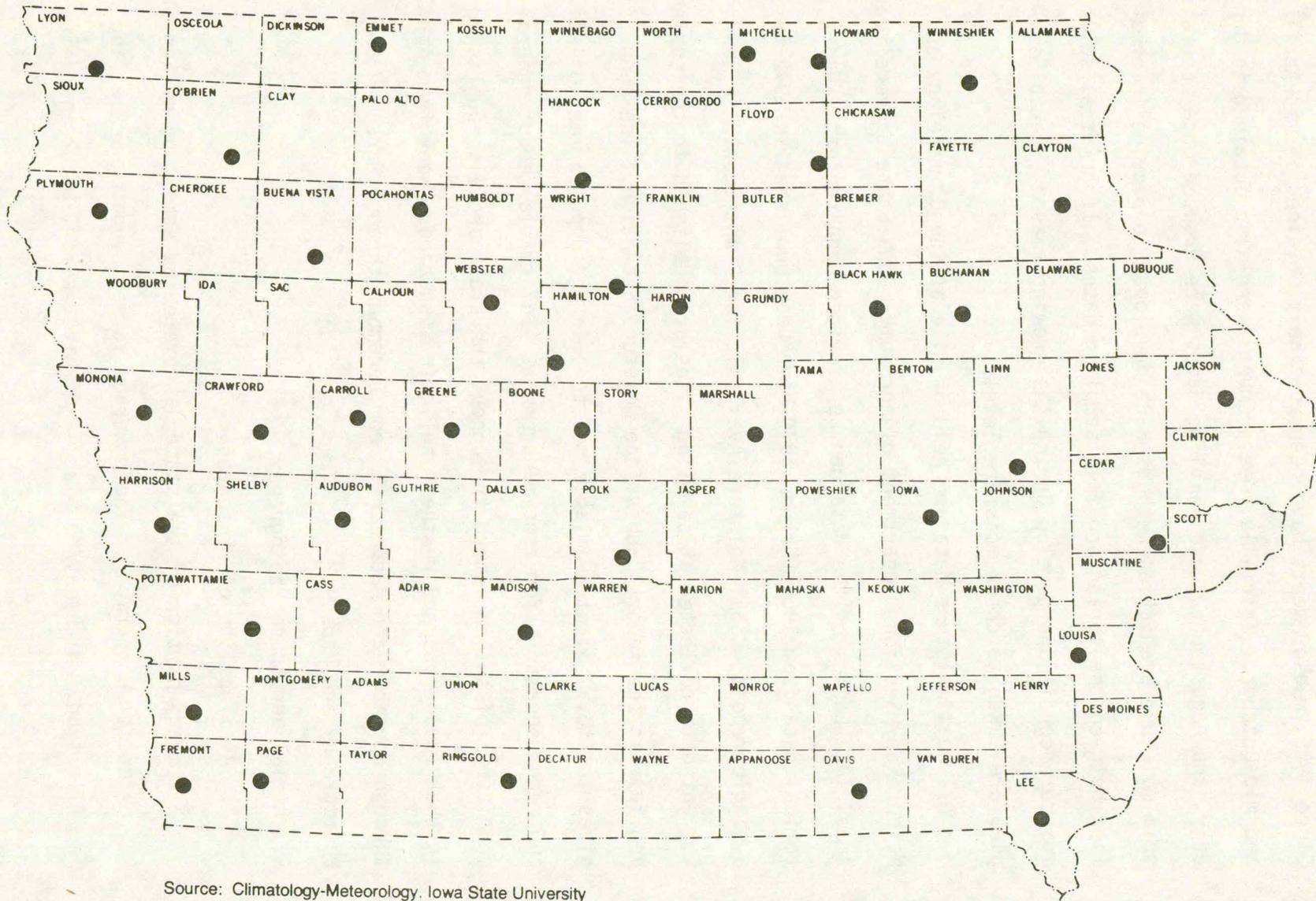
There has been a limited amount of digitizing and computer storage of soils data for Iowa. The Iowa Agriculture and Home Economics Experiment Station is currently digitizing soils data for Buchanan County. Soil type, slope class, erosion class, and soil boundary lines are being coded and stored for each half-acre area. The Land Use Analysis Laboratory at the Iowa State University is similarly digitizing soils data for Wapello County.

B. Soil Temperatures

The Iowa Department of Agriculture and the National Weather Service are presently collecting daily soil temperatures at 7 locations in Iowa: Ames, Burlington, Castana, Dubuque, Estherville, Oelwein, and Shenandoah. Historical records for 6 other discontinued stations are also available. Measurements are made at several depths (usually 2.25, 4, 8, 20, and 40 inches) and twice a day (at 7:00 or 8:00 a.m. and at 5:00 or 6:00 p.m.). Soil temperature data are published in both the monthly and annual reports of "Climatological Data" of the National Climatic Center. Monthly reports list daily values for all depths and times; the annual summary lists monthly and annual averages and minimum and maximum extremes. Site descriptions given include soil type, cover, depth of cultivation, degree of slope, aspect, and type of thermometer.

C. Soil Moisture

A soil moisture sampling program is currently supported by the Iowa State University through the Climatology and Meteorology Section of the Department of Agronomy. The program was begun in 1954 with 10 sampling sites. In 1977, soil moisture measurements were taken at 44 sites (fig. 19). The amount of plant-available soil



Source: Climatology-Meteorology, Iowa State University

Figure 19. Locations of Soil Moisture Sampling Sites (1977)

moisture is determined at 1-foot increments to a depth of 5 feet. Since 1965, measurements have been routinely obtained in mid-April and mid-October. Initially, measurements were also obtained in June, July, and August but these sampling dates were dropped once accurate soil moisture prediction methods were developed to provide information between the spring and fall sampling dates. If critical soil moisture conditions develop during the growing season, special samples are taken to check moisture levels.

All soil moisture data are held on file at the Climatology and Meteorology Section, Department of Agronomy, Iowa State University, Ames, IA. Copies of the data can be provided upon request. Historical data from 1954 through 1970 have been published in 1972 in a single report, "Soil Moisture Available for Plant Growth in Iowa." Current data collected at sampling sites are published in the spring and fall in the report "Subsurface Moisture Situation." The report gives the total plant-available moisture in the upper 5 feet of soil and recommendations for crop management. Information about general conditions of soil moisture throughout the state are also published in the "Iowa Crops and Weather" bulletin issued each week from April through November and each month from December through March.

III. Photography and Maps

A. Aerial and Space Photography

1. Availability of Photography

Every portion of the state is covered by some type of aerial or space photography. The coverage varies by date, scale, and film type, which may be black and white, color, black and white

infrared, color infrared, or multiband film. The most extensive compilation of available photography is the "Guide to Aerial Imagery of Iowa" first prepared by the Remote Sensing Laboratory of the Iowa Geological Survey (IGS) in 1974 and updated in 1977. The Guide includes index maps and descriptions of most photography available from governmental and private producers.

The National Cartographic Information Center (NCIC), Reston, VA, was organized by the USGS in 1974 as an information service for cartographic data: maps and charts, aerial and space photography, geodetic control data, and digitized map data. The Aerial Photography Summary Record System (APSRs) is the computer data management system used by the NCIC to store and disseminate information on existing, in-progress, and planned aerial photography in the United States. The Remote Sensing Laboratory of the IGS is the state representative through which information on photography produced by Iowa state agencies is entered into APSRS. Users of the NCIC and APSRS services are provided information on what photography for a given area is available, where it is located, and how it can be ordered.

The EROS (Earth Resource Observation Systems) Data Center, Sioux Falls, SD, will also provide information on the available photography. Computer search and listings can be requested for aerial mapping photography and for NASA aircraft, Skylab, and LANDSAT imagery. In addition, copies of most unclassified photographs can be purchased from the EROS Data Center.

There is no central storage and distribution center in Iowa from which photographs can be obtained. However, many agencies

maintain limited collections of photographs that they have produced or obtained from other agencies. The principal agencies and the more widely used types of photography are described below.

2. U.S. Agricultural Stabilization and Conservation Service (ASCS)

The most extensive coverage of aerial photography in Iowa is produced by the ASCS. Since the late 1930's, the ASCS has periodically obtained aerial photographs of agricultural areas of the United States for use in acreage control programs. Complete photographic coverage for each county in Iowa has been acquired once every 5 to 10 years since 1938 (fig. 20). The photographs are produced from black and white film and range in scales from 1:15,840 to 1:40,000. Since the photographs are used to measure crop acreages, they are normally taken in late spring and summer. The most recent sets of photographs available for a given county may be inspected at the respective county ASCS offices or for all counties at the state office in Des Moines. Copies may be ordered from the ASCS, Western Aerial Photography Laboratory, Salt Lake City, UT.

3. U.S. Army Corps of Engineers (ACE)

The ACE has produced aerial photographs for reconnaissance and engineering purposes at reservoir sites and along the Mississippi and Missouri and major interior rivers of Iowa. The scales of the photographs range from 1:3,000 to 1:120,000. Most of the photography is black and white, but some color, color infrared, and black and white infrared has been produced. Copies may be inspected or obtained at the ACE District Offices.

The ACE produced black and white photography for the entire state at a scale of 1:70,000 in the fall of 1949 and spring of 1950.

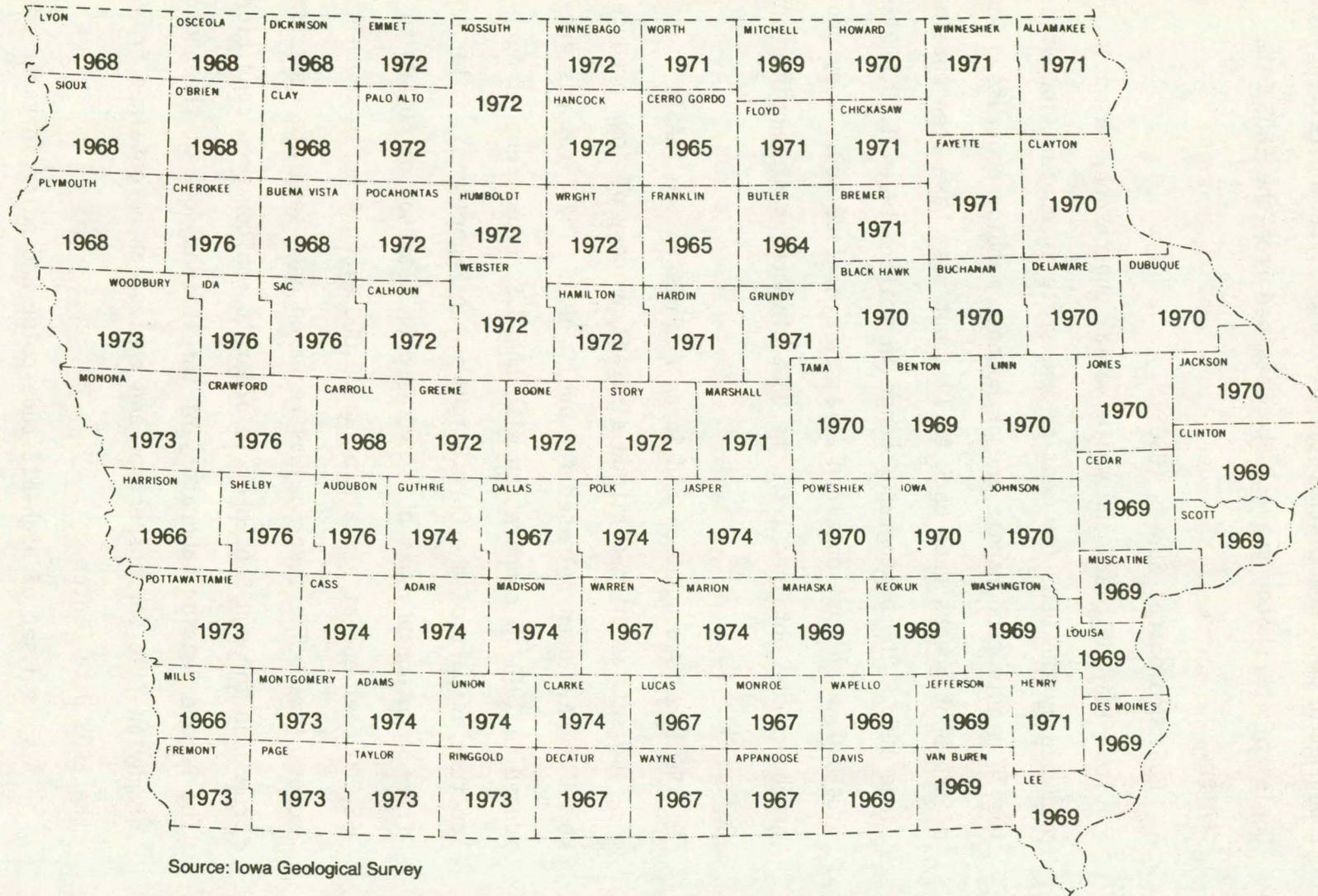


Figure 20. Dates of Recent ASCS County Aerial Photography (1977)

The photography was used to prepare the 1:250,000 NK series of topographic maps now distributed by the U.S. Geological Survey. Copies of the photography can be obtained from the EROS Data Center.

4. U.S. Geological Survey (USGS)

Low-altitude black and white aerial photography has been produced by the USGS for most of the state in conjunction with the 7½-minute topographic and orthophoto mapping programs. Some of the photographs date back to 1947, but most have been obtained since 1963. The photographs range in scale between 1:18,000 and 1:34,000, with most obtained at a scale of 1:20,000. Copy photographs can be obtained from the USGS, Midcontinent Mapping Center, Rolla, MO.

5. National Aeronautics and Space Administration (NASA)

Two sets of high-altitude aircraft imagery of Iowa produced by NASA have been released for public use. The first was produced in 1971 in cooperation with the U.S. Department of Agriculture as part of the Corn Blight Watch Experiment. Color infrared photography was obtained from an altitude of 60,000 to 65,000 feet and at a scale of 1:130,000 along 4 north-south strips across Iowa. The coverage was repeated on 8 separate occasions from June through September in order to monitor crop conditions. The Remote Sensing Laboratory of the IGS has some of the photography on file for inspection and copies can be obtained from the EROS Data Center.

A second set of high-altitude color and color infrared photography at a scale of 1:180,000 is also available from a NASA

mission flown in November, 1973. The area covered is about 50 miles wide and extends from central Iowa to the Missouri River. The Iowa Geological Survey and the EROS Data Center hold copies of this imagery.

Space photographs of Iowa have been acquired since July, 1972, from LANDSAT satellites, formerly known as the Earth Resources Technology Satellite or ERTS. The present satellite orbits 560 miles above the earth and produces new images of the state every 18 days. Black and white images are produced for each spectral band: green, red, red-to-infrared, and infrared. False-color composites can also be produced from the black and white images. The imagery is available at scales of 1:3,700,000 and 1:1,000,000 with an areal coverage of 2100 square miles per image.

Space photographs have also been obtained from 3 manned Skylab satellite missions in operation for periods between May, 1973, and February, 1974. One Skylab camera system produced simultaneous color, color infrared, and multiband photographs, all at a scale of 1:2,800,000 with an areal coverage of about 10,000 square miles per photograph. A second camera system produced color or color infrared photographs at a larger scale, 1:950,000 covering 4600 square miles per photograph. The four flight tracks cover nearly all of Iowa. However, because of prevailing cloud conditions satisfactory photography for portions of the state was not obtained.

6. U.S. Soil Conservation Service (SCS)

Aerial photography is produced by the SCS as an aid in mapping soil types for county-wide soil surveys. Coverage for 50 counties

has been acquired since 1969 (fig. 21). Black and white photographs are commonly produced at a scale of 1:38,000. A limited amount of color infrared photography is also available. The photography is held at the county SCS offices where soil surveys are in progress and at the state SCS office in Des Moines.

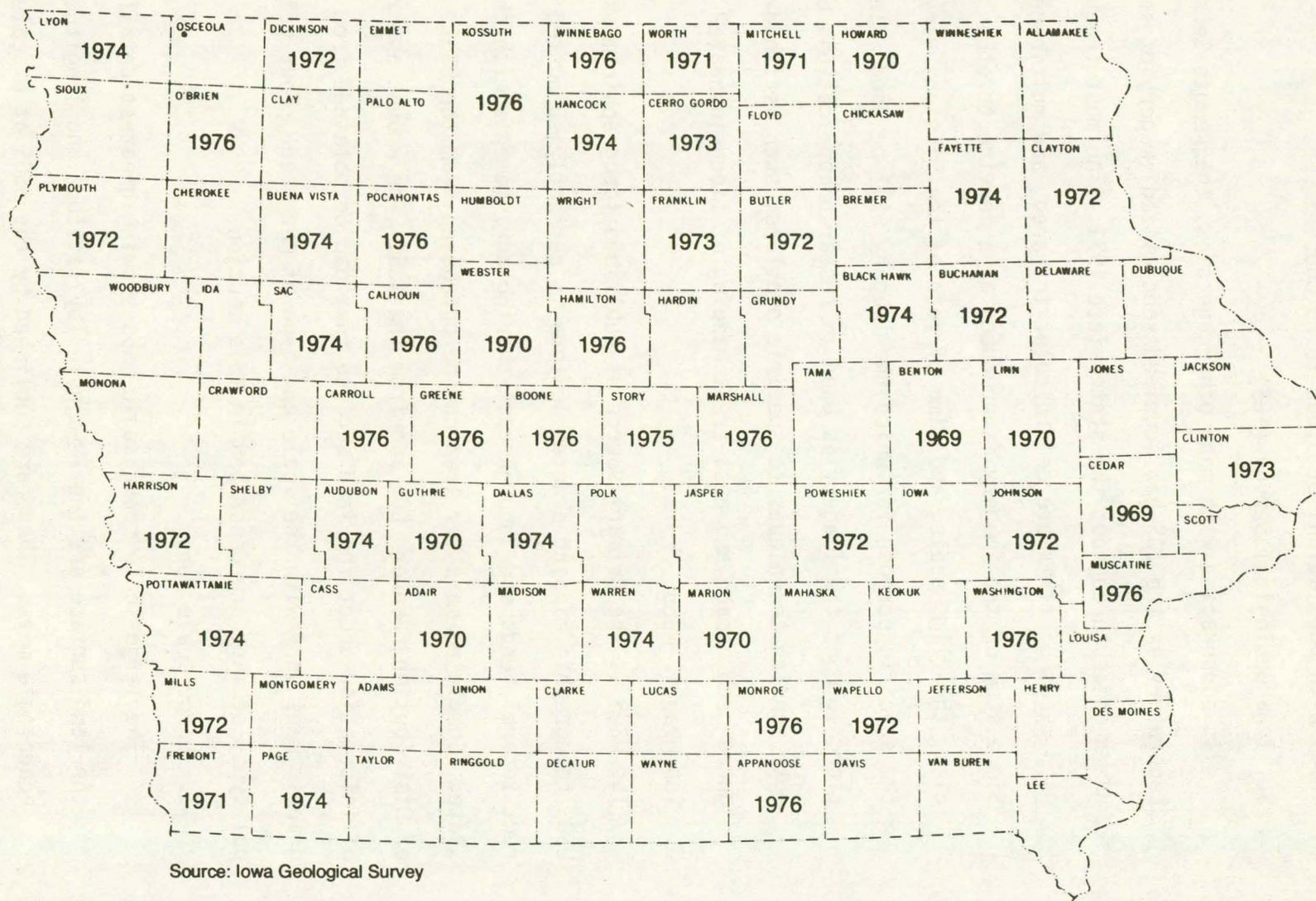
7. Iowa State Conservation Commission (ICC)

Beginning in 1975, the ICC embarked on an extensive aerial photographic inventory of lands under its control. The inventory to date includes both color and color infrared photography of the Yellow River State Forest in northeast Iowa, color photography of the Stephens State Forest in Central Iowa (both at a scale of 1:8,000) and color infrared imagery (1:15,840) of most state wildlife refuges, parks, and forests. Color infrared imagery (1:15,840) has also been obtained for the Iowa reaches of the Missouri River in 1976 and the Mississippi River in 1974 and 1976.

8. Iowa Department of Transportation (IDOT)

The Highway Division of the IDOT has acquired black and white and some color aerial photography for planning highway construction. Photographs of the rights-of-way of state and federal highways are taken at scales ranging from 1:3,000 to 1:18,000. However, since they are used to determine road location and design characteristics, the larger scale is more commonly acquired to facilitate topographic mapping at a one-foot contour interval.

Small scale imagery (1:80,000) has also been obtained for several urban areas. Sixteen areas with populations greater than 25,000 were photographed during the summers of 1969 and 1973.



Source: Iowa Geological Survey

Figure 21. Dates of Recent SCS County Aerial Photography (1977)

Photographs at the same scale were acquired in 1971 for urban areas with populations of 5,000 to 25,000.

9. Iowa Geological Survey (IGS)

In cooperation with many other agencies, the Remote Sensing Laboratory of the IGS has acquired specialized imagery of selected areas throughout the state since 1971. The most frequently used types of films are color, color infrared, and multiband. Since some of the imagery is produced as a service to other agencies, the film, scale, and time of year of the missions vary with the specific purpose for which the imagery will be used. In addition, some of the imagery is used to research applications of remote sensing techniques to specific problems, such as flood-induced crop damage and post-crest mapping of flood-inundated areas.

B. Topographic Maps

The USGS is the primary source of published topographic maps. The USGS topographic mapping program in Iowa is currently supported by direct federal funds and through cost-sharing arrangements with the state. Completed maps for Iowa can be purchased from the USGS, Branch of Distribution, Denver, CO, and from the IGS. The amount and kind of information about the land surface that can be obtained from topographic maps vary with the scale and type of map used. Four principal types of maps are described in this section.

1. Large-scale Maps

The large-scale topographic maps showing greatest detail of the land surface are the 7½-minute (by latitude and longitude) quadrangle maps. These are published by the USGS at a scale of 1:24,000 (1 inch = 2000 feet) with a contour interval of 10 or

20 feet. There are 1083 7½-minute quadrangles covering Iowa, 53% of which are completed and published (fig. 22). The number of maps in various stages of completion are

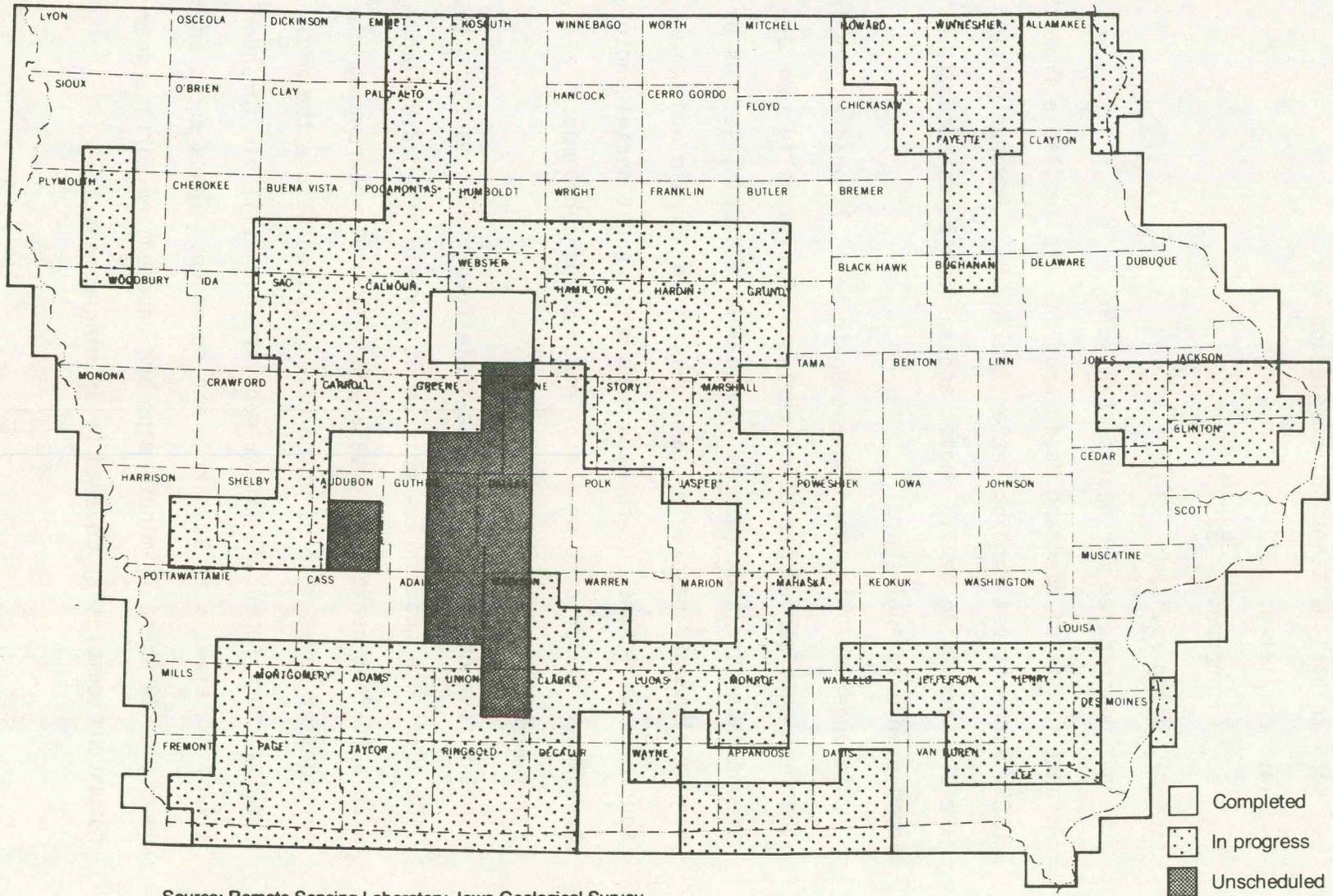
- a. completed: 572
- b. in progress: 365
- c. being revised: 71
- d. unscheduled for near future: 75

Advance prints of quadrangles in progress are available from the USGS, Midcontinent Mapping Center, Rolla, MO. Advance prints are blue and white ozalid copies and may not be as accurate as completed quadrangles are.

In order to bring map content up-to-date, 71 quadrangles in the 7½-minute series are being revised. Revisions in some areas are necessary to show changes in man-made features, such as urban development, reservoirs, and changes in terrain and water-sources. Revisions interpreted from more recent aerial photographs are overprinted on the original topographic map.

2. Intermediate-scale Maps

The most common intermediate-scale topographic maps are the USGS 15-minute quadrangles printed at a scale of 1:62,500 and with a 20-foot contour interval. There are 64 quadrangles for portions of Iowa, most of which were prepared before the mid-1950's. More recent 7½-minute maps are now available for nearly all of the areas with 15-minute map coverage. Those areas shown on figure 22 where 7½-minute maps are unscheduled for the near future are completely covered by 15-minute maps.



Source: Remote Sensing Laboratory, Iowa Geological Survey

Figure 22. Status of 7 1/2-minute Topographic Mapping (1977)

The SCS is preparing a new series of county-wide, metric topographic maps at a scale of 1:100,000. Maps for all counties in the United States should be completed by 1981 or 1982. In Iowa, maps for 5 counties have been completed (fig. 23). Those for 8 other counties are in progress and should be completed by August, 1978.

3. Small-scale Maps

Small-scale topographic maps cover large areas and are useful for comprehensive views of the regional landscape. The principal small-scale map series is designated the U.S. 1:250,000 NK series (1 inch = approximately 4 miles). The quadrangle size is 1° latitude by 2° longitude and the contour interval for maps of Iowa is 50 feet. Fifteen quadrangles published by the USGS provide complete coverage for Iowa.

4. Orthophoto Maps

Orthophoto maps are a type of photoimage map prepared by the USGS for selected 7½-minute quadrangles. They show surface features by photographic images in true horizontal position and are printed in shades of gray with minimal cartographic symbolization and vertical control. Orthophotoquad coverage in Iowa (fig. 24) coincides with areas without 7½-minute topographic map coverage and with a large portion of the state where maps are in progress and not yet published.

5. Other Map Sources

Topographic data and maps are collected and prepared by the Highway Division of the IDOT for highway construction sites and by the SCS for small watershed projects. Coverage is generally

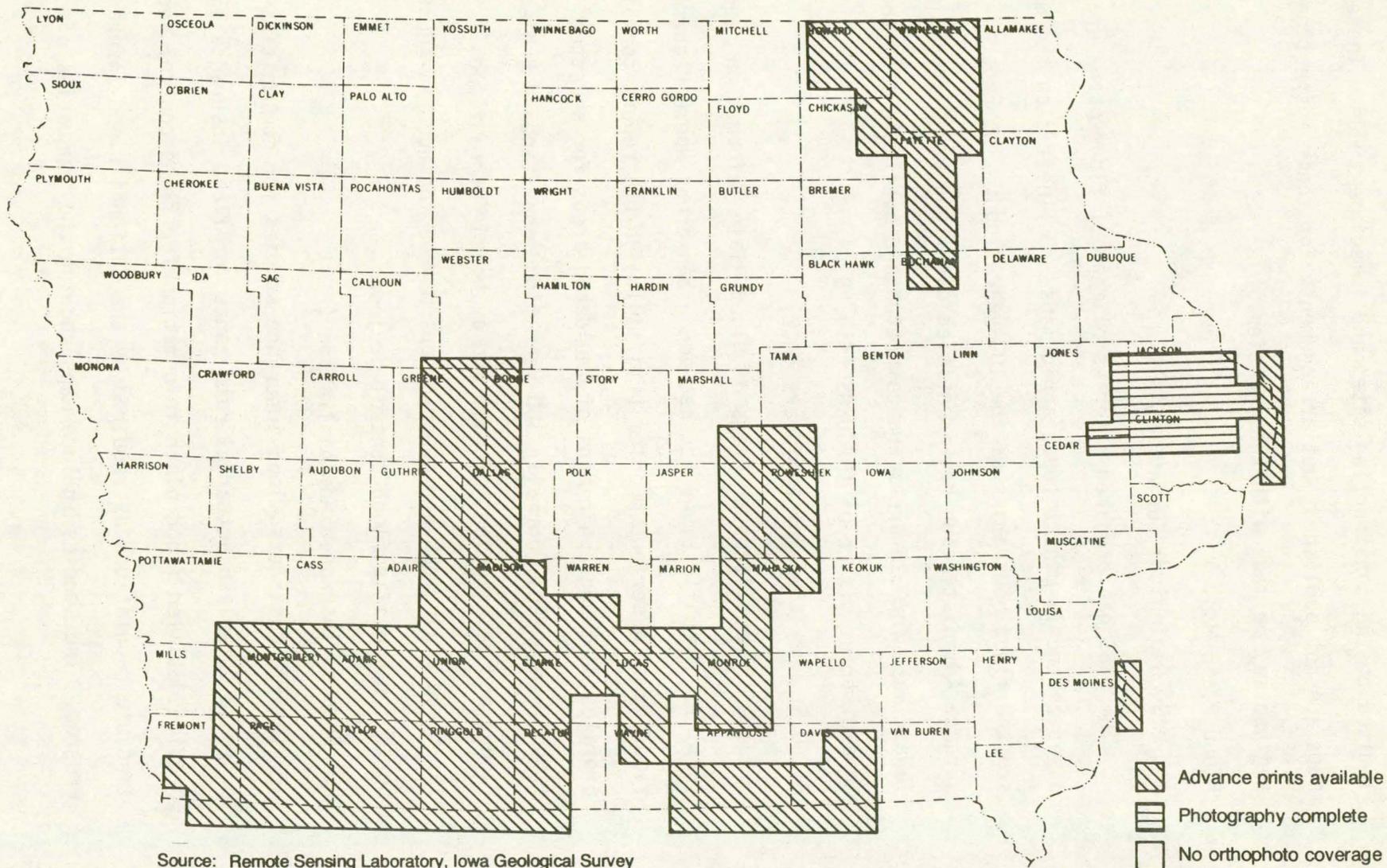


Figure 24. Status of Orthophoto Mapping (1977)

limited to the construction sites and immediate areas. These maps are not published, but arrangements for their inspection and use may be made with the agencies.

C. Flood Plain Maps

1. U.S. Geological Survey (USGS)

The USGS has prepared a series of maps of flood-prone areas based on the 7½-minute topographic maps. Delineated on the maps are the flood boundaries of the 100-year flood. The Federal Insurance Administration has identified 444 flood-prone areas in Iowa. Maps for 326 areas are completed and available from the Iowa District Office of the USGS (fig. 9).

2. U.S. Army Corps of Engineers (ACE)

The ACE publishes a series of Flood Plain Information reports (FPI) for specific river reaches and urban areas where recurrent flooding is a serious problem (fig. 10). An FPI report contains profiles on topographic maps of inundated areas for selected flood frequencies (normally 100-year flood and Standard Project Flood) and descriptions of past and expected future floods. Similar flood plain maps and descriptions may be included in ACE reports for specific flood control projects.

3. Federal Insurance Administration (FIA)

The FIA contracts flood insurance studies for communities in order to establish actuarial rate zones for flood insurance and to provide detailed flood plain information for flood control and land use regulations as required by the National Flood Insurance Program. The studies include maps showing the boundaries of

floodways, the 100-year and 500-year floods, flood plain cross-sections, and insurance rate zones. Copies of the insurance studies and the FIA Flood Boundary and Floodway Maps are available from the program's State Coordinator with the Iowa Natural Resources Council. Copies of the Flood Insurance Rate Maps are distributed by the National Flood Insurance Program, Bethesda, MD.

D. Navigational Charts

The U.S. Army Corps of Engineers has prepared navigational charts for the Mississippi and Missouri Rivers from available aerial photography and river surveys. The charts show river shoreline, midchannel line, river miles, navigational aids, and river control structures such as locks, wing dams, levees, and bank protection works. Near-river roads, recreational sites, wildlife sancturies, and government property are also identified.

E. Bathymetric Maps

The Iowa State Conservation Commission has prepared 54 bathymetric maps for 56 publicly-owned lakes in Iowa. The maps show water depth and topography of the lake bottom. The maps are available at no or nominal cost from the Conservation Commission.

IV. Sources of Data

Major sources of data on basin characteristics are described below and indexed in Table 5 by type of data.

A. Published Data Sources

1. "Drainage Areas of Iowa Streams"
Published by the Iowa Highway Research Board, Bulletin No. 7, and prepared by O.J. Larimer, U.S. Geological Survey, in cooperation with the Iowa State Highway Commission. The first edition was published in 1957 and reprinted in 1974 with revision of some stream names.
Contents: drainage areas of interior streams with basins larger than 5 square miles.
2. "Interior Iowa Waters Inventory"
Prepared by the Iowa State Conservation Commission, Planning and Coordination Section, in 1971 and updated in 1977.
Contents: length and area of warm water and of cold water streams, area of natural lakes, artificial lakes, natural marshes, artificial marshes, and reservoirs, and number and area of farm ponds in each county; data are tabulated for individual water bodies and as county totals.
3. "Drainage Report of the Iowa - Cedar Rivers Basin"
Prepared by the U.S. Soil Conservation Service in 1975.
Contents: number, location, and area of drainage districts with tile outlets of various capacities.
4. "Census of Agriculture"
Published by the U.S. Bureau of the Census every 5 years.
Contents: acres of artificially drained land in each county; also acres in various agricultural land use categories (cropland, woodland, etc.).
5. "Iowa Conservation Needs Inventory"
Prepared by the Iowa Conservation Needs Committee and published in 1970.
Contents: acres of each county in several land use categories and needing various conservation treatment, including acres requiring artificial drainage.
6. "County Soil Surveys"
Published by the National Cooperative Soil Survey and prepared by cooperating state and federal agencies. Older surveys are available for most Iowa counties. Since 1954, 57 modern surveys have been published or are awaiting final publication.

Contents: soils maps, descriptions of physical, chemical, and engineering properties of soils, and soil use interpretations.

7. "Climatological Data - Iowa"
Published as monthly and annual issues for each state by the National Climatic Center of the National Oceanic and Atmospheric Administration.
Contents: monthly issue: daily measurements of soil temperatures, usually at depths of 2.25, 4, 8, 20, and 40 inches; annual issue: monthly and annual averages and minimum and maximum extremes; issues also contain climatic data collected by the National Weather Service.
8. "Soil Moisture Available for Plant Growth in Iowa"
Published in 1972 by the Iowa Agriculture and Home Economics Experiment Station and the Cooperative Extension Service, Iowa State University, as Special Report No. 70. Prepared by R.H. Shaw, R.E. Felch, and E.R. Duncan.
Contents: summary of soil moisture data collected at 22 locations from 1954 through 1970; includes amounts and probabilities of plant-available soil moisture at beginning of each month from April to November.
9. "The Subsoil Moisture Situation"
Published by the Cooperative Extension Service, Iowa State University, every spring and fall since 1954.
Contents: summary of subsoil moisture data collected in spring or fall, state-wide map of soil moisture conditions, and recommendations for cropping and farm land management.
10. "Iowa Crops and Weather"
Published by the Iowa Department of Agriculture, National Oceanic and Atmospheric Administration, and U.S. Department of Agriculture. Issued weekly from April through November and monthly from December through March.
Contents: summary of soil moisture, weather, and their effects on agriculture; current conditions of crops and livestock; maps of soil moisture conditions and precipitation, and growing degree days.
11. "Aerial and Space Photography"
Produced by several federal, state, and private organizations.
Contents: in general, photographs show surface features such as land forms, water bodies, relative soil moisture conditions, vegetation, snow cover, and cultural features; however, specific data content varies with type of film (black and white, color, color infrared, black and white infrared, or multiband film), scale of photograph, time of year, cloud cover, flight altitude, and image enhancement techniques.

12. "Guide to Aerial Imagery of Iowa"
Published by the Iowa Geological Survey as Public Information Circular No. 8 in 1974 and updated in 1977.
Contents: inventory of aerial photography and other remote sensing imagery of Iowa produced by state and federal agencies and private organizations; includes index maps of areal coverage and information on how to obtain copies of imagery.
13. "Aerial Photography Summary Record System Catalog and Listing"
Published since 1975 by the National Cartographic Information Center of the U.S. Geological Survey.
Contents: catalog: computer-printed maps of the U.S. showing coverage, acquiring agency, and general scale and date of photography currently available, in-progress, and planned; listing: computer printout in microfiche giving amount of cloud cover, type of film and camera, specific scale, date of coverage, and agency project codes.
14. "Topographic Maps"
Published by the U.S. Geological Survey since the late 1800's. Principal series are the 7½-minute, 15-minute, NK, and orthophoto maps. County-wide topographic maps are being prepared by the U.S. Soil Conservation Service with the cooperation of the U.S. Geological Survey.
Contents: elevation and shape of land surface shown by contour lines, lakes and stream networks, woodland cover, and principal cultural features; orthophoto maps are printed on aerial photographic base; details of map content vary with scale and type of map.
15. "Flood Prone Area Maps"
Prepared by the Iowa District Office, U.S. Geological Survey, during 1972-76. Of the 444 designated areas in Iowa, 326 have completed map coverage.
Contents: boundaries for the 100-year flood are delineated on standard 7½-minute topographic maps.
16. "Flood Plain Information Reports"
Compiled by U.S. Army Corps of Engineers for 29 selected river basins, river reaches, and urban areas since 1964.
Contents: review of flood history, estimates of possible future floods (100-yr flood and Standard Project Flood), maps of flooded areas, profiles, cross-sections, flow velocities, and durations.

17. "Flood Insurance Study"
Prepared for the Federal Insurance Administration and used to establish actuarial rate zones applied in the National Flood Insurance Program. Fifteen studies have been completed in Iowa.
Contents: descriptions of flood problems, flood plain development, estimates of future flood profiles and velocities, planimetric maps of flood plain and 100- and 500-year flood boundaries.
18. "Navigation Charts"
Prepared by the U.S. Army Corps of Engineers for the Missouri and Mississippi Rivers.
Contents: shoreline, river miles, midchannel line, navigational aids, river control structures, recreational sites, wildlife sanctuaries, roads, and related river features.
19. "Bathymetric Maps"
Prepared by the Iowa State Conservation Commission for 56 publicly-owned lakes.
Contents: contour lines show water depth and topography of lake bottom.
20. "Land-use in Iowa: 1976" and "Land-use in Iowa: 1976; an Explanation of the Map:
Map and accompanying report published by the Iowa Geological Survey as Miscellaneous Map Series No. 5 and Technical Information Series No. 4.
Contents: 1:500,000-scale map showing 9 land-use categories: urban residential, commercial-industrial, and open space, transportation networks, extractive land, agricultural land, forest land, water, and reservoir flood pools; report describes data sources and mapping procedures.

B. Unpublished Data Sources

1. The Iowa District Office of the U.S. Geological Survey has compiled data on drainage basin characteristics for areas upstream from gaging sites. These include drainage areas, percent of land in forest, lakes and ponds, depth of loess cover, soil infiltration index, and average precipitation and temperature indexes. Existing data on drainage areas (published in A.I.) are being augmented with new measurements of basins 2 to 5 square miles in area and data on stream lengths and slopes for each reach between measurement sites. Stream channel data collected and on file include channel width, depth, length, and slope.
2. Three agencies hold data on dam and reservoir structures in Iowa. The U.S. Army Corps of Engineers, Rock Island District has inventoried structures that store more than 50 acre-feet

of water or are at least 25 feet in height. The U.S. Soil Conservation Service has compiled inventory data on reservoir projects for which it has provided assistance. The Iowa Natural Resources Council keeps design plans and related information on dams and reservoirs that store at least 18 acre-feet of water.

3. Drainage districts are required to maintain permanent drainage records with the local county auditor. These include records of district proceedings and all planning and engineering reports describing poorly drained lands, lands benefited or affected by drainage works, costs of each drainage structure, and plats and profiles showing the course and design of each structure.
4. Soil survey data are available in advance reports between the time when field work is completed and final reports are published. Advance reports contain soil maps with slope and drainage classes, county descriptions, and detailed data on soil properties and soil use capabilities. Data tables for each soil type include information on environmental setting (e.g., slopes, vegetation, parent material), hydrologic characteristics (flooding, erosion, water tables depth, permeability, available water capacity), physical and chemical properties on soils with depth, land capabilities and crop yields. A limited number of advance reports are available within counties and from cooperating soil survey agencies.
5. Soil moisture data are held on file at the Iowa State University, Department of Agronomy, Climatology-Meteorology Section. These include the actual measurements of soil moisture and the predicted soil moisture values for periods between measurements.
6. Advance prints of topographic maps in progress are available from the U.S. Geological Survey, Midcontinent Mapping Center, Rolla, MO. Advance prints are produced as blue and white ozalid copies. Since advance prints are used as working drafts during various stages of producing final maps, they may not be as accurate or complete as the final maps are.
7. The Iowa Department of Transportation and the U.S. Soil Conservation Service prepare large scale topographic maps of construction sites. The maps and related land survey data are held by the agencies.

C. Computer Storage and Retrieval

1. The EROS Data Center can provide at no cost a computer listing of available aerial mapping photography and NASA aircraft, Skylab, and LANDSAT imagery. This "Geographical Computer Search" may be requested for either point locations (for small areas such as towns) or for large areas (county or multi-county areas).

2. The National Cartographic Information Center of the U.S. Geological Survey provides a computer indexing service for aerial and space photography, maps, charts, and digitized map data. Computer-printed index maps and microfiche listings of photography are published in the "Aerial Photography Summary Record System Catalog and Listing." Information on photography and maps for specific locations can also be obtained by request.
3. A very limited amount of soil map digitizing and computer storage has been attempted in Iowa. The Iowa Agriculture and Home Economics Experiment Station is presently digitizing soils data for Buchanan County. Soil type, slope class, erosion class, and soil boundaries are being coded and stored for each half-acre area. The Iowa State University, Land Use Analysis Laboratory is similarly digitizing soils data for Wapello County.
4. The U.S. Geological Survey has developed a large-scale computer system, the National Water Data Storage and Retrieval System, or WATSTORE, for the storage, processing, and dissemination of water data. The Iowa District Office of the USGS can enter and retrieve data on basin characteristics as well as other surface water, ground water, and water quality data obtained by the USGS.

TABLE 5. SUMMARY OF BASIN CHARACTERISTICS DATA COLLECTION

<u>Data Type</u>	<u>Collecting Agency</u>	<u>Published</u> ¹	<u>Unpublished</u> ¹	<u>Computer Storage</u> ¹
Basin Characteristics	USGS	A1	B1	C4
	IGS	A20		
	Bureau of Census	A4		
	Conservation Needs Committee	A5		
Channel Characteristics	USGS		B1	
Surface Water Features	ICC	A2		
	ACE		B2	
	SCS		B2	
	INRC		B2	
Artificial Drainage	Drainage Districts		B3	
	SCS	A3		
	Bureau of Census	A4		
	Conservation Needs Committee	A5		

<u>Data Type</u>	<u>Collecting Agency</u>	<u>Published</u> ¹	<u>Unpublished</u> ¹	<u>Computer Storage</u> ¹
Soil Surveys	Cooperative Soil Survey Agencies	A6	B4	C3
Soil Temperatures	NWS (5 stations)	A7		
Soil Moisture	ISU	A8, A9, A10	B5	
Aerial Photographs	ASCS, ACE, USGS, SCS, NASA, ICC, IDOT, IGS	A11, A12, A13		C1, C2
Space Imagery	NASA	A11, A12, A13		C1, C2
Topographic maps	USGS	A14	B6	C2
	SCS, IDOT		B7	
Flood Plain Maps	USGS	A15		C2
	ACE	A16		C2
	FIA	A17		
Nautical Charts	ACE	A18		C2
Bathymetric Maps	ICC	A19		

¹Codes refer to items described in IV Sources of Data.

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