WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEARS 1979 AND 1980

U.S. GEOLOGICAL SURVEY
WATER-RESOURCES INVESTIGATIONS
OPEN-FILE REPORT 81-348

UNITED STATES
DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEARS 1979 AND 1980

Compiled by H. E. McGovern and L. J. Combs

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations

Open-File Report 81-348

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CONTENTS

Page

Introduction - 4
Program funding- 7
Data-collection programs - 9
Surface-water stations (KS-001) - 10
Ground-water stations (KS-002)- 16
Water-quality stations (KS-003) - 20
Sediment stations (KS-004)- 26
Automated water-use data base (KS-007)- - - - - - - - - - - - - - - - - - 27
Hydrologic data base (KS-086) - 28
Local or areal investigations- 29
Flood-insurance studies (KS-006)- 29
Effect of urbanization, Wichita (KS-013)- - - - - - - - - - - - - - - - - - 30
Water for municipal supply during droughts (KS-058) - - - - - - - - - - - 31
Discharge of saltwater from Permian rocks (KS-073) - - - - - - - - - - - - 32
Saline discharge to Smoky Hill River (KS-074) - - - - - - - - - - - - - - 33
Water resources in north-central Kansas (KS-075)- - - - - - - - - - - - - 34
Quality of water, mined areas (KS-076)- - - - - - - - - - - - - - - - - - 35
Sandstone aquifers, southwest Kansas (KS-079) - - - - - - - - - - - - - - 36
Hydrology of mined lands (KS-081) - 37
Geohydrology for water-supply planning (KS-082) - - - - - - - - - - - - - 38
Fluvial sediment, northeast Kansas (KS-083) - - - - - - - - - - - - - - - 39
Geohydrology of Arkansas River valley (KS-088)- - - - - - - - - - - - - - 40
Estimating ground-water withdrawals (KS-090)- - - - - - - - - - - - - - - 41
Glacial deposits, northeast Kansas (KS-091) - - - - - - - - - - - - - - - 42
"Equus beds" aquifer, central Kansas (KS-092) - - - - - - - - - - - - - - 44
Kansas River bank stabilization (KS-095)- - - - - - - - - - - - - - - - - 45
Water quality from urban runoff, Topeka (KS-096)- - - - - - - - - - - - - 46
Wellington aquifer near Salina (KS-098) - - - - - - - - - - - - - - - - - 47
Effects of strip mining, Linn, Miami, and Bourbon
Counties (KS-099)- 48
Models, North and South Fork Solomon Rivers (KS-100)- - - - - - - - - - - 49
Ground-water depletion maps, west-central Kansas (KS-105) - - - - - - - - 50
Water resources of Ford County (KS-106) - - - - - - - - - - - - - - - - - 51
Effects of ground-water withdrawals, Arkansas River (KS-107)- - - - - - - 52
Water quality, deep aquifers, western Kansas (KS-109) - - - - - - - - - - 53
Geohydrology, Wellington Formation, Salina area (KS-110)- - - - - - - - - 54
Statewide or regional investigations - 55
Flood investigations (KS-010) - 55
Streamflow characteristics (KS-011) - - - - - - - - - - - - - - - - - - - 56
Kansas-Oklahoma Arkansas River Commission (KS-041)- - - - - - - - - - - - 57
Short-term hydrologic investigations (KS-045) - - - - - - - - - - - - - - 58
Numerical models of streamflow (KS-059) - - - - - - - - - - - - - - - - - 59
Flood-hazard mapping (KS-062) - 60
Evaluation of Ground-Water-Quality Network (KS-077) - - - - - - - - - - - 61
Potential for liquid-waste injection (KS-078) - - - - - - - - - - - - - - 62
Aquifer-test evaluation (KS-093)- 63
High Plains aquifer study (KS-094)- 64
Central Midwest aquifer study (KS-111)- - - - - - - - - - - - - - - - - - 65

Page

Research projects- 66
Sediment, active-channel geometry (KS-085)- - - - - - - - - - - - - - - 66
Channel geometry of regulated streams (KS-087)- - - - - - - - - - - - - 67
Water-yield estimation (KS-089) - 68
Streamflow characteristics, coal-lease areas (KS-097) - - - - - - - - - 69
Precipitation variability (KS-101)- - - - - - - - - - - - - - - - - - - 70
Distribution information systems (KS-102) - - - - - - - - - - - - - - - 71
List of reports published or released during 1979 and 1980 fiscal years- 72
Hydrologic-data stations in Kansas, 1980 water year- - - - - - - - - - - - 75

ILLUSTRATIONS

Figure Page

1. Map showing location of offices of the Water Resources Division, U.S. Geological Survey, Kansas- 4
2. Map of Kansas showing areas not covered by U.S. Geological Survey topographic quadrangles, as of February 1979 - - - - - - - - - - - - - - - - 6
3. Pie diagram showing distribution of funding for the water-resources program of the U.S. Geological Survey in Kansas, fiscal years 1979 and 1980 - 6
4. Map of Kansas showing location of complete-record surface-water gaging stations, 1980 water year - - - - - - - - - - - - - - - - - - 12
5. Map of Kansas showing location of partial-record surface-water gaging stations, 1980 water year - 14
6. Map of Kansas showing location of observation wells, 1980 water year - 18
7. Map of Kansas showing location of surface-water-quality stations, 1980 water year- 22
8. Map of Kansas showing location of ground-water-quality sampling sites, 1980 water year- 24
9. Diagram showing well-numbering system- - - - - - - - - - - - - - - - - 77

TABLES

Table Page

1. Complete-record surface-water gaging stations- - - - - - - - - - - - - 79
2. Partial-record surface-water gaging stations - - - - - - - - - - - - - 85
3. Ground-water-level observation wells - - - - - - - - - - - - - - - - - 91
4. Surface-water-quality stations - 97
5. Ground-water-quality sampling sites- - - - - - - - - - - - - - - - - - 102

INTRODUCTION

The Organic Act of March 3, 1879, established the U.S. Geological Survey as a separate Bureau of the Department of the Interior. The Survey's principal mission became (1) the classification and survey of public lands, (2) the examination of the geologic structure and the mineral resources of the national domain, and (3) the determination of the water resources of the United States. Seven years later, in 1886, the first water-resources investigation by the U.S. Geological Survey in Kansas was completed by A. C. Peale. A cooperative program with the Kansas State Board of Irrigation and Surveys instituted the first stream-gaging stations in western Kansas during 1895. The gaging program later was extended to eastern Kansas in 1899.

From these early beginnings, the Water Resources Division of the U.S. Geological Survey has expanded its work in Kansas to meet the growing demand for scientific data by Federal, State, and local agencies for use in the planning and management of one of the State's most precious resource--water. The Kansas District of the Water Resources Division, with headquarters in Lawrence and subdistrict offices in Garden City and Salina (fig. 1), investigates the occurrence, quantity, quality, distribution, and movement of surface and ground waters. Its activities include the systematic collection, analysis, and interpretation of data; the investigation of water demand for public supply, industrial, domestic, and agricultural purposes; and the research and development of new techniques to improve the scientific basis of data collection and investigative principles.

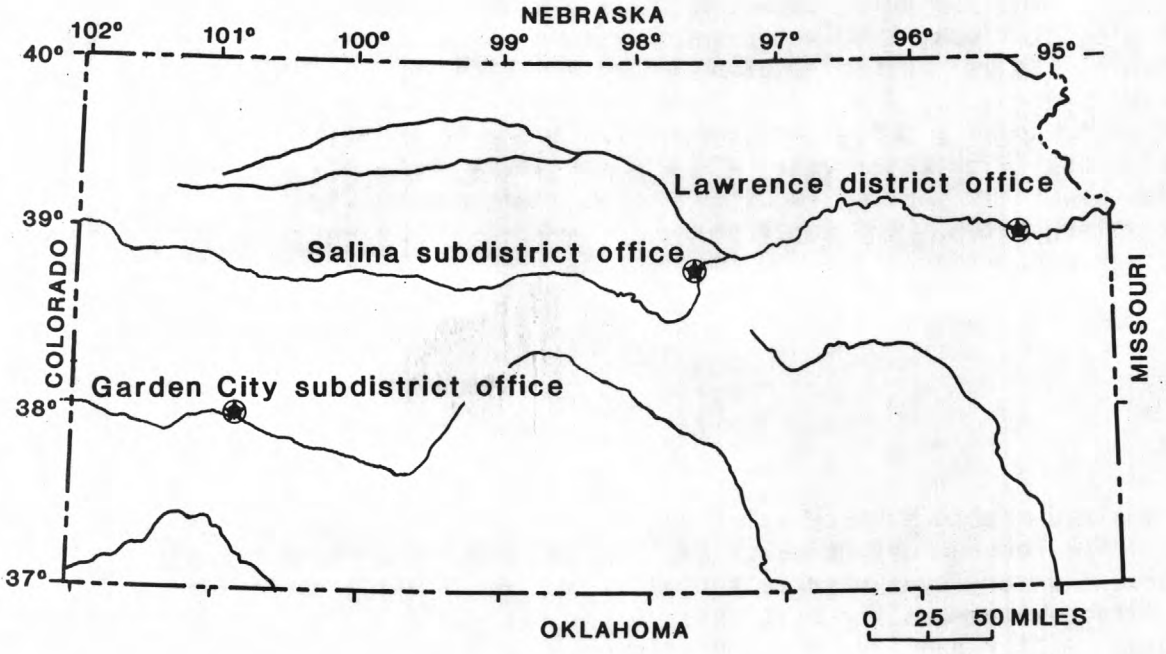


Figure 1.--Location of offices of the Water Resources Division, U.S. Geological Survey, Kansas.

Water-resources data and the results of hydrologic investigations in Kansas are published or released either by the U.S. Geological Survey, by cooperating agencies, or by journals of technical and scientific organizations. Requests for such information and for publications resulting from past or present investigations of the U.S. Geological Survey in Kansas should be addressed to one of the following:

District Chief
U.S. Geological Survey
Water Resources Division
1950 Avenue "A" - Campus West
Lawrence, Kansas 66045
Phone: 913-864-4321

Subdistrict Chief
U.S. Geological Survey
Water Resources Division
206 Fulton Terrace
Garden City, Kansas 67846
Phone: 316-275-4123

Subdistrict Chief
U.S. Geological Survey
Water Resources Division
211 W. Iron St., Rm. 209
Salina, Kansas 67401
Phone: 913-827-3330

The Topographic Division of the U.S. Geological Survey also conducts an extensive mapping program in Kansas from its regional office in Rolla, Missouri. Standard topographic quadrangle maps published in the 7 1/2- and 15-minute series provide coverage for almost the entire State (see fig. 2). These maps may be purchased from:

Kansas Geological Survey
Publication Sales, 4th Floor
1930 Avenue A - Campus West
Lawrence, Kansas 66045

For additional information on the Topographic Division's mapping program in Kansas, write to:

National Cartographic Information Center
U.S. Geological Survey
507 National Center
Reston, Virginia 22092

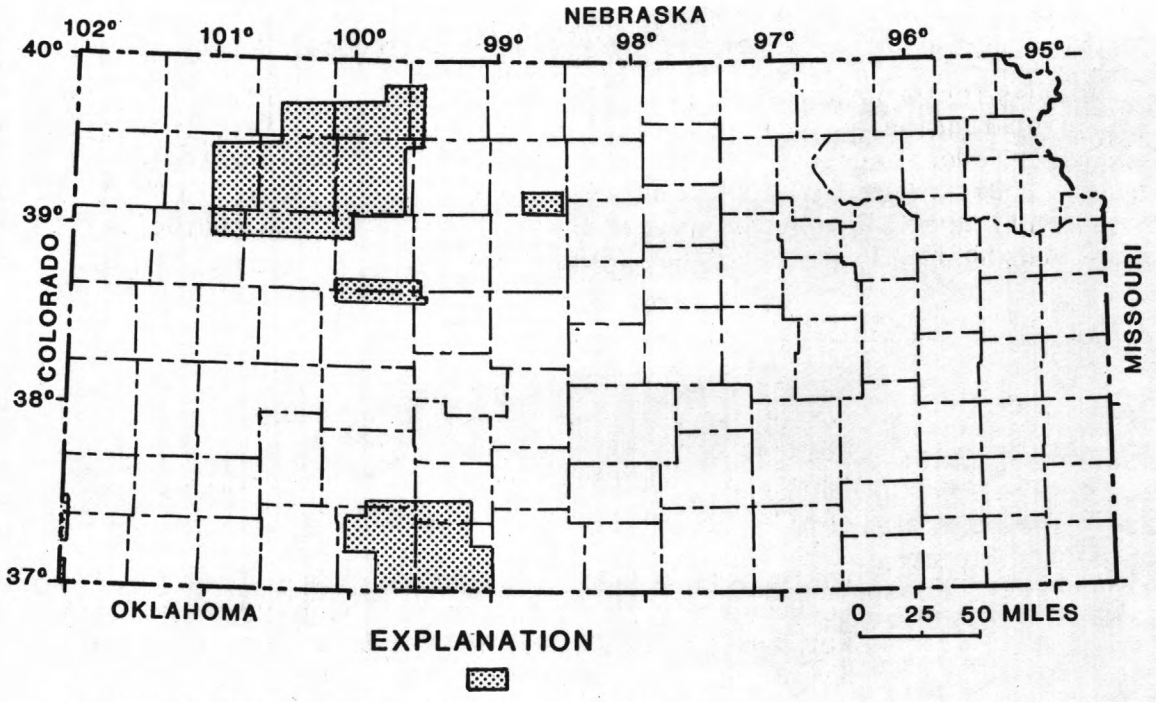


Figure 2.--Areas not covered by U.S. Geological Survey topographic quadrangles, as of February 1979.

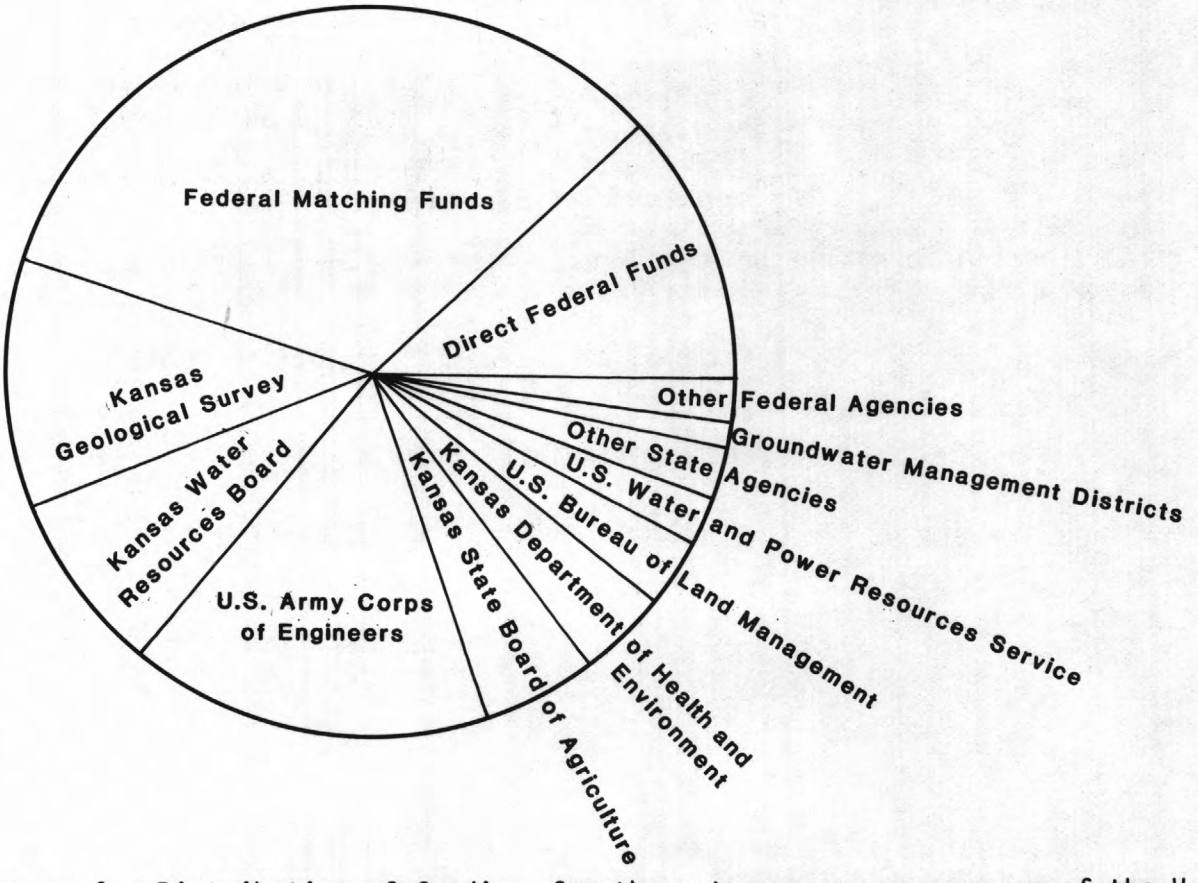


Figure 3.--Distribution of funding for the water-resources program of the U.S. Geological Survey in Kansas, fiscal years 1979 and 1980.

PROGRAM FUNDING

Moneys for program operation of the Water Resources Division in Kansas come from joint-funding agreements with State and local agencies, transfer of funds from other Federal agencies, and direct Federal allotments to the U.S. Geological Survey . Distribution of funding for program operation in FY79-80 is illustrated in figure 3. Those agencies cooperating with the U.S. Geological Survey in Kansas during the 1979 and 1980 fiscal years were:

State and local agencies

Kansas Geological Survey
Kansas Water Resources Board
Kansas State Board of Agriculture
Kansas Department of Health and Environment
Kansas Department of Transporation
City of Wichita
Western Kansas Groundwater Management District No. 1
Southwest Kansas Groundwater Management District No. 3
Northwest Kansas Groundwater Management District No. 4
Kansas-Oklahoma Arkansas River Commission

Federal agencies

U.S. Department of Agriculture, Soil Conservation Service
U.S. Department of Army, Corps of Engineers
U.S. Department of Housing and Urban Development
U.S. Department of Interior, Bureau of Land Management
U.S. Department of Interior, Fish and Wildlife Service
U.S. Department of Interior, Office of Surface Mining Reclamation and Enforcement
U.S. Department of Interior, Water and Power Resources Service

The following projects were funded for fiscal years 1979 and 1980 in the Kansas District:

001 Surface-water stations
002 Ground-water stations
003 Water-quality stations
004 Sediment stations
006 Flood-insurance studies
007 Water-use data base
010 Flood investigations
011 Streamflow characteristics
013 Urban runoff, Wichita
041 Kansas-Oklahoma Arkansas River
045 Short-term hydrologic investigations
058 Municipal supply during droughts
059 Streamflow models
062 Flood-hazard mapping
073 Saltwater, Permian rocks
075 Water resources, north-central Kansas
076 Water-quality mined areas, southeast Kansas
077 Ground-Water-Quality Network evaluation
078 Liquid-waste disposal, Arbuckle Group
079 Sandstone aquifer, southwest Kansas
081 Mined-land hydrology, southeast Kansas
082 Geohydrology for planning, western Kansas
083 Fluvial sediment, northeast Kansas
085 Sediment, active-channel geometry
086 Hydrologic-data base, southwest Kansas
087 Channel geometry, regulation
088 Geohydrology, Arkansas River valley
089 Water-yield estimation
090 Estimated ground-water withdrawals
091 Glacial deposits, northeast Kansas
092 "Equus beds" aquifer
093 Aquifer-test evaluation
094 High Plains aquifer study
095 Stabilization, Kansas River
096 Urban storm-water quality, Topeka
097 Channel geometry - coal areas
098 Wellington aquifer near Salina
099 Coal hydrology, east-central Kansas
100 Models, North & South Fork Solomon Rivers
101 Precipitation variability
102 Information systems, Kansas
105 Ground-water depletion maps
106 Water resources of Ford County
107 Ground-water withdrawals, Arkansas River
109 Water quality, deep aquifers, western Kansas
110 Geohydrology, Wellington Formation, Salina area
111 Central Midwest aquifer study

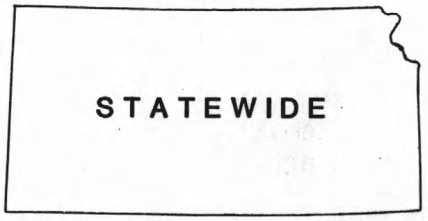
Subsequent sections of this report describe these projects under the general headings of: (1) data-collection programs, (2) local or areal investigations, (3) statewide or regional investigations, and (4) research projects.

DATA-COLLECTION PROGRAMS

Throughout its long history of service to the people of Kansas, the primary mission of the Water Resources Division has remained the same--the comprehensive and systematic collection of hydrologic data and the timely release of such data for public use. To help provide this valuable service, a network of hydrologic-data stations is maintained throughout Kansas to obtain records of (1) stage, discharge, chemical quality, and sediment yield of streams; (2) stage, content, and chemical quality of lakes and reservoirs; and (3) water levels and chemical quality of ground water.

Hydrologic data collected in Kansas as part of the water-resources-data network are published annually in a comprehensive report entitled "U.S. Geological Survey Water-Data Report KS-80-1 (or KS-80-2)." The report number identifies the two-letter state abbreviation (KS), the last two digits of the water year (80), and the volume number (1, Missouri River basin; 2, Arkansas River basin). Water-data reports are available from the U.S. Geological Survey office in Lawrence, Kansas, or from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161.

Hydrologic data also are stored in both current and historical computer files in the U.S. Geological Survey's National Water-Data Storage and Retrieval System (WATSTORE). The data are available for water planning and management in machine-readable form, computer-printed tables or graphs, statistical analyses, and digital plots. Local assistance in the acquisition of computer services is available from the Kansas District office in Lawrence.



PROJECT TITLE: Surface-water stations
PROJECT NUMBER: KS-001
COOPERATING AGENCY: Multifunded
PROJECT CHIEF: C. O. Geiger

Problem -- Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, operation, and management in such water-related fields as water supply, hydroelectric power, flood control, irrigation, flood-plain management, and water-resources development. To provide this information, an appropriate and comprehensive data base is necessary.

Objective -- Collect surface-water data sufficient to satisfy needs for current-purpose uses, such as (1) assessment of water resources, (2) operation of reservoirs or industries, (3) forecasting, (4) disposal of wastes and pollution controls, (5) discharge data to accompany water-quality measurements, (6) compact and legal requirements, and (7) research or special studies.

Collect data necessary for analytical studies to define, for any location, the statistical properties of, and trends in, the occurrence of water in streams, lakes, and reservoirs for use in planning and design.

Approach -- A network of gaging stations is maintained to provide surface-water data for management and operation, for determination of long-term trends, and for research and special studies. Data are collected on stage and discharge of streams or canals, and on stage, surface area, and content of lakes and reservoirs.

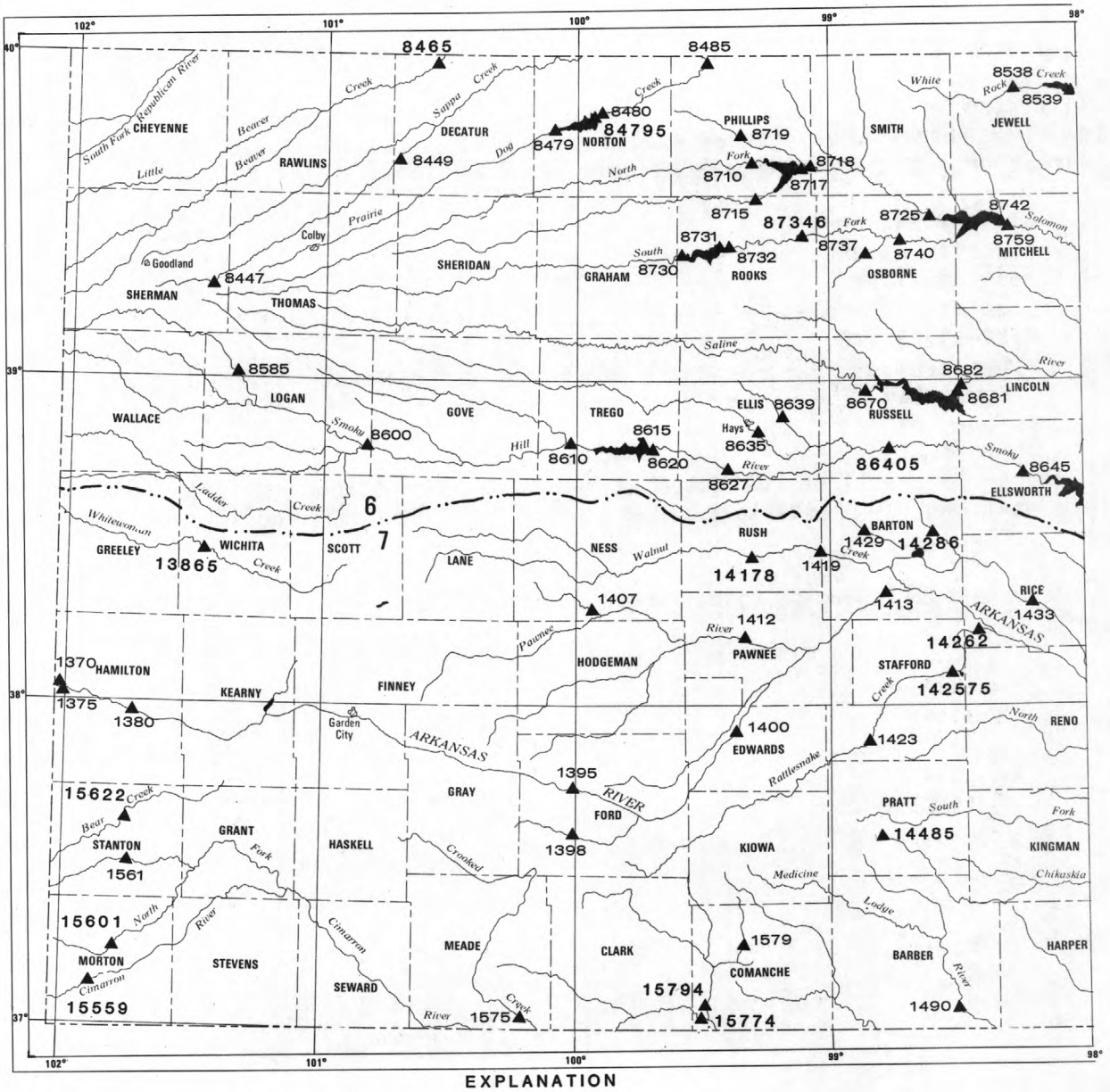
Progress -- The network of stations is revised periodically to ensure the collection of meaningful and worthwhile data. Figures 4 and 5 and tables 1 and 2 (given at the conclusion of this report) list the surface-water stations in operation during the 1980 water year.

Complete-record stations (shown in figure 4 and listed in table 1) provide continuous data for determination of flow or volume of water in storage on a daily, monthly, or annual basis. Partial-record stations (shown in figure 5 and listed in table 2) provide limited data collected systematically to record low-flow (base-flow) discharges and crest-stage (flood-stage) or maximum discharges on additional streams at selected locations.

Gaging-station classification	Number of stations
Stream stations	285
Complete-record	147
Partial-record	
Crest-stage	116
Low-flow	22
Lake and reservoir stations	21

Plans--Data will be collected at 143 continuous streamflow sites, 22 reservoir stations, 47 crest-stage gages, and 23 low-flow sites during the 1981 water year.

Reports published or released--See numbers 31, 36, and 37 in "List of Reports... ."



EXPLANATION

▲1720

Complete-record stations and number

Note: numbers shown are abbreviated versions of the complete numbers given in text

Drainage basins

6 Missouri River basin

7 Arkansas River basin

Basin boundary

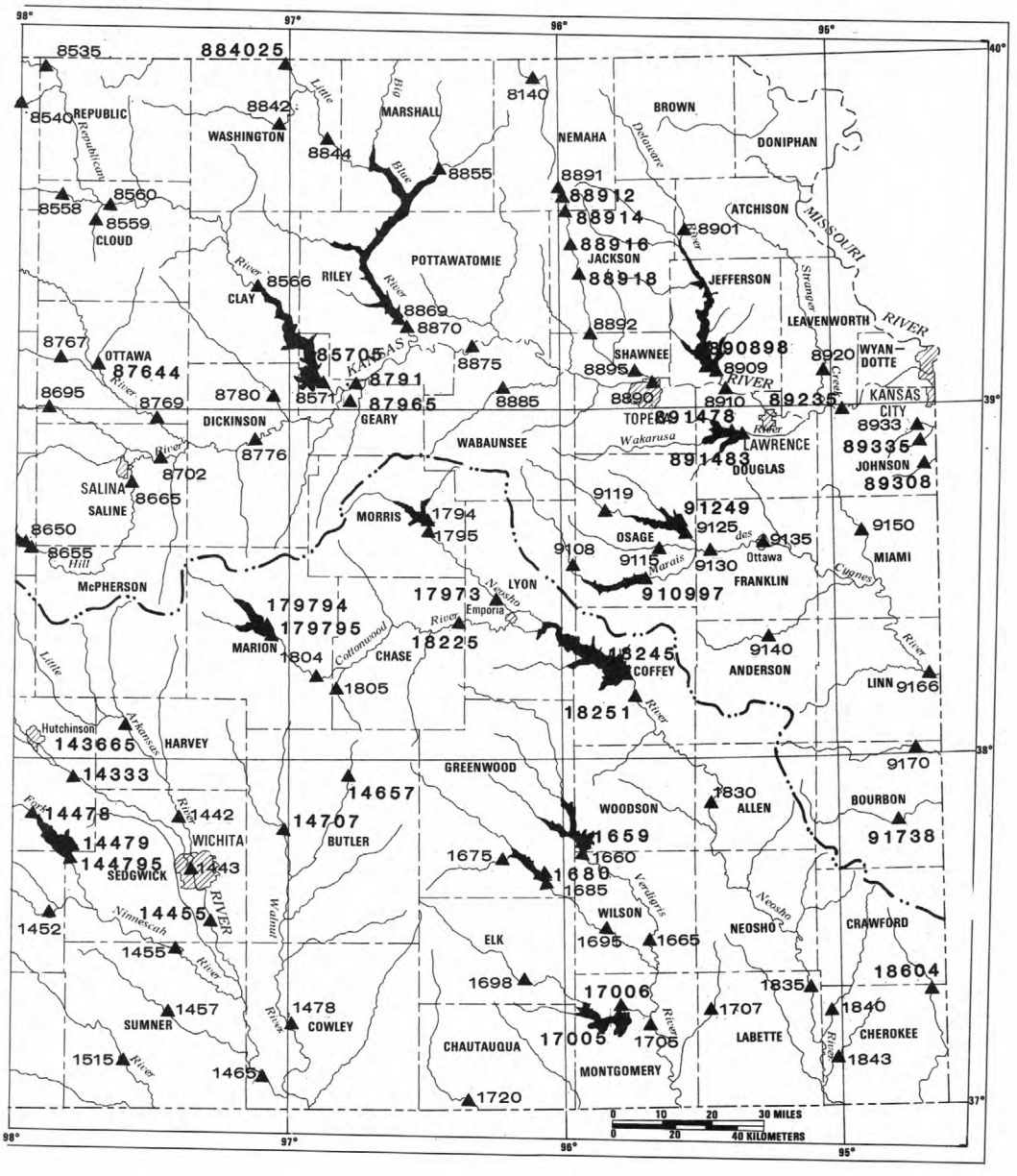
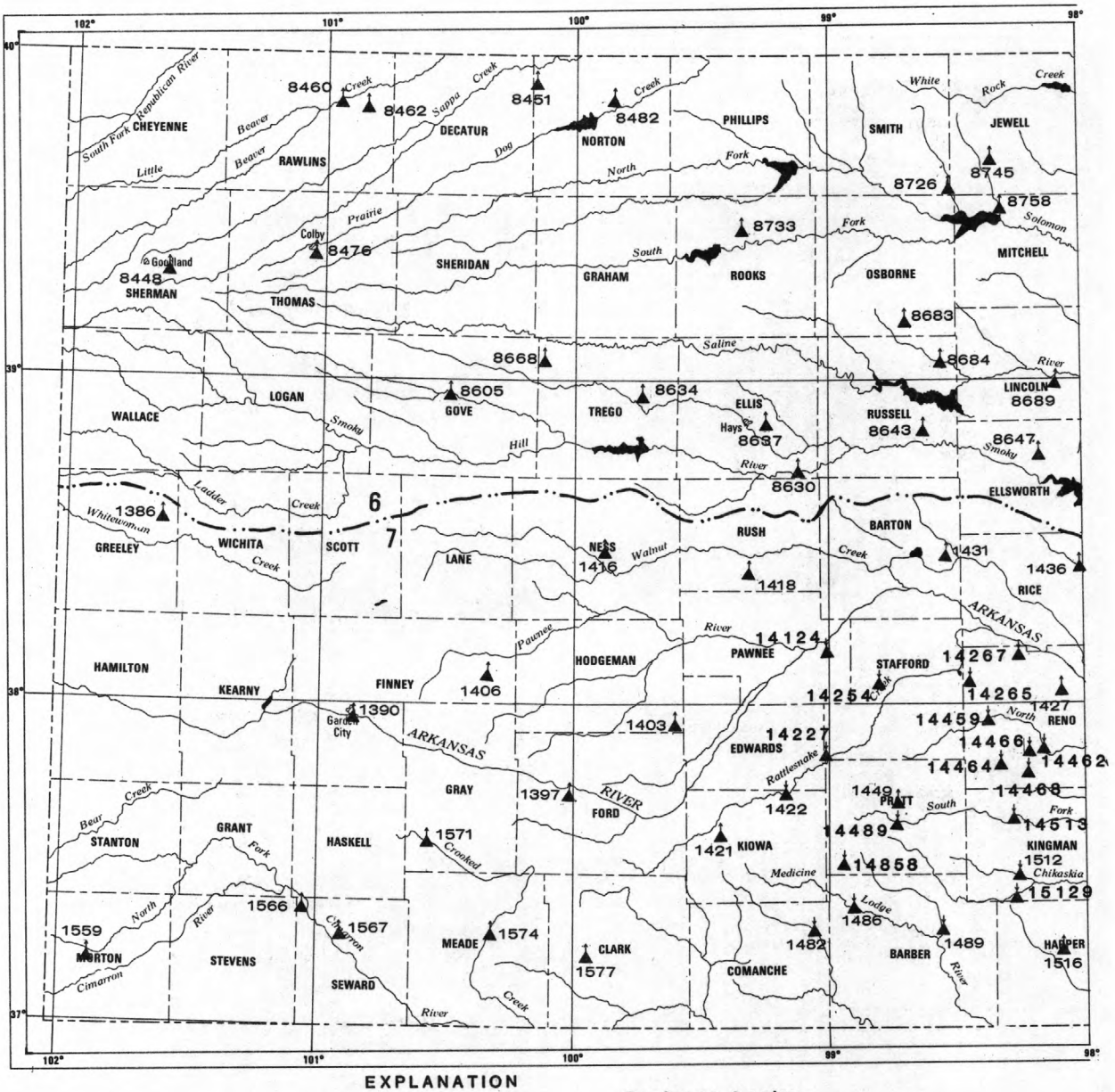


Figure 4.--Location of complete-record surface-water gaging stations, 1980 water year. Stations are listed in table 1.



EXPLANATION

8137 ▲ Crest-stage station and number

1512 ▲ Low-flow station and number

Note: numbers shown are abbreviated versions of the complete numbers given in text

Drainage basins

6 Missouri River basin

7 Arkansas River basin

Basin boundary

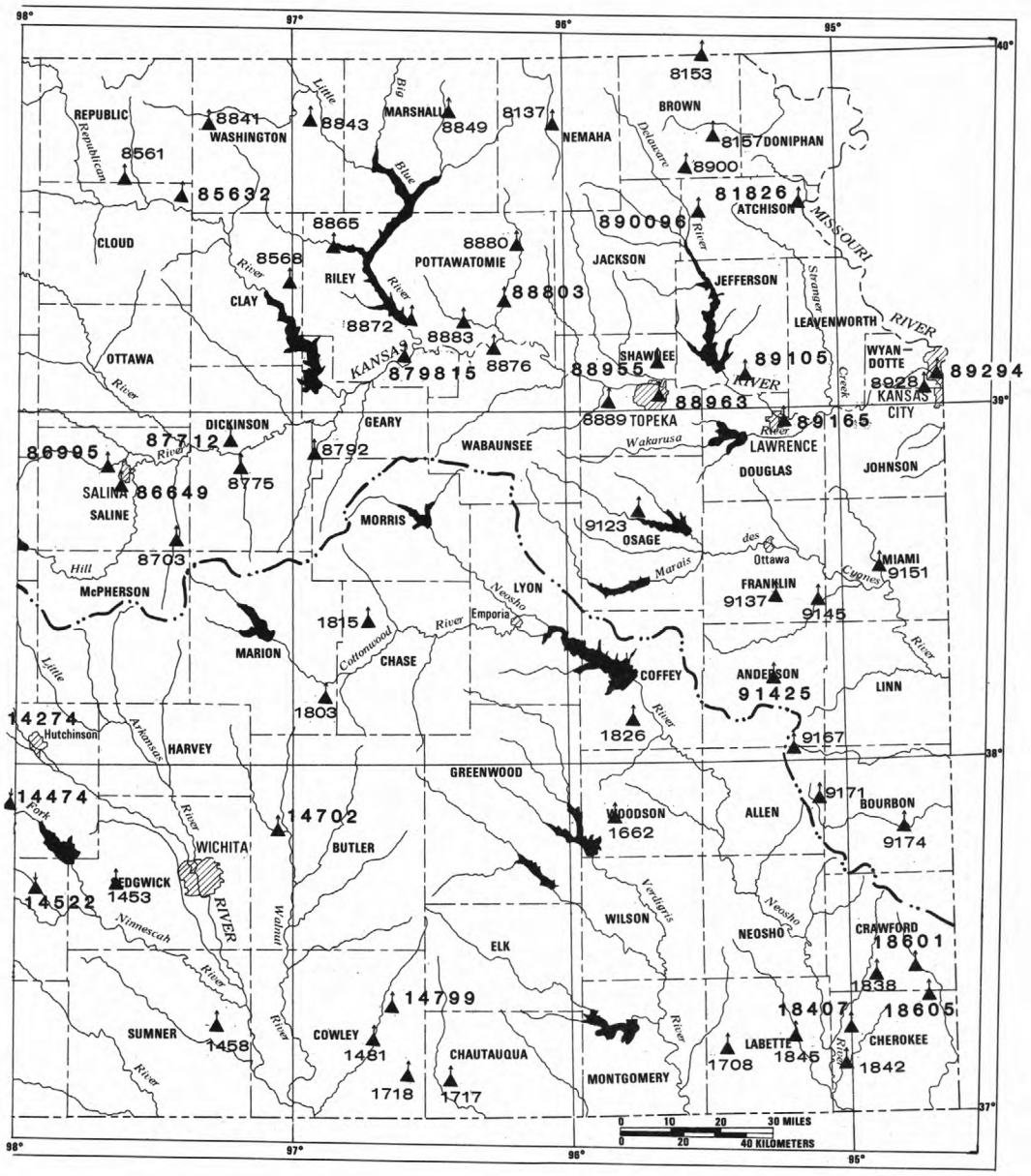


Figure 5.--Location of partial-record surface-water gaging stations, 1980 water year. Stations are listed also in table 2.

PROJECT TITLE: Ground-water stations
PROJECT NUMBER: KS-002
COOPERATING AGENCY: Multifunded
PROJECT CHIEF: C. O. Geiger

Problem -- Long-term water-level records are needed (1) to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems in Kansas, (2) to provide a data base from which to measure the effects of development, (3) to assist in the prediction of future supplies, and (4) to provide data for management of the resource.

Objective -- Collect water-level data sufficient to provide a minimum long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and so that potential problems can be defined early enough to allow proper planning and management.

Provide a data base against which the short-term records acquired in areal studies can be analyzed. This analysis must (1) provide an assessment of the ground-water resources, (2) allow predictions of future conditions, (3) detect and define pollution and supply problems, and (4) provide the data base necessary for management of the resource.

Approach -- A network of observation wells is measured to provide a data base for monitoring the general response of ground-water systems to natural climatic variations and to stresses of pumpage. A long-term record of water-level measurements, in conjunction with a determination of the hydrologic system, provides data for proper planning and management.

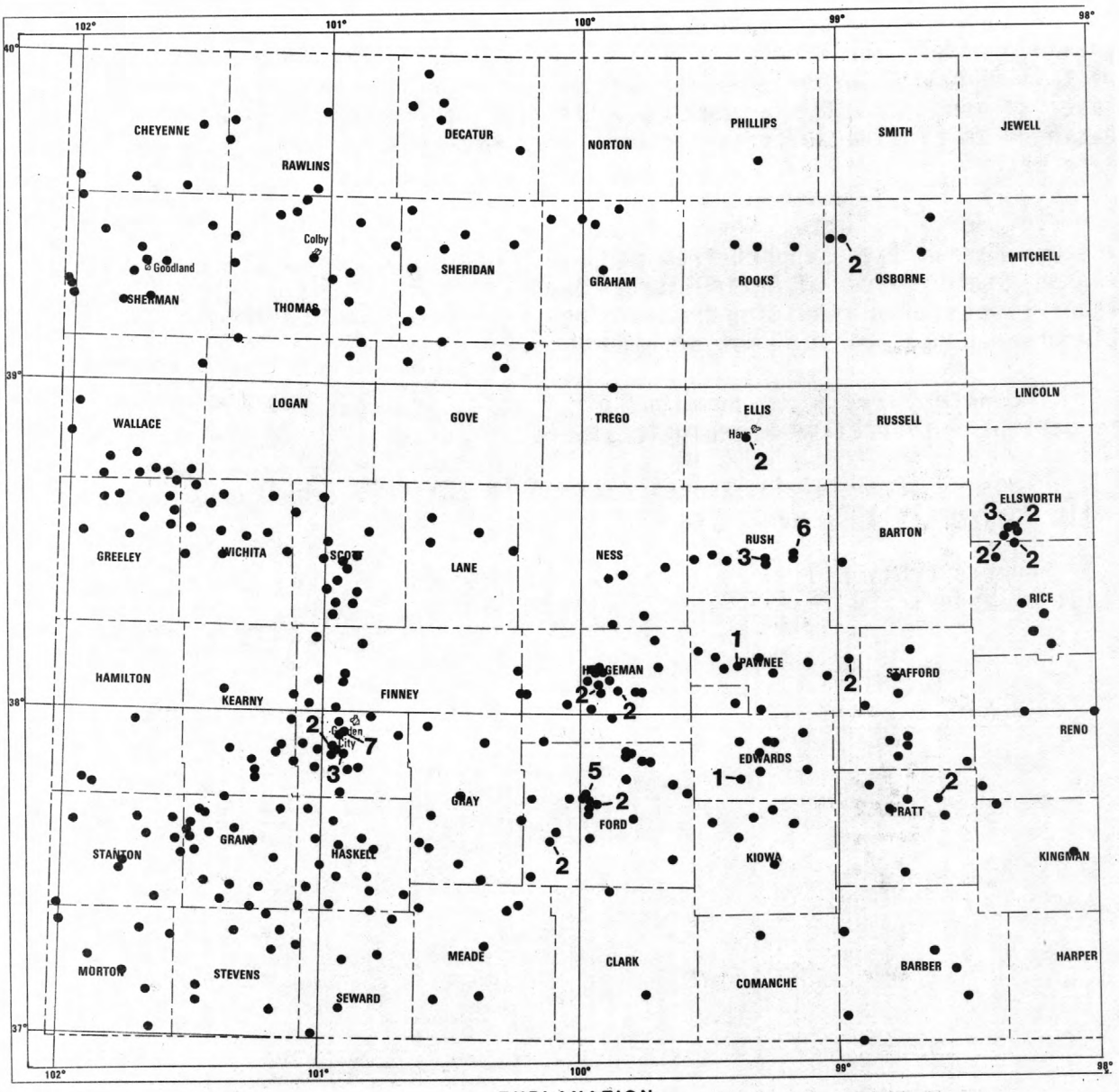
Progress -- Water levels were measured in 470 observation wells during the 1980 water year (shown in figure 6 and listed in table 3 at the conclusion of this report) on a regularly scheduled basis ranging from continuous (recording gage) to annually. The network of wells and the regularity of measurements are designed to provide sufficient water-level data to establish a minimum long-term data base.

In addition, water levels in about 1,475 wells are measured annually in western Kansas with support from personnel of the Division of Water Resources, Kansas State Board of Agriculture. Annual reports are published to show the water-level change resulting from ground-water withdrawals, principally irrigation (see number 24 in "List of Reports...").

The water levels in numerous other wells are measured for short periods as part of interpretive hydrologic studies.

Plans -- Water-level measurements will be obtained from approximately 1,950 wells during the 1981 water year.

Reports published or released -- See numbers 24, 26, 31, 36, and 37 in "List of Reports... ."



EXPLANATION

2

Observation well

Number indicates more than one well at this site

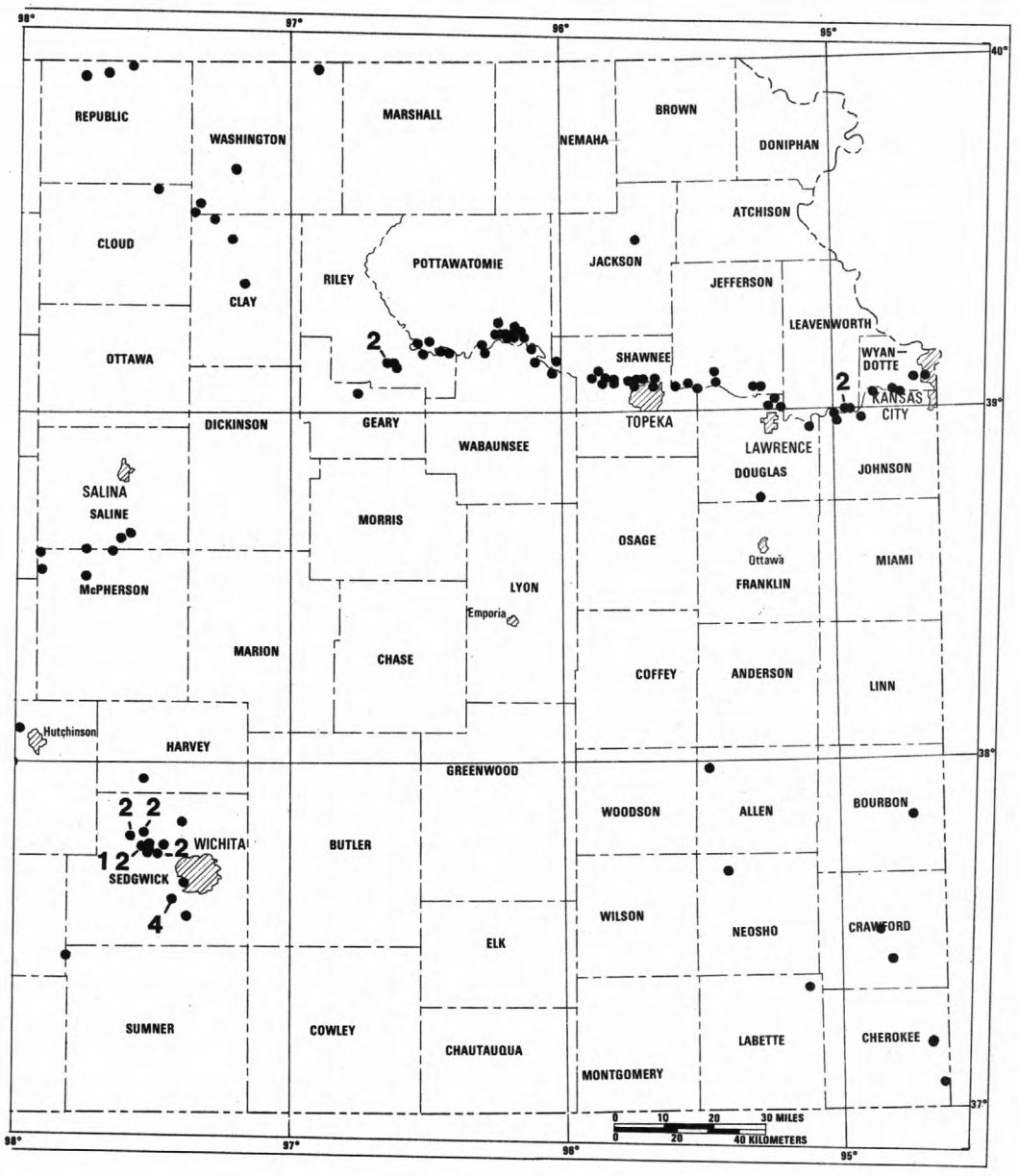
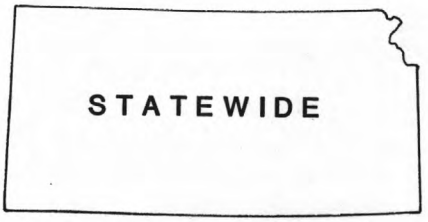


Figure 6.--Location of observation wells, 1980 water year. Well locations are listed also in table 3.



PROJECT TITLE: Water-quality stations
PROJECT NUMBER: KS-003
COOPERATING AGENCY: Multifunded
PROJECT CHIEF: C. O. Geiger

Problem --Water-resource planning and water-quality assessment require a national data base of relatively standardized information. For intelligent planning and realistic assessment of the water resource, the chemical and physical quality of the rivers, streams, lakes, and reservoirs, as well as major ground-water aquifer systems, must be defined and monitored.

Objective -- To provide a national bank of water-quality data for State, local, and Federal planning and action programs, and to provide data for the Federal management of interstate waters.

Approach -- Surface-water-quality stations are maintained in Kansas to monitor long-term and short-term trends related to changes in streamflow, reservoir operation, and local or regional pollution. In addition, a collection network of surface-water-quality data, identified as the National Stream-Quality Accounting Network (NASQAN), is designed by the U.S. Geological Survey to meet many of the information demands of agencies or groups involved in national or regional water-quality planning and management. Primary objectives of the network are to depict areal variability of streamflow and water-quality conditions nationwide on a year-by-year basis and to detect and assess long-term changes in streamflow and water quality. Water samples are collected also at a few regular surface-water stations, as a Federal interagency activity, for monitoring the concentration and distribution of pesticides in streams where potential contamination could result from continued or future application of the commonly used insecticides or herbicides. As part of a nationwide sampling of major drainage basins, water also is collected at one station to be analyzed for radioisotopes.

Approach -- continued.

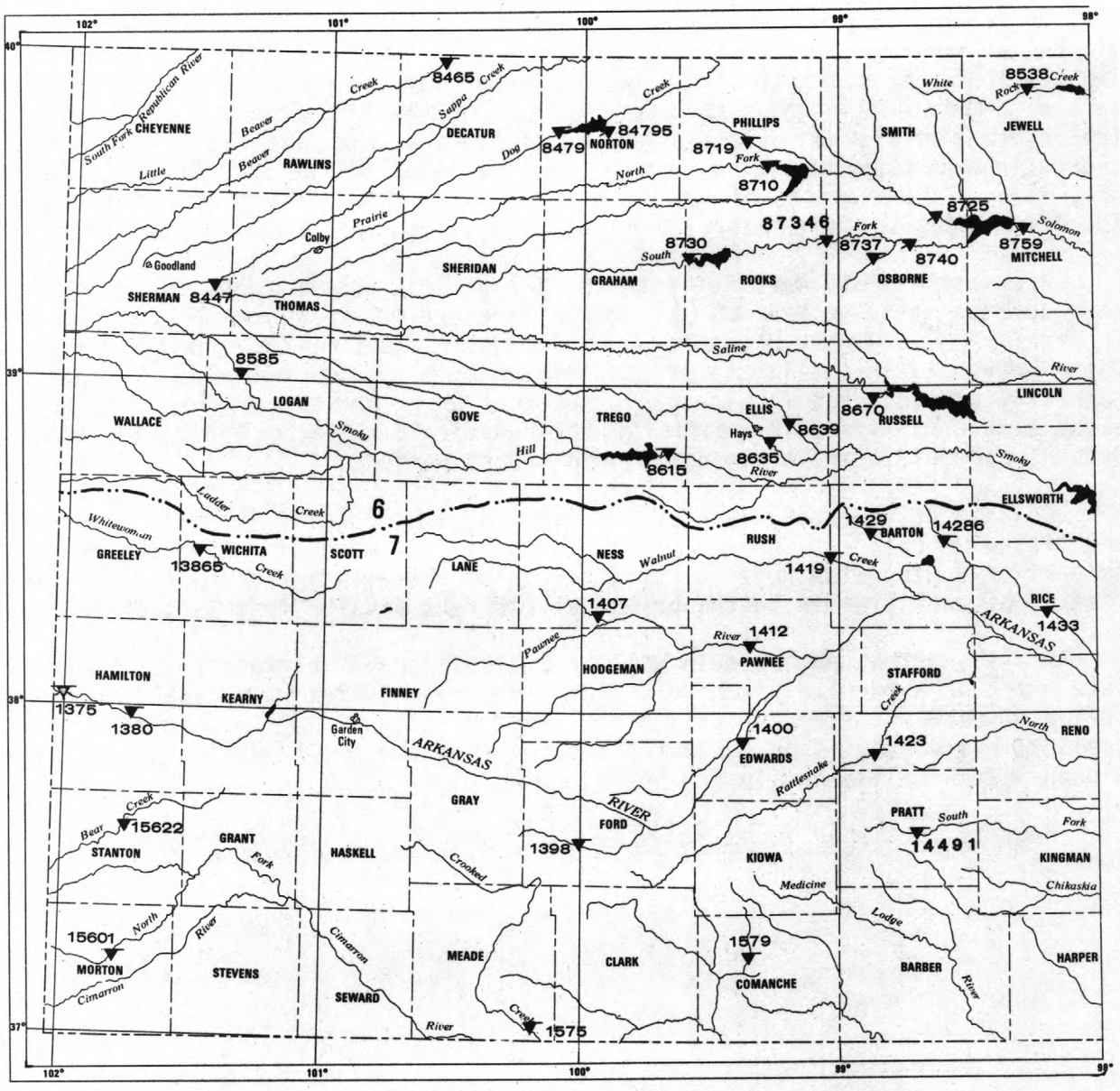
Water-quality data are collected from a network of wells to determine the chemical characteristics of ground water in the principal aquifers and to assess the suitability of the water for use in domestic and municipal supplies. The information also is collected to establish an adequate data base for monitoring change in water quality according to the provisions of the Safe Drinking Water Act, 1975. Other samples of ground water from various geologic formations at specific locations are analyzed for interpretive hydrologic investigations.

Progress -- Data were collected on a routinely scheduled basis (generally near surface-water gages) at 131 complete-record stations and 2 lakes (shown in figure 7 and listed in table 4 at the end of this report) during the 1980 water year. Water-quality samples collected on a routine basis at 79 stations generally are analyzed for inorganic chemical constituents; samples at selected sites also are analyzed for pesticide, radiochemical, biologic, and bacteriologic data as part of interpretive hydrologic investigations.

Collection and analysis of water samples from 430 wells (shown in figure 8 and listed in table 5 at the end of this report) were made in the 1980 water year as part of a statewide network for determining the existing chemical characteristics of ground water in the principal aquifers and for detecting pollution.

Plans -- Water-quality data will be collected at 131 streamflow sites and 2 lake sites on a regularly scheduled basis during the 1981 water year. Samples collected at 79 of these sites will be analyzed for inorganic chemical constituents. Chemical analyses will be conducted also on samples from 430 wells in the Kansas Ground-Water-Quality Monitoring Network.

Reports published or released -- See numbers 31, 36, and 37 in "List of Reports... ."



EXPLANATION

- ▼ Chemical
- ▼ Biological
- ▽ Monitor
- ▼ Temperature
- ▼ Sediment

Note: numbers shown are abbreviated versions of the complete numbers given in text

Drainage basin

- 6 Missouri River basin
- 7 Arkansas River basin

Basin boundary

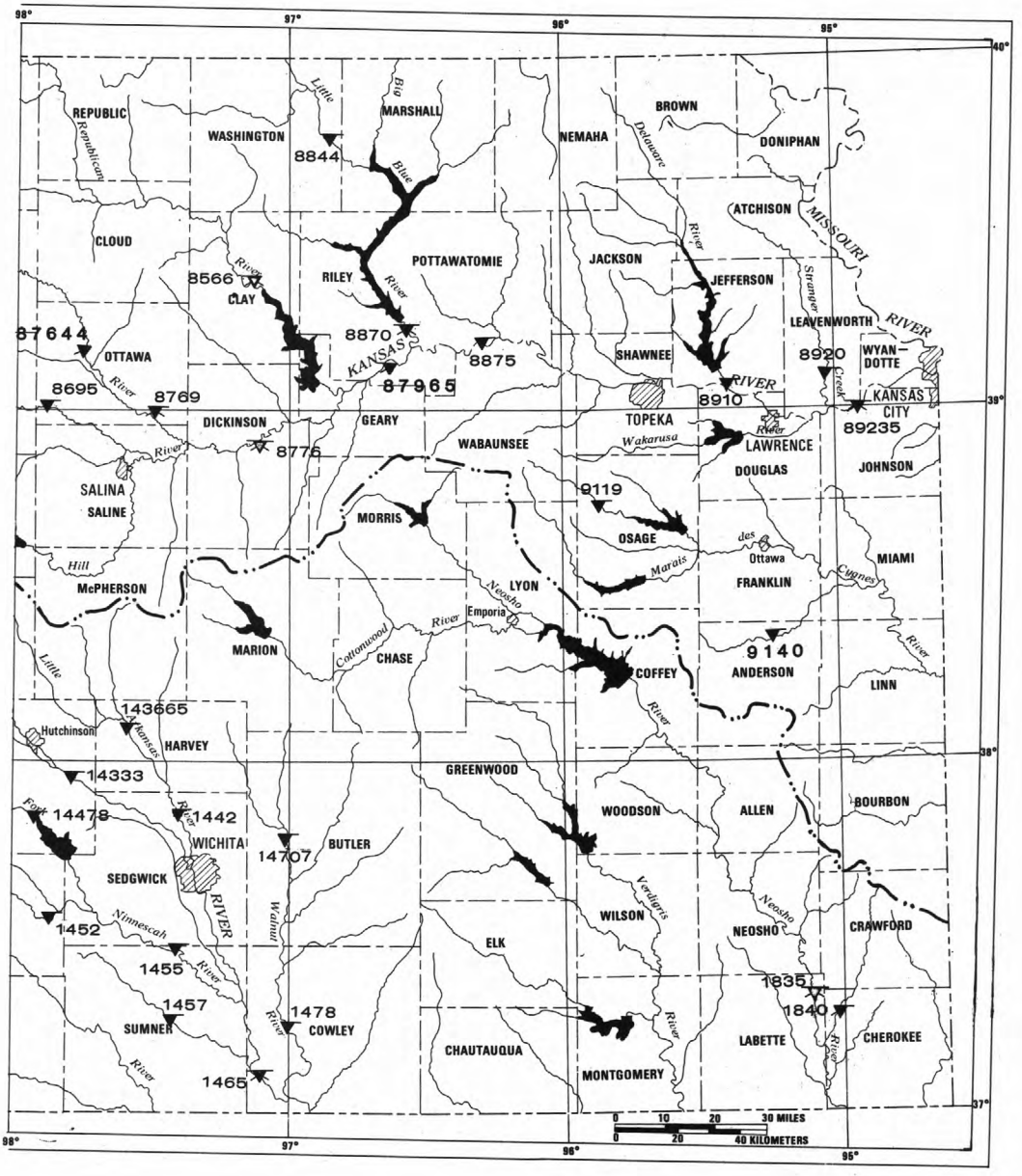
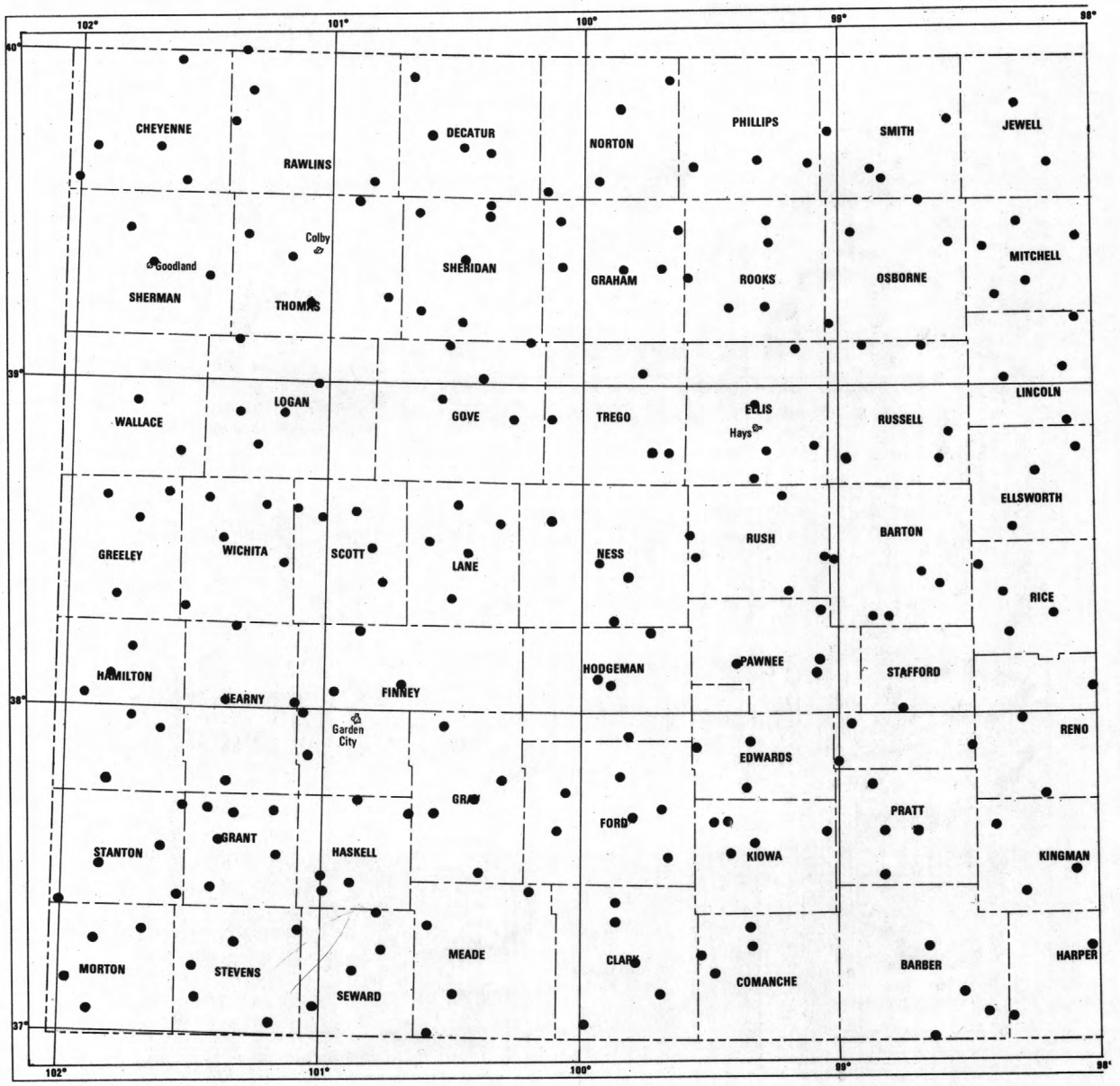


Figure 7.--Location of surface-water-quality stations, 1980 water year. Stations are listed also in table 4.



EXPLANATION

2

Ground-water-quality sampling site

Number indicates more than one well at this site

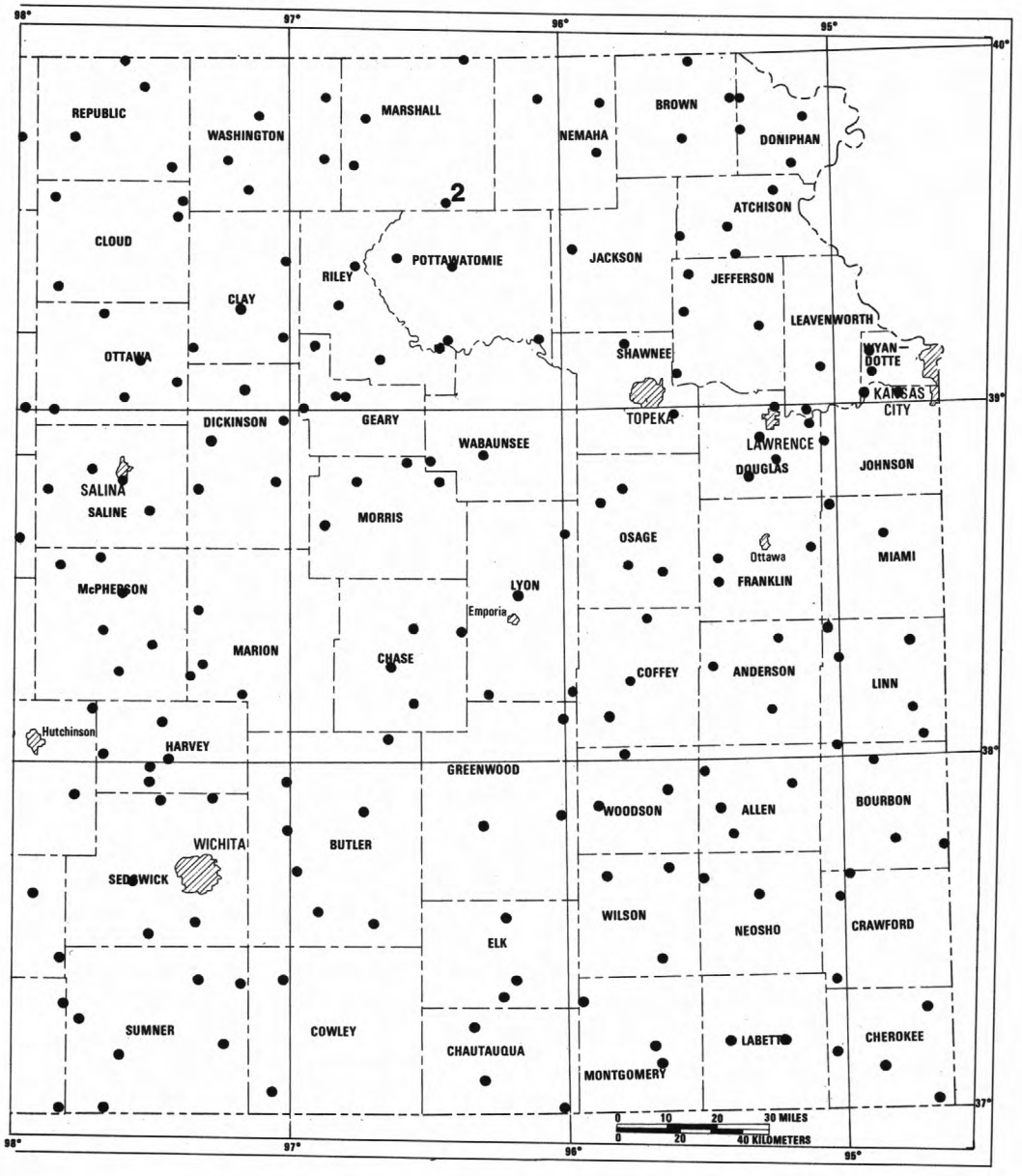
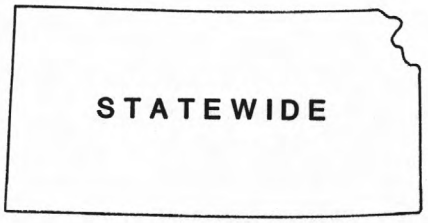


Figure 8.--Location of ground-water-quality sampling sites, 1980 water year. Sampling sites are listed also in table 5.



PROJECT TITLE: Sediment stations
PROJECT NUMBER: KS-004
COOPERATING AGENCY: Multifunded
PROJECT CHIEF: C. O. Geiger

Problem -- Sediment concentrations and discharges in rivers and streams must be defined and monitored in order to make a comprehensive water-quality assessment of the Nation's water resources.

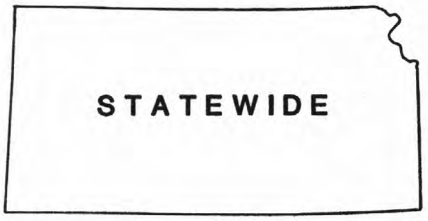
Objective -- To provide a national data base of standardized sediment information for use in State, local, and Federal planning and action programs and to provide data for Federal management of interstate waters.

Approach -- A network of sediment stations has been established to provide spatial and temporal averages and trends of sediment concentration, discharge, and particle size being transported by rivers and streams.

Progress -- Water samples were collected on a routine basis at 131 stations during the 1980 water year for analysis and determination of suspended-sediment discharge. In addition, measurements were made of the particle-size distribution of suspended sediment and bed material. Figure 7 and table 4 (at the conclusion of this report) give the location of these sediment stations.

Plans -- Water samples are to be collected on a routine basis at 131 sites for analysis and determination of suspended-sediment discharge.

Reports published or released -- See numbers 31, 36, and 37 in "List of Reports... ."



PROJECT TITLE: Automated water-use data base in Kansas
PROJECT NUMBER: KS-007
COOPERATING AGENCY: Division of Water Resources, Kansas State Board of Agriculture
PROJECT CHIEF: C. H. Baker, Jr.

Problem -- Use of Kansas waters and competition among types of uses are increasing each year. State water-rights agencies need detailed information about water use in order to effectively manage the resource. As part of the National Water-Use program in Kansas, plans have been made to create a State-operated and maintained water-use/water-rights data base. This long-term plan has been pushed into the immediate foreground by a growing concern within the State for automated handling of water-use/water-rights data. In order to facilitate the progress of the water-use program in Kansas and to insure that the resulting State data base will fully meet the needs of the National Water-Use program, it is important for the U.S. Geological Survey to participate in the State data-base development.

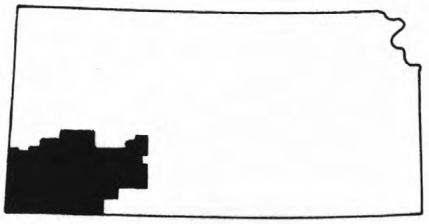
Objective -- To design, implement, load, and evaluate an automated State water-use/water-rights data base. The data base will serve the dual functions of a management tool for administering water rights within the State and of acting as a repository for vital water-use data to meet National and State needs.

Approach -- Actual development of the data base will be done by the State Department of Administration, Division of Computer Services. Data capture, preparation, and input will be handled jointly by the Division of Water Resources, Kansas State Board of Agriculture, and the State Division of Computer Services. U.S. Geological Survey personnel will work closely with both State agencies to insure that all data elements needed for the National Water-Use program are provided in the data base and to provide for data exchange between the completed State data base and the National Water-Use Data System.

Progress --State personnel made excellent progress in the design and creation of water-rights/water-use data base on a State-owned computer. Programming is 80-percent complete, and data entry is about 40-percent complete. About 250 wells were visited by State and contractor personnel under the well-audit program to improve the quality of water-use data.

Plans -- The well-audit program will be continued, primarily with contractor personnel. Water-rights/water-use data base programming should be completed and the system fully operational by the second quarter of 1981.

Reports published or released -- C. H. Baker presented an abstract of the National Water-Use Data Program before the 1979 spring meeting of the American Geophysical Union. Also see number 1 in "List of Reports... ."



PROJECT TITLE: Hydrologic-data base for management decisions in Southwest Kansas Groundwater Management District No. 3
PROJECT NUMBER: KS-086
COOPERATING AGENCY: Southwest Kansas Groundwater Management District No. 3
PROJECT CHIEF: H. F. Grubb

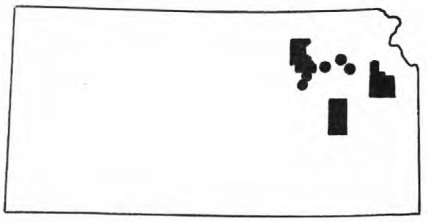
Problem -- Management, planning, and administration of water rights depend on the availability of and ready access to hydrologic data. State and local water agencies that must make these decisions have requested establishment of a system to provide current information on (1) large-yield wells in southwest Kansas, (2) the amount and time distribution of ground-water withdrawals, (3) the amount and location of irrigated acreage, (4) the hydraulic characteristics of the Ogallala aquifer, (5) the configuration of the water table, (6) the annual changes in saturated thickness, and (7) the movement of ground water through the aquifer system. Most of this data are readily amenable to storage, retrieval, and analysis using digital computers.

Objective -- To develop and maintain a comprehensive hydrologic-data base for the area within the Southwest Kansas Groundwater Management District and to provide timely storage, retrieval, and analyses of the data for use principally by the Management District and by the Division of Water Resources, Kansas State Board of Agriculture, in the management, planning, and administration of water rights.

Approach -- Establish and monitor a comprehensive observation-well network, complete and update an inventory of large-yield wells, perform several aquifer tests on selected wells, and assist the Management District in measuring and monitoring ground-water withdrawals for irrigation. Compile all data pertinent to the hydrology of the area in readily accessible computer files for various analyses essential to management and administrative decisions.

Progress -- The water available and the percentage of available water appropriated were calculated for northwestern Finney County based on the Groundwater Management District's depletion rules. A report is in preparation that describes a 9-square-mile radial-flow model and the use of interactive-computer files of water availability and water rights for identification of areas where managers can allow further development of ground water was completed.

Plans -- A saturated thickness map will be prepared for the Southwest Kansas Groundwater Management District No. 3 from January 1981 water-level measurements. Kriging techniques and computer-based files of bedrock altitudes and water-table altitudes will be used to produce an error map and a machine-reproducable saturated thickness map. The completed report will be processed for publication.



PROJECT TITLE: Flood-insurance studies for Federal Insurance Administration
PROJECT NUMBER: KS-006
COOPERATING AGENCY: U.S. Department of Housing and Urban Development, Federal Insurance Administration
PROJECT CHIEF: K. D. Medina

Problem -- The National Flood Insurance Act of 1968 directs the Department of Housing and Urban Development to operate a flood-insurance program through the Federal Insurance Administration. Flood studies are needed in selected areas to determine applicable flood-insurance premium rates.

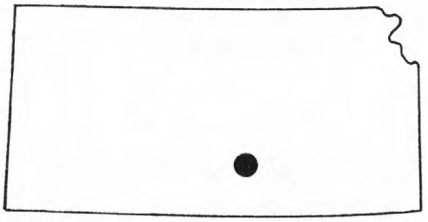
Objective -- Develop hydrologic and hydraulic data for actual and theoretical floods with 10-, 50-, 100- and 500-year recurrence intervals. Provide data to the Federal Insurance Administration for use in operating the flood-insurance program.

Approach -- Compute magnitudes and profiles of floods using ground surveys, photogrammetric methods, and computer models. Delineate, on planimetric base maps, areas that would be inundated by 100-year and 500-year floods.

Progress -- Intermediate meetings were held for Eudora, Manhattan, Ogden, Riley County, and Wichita, Kansas, and final meetings were held for Baldwin City, Douglas County, Lawrence, Perry, Rossville, Riley, St. Marys, and Wamego, Kansas.

Plans -- Complete review process, continue coordination with other agencies involved in flood-insrance studies, and participate in final meetings for remaining studies.

Reports published or released -- See numbers 30, 33, 34, and 35 in "List of Reports... ."



PROJECT TITLE: Effect of urbanization on flood runoff in the Wichita area
PROJECT NUMBER: KS-013
COOPERATING AGENCY: City of Wichita, Kansas
PROJECT CHIEF: C. A. Perry

Problem -- The effects of urbanization on flood-frequency discharges in Kansas have not been quantified. Sprawling urbanization in Wichita and vicinity has caused increased concern for the effect of urbanization on design discharges. Data on the magnitude and frequency of flood flows are needed in designing urban-drainage systems.

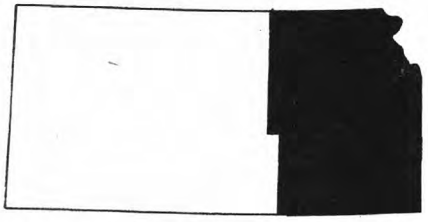
Objective -- Derive a method of estimating the relation of peak (flood) discharges to frequencies that is applicable to basins, with various degrees of urbanization, in the Wichita area.

Approach -- Collect rainfall-runoff data in basins where the land use and percentage of impervious surface can be determined. Define the shape of unit hydrographs and changes resulting from urbanization. Test and calibrate a digital rainfall-runoff model for predicting peak discharges from small urbanized basins.

Progress -- The report on evaluation of a method for determining the relation of peak discharge to rainfall was approved and published. Data collection continued for a more detailed study using a rainfall-runoff model.

Plans -- Continue collecting stage and rainfall data from small urban basins in Wichita and prepare data for use in a rainfall-runoff model.

Reports published or released -- See number 27 in "List of Reports... ."



PROJECT TITLE: Water for municipal supply during severe droughts in eastern Kansas
PROJECT NUMBER: KS-058
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: H. G. O'Connor

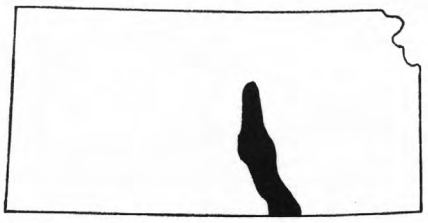
Problem -- Municipal water supplies for many cities in eastern Kansas are obtained from wells, springs, or streams with yields that historically have been insufficient to meet the demand for water during extended periods of drought.

Objective -- Locate and evaluate the adequacy of all feasible sources of water in eastern Kansas that could be used for supplementing municipal supplies during periods of severe drought.

Approach -- Compile all available information from State and local water agencies to identify cities that have limited water supplies in relation to the population served, especially those cities that were critically short of water during the drought from the fall of 1951 to the spring of 1957. Evaluate the availability of water from all feasible sources for use as a supplemental supply during droughts, including the emergency utilization of trucks, railroads, existing pipelines, or temporary pipelines.

Progress -- All available information collected during the study, including 250 pages of tables and descriptive information for 43 counties in eastern Kansas, have been placed in the Kansas Geological Survey's open-file (informal publication).

Plans -- A summary of the report will be published by the Kansas Geological Survey in their Journal Series. The project was completed in FY 79.



PROJECT TITLE: Discharge of saltwater from the Permian rocks to major stream-aquifer systems in central and south-central Kansas
PROJECT NUMBER: KS-073
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: A. J. Gogel

Problem -- Degradation of freshwater aquifers and streams in central Kansas has occurred locally as a result of natural saline-water discharge from the Wellington Formation of Permian age. Although this occurrence is well known, little documented information is available on the cause, areal extent, and severity of degradation from saline-water movement. The chemical suitability of both ground and surface water for municipal, industrial, and irrigation supplies is adversely affected by the saline water in a large, heavily populated area of Kansas.

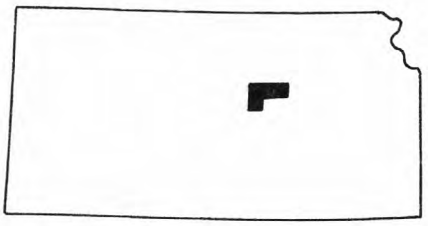
Objective -- Describe the general geohydrologic relation of the saline water in the Wellington Formation to the freshwater in the major unconsolidated aquifers in central Kansas; determine the location, extent, and severity of the natural saline-water discharge into the major stream-aquifer systems; and provide State and local water agencies with possible methods for alleviation or control of pollution.

Approach -- Compile all available data from previous reports and from files; drill test wells for geologic and hydrologic information; obtain water-level measurements from the different water-bearing formations; make seepage-salinity measurements in selected streams to detect changes in quantity and quality of flow; and collect ground-water samples for analysis to define the general operation of the geohydrologic system. Determine the probable source and movement of saline water from the Wellington to freshwater aquifers or streams. Construct and calibrate a digital model of the system for evaluating various schemes of alleviating or controlling pollution.

Progress -- The final report for this study has been approved for release to the U.S. Geological Survey Open-File, pending formal publication in the Kansas Geological Survey's Chemical Quality Series (see number 9 in "List of Reports ... ."

Plans -- Project completed.

Reports released or published -- See number 9 in "List of Reports...".



PROJECT TITLE: Saline discharge to the Smoky Hill River between Salina and Abilene, central Kansas
PROJECT NUMBER: KS-074
COOPERATING AGENCY: Kansas Water Resources Board
PROJECT CHIEF: J. B. Gillespie

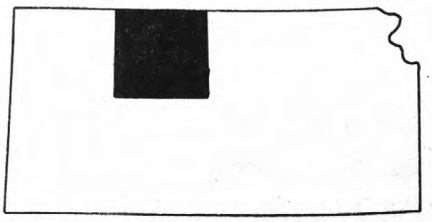
Problem -- The chemical quality of water in the Smoky Hill River is degraded by the natural inflow of saline water from Permian rocks. The saline inflow increases the concentration of chlorides to more than 250 milligrams per liter at downstream municipal and industrial intakes. Water from storage in reservoirs, which probably will be needed for water supply in the future, is currently being released to dilute the in-stream river flow.

Objective -- Determine the location and extent of saline-water inflow to the Smoky Hill River, the source and movement of saline water in the adjacent rocks, and possible methods of controlling or alleviating the pollution caused by the natural inflow of saline water.

Approach -- Collect data on existing wells and drill additional wells; make stage-discharge measurements of the Smoky Hill River; and collect groundwater and surface-water samples for analysis to determine the hydrologic and chemical relations of water in the Permian rocks, the alluvium, and the river. Construct and test a digital model of the existing river-aquifer system to check the conceptual model of the hydrologic system.

Progress -- The final report is in the last stages of technical review.

Plans -- Revise final report, following review, as necessary to improve accuracy and clarity. Submit report for Director's approval to publish as a Kansas Water Resources Board Bulletin.



PROJECT TITLE: Water resources in north-central Kansas
PROJECT NUMBER: KS-075
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: L. E. Stullken

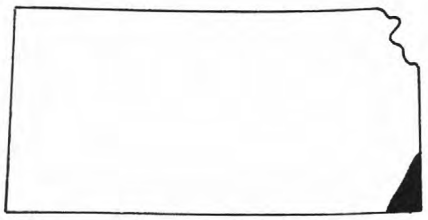
Problem -- Inflow to reservoirs from ground- and surface-water sources in north-central Kansas has been decreasing. The reservoirs were constructed to provide water for irrigation, municipal supplies, recreation, and water-quality control and to provide storage for flood control and the administration of water rights. The reduced availability of water in the reservoirs is adversely affecting downstream irrigation and is aggravating conflicts over water rights.

Objective -- Determine (1) the availability of ground water from principal aquifers in Norton, Phillips, Smith, Graham, Rooks, Osborne, Trego, Ellis, and Russell Counties; (2) the availability of surface-water runoff to major streams in the area; (3) the interrelationship between ground and surface water in the geohydrologic system; and (4) the effects of irrigation on the system.

Approach -- Compile information from existing high-yield wells and from drilled test wells to determine the character of the geohydrologic system and the areal extent and effects of ground-water development. Define the stream-aquifer system in the major valleys and construct a digital model for use by State and local agencies in the management and planning for conjunctive use of the available ground-water and surface-water supplies.

Progress -- (1) Constructed, calibrated, and reported on steady-state models of two stream-aquifer systems--the North Fork Solomon River and Prairie Dog Creek; (2) compiled a hydrologic-data report of all high-yield wells and logs of all unpublished U.S. Geological Survey and Kansas Geological Survey test holes drilled in the nine-county area; and (3) determined that sufficient data are not available to calibrate a steady-state model of the South Fork Solomon River stream-aquifer system and subsequently advanced to the construction of a transient-state model.

Plans -- Calibrate the transient-flow model of the South Fork Solomon River valley and report on simulation.



PROJECT TITLE: Quality of water in streams draining mined areas in southeast Kansas
PROJECT NUMBER: KS-076
COOPERATING AGENCY: Kansas Department of Health and Environment
PROJECT CHIEFS: A. M. Diaz and H. E. Bevans

Problem -- Information is needed to establish "benchmark" or baseline data on flow and current water-quality characteristics of streams draining areas in southeast Kansas that have been deep-shaft and strip mined for coal, lead, and zinc; to determine water-quality degradation associated with mining and with land-reclamation activities; and to evaluate the effects of State and Federal mining regulations on water-quality degradation in areas that may be mined in the future.

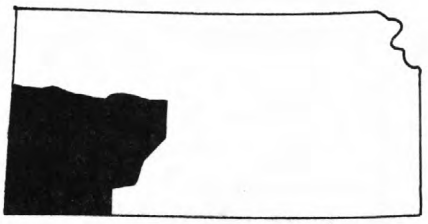
Objective -- Provide the data and interpretive evaluation needed to define the water-quality characteristics and the water, chemical, and sediment discharges of streams draining areas mined for coal, lead, and zinc. Determine the source, extent, type of chemical pollution, and effects of degradition on the quality of streamflow.

Approach -- Establish gaging stations on selected streams and collect baseline data on water discharge, chemical quality, and sediment discharge and determine the principal chemical and biological constituents, trace elements, and physical characteristics. Analyze samples to determine concentrations of nitrogen and phosphorus, total organic carbon, chemical oxygen demand, pesticides, and herbicides and to determine the concentration of suspended sediment and the particle size of suspended and bed material.

Progress -- Hydrologic-data collection at selected sites on Cow Creek and Cherry Creek was completed. The peak of record was measured on Cow Creek, November 22, 1980. Data analysis and interpretation continued. Two open-file reports were completed and published. A final interpretive report for the project is in preparation. The stations Cow Creek near Weir and Cherry Creek near Hollowell were selected for continued monitoring by inclusion in the statewide hydrologic-data network of streamflow stations.

Plans -- Complete interpretive report.

Reports published or released -- See numbers 3 and 4 in "List of Reports ... ."



PROJECT TITLE: Availability and chemical quality of ground water from sandstone aquifers in southwest Kansas
PROJECT NUMBER: KS-079
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: Jack Kume

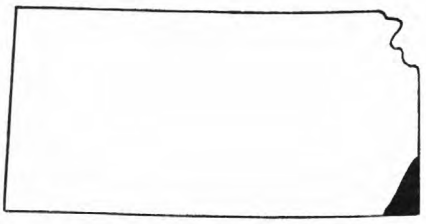
Problem -- A significant potential may exist for the development of ground-water supplies from sandstone units in Upper Permian, Upper Jurassic, and Lower Cretaceous rocks in southwest Kansas. Previous studies commonly considered the sandstone units as a single undifferentiated aquifer, which has lead to erroneous conclusions. Detailed studies are needed to define the geohydrology and the chemical quality of water in the sandstone-aquifer system.

Objective -- Define the character of geologic formations that compose the sandstone-aquifer system; determine the geohydrologic relations between the individual aquifers; describe the chemical quality and suitability of water for most uses; and predict possible effects of ground-water development on the availability and chemical quality of water resulting from induced leakage between sandstone units.

Approach -- Compile data from previous studies and from existing wells and drill additional test wells to define the geologic and hydrologic characteristics of the sandstone-aquifer system. Obtain more detailed information on the areal extent, thickness, and degree of cementation of individual sandstone units and on the effects of hydraulic interconnection between units.

Progress -- The field work has been completed. The hydrologic-data and final interpretive reports have been written and are in review.

Plans -- Drafts of the hydrologic-data report and the final interpretive report will be reviewed and published.



PROJECT TITLE: Effects of mining and land reclamation on hydrology of southeast Kansas
PROJECT NUMBER: KS-081
COOPERAITNG AGENCY: Kansas Geological Survey
PROJECT CHIEFS: A. M. Diaz, J. F. Kenny, J. R. Mccauley

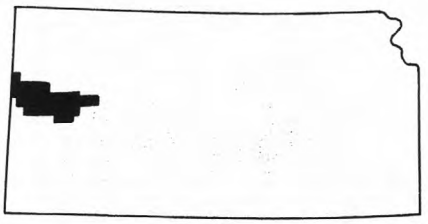
Problem -- Effects of past and present mining of coal, lead, and zinc in southeast Kansas have caused degradation of streams draining the mined areas. Quantitative measures of degradation and identification of source areas are needed to assess the effectiveness of pollution-control measures, the possible need for changes in mining and reclamation procedures,and the design of a long-term water-quality-monitoring network in southeast Kansas.

Objective -- Utilize the extensive water-quality data being collected in project KS-076 and remotely sensed data from aircraft and LANDSAT to (1) identify the point-source areas where poor-quality water discharges from old shaft mines, strip pits, collapsed areas, spoil embankments, and reclaimed areas; (2) evaluate the land-reclamation effects on water quality by analyzing areal and temporal changes in vegetative vigor in reclaimed areas; (3) establish a continuing monitor program, using computer-enhanced imagery, to detect anomolies associated with acid drainage; and (4) use results from this information to design an improved long-term water-quality-monitoring network for the mining areas in southeast Kansas.

Approach -- Remote-sensing techniques will be used to obtain data for analysis with signal-enhancement systems and digital densitometers to discriminate differences in water quality, degrees of vegetative vigor, and "hot spots" in mined areas versus degradation related to drainage from shaft mines, stripped areas, collapsed underground workings, and coal-processing activities. Additional ground-truth data will be collected in anomolous areas identified from the remotely sensed data. The data will be used to design a long-term water-quality-monitoring network.

Progress -- Analysis and interpretation of data from remote-sensing imagery continued. Maps of the coal-mined areas were prepared showing: (1) The extent of deep mining in the project area; (2) the extent of strip mining; (3) mined-land inventory; and (4) the hydrology and extent of stream degradation. Geologic cross sections showing the relationship of the mined-out coal seams, streambeds, and point-source contamination were also prepared. An interpretative report for the study was completed.

Plans -- Complete report review and obtain Director's approval for publication.



PROJECT TITLE: Geohydrology for water-supply planning in Groundwater Management District No. 1, west-central Kansas
PROJECT NUMBER: KS-082
COOPERATING AGENCY: Western Kansas Groundwater Management District No. 1
PROJECT CHIEF: Jack Kume

Problem -- Withdrawals of ground water for irrigation in west-central Kansas are depleting the amount of water stored in the unconsolidated deposits. Because the local irrigation-based economy is being adversely affected, the continued availability of ground water is of immediate concern to State and local water-planning and management agencies. Information is needed to determine the effects of various water-management alternatives to conserve ground water through efficient use.

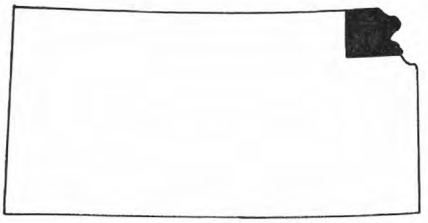
Objective -- Compile and maintain a comprehensive hydrologic-data base; provide a detailed description of the geohydrologic system; and construct and calibrate a digital model of the system's operation. Apply models to "critical areas" designated by the Management District to analyze the effects of various management strategies for improving irrigation efficiency and for optimal development of ground water.

Approach -- Establish a comprehensive ground-water data base and prepare geohydrologic studies of "critical areas" designated by the Management District. One study will establish a project area that demonstrates the conservation of water and energy through improved irrigation efficiency. Other studies will utilize digital models to test effects of management alternatives on irrigation efficiency and on the conservation of ground water.

Progress -- The field work and data collection have been completed. An observation well in the Ogallala aquifer was installed at a recharge site near Modoc. A stream-gaging station and low-flow control were also constructed near this site. A hydrologic-data report has been published (see number 13 in "List of Reports..."). The final interpretive report have been written and is in review. A short report showing simulated water-level declines near Marienthal, west-central Kansas has been written, reviewed, and published (see number 8 in "List of Report...").

Plans -- Continue monitoring the water-levels in observation wells at the Modoc recharge site, adjacent to the tailwater pit, and along Ladder Creek, and monitor the amount of rainfall and runoff at the gaging station near Modoc. Complete the review process on the final interpretive report and publish.

Reports published or released -- See numbers 8 and 13 in "List of Reports ... ."



PROJECT TITLE: Fluvial sediment and water quality in selected SCS watersheds of northeast Kansas
PROJECT NUMBER: KS-083
COOPERATING AGENCY: Soil Conservation Service
PROJECT CHIEF: A. M. Diaz

Problem -- A practical definition is needed for sediment-transport conditions from small drainage areas in Kansas. The Soil Conservation Service (SCS) is especially interested in the environmental impact of land-treatment practices on sediment yield and the chemical quality of water in areas with flow-way structures. Data are required to define a base for conditions necessary to maintain water quality within design limits for use as guidelines in future watershed developments.

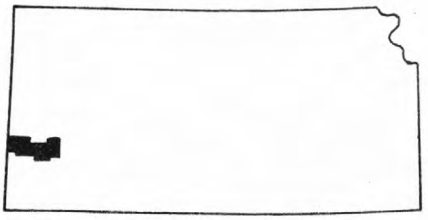
Objective -- Provide chemical- and sediment-discharge parameters in relation to water discharge at 12 selected sites in northeastern Kansas; define the relation of streamflow parameters to sediment concentrations and particle sizes; and investigate the general relation of chemical quality of water to streamflow and to sediment characteristics.

Approach -- Install equipment at 12 measurement sites, including single-stage sediment samplers and wire-weight gages. Four sites also will have crest-stage gages for recording maximum flow elevations. One site will be equipped with an electrically operated single-stage sampler, a peak-stage recorder, and a chemical-quality monitor for evaluation. Observers will collect sediment samples during rainfall-runoff periods, and hydrographers will make measurements to define relations of streamflow to gage heights, sediment concentrations, and chemical quality.

Progress -- Suspended-sediment and chemical-quality samples were collected as scheduled in fiscal year 1979. Chemical analyses of water, sediment, and bed material show no indication of toxic constituents for expected uses. Selected analyses of bacteria indicated high fecal coliform count during rainfall-runoff events. Four sites on Pony Creek near Sabetha were equipped with crest-stage and single-stage sediment samplers. Chemical quality with pesticide and biological samples were collected at the Pony Creek sites.

In fiscal year 1980, statistical summaries of fluvial-sediment data were prepared. Synthetic flow-duration curves were developed for the study area. An analysis of a covariance test indicated that suspended-sediment loads per unit discharge have not changed as a result of Soil Conservation Service sediment-control structures in the project area. Channel cross-sections were resurveyed to determine the effects of SCS sediment-control structures on channel stability. Collection of suspended-sediment and chemical-quality samples continued but was hampered by drought conditions and a relative shortage of runoff events.

Plans -- Publish interpretive report.



PROJECT TITLE: Geohydrology of the Arkansas River valley in southwest Kansas
PROJECT NUMBER: KS-088
COOPERATING AGENCY: Division of Water Resources, Kansas State Board of Agriculture
PROJECT CHIEF: R. A. Barker

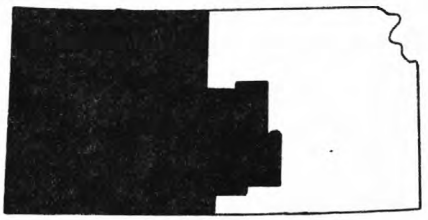
Problem -- Flow of the Arkansas River between the Colorado-Kansas State line and the Kearny-Finney County line in Kansas has continued to decrease in recent years. Consequently, the availability of surface water for diversion at the headgates of irrigation ditches has been inadequate to meet demands. Withdrawals of ground water from wells in the valley alluvium, which is hydraulically connected to the stream, are thought to be depleting streamflow and adversely affecting senior water rights.

Objective -- Define the relationship between ground water and surface water in the Arkansas River valley and determine the effects of ground-water withdrawals on streamflow. Construct and calibrate a digital model of the river-aquifer system that can be used by State and local management agencies to improve conjunctive use of ground and surface waters within the constraints of the water-rights structure in Kansas.

Approach -- Determine the hydrologic boundaries of the stream-aquifer system, the hydraulic characteristics of the aquifer, the hydrologic stresses imposed on the system, and the effects of those stresses on ground-water storage and on streamflow. These data will be used in a digital model of the system to predict the results of various management alternatives designed to optimize conjunctive use of ground and surface waters.

Progress -- Calibration was partially completed on a finite-element model to simulate the interaction between the Arkansas River and the adjacent alluvial aquifer. Depletion of ground and surface waters in the project area during the 1970's was found to have resulted most significantly from (1) decreased streamflow delivery from Colorado, (2) increased ground-water pumpage, and (3) the combination of decreased precipitation and increased evapotranspiration caused by the drought of the early and middle 1970's. State-line streamflow decreased from an average 168,000 acre-feet per year during 1951-69 to an average annual rate of 60,000 acre-feet between 1970-78. Pumpage increased from about 20,000 acre-feet during 1970 to nearly 60,000 acre-feet during 1978. Precipitation between 1970-78 averaged 15 percent less than the 85-year average at Syracuse.

Plans -- Use calibrated model to analyze the response of the modeled system to possible future conditions of stress, and complete report describing the geohydrology and computer simulation of the project area.



PROJECT TITLE: Techniques for estimating ground-water withdrawals in western Kansas
PROJECT NUMBER: KS-090
COOPERATING AGENCY: Kansas Water Resources Board
PROJECT CHIEF: C. H. Baker, Jr.

Problem -- One of the principal unknown factors in quantitative ground-water hydrology and management of ground-water resources is the quantity of water withdrawn for irrigation use. The measurement of ground-water pumpage by installation of totalizing flow meters is possible but very expensive.

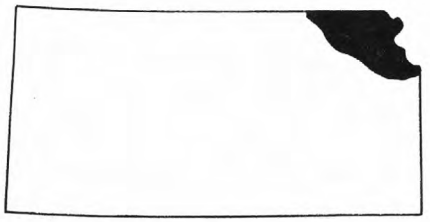
Objective -- Investigate methods, other than metering of wells, for determining the withdrawal of ground water from irrigation wells in Kansas with an acceptable degree of accuracy and test such methods by application to a large irrigated area.

Approach -- The project is divided into two parts: Part 1 will be to list, describe, and evaluate different methods of obtaining discharges at a well site and for an area; Part 2 will be to field test any suitable method(s) evaluated in Part 1 on a large irrigated area, such as a ground-water management district.

Progress -- An interim report was completed and approved for publication. During the 1979 irrigation season, about 80 wells in Scott County, Kansas, were equipped with running-time sentry units. These wells were monitored for running time and discharge rate to obtain good records of the total amount of water pumped for irrigation for specific crops. Data collection and analyses continued through the 1980 irrigation season.

Plans -- Complete final report.

Reports published or released -- See number 2 in "List of Reports... ."



PROJECT TITLE: Glacial deposits (Pleistocene) in northeast Kansas
PROJECT NUMBER: KS-091
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: J. E. Denne

Problem -- As population and demand for water increase in northeast Kansas, ground-water supplies are gaining in significance. They are especially important during periods of low precipitation when surface-water supplies decline. Although the bedrock formations in the area generally contain little, if any, good-quality water, the glacial buried-valley aquifers may yield up to several hundred gallons per minute of freshwater to wells.

Because the buried-valley aquifers are variable in location, extent, and hydrologic characteristics, detailed study of them is necessary. Current aquifer usage and development potential for domestic, municipal, agricultural, and industrial needs also must be evaluated. These analyses will allow realistic water-resource planning for the area. Knowledge of aquifer locations also should allow protection of ground water from contamination.

The geophysical techniques (for example, seismic, resistivity, and thermal) developed and utilized in this program should prove useful for studies of other unconsolidated aquifers in Kansas.

Objective -- The objectives of this study are to: (1) Locate and delineate the major Pleistocene aquifers of northeast Kansas, (2) determine ground-water levels in and saturated thicknesses of these aquifers, (3) analyze the Pleistocene stratigraphy and the character of the glacial deposits, (4) analyze the quality of waters contained in the Pleistocene aquifers, (5) determine current municipal, agricultural, and industrial usage of the aquifers, and (6) evaluate future potential of the aquifers for water supplies.

Approach -- Buried-valley aquifers will be located by evaluation of existing hydrogeologic information, interpretation of maps and remote-sensing data, and field work (drilling and geophysical investigations). Ground-water levels will be measured in wells and test holes, and saturated thicknesses will be calculated. Grain size and clay mineralogy of sediments will be analyzed for stratigraphic correlation and aquifer evaluation. Chemical constituents of water from Pleistocene aquifers will be determined by sample analyses (performed by the Kansas Department of Health and Environment).

Progress -- Geologic and ground-water information for the 16-county study area has been collected and assembled from published and unpublished sources. Well logs have been obtained from drillers and engineering firms, the Kansas Department of Transportation, the Missouri Division of Geology and Land Survey, and other sources. Approximately 1,000 water-well records and other well logs have been field checked for location and surface elevation. Additional data have been obtained by auger and rotary test drilling in Nemaha, Leavenworth, Jefferson, Atchison, Brown, Washington, and Johnson Counties. More than 150 test holes have been drilled. Thicknesses of unconsolidated deposits, elevation of bedrock and water levels have been plotted on 1:62,500-scale county maps. Data for several counties have been entered into a computer file.

Geophysical techniques (including seismic and resistivity) have been used to obtain additional information regarding bedrock depths, character of unconsolidated deposits, and water levels. Shallow earth temperatures have been measured over known and suspected buried valleys in Jefferson County. Positive (warm) anomalies in winter and negative (cool) anomalies in summer have been found over the aquifers.

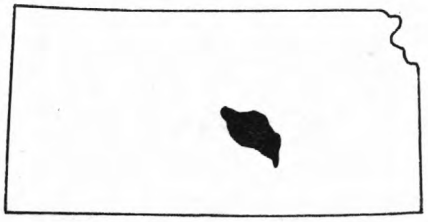
Thermal and LANDSAT imagery, mosaics of conventional aerial photographs, and topographic maps are being evaluated to determine whether glacial buried valleys have characteristic surface expressions. Some field investigations are being done in areas with tonal or topographic features that could correspond to buried valleys.

Sediment samples have been collected from test holes for laboratory analyses and evaluation of the hydrologic character of the aquifers. Municipal, industrial, and irrigation water-use data for northeast Kansas were obtained from the Division of Water Resources, Kansas State Board of Agriculture.

Water-quality data available from the U.S. Geological Survey were obtained and evaluated. Maps and charts showing certain water-quality parameters, well depths, and aquifers were prepared for Nemaha, Brown, and eastern Marshall Counties. Additional sites for water-quality sampling in buried valleys have been selected from water-well records.

Plans -- Continue drilling and geophysical investigations. Collect water-quality samples from buried valleys and inventory water levels. Begin computer mapping of data and continue ongoing program elements.

Reports published or released -- See number 7 in "List of Reports... ."



PROJECT TITLE: Hydrogeology of the "Equus beds" aquifer, central Kansas
PROJECT NUMBER: KS-092
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: J. B. Gillespie

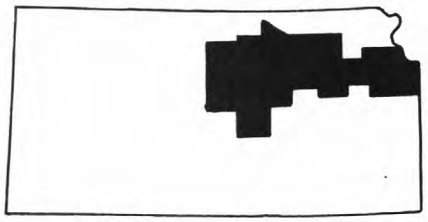
Problem -- Unconsolidated deposits of Pleistocene age, commonly known as the "Equus beds," are the major source of water for municipal, industrial, and irrigation use in central Kansas. Continued increasing withdrawals of water from this important aquifer will result in mining of water, reduced well yields, deterioration of water quality, and impairment of existing water rights.

Objective -- Determine the effects that increased ground-water withdrawals will have on (1) ground-water availability and (2) chemical quality of the ground water as they relate to the possible contamination of parts of the "Equus beds" as a result of induced movement of saline water now present in the aquifer and saline-water inflow from the underlying Wellington aquifer.

Approach -- Additional data will be collected with special emphasis on defining the chloride distribution in the aquifer and on modeling of the ground-water flow system. An appropriate model will be selected that will simulate the movement of saline water. Evaluation of the simulation will be made, and new model development may result.

Progress -- A seepage run was made during low-flow conditions on the Little Arkansas River. All municipal pumpage data have been collected, compiled, and entered into the automatic-data-processing system. A bedrock map has been completed. Aquifer tests have been reanalyzed, and a transmissivity map is essentially complete. Two observation wells were completed at each of two sites, with wells screened immediately above bedrock and about 40 feet below the water table. Six auger holes were drilled and completed as observation wells. Water-quality samples and pumpage data were collected from the observation wells.

Plans -- Construct and calibrate a ground-water flow model and a solute-transport model of the "Equus beds" area. Write the final report.



PROJECT TITLE: Channel-geometry investigations for the Kansas River Bank Stabilization Study
PROJECT NUMBER: KS-095
COOPERATING AGENCY: U.S. Department of Army, Corps of Engineers
PROJECT CHIEF: W. R. Osterkamp

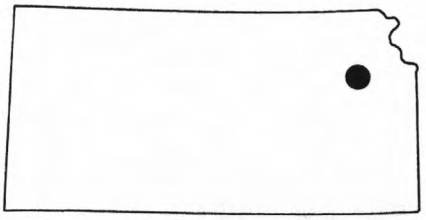
Problem -- The U.S. Army Corps of Engineers, Kansas City, has undertaken a comprehensive bank-stabilization study of the Kansas River and some of its major tributaries. The study was initiated to identify possible causes of various types of recent channel instability, including widening, scouring, and lateral shifting. The influence of discharge regulation and interruption of sediment supply by major reservoirs in the basin are to be investigated. Integral parts of the study include investigations of channel-geometry and sediment-discharge characteristics. Both investigations should provide pertinent information for the interpretive phase of the bank-stabilization study.

Objective -- Identify relative degrees of chemical instability in the downstream direction and determine why current channel changes are occurring. Identify significant alterations in sediment size and supply to the lower part of the basin that have occurred in the last few decades and, if possible, relate the alterations to trends in land-use practices and to construction of major reservoirs.

Approach --Channel-geometry width, channel-gradient, and particle-size data will be collected in the Kansas River basin below major reservoirs. The data will be analyzed by computer to obtain relations between discharge and other variables currently typical for the basin and to determine downstream changes in the relations. Deviations of data sets from previously determined relations will be used to interpret the possible instability of a reach. All pertinent sediment data for the area will be compiled and analyzed for sucessive changes in sediment concentrations and discharge; similar analyses will be made for the sizes of suspended and bed sediment.

Progress --Field measurements, sample collection, and compilation of sediment data are complete. Initial maps showing areal variation of sediment yields in the Kansas River basin were constructed. Computer analyses of channel-geometry data and final interpretations of areal variations in sediment yields were made.

Plans -- A final report is being prepared.



PROJECT TITLE: Quality of water from urban runoff, Topeka
PROJECT NUMBER: KS-096
COOPERATING AGENCY: Kansas Department of Health and Environment
PROJECT CHIEFS: A. M. Diaz and L. M. Pope

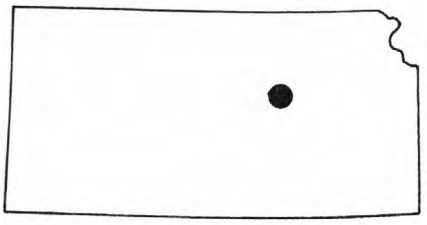
Problem -- The Kansas Department of Health and Environment must obtain information to evaluate the impact of urbanization on the water resources of the State. Some Kansas counties are heavily urbanized, others currently are being urbanized, and still others are planned for urban development. One of the major urban developments in Kansas is in Shawnee County. Urbanization has seriously affected the hydrology of Shawnee County. A critical need exists for data relating to characteristics of urban runoff in the county, primarily with respect to the quality of water from runoff in the City of Topeka.

Objective -- Establish a data base from selected study areas within the City of Topeka that will include streamflow, physiographic, climatic, and water-quality information. Evaluate the quality of water by defining the physical, chemical, and biological characteristics of runoff from selected urban areas under existing conditions and make projections of these characteristics of runoff that may occur with future urban development.

Approach -- Streamflow, physiographic, climatic, and water-quality data will be collected at selected sites, which will be equipped with stream-gaging and water-quality monitoring equipment. Data will be collected to determine the variation of water quality within storm events and among seasons. Peak chemical concentrations and total chemical loads will be identified. Water-quality parameters will consist of chemical inorganics, trace metals, nutrients, organics, biological, bacteriological, and sediment.

Progress -- Collection of baseline and runoff data continued. Shelters to house automatic sample-collection equipment, water-quality monitors, and recording rain gages were installed at five of the continuous-recording streamflow sites.

Plans -- Complete the installation of sampling and monitoring equipment, continue data collection, and prepare progress report. Select two small basins (one urbanized, one undeveloped) for later instrumentation and model application.



PROJECT TITLE: Hydrologic properties of the Wellington aquifer near Salina
PROJECT NUMBER: KS-098
COOPERATING AGENCY: U.S. Department of Army, Corps of Engineers
PROJECT CHIEF: J. B. Gillespie

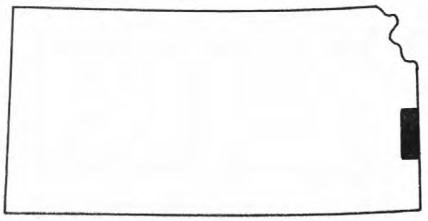
Problem -- The U.S. Army Corps of Engineers is undertaking a water-management study of the Kansas River basin. As part of the study, the Corps is interested in the saline ground-water discharge into the Smoky Hill River near Salina. The source of the saline water entering the Smoky Hill River is the Wellington aquifer, which mainly underlies the alluvium of the Smoky Hill Valley in this area. No measured values of the hydrologic properties are available for the Wellington aquifer near Salina. Such data are needed to determine more accurately brine distribution and movement in this area.

Objective -- Determine the transmissivity and storage coefficient of the brine-filled Wellington aquifer northeast of Salina and obtain hydrogeologic data on the gypsum-cavity distribution and limits of the brine flow in the Wellington aquifer in the study area.

Approach -- Production wells, with observation wells at appropriate distances, will be installed. The well casings will be cemented to prevent contamination of the overlying alluvial aquifer. Brine produced from the wells will be disposed of by storage in surface tanks and tank trucks, if the well discharge is small, or piped one-half mile and injected back into the Wellington aquifer, if the well discharge would be too large for surface storage. Aquifer tests will be conducted, and the results analyzed using the latest analytical methods available.

Progress -- Four test wells were drilled and installed in the Wellington aquifer. Data were obtained from two aquifer tests by pumping from one well at 21.2 gallons per minute into a pipeline and injecting the pumped brine into a well 2,600 feet away. Observation wells were placed 50 feet away from each of the test wells.

Plans -- Plans are to complete data analysis and interpretation. This was a one-year project begun in FY 79 and was combined with project number KS-110 for fiscal year 1980.



PROJECT TITLE: Effects of strip mining on the hydrology and water quality in Linn, Miami, and Bourbon Counties
PROJECT NUMBER: KS-099
COOPERATING AGENCY: U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement
PROJECT CHIEF: H. E. Bevans

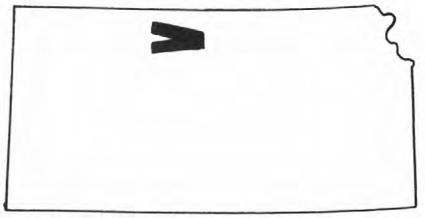
Problem -- Strippable reserves of the Mulberry Coal in Linn, Miami, and Bourbon Counties in east-central Kansas are estimated to be between 40-50 million tons. Because of the projected demand for coal, it is expected that extensive mining will probably begin in Kansas by about 1980-81. The major stream drainages traversing the three-county area are those of the Marais des Cygnes, the Little Osage, and the Marmaton Rivers. The thickness of the strippable coal is generally less than 4 feet; hence, the ratio of land-surface area disturbed to tonnage of coal mined will probably be one of the highest in the industry. The regional impact on hydrology must be evaluated by pre- and post-mining assessment.

Objective -- Determine the available hydrologic and related data for the study area and provide the interpretation and supportive data needed to describe the hydrologic environment. Determine future data and studies necessary for evaluating the impact of strip mining on the water-quality characteristics (physical, chemical, and biological) of the ground- and surface-water systems. Finally, model predictive changes in the quality of water in the hydrologic system during and after mining of an area.

Approach -- Hydrologic information will be obtained from a systematic three-phase project. Phase I will be directed toward the compilation of maps describing the physical setting and hydrology of the study area. Phase I interpretive results will be used in phase II to determine (1) site selection, (2) hydrologic-data needs, (3) site-specific data needs, and (4) frequency of sample collection. In phase III, predictive model(s) will be developed to determine the impact of strip mining on the hydrology of the study area. Ideally the model(s) would be developed for a selected subbasin with a drainage area of 15 square miles or less. The model(s) would have utility in the planning of future strip-mining activities.

Progress -- Data-collection sites were selected, and sampling frequencies and laboratory schedules were finalized. Scheduled data-collection activities were initiated. Continuous-recording streamflow gages were installed at three sites on North Sugar Creek. Work continued on a preliminary report describing the physical setting of the project area.

Plans -- Continue the collection of hydrologic data. Begin data analysis and interpretation and preparation of final report.



PROJECT TITLE: Conjunctive-use models for North and South Fork Solomon Rivers, north-central Kansas
PROJECT NUMBER: KS-100
COOPERATING AGENCY: U.S. Department of the Interior, Water and Power Resources Service
PROJECT CHIEF: R. D. Burnett

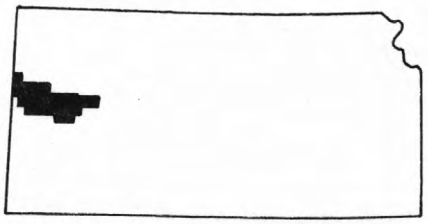
Problem -- The management of surface water and ground water, which are used for irrigation in the Solomon River valleys, is becoming more critical. Deficiencies in recent years of surface water for irrigation have resulted in the increasing use of ground water to supplement the available surface water. The conjunctive use of surface and ground waters will be required for optimal use of the water resources of the valleys. The streams and alluvial aquifers are in close hydraulic connection and should be studied as a stream-aquifer system.

Objective -- Model the stream-aquifer systems in the valleys of the North and South Fork of the Solomon River above Waconda Lake and below Kirwin and Webster Dams and evaluate various management alternatives for the stream-aquifer systems utilizing the digital model.

Approach -- A digital model of each stream-aquifer system will be utilized. The models will be capable of "inputting" streamflow, surface-water irrigation, pumping, and recharge data on a monthly basis. Various water allocations both of surface water and ground water will be tested as management alternatives, and a prediction as to the response of the stream-aquifer system will be made. The model of the valley of the South Fork Solomon River is to be studied in phase 1. The modeling of the valley of the North Fork Solomon River will be considered in phase 2.

Progress -- A transient numerical model has been developed for the South Fork Solomon Basin between Webster Reservoir and Waconda Lake, and predictive simulations of management alternatives have been completed. A transient finite-element model has been completed on the North Fork Solomon River.

Plans -- Predictive simulations of management alternatives will be completed, and reports will be written on both the North Fork and South Fork Solomon River valleys.



PROJECT TITLE: Ground-water depletion maps, west-central Kansas
PROJECT NUMBER: KS-105
COOPERATING AGENCY: Western Kansas Groundwater Management District No. 1
PROJECT CHIEF: Lloyd E. Dunlap

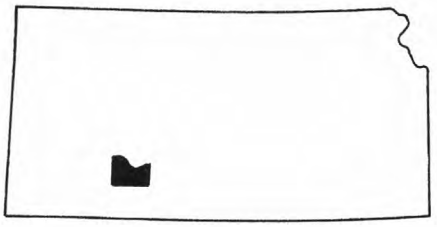
Problem -- The ground water in west-central Kansas is being mined primarily for irrigation. The Western Kansas Groundwater Management District No. 1 has developed a management plan for this area based on the percentage depletion of the ground-water resources since 1950. The management District needs, on an annual basis, a map that will accurately represent the state of ground-water depletion and that will be relatively free from the effects of local anomalies.

Objective -- (1) Investigate methods of transforming contour maps to digital form, (2) identify digitizing methods that will preserve the hydrogeologic interpretations of the various maps and provide consistent digital information on a square-mile basis, (3) select a reproducible methodology for preparing maps of saturated thickness and percentage change in saturated thickness, and (4) prepare maps of 3-year average saturated thickness and percentage change in saturated thickness since 1950 for Western Kansas Groundwater Management District No. 1.

Approach -- Simple polynomial interpolation, trend surface analysis, and other regionalization techniques, such as kriging, will be used to obtain estimates of bedrock elevation and 1978 water levels for each square mile of the Groundwater Management District using available point data. The utility of the different methods will be evaluated by preparing a 1978 saturated thickness map of the study area and by making comparisons with the map previously prepared by the point data and the bedrock/water-level contour intersection method.

Progress -- The technique of kriging was used to estimate the 1978-80 water-table surface at unmeasured sites in the management district. Bedrock and 1950 water-table surfaces were estimated also for the centers of mile sections in the district. From this data, maps and plots of the 1978-80 water-table surface, saturated thickness, and percentage change of saturated thickness were produced for the management district.

Plans -- Write an interpretive report and construct a map report.



PROJECT TITLE: Water resources of Ford County
PROJECT NUMBER: KS-106
COOPERATING AGENCY: Southwest Kansas Groundwater Management District No. 3
PROJECT CHIEF: Joseph Spinazola

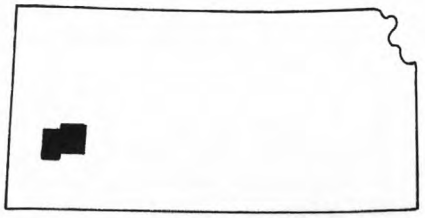
Problem -- The rate of depletion of the water resources in Ford County has accelerated in recent years. Increased ground-water pumpage and coincident drought conditions have caused declines in water levels. Water levels in the unconsolidated aquifer have declined 7 to 10 feet since 1940. Industrial and agricultural demand for water continues to be strong, and available data are not adequate for local water managers to allocate the diminishing water supply in an equitable and hydrologically sound fashion.

Objective -- (1) Update the hydrologic data base for the county, including an estimate of water use from the unconsolidated aquifers, (2) document the areal aquifer response to pumping stresses, and (3) determine the availability of water, for irrigation or other uses, as defined by the guidelines of the Southwest Kansas Groundwater Management District No. 3.

Approach -- The hydrologic data base will be updated by an inventory of large-capacity wells in the county and by measurement of the discharge of about 8 percent of the wells. Total ground-water withdrawal will be estimated by an evapotranspiration model, which utilizes a soil-moisture accounting procedure. The aquifer's areal response to pumping will be shown by a water-table map constructed during the pumping season. Availability of water for large-capacity wells will be determined by using the water-table map and the 9-square-mile depletion model recently developed by the U.S. Geological Survey for a project in west-central Kansas (KS-082).

Progress -- Inventory of approximately 750 irrigation wells is 98 percent complete. Driller's logs were assembled from the Kansas Geological Survey. Discharge was measured from 25 irrigation wells.

Plans -- Assemble crop-acreage data for crop years 1980 and 1981. Construct bedrock, saturated thickness, and water-level maps, and enter data report into District review.



PROJECT TITLE: Effects of ground-water withdrawals on water levels and streamflow in the Arkansas River near Garden City
PROJECT NUMBER: KS-107
COOPERATING AGENCY: Division of Water Resources, Kansas State Board of Agriculture
PROJECT CHIEF: Lloyd E. Dunlap

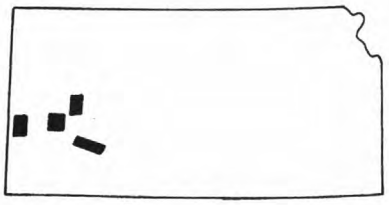
Problem -- The flow of the Arkansas River at Garden City has diminished during the last decade such that the frequency of flow has decreased from about 90 to 10 percent. Concurrently, large-scale irrigation has developed in the sand hills south of the river from the Bear Creek Fault in Kearny County to the vicinity of Garden City. Consequently, the yields of old irrigation wells near the river have decreased, and the rate of water-level declines has accelerated. Recent requests for appropriation of large quantities of ground water for industrial use in this area may adversely affect senior water rights.

Objective -- Define the relationships among the Arkansas River, the valley alluvial aquifer, and the underlying unconsolidated aquifer of the Ogallala Formation; determine the changes in the relationship between the ground-water system and the Arkansas River; and construct, test, and apply a digital ground-water flow model to determine the effects of pumping ground water from the unconsolidated Ogallala aquifer south of the Arkansas River on flow of the river, on the yield of wells in the valley alluvial aquifer, and on water-level declines north of the river.

Approach -- Principal work items in this project will be to determine: (1) The hydrologic boundaries of the stream-aquifer system, (2) the hydraulic characteristics of the aquifers, (3) the hydrologic stresses that are being imposed on the system, and (4) the effects of the hydrologic stresses on the stream-aquifer system. These data will be used in a multilayer digital ground-water flow model of the system to evaluate the effects of various management alternatives on the availability of ground water and on flow of the Arkansas River.

Progress -- Streamflow, water-level, and climatic data were collected and compiled. A well inventory of the project area was completed, and 12 observation wells were drilled in the alluvium. Horizontal and vertical boundaries of the aquifer indicate that it is a multilayer system.

Plans -- Continue to collect and compile hydrologic data in the project area. Collect pumpage data by means of a soil-zone model. Calibrate a three-dimensional, finite-difference model of the area and then make projections for the future.



PROJECT TITLE: Geohydrology and water quality of deep-aquifer systems, Cretaceous and Jurassic ages, western Kansas
PROJECT NUMBER: KS-109
COOPERATING AGENCY: Kansas Department of Health and Environment
PROJECT CHIEF: Jack Kume

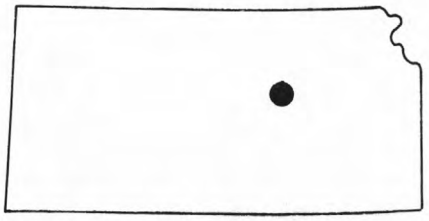
Problem -- The High Plains aquifer system has been stressed extensively in much of western Kansas. The underlying rocks of Cretaceous and Jurassic ages contain permeable units that have potential for use as alternative sources of water supply. The permeable zones within these rocks are used for disposal of brine that is produced with oil and gas from the underlying rocks. A real hazzard exists for contamination of the Cretaceous-Jurassic aquifer system if brine disposal continues without a sound hydrologic basis.

Objective -- Define the geohydrology of the rocks of Cretaceous and Jurassic ages in detail at selected sites. Determine the vertical and horizontal variation in chemical quality of water in the permeable zones and determine the head differences between permeable zones and across confining beds. Determine the hydraulic characteristics of principal permeable zones and regionalize the results using available geophysical logs and other oil- and gas-exploration data.

Approach -- Use lithologic and geophysical logs of oil and gas test wells to determine test-drilling sites. A test-drilling program will provide detailed geohydrologic data needed to define the hydrology of the aquifers and the confining beds in the rocks of Cretaceous and Jurassic ages. Arrangements will be made to use selected unsuccessful oil and gas test holes before they are plugged or to re-enter plugged test holes. Special well-completion and packer tests will be used, as applicable, to permit the independent measurements of heads in permeable zones, the testing of hydraulic characteristics, and the obtaining of ground-water samples.

Progress -- Geophysical logs from oil and gas tests have been studied for correlation of formations and site selection of dry and abandoned oil wells. Water samples have been collected from seven stock, domestic, and industrial wells in the lower Cretaceous aquifers.

Plans -- Six abandoned oilfield wells are to be converted into freshwater observation wells. Water sampling will continue.



PROJECT TITLE: Geohydrology of the Wellington Formation and Smoky Hill Valley alluvium in the Salina area, central Kansas
PROJECT NUMBER: KS-110
COOPERATING AGENCY: Kansas Water Resources Board
PROJECT CHIEF: J. B. Gillespie

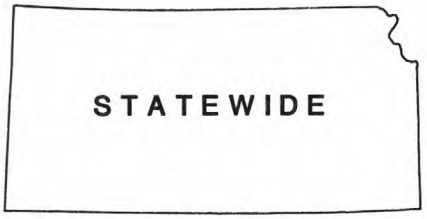
Problem -- Saline water is discharged from the alluvial aquifer into the Smoky Hill and Solomon Rivers east of Salina. The source of the saline water is brine from the underlying Wellington aquifer. The eastward movement of brine in the Wellington aquifer is believed to be confined to a limited cross section under the alluvium of the Smoky Hill Valley. A tight confining shale layer exists between the two aquifers northeast of Salina. The most promising method for alleviation of saline-water contamination of the aquifer-stream system may be the construction of a line of relief wells in the Wellington aquifer extending across the Smoky Hill River valley in the area northeast of Salina. The brine discharged from the relief wells could possibly be injected into deep saline aquifers.

Objective -- Define more accurately the area under which the brine is flowing eastward in the Wellington aquifer. Determine the volume of brine moving eastward and delineate any areas of saline-water contamination in the alluvial aquifer in the Salina area. Determine location of relief wells to intercept eastward-flowing brine and predict the effects of different pumping alternatives on brine flow by using a digital model.

Approach -- Test holes will be drilled on the north and south sides of the valley boundaries to determine if there is any brine following underneath the adjacent uplands. Also, additional wells will be installed in the Wellington aquifer underlying the valley alluvium. Aquifer tests will be conducted on these wells, and the brine will be injected into the deep Arbuckle aquifer. Short- and long-term aquifer tests will be conducted on both aquifers simultaneously. Observation wells will be augered in the alluvium. Water samples from both the Wellington and alluvial aquifers will be collected for chemical analysis. A quasi-three-dimensional digital model will be constructed to predict the effects of different pumping on brine flow.

Progress -- Conducted one aquifer test on a well in the Wellington aquifer drilled by the U.S. Army Corps of Engineers in 1979. The preliminary results indicate a transmissivity of about 1,500 feet squared per day. The chloride concentration was 145,000 milligrams per liter.

Plans -- Conduct a long-term aquifer test (1 month) on a Wellington aquifer well in the center of the Smoky Hill Valley and dispose of the brine in an Arbuckle well about 400 feet away. Test drilling and augering will be conducted also.



PROJECT TITLE: Flood investigations - Department of Transportation
PROJECT NUMBER: KS-010
COOPERATING AGENCY: Kansas Department of Transportation
PROJECT CHIEF: R. W. Clement

Problem -- There is a continuing need for adequately defined flood-frequency characteristics for Kansas streams to assist in the efficient design of highway drainage structures, for flood-plain analysis, and to evaluate flood-risk factors. Long-term records of annual peak discharges are necessary to adequately define flood-frequency characteristics. Although streamflow records have been collected on Kansas streams since 1895, they are limited primarily to those streams that drain areas larger than 100 square miles. Very little long-term data are available for streams draining areas of less than 100 square miles.

Objective -- Define the flood-frequency characteristics on gaged streams in Kansas using long-term data, both observed and synthesized, and extend those characteristics to ungaged locations.

Approach -- Records of annual peak discharges on small drainage areas are obtained from a crest-stage gage network. Selected crest-stage gage sites are equipped to collect simultaneous records of continuous rainfall and discharge. Long-term records of annual peak discharges are synthesized through the use of a rainfall-runoff model and a record of long-term rainfall. Data for large drainage areas are available from the regular stream-gaging network. Flood-frequency relations, determined by statistical methods, are extended to ungaged sites by using physical and climatic factors.

Progress -- Peak-flow data were collected and published for 60 crest-stage gage stations, including 10 rainfall-runoff sites. Long-term synthesis was completed using rainfall-runoff models for 13 previously operated sites and 3 long-term rainfall records. Prepared draft of report on results of rainfall-runoff models in eastern Kansas.

Plans -- Operation of 60 crest-stage gages, including 10 rainfall-runoff sites, will be continued. Continue compiling data from 10 currently operating rainfall-runoff stations. Begin preparation of data for updating flood-frequency characteristics on Kansas streams. New data will include results of long-term synthesis of rainfall-runoff models. Prepare bridge-site reports upon request from cooperator.

Reports published or released -- See numbers 31, 36, and 37 in "List of Reports... ."

PROJECT TITLE: Streamflow characteristics
PROJECT NUMBER: KS-011
COOPERATING AGENCY: Kansas Water Resources Board
PROJECT CHIEF: P. R. Jordan

Problem -- There is a need to express basic streamflow records in more useful forms and to develop improved methods of estimating the frequency of various types of flow in gaged and ungaged streams in Kansas.

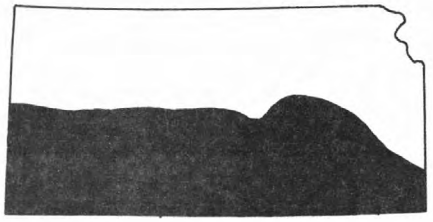
Objective -- Define the significant characteristics of streamflow in Kansas; determine the interrelation between streamflow and ground-water storage; analyze and summarize existing data in useful terms for developing optimum benefit from the available water supplies and optimum protection from floods.

Approach -- Analyze significant streamflow characteristics and update results of previous studies using improved methods applied to initial data and additional data from 16 to 20 years of records, particularly that data from small drainage basins. Where available, improved analytical techniques will be used to determine flow probabilities.

Progress -- The statistical summary of streamflow characteristics for the Missouri River basin in Kansas was completed and transmitted to the cooperator for publication. Fulfilled numerous requests for hydrologic data, including a summary of surface-water data on western Kansas streams for use in the High Plains Economic Study. Analyzed low-flow data and began preparation of report on low-flow frequency.

Plans -- Complete report on low-flow frequency (statewide) and begin analysis of high-flow-volume data. Fulfill requests for hydrologic data from the cooperator and the public.

Reports published or released -- See number 12 in "List of Reports... ."



PROJECT TITLE: Duties for the Kansas-Oklahoma Arkansas River Commission
PROJECT NUMBER: KS-041
COOPERATING AGENCY: Kansas-Oklahoma Arkansas River Commission
PROJECT CHIEF: E. R. Hedman

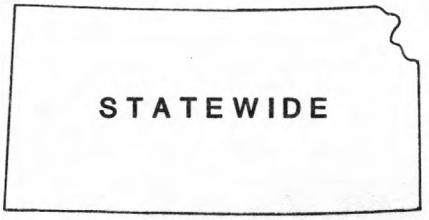
Problem -- The Kansas-Oklahoma Arkansas River Commission is composed of representatives of the States of Kansas and Oklahoma. The administration of the compact requires that certain water data be compiled and presented to the Commission.

Objective -- Compilation of water data needed for the administration of the Arkansas River compact and performance of duties as Secretary-Treasurer for the Commission.

Approach -- Water data needed are collected as part of existing programs, and data are compiled, as required, and are presented to the Commission. Duties of Secretary-Treasurer for the Commission are performed by the project chief.

Progress -- Data were compiled as needed, and the Twelfth Annual Report -- Fiscal Year 1979 was transmitted to the Kansas-Oklahoma Arkansas River Commission.

Plans -- Continue compilation of data as needed and supply information to the Commission. Continue performance of required duties as Secretary-Treasurer of the Commission.



PROJECT TITLE: Special short-term hydrologic investigations and public inquiries
PROJECT NUMBER: KS-045
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: H. G. O'Connor

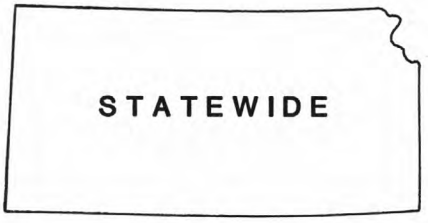
Problem -- Cooperating State agencies frequently request short-duration studies of specific high-priority problems that cannot be accommodated readily in ongoing projects. Information commonly is needed in areas other than those where projects currently are in progress, and an analysis of the problem may require special techniques or expertise generally not available from the requesting agency's staff.

Objective -- Provide a flexible means for programming short-duration, high-priority studies done at the special request of cooperating State agencies and provide a means of supplying geohydrologic information for specific requests by other Federal, State, and local agencies and by the general public.

Approach -- Collect, analyze, and interpret data for short-duration studies as required by cooperating State agencies and provide geohydrologic data requested by Federal, State, and local agencies and by the general public.

Progress -- Responded to more than 500 public inquiries and continued to assist the Governor's Task Force on Water Resources in fiscal year 1979. In fiscal year 1980, responded to more than 800 public inquiries.

Plans -- Continue to provide geohydrologic information as requested by cooperating State agencies and provide information requested by Federal, State, and local agencies and by the general public.



PROJECT TITLE: Numerical models of streamflow
PROJECT NUMBER: KS-059
COOPERATING AGENCY: Kansas Water Resources Board
PROJECT CHIEF: P. R. Jordan

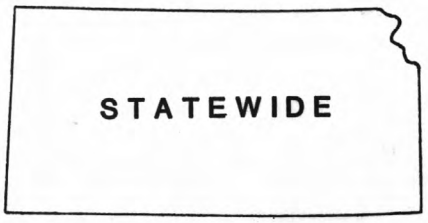
Problem -- Currently available numerical models give reasonably satisfactory estimates of medium and high flows in Kansas, but modifications are needed to improve estimates of low flows. Because the rainfall-runoff relations of some streams apparently have changed in recent years, modifications of numerical models also are needed to aid in the revision of plans and operating procedures for some water-development projects.

Objective -- Develop modifications to improve the capability of numerical models for determining flow in Kansas streams (particularly low flow), the magnitude of changes in rainfall-runoff relations in some streams, and the future runoff expectancy under changed conditions.

Approach -- Examine possible improvements in modeling techniques by using data from drainage basins with different characteristics and by applying physical principles and empirical data on soil moisture, evapotranspiration, and groundwater recharge and discharge. Use modified numerical models to determine changes in rainfall-runoff relations and to calculate future runoff magnitude and probabilities for selected streams.

Progress -- Analyses of streamflow and rainfall data for changes in rainfall-runoff relations have been completed for four streams in western Kansas. Significant changes to smaller amounts of streamflow were found for three of the streams. Final adjustments were made to the rainfall-runoff model.

Plans -- The final report will be completed.



PROJECT TITLE: Flood-hazard mapping
PROJECT NUMBER: KS-062
COOPERATING AGENCY: Federal
PROJECT CHIEF: C. A. Perry

Problem -- The U.S. Geological Survey has been assigned the responsibility of providing flood-hazard information according to a national program outlined by U.S. House of Representative Document 465. Areas that would be inundated by a 100-year flood are delineated on U.S. Geological Survey 7 1/2-minute topographic maps.

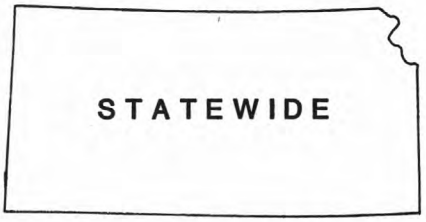
Objective -- Determine the extent of areas that would be inundated by a 100-year flood based on data from existing flood-frequency studies and other available data and delineate those areas on topographic maps.

Approach -- Prepare maps of flood-prone areas using available data from gaging stations and relationships between flood depths, flood discharges, frequency of occurrence, and drainage area to define flood profiles and flood boundaries.

Progress -- Prepared 41 flood-prone area maps, and reviewed and published 14 maps.

Plans -- Review, complete, and transmit 31 flood-prone maps that have been partially prepared.

Reports published or released -- Flood-prone area maps for the St. John North, St. John South, Alton, Harlan, Portis, Downs North, Downs South, Bloomington, Osborne, Dorrance SW, Holyrood NE, Black Wolf, Wilson, and Dorrance quadrangles were released during FY 80.



PROJECT TITLE: Evaluation of the Ground-Water-Quality Monitoring Network
PROJECT NUMBER: KS-077
COOPERATING AGENCY: Kansas Department of Health and Environment
PROJECT CHIEFS: A. M. Diaz and T. B. Spruill

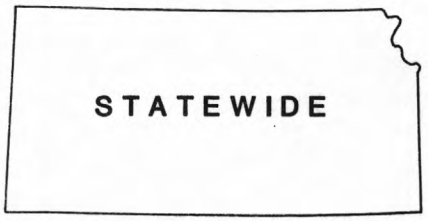
Problem -- Data on the chemical quality of ground water is needed from a statewide network of wells in response to State and Federal regulations imposed by the Safe Drinking Water Act of 1975 (Public Law 93-523). A continuing evaluation of the adequacy of the network is needed for monitoring the ground-water quality in the principal aquifers of the State.

Objective -- Evaluate the chemical-quality data to determine the adequacy of the network for describing baseline ground-water quality, for detecting pollution of the principal aquifers in the State, and for determining the significance of the data in respect to State and Federal water-quality standards imposed by the Safe Drinking Water Act.

Approach -- Collect water samples for chemical analysis from a statewide network of about 500 wells. The wells will be sampled to provide baseline data for determining the general chemical quality of ground water in the principal aquifers and to facilitate early detection of pollution in the area of existing drinking-water supplies. Interpretation of sampled data will continue, and the adequacy of data will be reanalyzed for detecting changes in chemical quality and in local occurrence of pollution.

Progress -- Sampling of network wells was continued. A preliminary draft of a report presenting all available chemical data from network wells and classification and assessment of regional ground-water quality in Kansas is being prepared. Data evaluation indicates that analyses of annually obtained ground-water samples are inadequate to assess long-term trends in ground-water quality. Reports on this topic and on the occurrance of nitrate-nitrogen are also in preparation.

Plans -- Continue sampling of established network wells and selection of additional wells to be added to the network where coverage is lacking. Continue entry of chemical data from WATSTØRE to the Ground-Water-Station Inventory File, and field verification of locations of wells within the Kansas network. Complete reports and evaluation of data and network design.



PROJECT TITLE: Potential for liquid-waste injection into the Arbuckle Group
PROJECT NUMBER: KS-078
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: A. J. Gogel

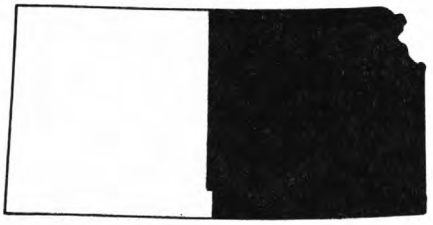
Problem -- Rocks of the Arbuckle Group, which underlie nearly all of Kansas, are important oil reservoirs in much of the State and are an important freshwater aquifer in the southeastern part. The rocks also are a primary horizon for waste disposal, particularly oilfield brine. Little is known about the regional geohydrology and the potential effects of contamination to freshwater aquifers.

Objective -- Determine the regional geohydrology of the Arbuckle Group from available data and further define the Arbuckle Group by making a preliminary assessment of the potential for waste injection to the aquifer. Determine the hydraulic parameters and potential for liquid-waste injection at site-specific areas.

Approach -- Compile data to determine the areal extent and thickness of aquifers, the areal changes in hydraulic and chemical characteristics, and the configuration of the potentiometric surface of saline water in the Arbuckle and other aquifers. Observation wells will be installed at selected sites to monitor changes in head and chemical quality. Modeling techniques will be used to evaluate the potential for future injection and storage of liquid wastes and to assess the effects of waste injection on freshwater aquifers.

Progress -- All drill-stem test data have been analyzed for transmissivity, hydraulic conductivity, and freshwater-equivalent potentiometric surface. Potentiometric maps of six geologic horizons have been completed. Four deep observation wells were completed in the Arbuckle in Douglas, Miami, Labette, and Saline Counties. These wells were tested at various horizons for hydraulic information, and water-quality samples were collected from the Arbuckle.

Plans -- Consider the effects of variable water density on flow direction. Injection tests will be conducted at two of the drilling sites. Data gained from these tests will be used to construct digital ground-water flow models at each site. This will allow preliminary determination of acceptability of site(s) for liquid-waste disposal.



PROJECT TITLE: Aquifer-test evaluation
PROJECT NUMBERS: KS-093
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: R. D. Burnett

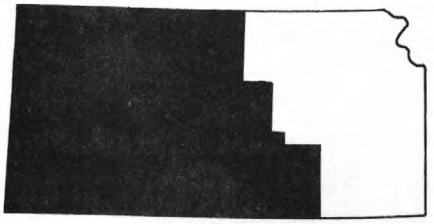
Problem -- Current aquifer appraisal projects in eastern Kansas require more accurate values for hydraulic characteristics than those available from previous studies. The files of the U.S. Geological Survey, the Kansas Geological Survey, and the Division of Water Resources of the Kansas State Board of Agriculture contain data from numerous aquifer tests, which have been conducted since 1937. These tests need to be reanalyzed to provide a cohesive set of reliable aquifer parameters that may be used as the basic building blocks for quantitative evaluations.

Objective -- To create an accurate reproducible documented file of aquifer parameters by aquifer and by area for use in current areal investigations and investigations that are being considered for the future.

Approach -- Compile all available data from aquifer tests in eastern Kansas; evaluate tests for adequacy of documentation; and collect supplemental data from other sources for interpretation. Determine the appropriate analytical or numerical techniques for application to the aquifer tests, and collate aquifer-test results in a useful summary form.

Progress -- Pumping test data for approximately 60 aquifer tests scattered over the project area have been collected. About 40 pumping tests have been analyzed using methods developed by Jacob, Hantush, and Boulton. Preliminary work on the final report has begun.

Plans -- Continue aquifer-test analyses and finish report.



PROJECT TITLE: High Plains regional aquifer-system analysis, western Kansas
PROJECT NUMBER: KS-094
COOPERATING AGENCY: Federal
PROJECT CHIEF: L. E. Stullken

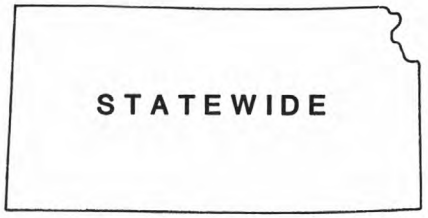
Problem -- The Ogallala Formation is the principal aquifer underlying the High Plains. The aquifer contains about 2 billion acre-feet of water in storage, but water is being withdrawn for irrigation in excess of the rate of natural replenishment. The economic future of the High Plains in eight states, including Kansas, is dependent upon the capacity of the aquifer to sustain withdrawals. A detailed knowledge of the aquifer system is needed so that the system can be simulated, water-management alternatives evaluated, and the economic life of the aquifer projected.

Objective -- Previous studies of the hydrology of the High Plains have been limited by political boundaries. This study will provide a regional description of the water resources and the operation of the hydrologic system consistent with the natural hydrologic boundaries of the High Plains. Computer models of the aquifer system will be developed and used to project the future response of the system to proposed future withdrawals and provide a basis for the economic evaluation of water-management alternatives.

Approach -- Existing hydrologic data will be compiled and reviewed. Data collection networks will be revised or initiated to provide adequate coverage for the study area. The data will be regionalized to provide a detailed description of the aquifer system and stored in a digital computer for processing and retrieval. The computerized data file will provide the data base needed for the development of computer models of the aquifer system. Proposed water-management alternatives and their effects on the aquifer system will be simulated by the models to evaluate the economic life of the system for each management alternative.

Progress -- Measured irrigation-well discharges and time-of-operation at 90 randomly selected sites in the High Plains tri-state water-use test area. Compiled a map report on the "Generalized configuration of the base of the High Plains regional aquifer system in Kansas." Mapped type of irrigation and irrigated crops in Cheyenne and Sherman Counties, Kansas, and completed an analysis of base flows from the Ogallala aquifer. Mapped 1975, 1970, 1965, 1960, and predevelopment water levels in High Plains aquifer; mapped specific yield and hydraulic conductivity in the High Plains aquifer; calculated the pumpage from the High Plains aquifer; and initiated digital modeling of the High Plains aquifer system in two dimensions--in western Kansas by U.S. Geological Survey staff and in south-central Kansas by contract with the Kansas Geological Survey.

Plans -- Continue steady-state modeling effort and reconsider the adequacy of currently available data and time in terms of developing transient-state ground-water models for evaluation of water-management alternatives.



PROJECT TITLE: Central Midwest Regional Analysis
PROJECT NUMBER: KS-111
COOPERATING AGENCY: Federal
PROJECT CHIEF: C. H. Baker, Jr.

Problem -- The hydrology of the deeper freshwater, brackish-water, and saline-water aquifer systems in rocks of Cambrian-Ordovician to Cretaceous ages is not well defined. Because of the increased demand on the overlying High Plains aquifer system in western Kansas, aquifers in this deeper rock system are being looked upon as a potential source of additional water supply. In addition, increased demand in eastern Kansas has caused saline-water encroachment into aquifers of this rock system. Added to these problems are those resulting from injection of industrial wastes and oilfield brine into these rocks.

Objective -- Describe the hydrology of the freshwater, brackish-water, and saline-water aquifer systems in rock of Cambrian-Ordovician to Cretaceous ages. Create a regional data base for the rock systems and describe present and potential problems associated with current and future water use. Evaluate the aquifer-system response to future stresses.

Approach -- A search of the available literature will be made to determine the extent of geologic-framework interpretations and available data. Data collection will follow literature search to establish a data base of regional significance that will include detailed lithologic descriptions for selected wells, water-quality information, hydraulic characteristics of the rock systems, and information on water use, waste disposal, and brine injection. Appropriate maps will be prepared, and a steady-state digital model constructed to test the conceptual-flow system and to define additional data needs to calibrate a digital model capable of simulating the flow system for predictive purposes.

Progress -- New project.

Plans -- Prepare detailed work plan and assemble staff. Review literature and compile and review existing data.

PROJECT TITLE: Influence of sediment and other variables on active-channel geometry
PROJECT NUMBER: KS-085
COOPERATING AGENCY: Federal
PROJECT CHIEF: W. R. Osterkamp

Problem -- Recent methods for estimating streamflow characteristics from channel-geometry data commonly result in large standard errors in width-discharge regressions. Current studies indicate that the regressions are strongly influenced by sediment and other variables, but insufficient data are available for adequate refinement. Information on the effects of particle size on channel shape and stability are needed to evaluate changes in response to land use and hydraulic structures.

Objective -- Determine the influence of sediment on the channel geometry of alluvial streams and the manner in which the silt-clay content of bed and bank material affects width-discharge regressions. Define the quantitative influence of sediment on channel-geometry methods to improve estimates of discharge from ungaged streams.

Approach -- Collect data on active-channel geometry at established gages in the Missouri River basin, collect bed and bank samples for size analyses, and correlate channel geometry to discharge and to silt-clay content in bed and bank material. Develop equations to express the effect of sediment on the channel-geometry relation within large ranges of climate and topography.

Progress -- Data were analyzed by digital computer, and the resulting power-function equations described the manner in which width-discharge relations of alluvial channels vary with the sediment characteristics.

Plans -- Project has been completed.

Reports published or released -- See number 17 in "List of Reports... ."

PROJECT TITLE: Channel geometry as related to discharge characteristics of regulated Kansas streams
PROJECT NUMBER: KS-087
COOPERATING AGENCY: Kansas Water Resources Board
PROJECT CHIEF: W. R. Osterkamp

Problem -- Differences in discharge variability are known to have a significant effect on the channel geometry of streams with similar mean discharge. Although previous studies have related channel width and depth to mean discharge and to flood-frequency discharges, little consideration has been given to the effect of discharge variability on channel shape. The increasing regulation by reservoirs has caused many streams in Kansas to have low flood discharges relative to mean discharge. The relation of channel geometry to flow characteristics in regulated streams is poorly defined.

Objective -- Define the relation of channel geometry to various parameters of discharge, specifically for regulated streams; determine the downstream changes in channel shape that occur on regulated streams; determine the changes in channel shape, gradient, sinuosity, and elevation as a result of reservoir regulation; and define the influence that sediment transport exerts on the geometry of regulated streams.

Approach -- Collect channel-geometry data and particle-size data of bed and bank material at established gaging stations and at sites between stations on regulated stream reaches. Utilize computer techniques of simple- and multiple-regression analyses to relate various discharge characteristics determined from gaging-station records. Analyze the results of rating-curve shifts for specific gaging stations and the measurable changes in channel sinuosity and gradient that have occurred during regulated periods.

Progress -- Data collection and computer analyses of the data have been completed. Results suggest that reservoirs affect channel-geometry partly by reducing flood peaks and partly by limiting the proportion of total sediment discharge that can be moved as bedload.

Plans -- The final report will be submitted for colleague review.

Reports published or released -- See numbers 18, 19, and 22 in "List of Reports... ."

PROJECT TITLE: Water-yield estimation for small ungaged basins in Kansas
PROJECT NUMBER: KS-089
COOPERATING AGENCY: Kansas Water Resources Board
PROJECT CHIEF: W. J. Carswell, Jr.

Problem -- Many communities and other water users, which are dependent on streamflow, experienced shortages during the drought of 1976-77 in Kansas and recognize the need to expand water supplies. An adequate method for estimating yields and carry-over storage requirements from streams draining less than 100 square miles is not available. Existing methods for estimating water yields from drainage basins exceeding 100 square miles in size previously have not been tested for smaller areas because of the lack of sufficient streamflow data for small streams in Kansas.

Objective -- Test the applicability and limitations of applying existing methods for estimating water yields and carry-over storage requirements for basins larger than 100 square miles to smaller basins. If existing methods are not applicable, develop new methods of estimating water yield and carry-over storage requirements for ungaged basins with drainage areas smaller than 100 square miles.

Approach -- Water yields and carry-over storage requirements shown by existing low-flow data on small basins will be compared to values calculated by techniques available for ungaged basins larger than 100 square miles to test the applicability of the techniques to smaller basins. If existing techniques are found to be inadequate, new techniques will be developed for estimating water yields and carry-over storage requirements for ungaged small basins. Approaches to be examined will include nonlinear extension of the large-area methods, use of statistically regionalized flow parameters, and selection of an existing streamflow model for adaptation.

Progress -- Completed reports on multiyear low flow of streams in southeast and northeast Kansas. Storage requirements have been calculated for small gaged basins in Kansas. Using these results, a technique is being developed to estimate carry-over storage requirements for ungaged basins.

Plans -- The study will be completed and findings published as a U.S. Geological Survey Water-Resources Investigations in fiscal year 1981.

Reports published or released -- See numbers 5 and 6 in "List of Reports ... ."

PROJECT TITLE: Streamflow characteristics related to channel geometry of streams in coal-lease areas
PROJECT NUMBER: KS-097
COOPERATING AGENCY: Federal
PROJECT CHIEF: E. R. Hedman

Problem -- Estimates of streamflow characteristics are presently required for hydrologic studies and assessment of the impact of coal mining in the central and western United States. In the regions where it is difficult to relate the streamflow characteristics to precipitation, drainage area, and other basin characteristics, additional methods are needed. Channel geometry is one such method. Streamflow characteristics have been related to channel geometry of streams in much of the western United States through many individual studies, mostly state wide. Results have been good for most perennial streams. These relations probably can be transferred to other areas, but some verification in each area will be necessary to assure this.

Objective -- The principal objectives of the study will be directed specifically to the strippable-coal areas in the central and western United States and are: (1) To verify the transferability of the existing relations of streamflow characteristics to measurable dimensions of channel geometry and channel material of perennial streams; (2) to develop new relations of streamflow characteristics to measurable dimensions of channel geometry and channel material of ephemeral streams; and (3) to investigate the feasibility of estimating sediment-transport characteristics for perennial and ephemeral streams.

Approach -- Channel-geometry data should be collected at gaging stations with 20 or more years of record on perennial streams, in or near the major coal areas, to verify existing relations. Existing relations could then be used directly or with adjustments if necessary. Channel-geometry data sufficient to develop statistically significant regression equations would be collected from suitable ephemeral sites throughout the western United States. Measurements should be made of the dimensions of channel geometry that have proved successful in other studies; for example, width and average depth of the channel cross section between in-channel depositional bars, the active channel, and the bankfull stage. Data collection should include sampling and particle-size analyses of bed and bank material.

Progress -- Data have been collected at 142 recording streamflow-gaging-station sites, of which 100 were ephemeral and the remainder were perennial and intermittent. Bed and bank material samples have been analyzed, and all data have been entered in a computer file.

Plans -- Additional data will be collected at gaging sites in California, New Mexico, and Oklahoma. All data will be related to streamflow characteristics. Complete final report.

Reports published or released -- See number 21 in "List of Reports... ."

PROJECT TITLE: Planning study for regional investigation of precipitation volume and intensity, its variability and possible fluctuation over a period of record
PROJECT NUMBER: KS-101
COOPERATING AGENCY: Federal
PROJECT CHIEF: C. A. Perry

Problem -- Precipitation is an important parameter in most hydrologic investigations, including studies of the hydrology of coal-mining areas. If precipitation is subject to time trends or cycles, the conclusions of many hydrologic studies would have questionable validity. Several studies have confirmed the absence of trends or cycles in long records of precipitation at a specific site. However, recent studies have indicated the possibility of cycles in the average precipitation over large areas. An investigation is needed to determine the presence or absence of cycles in average precipitation over the size of areas important for hydrologic studies.

Objective -- Conceptualize a regional investigation of areal precipitation volume and intensity to determine precipitation variability and possible trends or cycles over a long period of time. Assemble a data base from existing data and determine a plan of study for a regional investigation. Include possible effects of trends or cycles in precipitation data on other hydrologic studies.

Approach -- Conduct a literature search for best methods for study of time trends or cycles in precipitation data. Acquire precipitation data, as well as other supportive meteorological data, in a form that is compatible for high-speed computer usage. Prepare and publish a plan of study for a definitive investigation of trends or cycles in areal precipitation.

Progress -- The project began in May 1979 with data acquisition and a literature search. Data on annual precipitation for eight regions, annual sunspot numbers, and number of sudden geomagnetic-storm commencements were analyzed. The correlation among regional precipitation, sunspot numbers, and sudden geomagnetic-storm commencements was studied. The project's concepts and objectives were coordinated with the National Center for Atmospheric Research. A report on the preliminary analysis and plan of study was written.

Plans -- Report is to be published. Project ended at close of FY 79.

PROJECT TITLE: Distribution information systems
PROJECT NUMBER: KS-102
COOPERATING AGENCY: Federal
PROJECT CHIEF: J. M. McNellis

Problem -- The increasing demand for information concerning water resources, coupled with personnel ceilings, has worked to prevent timely assessment and distribution of water data. Technology transfer in the area of computer applications is slow to almost nonexistent, particularly for the final users of computer data.

Objective -- Demonstrate the feasibility of putting computer power in the hands of individual users and develop a plan for acquisition of minicomputers in the Water Resources Division of the U.S. Geological Survey.

Approach -- A Harris minicomputer has been installed in the Kansas District, and it is one of only three in the entire Water Resources Division. The others are located in New Mexico and in Reston, Virginia. The Kansas District will implement ground-water flow models, automatic rating analysis, and numerous other applications. Coordination and exchange of software among Kansas, New Mexico, and Reston will be maintained. In addition to the testing, coordination, and exchange, the results and experience of having minicomputer systems in the hands of users will be used in writing a request for purchase of other minicomputers for other locations in the Water Resources Division.

Progress -- A number of programs that are used extensively are running on the Harris minicomputer. Functional applications include administrative, basic data, publication, laboratory, computer, and hydrologic-investigation areas. The minicomputer is accessible to all Kansas District office personnel and is used directly by more than 50 percent and indirectly by all. Coordination and exchange of software among Kansas, New Mexico, and Reston are continuing.

Plans -- Development of programs for the minicomputer, with coordination and exchange among the three sites, will continue. Program developments include plotter, digitizer, and graphics capabilities. Information on minicomputers will be given to all Districts in the Water Resources Division, and the Districts will be polled as to their minicomputer requirements. Results of the poll will be used with the experience gained at the three demonstration sites in developing a request for purchase that will be written and sent to minicomputer vendors.

Reports published or released -- See number 15 in "List of Reports... ."

LIST OF REPORTS PUBLISHED OR RELEASED DURING 1979 AND 1980 FISCAL YEARS

1. Baker, C. H., Jr., 1979a, New instrumentation for the National Water-Use Data Program: Water Resources Division Bulletin, October-December 1978, January-June 1979, p. 46-47.

2. _____1979b, Evaluation of methods for estimating ground-water withdrawals in western Kansas: U.S. Geological Survey Water-Resources Investigations 79-92, 70 p.

3. Bevans, H. E., 1980, A procedure for predicting concentrations of dissolved solids and sulfate ion in streams draining areas strip mined for coal: U.S. Geological Survey Water-Resources Investigations, Open-File Report 80-764, 17 p.

4. Bevans, H. E., and Diaz, A. M., 1980, Statistical summaries of water-quality data for streams draining coal-mined areas, southeastern Kansas: U.S. Geological Survey Hydrologic Data, Open-File Report 80-350, p. 42 p.

5. Carswell, W. J., Jr., 1979, Multiyear low flow in southeastern Kansas: U.S. Geological Survey Water-Resources Investigations, Open-File Report 79-1288, 26 p.

6. Carswell, W. J., Jr., and Bond, S. V., 1980, Multiyear low flow of streams in northeastern Kansas: U.S. Geological Survey Water-Resources Investigations, Open-File Report 80-734, 26 p.

7. Denne, J. E., 1979, Uncovering buried valleys in northeastern Kansas: Kansas Geological Survey, The Journal, v. 1, no. 3, 4, p.

8. Dunlap, L. E., 1980, Simulated water-level declines near Marienthal, west-central Kansas: U.S. Geological Survey Water-Resources Investigations 80-39, 15 p.

9. Gogel, A. J., 1979, Discharge of saltwater from Permian rocks to major stream-aquifer systems in central and south-central Kansas: U.S. Geological Survey Open-File Report 79-1055, 79 p.

10. Gutentag, E. D., Lobmeyer, D. H., and Slagle, S. E., 1980, Geohydrology of southwestern Kansas: U.S. Geological Survey Open-File Report 80-218, 97 p.

11. Jordan, P. R., 1979a, Relation of sediment yield to climatic and physical characteristics in the Missouri River basin: U.S. Geological Survey Water-Resources Investigations 79-49, 26 p.

12. _____1979b, Statistical summary of streamflow data for Kansas streams in the Missouri River basin: Kansas Water Resources Board Technical Report No. 14B, 334 p.

13. Kume, Jack, Dunlap, L. E., Gutentag, E. D., and Thomas, J. G., 1979, Hydrologic and related data for water-supply in an intensive-study area, northeastern Wichita County, Kansas: U.S. Geological Survey Water-Resources Investigations 79-105, 51 p.

14. Lobmeyer, D. H., and Weakly, E. C., 1979, Water in the Dakota Formation, Hodgeman and northern Ford Counties, southwestern Kansas: Kansas Geological Survey Irrigation Series 5, 41 p.

15. Longwill, S. M., McNellis, J. M., and Posson, D. R., 1980, The use of minicomputers in a distributed information processing system--a feasibility study: U.S. Geological Survey, Open-File Report 80-326, 68 p.

16. McGovern, H. E., and Combs, L. J., 1979, Water-resources investigations in Kansas--fiscal year 1978: U.S. Geological Survey Open-File Report 79-561, 85 p.

17. Osterkamp, W. R., 1979a, Bed- and bank-sampling procedure at channel-geometry sites: National Conference on Quality Assurance of Environmental Measurements; Information Transfer Inc., p. 86-89.

18. _____1979b, Variation of alluvial-channel width with discharge and character of sediment: U.S. Geological Survey Water-Resources Investigations 79-15, 11 p.

19. _____1979c, Invariant power functions as applied to fluvial morphology; in Rhodes, D. D., and Williams, G. R., eds., Adjustments of the fluvial system: Kendall/Hunt Publishing Co., p. 33-54.

20. _____1980, Sediment-morphology relations of alluvial channels: American Society Civil Engineers Proceedings, Watershed Management Symposium, Boise, Idaho, 12 p.

21. Osterkamp, W. R., and Hedman, E. R., 1979, Discharge estimates in surface-mine areas using channel-geometry techniques: Proceedings-Symposium on Surface-Mine Hydrology, Sedimentology and Reclamation, University of Kentucky Bulletin 119, p. 43-49.

22. Osterkamp, W. R., McNellis, J. M., and Jordan, P. R., 1979, Guidelines for the use of structural versus regression analysis in geomorphic studies: U.S. Geological Survey Water-Resources Investigations 78-135, 22 p.

23. Osterkamp, W. R., and Wiseman, A. G., 1980, Particle-size analyses of bed and bank material from channels of the Missouri River basin: U.S. Geological Survey Hydrologic Data, Open-File Report 80-429, 31 p.

24. Pabst, M. E., 1979a, Januaary 1979 water levels, and data related to water-level changes, western and south-central Kansas: U.S. Geological Survey Open-File Report 79-925, 213 p.

25. _____1979b, Maps showing saturated thickness, January 1979, and percentage decrease in saturated thickness, 1950-79, of unconsolidated aquifer in west-central Kansas: U.S. Geological Survey Open-File Report 79-1340, 3 p., 2 pl.

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27. Peek, C. O., and Jordan, P. R., 1978, Determination of peak discharge from rainfall data for urbanized basins, Wichita, Kansas: U.S. Geological Survey Open-File Report 78-974, 49 p.

28. Rosenshein, J. S., 1979, Groundwater in the United States 1975-78: American Geophysical Union, Reviews of Geophysics and Space Physics, v. 17, no. 6, September 1979, p. 1240-1253.

29. Rosenshein, J. S., and McNellis, J. M., 1979, WRD prototype mini-computer system in the Kansas District: Water Resources Division Bulletin, October-December 1977, January-June 1979, p. 42-45.

30. U.S. Geological Survey, 1979a, Flood insurance study, City of Eudora, Kansas: Flood Insurance Administration, U.S. Department of Housing and Urban Development.

31. ____1979b, Water resources data for Kansas, water year 1978: U.S. Geological Survey Water-Data Report KS-78-1, 656 p.

32. ____1979c, Water resources data for Kansas, 1978: U.S. Geological Survey, pamphlet.

33. ____1980a, Flood insurance study, Douglas County, Kansas: Flood Insurance Administration, U.S. Department of Housing and Urban Development.

34. ____1980b, Flood insurance study, City of Perry, Kansas: Flood Insurance Administration, U.S. Department of Housing and Urban Development.

35. ____1980c, Flood insurance study, City of Wamego, Kansas: Flood Insurance Administration, U.S. Department of Housingand Urban Development.

36. ____1980d, Water resources data for Kansas, water year 1979--volume 1. Missouri River basin: U.S. Geological Survey Water-Data Report KS-79-1, 372 p.

37. ____ 1980e, Water resources data for Kansas, water year 1979--volume 2. Arkansas River basin: U.S. Geological Survey Water-Data Report KS-79-2, 362 p.

Explanation of Table Symbols

Cooperator of Supporting Programs

ARCA	Arkansas River Compact Administration
WDPW	City of Wichita, Department of Public Works
WWD	City of Wichita, Water Department
KDHE	Kansas Department of Health and Environment
KDOT	Kansas Department of Transporation
KSBA	Kansas State Board of Agriculture
KWRB	Kansas Water Resources Board
MRB	Missouri River Basin Program, Federal
SCS	Soil Conservation Service
CE A	U.S. Army Corps of Engineers, Albuquerque District
CE KC	U.S. Army Corps of Engineers, Kansas City District
CE T	U.S. Army Corps of Engineers, Tulsa District
WPRS	U.S. Water and Power Resources Service, Region 7 (formerly U.S. Bureau of Reclamation)
EPA	U.S. Environmental Protection Agency
USFW	U.S. Fish and Wildlife Service
BENCHMARK	U.S. Geological Survey, Federal
CBR	U.S. Geological Survey, Federal
NASQAN	U.S. Geological Survey, Federal
GWMD1	Western Kansas Groundwater Management District No. 1

Surface-Water Gaging Stations

Codes for Station Purpose

B - Benchmark or long-term trend station
C - Current-purpose station
H - A hydrologic station to meet objective of defining regional streamflow characteristics
P - Principal-stream stations to meet objective of measuring principal unregulated streams
R - A station required for systems analysis of a regulated stream to meet objective of defining regulated flow

Codes for Type of Gage

B - Bubble gage
C - Cableway
CSI - Crest-stage indicator
D - Digital recorder (stage)
Dp - Digital recorder (precipitation)
R - A-35 recorder
T - Telemetering equipment
W - Artificial control
WW - Wire weight

Remarks

A - Also a precipitation station
B - Equipped with digital stage recorder
C - Equipped with A-35 recorder
D - Equipped with wire weight
E - Equipped with bubble gage
F - Also a continuous record station
F - Also a crest-stage partial-record station

Ground-Water Wells

Well Numbers

Well numbers in these listings indicate the location of wells according to the land subdivisions of the U.S. Bureau of Land Management (fig. 9). An example of a typical well number is 12S 06E 06BCAC in Geary County. The first two digits indicate the township, which in Kansas are nearly all south of the 40th parallel base line. The second two digits indicate the range east or west of the Sixth Principal Meridian. The last two digits indicate the section in which the well is located. The first letter after those digits denotes the quarter section or 160-acre tract; the second, the quarter-quarter section or 40-acre tract; the third, the quarter-quarter-quarter section or 10-acre tract; and the fourth, when used, the quarter-quarter-quarter-quarter section or 2 1/2-acre tract. The quarter sections, quarter-quarter sections, and so forth, are designated A, B, C, and D in a counterclockwise direction, beginning with A in the northeast quadrant. If two or more wells are located within the smallest subdivision indicated, the wells are numbered serially.

Water-Level Notes

A - Annual observation
M - Monthly observation
Q - Quarterly observation
R - Continuous recorder

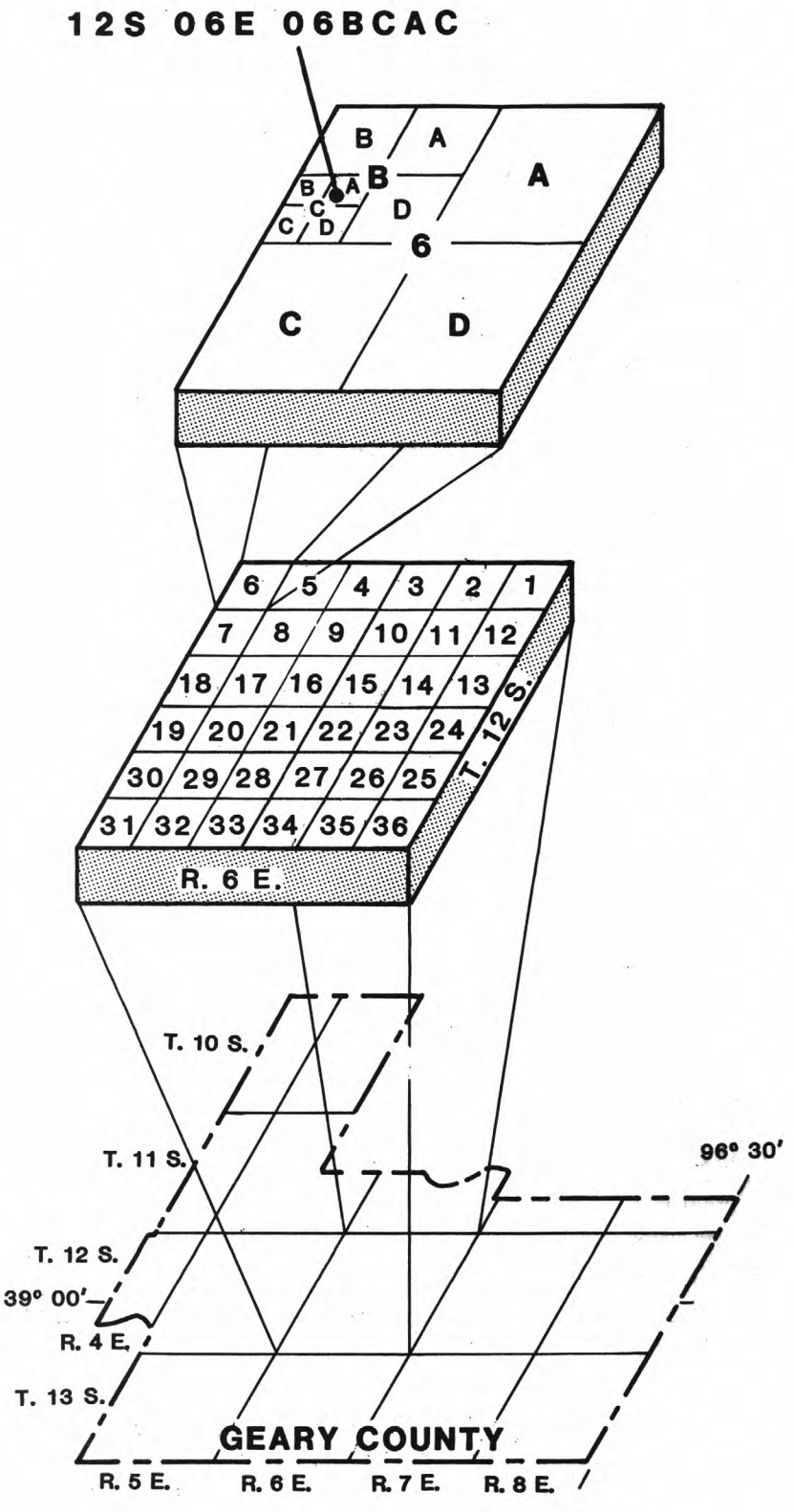

Figure 9.--Well-numbering system.

Sampling Purpose

CHEM	Chemical analyses, cations, anions, nutrients
CHEMB	Chemical analyses of bed material
BIOL	Biological analyses, phytoplankton, periphyton
TOC	Total organic carbon, suspended, dissolved
METAL	Trace metals analyses
METALB	Trace metals analyses of bed material
RAD	Radiochemical analyses
PEST	Pesticide analyses
PESTB	Pesticide analyses of bed material
SEDPT	Suspended sediment, point analyses
SED	Suspended sediment, particle analyses
BED	Bed material, particle analyses
COLI	Coliform, total, fecal, and fecal streptococcal
COAL	Coal separation
FIELD	Field measurements; discharge, water temperature, alkalinity, conductance, pH, dissolved oxygen
OBS	Field observer collects sample for conductance, chloride, and water temperature

Frequency of Sampling

1	Annual; July
2	Semiannually; October, April
4	Quarterly; November, February, May, August
6	Low flow
7	November, March, May, June, July, August, September
8	October, November, April, May, June, July, August, September
9	High flow
12	Monthly
13	Daily

Remarks

MONITOR	Water quality automatic monitor, water temperature, conductance
1	Sediment samples sent to Corps of Engineers, Tulsa District
2	Sediment sample above 30 cubic feet per second
4	Sediment sample above 50 cubic feet per second
5	Sediment sample above 100 cubic feet per second
6	Sediment sample above 150 cubic feet per second
7	Sediment sample above 200 cubic feet per second
8	Sediment sample above 400 cubic feet per second

Table 1.--Complete-record surface-water gaging stations

Missouri River Basin

Ident. no. 06-	Station name	Station purpose	Location Sec.	T.	R.	Type of gage	Coop. or support	Remarks
8140	Turkey Cr. nr Seneca	C	20	1S	12E	BDR	KWRB	
8447	S. Fk. Sappa Cr. nr Brewster	H	9	9S	37W	BR	KWRB	A
8449	S. Fk. Sappa Cr. nr Achilles	C	29	4S	30W	BR	KWRB	A
8465	Beaver Cr. at Cedar Bluffs	B,C,P	10	1S	29W	BR	CBR	A
8479	Prairie Dog Cr. ab Norton Res.	C	23	3S	25W	BCDRW	CE KC	A
84795	Norton Res. nr Norton		8	3S	23W	BR	KWRB	
8480	Prairie Dog Cr. at Norton	C,R	9	3S	23W	BDRW	KWRB	
8485	Prairie Dog Cr. nr Woodruff	C,R	9	1S	19W	DR	CBR	
8535	Republican R. nr Hardy, Nebr.	C,R	6	1S	5W	BDR	CBR	
8538	White Rock Cr. nr Burr Oak	C	7	2S	8W	BCDRW	CE KC	
8539	Lovewell Res. nr Lovewell		6	2S	6W	BR	KWRB	
8540	White Rock Cr. at Lovewell	C,R	17	2S	6W	BDRW	KWRB	
8558	Buffalo Cr. nr Jamestown	C	14	5S	5W	BDR	KWRB	
8559	Wolf Cr. nr Concordia	H	12	6S	4W	BDR	KWRB	
8560	Republican R. at Concordia	C,R	28	5S	3W	BDR	CE KC	
8566	Republican R. at Clay Center	C,R	17	8S	3E	BDRT	CBR	
85705	Milford Lake nr Junction City		20	11S	5E	RT	CE KC	
8571	Republican R. bl Milford Dam	C,R	--	--	--	BCDRT	CE KC	
8585	N. Fk. Smoky Hill R. nr McAllaster	P	17	12S	36W	BR	KWRB	A
8600	Smoky Hill R. at Elkader	B	34	14S	32W	BD	CE KC	A
8610	Smoky Hill R. nr Arnold	C,P	29	14S	24W	BDR	CE KC	
8615	Cedar Bluff Res. nr Ellis		36	14S	22W	BR	KWRB	
8620	Smoky Hill R. at Cedar Bluff Dam	C,R	1	15S	22W	BCRTW	KWRB	
8627	Smoky Hill R. nr Schoenchen	C,R	25	15S	19W	BDR	KWRB	
8635	Big Cr. nr Hays	C,P	30	14S	17W	BDR	KWRB	
8639	N. Fk. Big Cr. nr Victoria	C	27	13S	17W	BR	KWRB	
86405	Smoky Hill R. nr Bunker Hill	C,R	33	14S	13W	BDR	CE KC	
8645	Smoky Hill R. at Ellsworth	C,R	20	15S	8W	BDR	CE KC	
8650	Kanopolis Lake nr Kanopolis		3	17S	6W	BR	CE KC	
8655	Smoky Hill R. nr Langley	C,R	35	16S	6W	BDRT	CE KC	

Table 1.--Complete-record surface-water gaging stations--Continued

Ident. no. 06-	Station name	Station purpose	Location Sec.	T.	R.	Type of gage	Coop. or support	Remarks
8665	Smoky Hill R. nr Mentor	C,R	29	14S	2W	BDRT	CE KC	
8670	Saline R. nr Russell	B,C,P	34	12S	14W	BDR	KWRB	
8681	Wilson Lake nr Wilson		36	12S	11W	RT	CE KC	
8682	Saline R. at Wilson Dam	C,R	25	12S	11W	BDRT	CE KC	
8695	Saline R. at Tescott	C,R	16	12S	5W	BDRT	KWRB	
8702	Smoky Hill R. at New Cambria	C,R	8	14S	1W	BDR	MRB	
8710	N. Fk. Solomon R. at Glade	C,P	25	4S	18W	BDR	CE KC	
8715	Bow Cr. nr Stockton	C	1	6S	18W	BDR	CBR	
8717	Kirwin Res. at Kirwin		33	4S	16W	BR	KWRB	
8718	N. Fk. Solomon R. at Kirwin	C,R	33	4S	16W	R	KWRB	
8719	Deer Cr. nr Phillipsburg	H	24	3S	10W	BDR	KWRB	
8725	N. Fk. Solomon R. at Portis	C,R	5	6S	12W	BDR	CE KC	
8730	S. Fk. Solomon R. ab Webster Res.	C,P	8	8S	20W	BDR	CE KC	
8731	Webster Res. nr Stockton		27	7S	19W	BR	KWRB	
8732	S. Fk. Solomon R. bl Webster Res.	C,R	26	7S	19W	BCDR	KWRB	
87346	S. Fk. Solomon R. at Woodston	C	16	7S	16W	BR	WPRS	
8737	Kill Cr. nr Bloomington	H	11	8S	14W	BR	KWRB	
8740	S. Fk. Solomon R. at Osborne	C,R	20	7S	12W	BDR	KWRB	
8742	Waconda Lake at Glen Elder		27	6S	9W	BR	WPRS	
8759	Solomon R. nr Glen Elder	C,R	2	7S	9W	BCDRW	KWRB	
87644	Solomon R. nr Minneapolis	C	1	11S	4W	BR	WPRS	
8767	Salt Cr. nr Ada	C	36	10S	5W	BDR	KWRB	
8769	Solomon R. at Niles	C,R	31	12S	1W	BDRT	CE KC	
8776	Smoky Hill R. at Enterprise	C,R	20	13S	3E	BDRT	CE KC	
8780	Chapman Cr. nr Chapman	H	1	12S	3E	BDR	KWRB	
8791	Kansas R. at Ft. Riley	C,R	33	11S	6E	BDRT	CE KC	
87965	Kings Cr. nr Manhattan		18	11S	8E	BDR	CBR	
8842	Mill Cr. at Washington	H	1	3S	3E	BDR	KWRB	
8844	Little Blue R. nr Barnes	C,P	22	3S	5E	BDR	CE KC	
8855	Black Vermillion R. nr Frankfort	C	20	4S	9E	BDR	CE KC	
8869	Tuttle Creek Lake nr Manhattan		24	9S	7E	BR	CE KC	
8870	Big Blue R. nr Manhattan	C,R	30	9S	8E	BDRT	CE KC	
8875	Kansas R. at Wamego	C,R	9	10S	10E	BDRT	CE KC	
8885	Mill Cr. nr Paxico	C	27	11S	11E	BDRT	KWRB	
8890	Kansas R. at Topeka	C,R	28	11S	16E	BDRT	CE KC	

Table 1.--Complete-record surface-water gaging stations--Continued

Ident. no. 06-	Station name	Station purpose	Location Sec.	T.	R.	Type of gage	Coop. or support	Remarks
8891	Soldier Cr. nr Goff	C,H	16	5S	13E	BDR	KWRB	A
88912	Soldier Cr. nr Bancroft	C,H	28	5S	13E	BDR	KWRB	A
88914	Soldier Cr. nr Soldier	C,H	4	6S	13E	BDR	KWRB	A
88916	Soldier Cr. nr Circleville	C,H	10	7S	13E	BDR	KWRB	A
88918	Soldier Cr. nr St. Clere	C	12	8S	13E	BDR	KWRB	A
8892	Soldier Cr. nr Delia	C	5	10S	14E	BDR	CE KC	
8895	Soldier Cr. nr Topeka	C	14	11S	15E	BDR	CE KC	
8901	Delaware R. nr Muscotah	B,C	16	6S	17E	BDRT	CE KC	
890898	Perry Lake nr Perry		9	11S	18E	R	CE KC	
8909	Delaware R. bl Perry Dam	C,R	9	11S	18E	CR_2	CE KC	
8910	Kansas R. at Lecompton	C,R	34	11S	18E	BDRT	CE KC	
891478	Clinton Lake nr Lawrence		8	13S	19E	B	CE KC	
891483	Wakarusa R. bl Clinton Dam	C,R	15	13S	19E	BDRT	CE KC	
8920	Stranger Cr. nr Tonganoxie	B,C	7	11S	22E	BDRT	CE KC	
89235	Kansas R. at DeSoto	C,R	28	12S	22E	BDRT	KWRB	
89308	Blue R. nr Stanley	C	19	14S	25E	BDR	CE KC	
8933	Indian Cr. at Overland Park	C,H	6	13S	25E	BDR	KWRB	
89335	Tomahawk Cr. nr Overland Park	C	21	13S	25E	BDR	CE KC	
9108	Marais des Cygnes R. nr Reading	C	15	17S	13E	BDR	CE KC	
910997	Melvern Lake nr Melvern		1	18S	15E	R	CE KC	
9115	Salt Cr. nr Lyndon	B,C,H	34	16S	16E	BDR	KWRB	
9119	Dragoon Cr. nr Burlingame	C,H	27	15S	14E	BDR	CE KC	
91249	Pomona Lake nr Quenemo		19	16S	17E	R	CE KC	
9125	Hundred and Ten Mile Cr. nr Quenemo	C,R	20	16S	17E	BCDRT	CE KC	
9130	Marais des Cygnes R. nr Pomona	C,R	7	17S	18E	BDRT	CE KC	
9135	Marais des Cygnes R. nr Ottawa	C,R	36	16S	19E	BDRT	CE KC	
9140	Pottawatomie Cr. nr Garnett	C	6	20S	20E	BDR	KWRB	
9150	Big Bull Cr. nr Hillsdale	C	20	16S	23E	BCDR	CE KC	
9166	Marais des Cygnes R. nr Kansas-Missouri State Line	C,R	16	21S	25E	BDRT	KWRB	
9170	Little Osage R. at Fulton	B,C	25	23S	24E	BDR	KWRB	
91738	Marmaton R. nr Marmaton	C	4	26S	24E	BCDR	CE KC	

Table 1.--Complete-record surface-water gaging stations--Continued

Arkansas River Basin

Ident. no. 07-	Station name	Station purpose	Location Sec.	T.	R.	Type of gage	Coop. or support	Remarks
1370	Frontier Ditch nr Coolidge	C	21	23S	43W	RRT	CBR	
1375	Arkansas R. nr Coolidge	C,R	26	23S	43W	BDT	CBR ARCA	
1380	Arkansas R. at Syracuse	C,R	18	24S	40W	BDRT	KWRB	A
13865	Whitewoman Cr. nr Leoti	C,H	23	18S	38W	BR	KWRB	A
1395	Arkansas R. at Dodge City	C,R	35	26S	25W	BDRT	CE A	
1398	Mulberry Cr. nr Dodge City	H	24	28S	25W	BR	KWRB	
1400	Arkansas R. nr Kinsley	C,R	26	24S	19W	BDRT	CE A	
1407	Guzzler s Gulch nr Ness City	H	23	20S	24W	BR	KWRB	A
1412	Pawnee R. at Larned	B,C	30	21S	18W	BDRW	KWRB	
1413	Arkansas R. at Great Bend	C,R	33	19S	13W	BDRT	CE A	
14178	Walnut Cr. nr Rush Center	C,P	24	18S	19W	BDR	KWRB	
1419	Walnut Cr. at Albert	C,P	29	18S	15W	R	KWRB	
1423	Rattlesnake Cr. nr Macksville	P	16	25S	14W	BR	KWRB	
142575	Rattlesnake Cr. nr Zenith	C,P	26	22S	11W	BR	USFW	
14262	Rattlesnake Cr. nr Raymond	C,P	15	21S	10W	BR	KWRB	
14286	Cow Cr. nr Claflin	H	6	18S	11W	BR	KWRB	
1429	Blood Cr. nr Boyd	H	34	17S	14W	BR	KWRB	
1433	Cow Cr. nr Lyons	C,R	15	20S	8W	BDRT	KWRB	
14333	Arkansas R. nr Hutchinson	C,R	21	24S	4W	BDR	KWRB	
143665	Little Ark. R. at Alta Mills	H,P	30	22S	2W	BR	KWRB	
1442	Little Ark. R. at Valley Center	B,C	36	25S	1W	BDR	KWRB WDPW	
1443	Arkansas R. at Wichita	C,P	5	28S	1E	BDRT	KWRB WDPW	
14455	Arkansas R. at Derby	C,P	12	29S	1E	BDRT	CE T	
14478	N. Fk. Ninnescah R. ab Cheney Reservoir	C,P	25	25S	6W	BR	WWD	
14479	Cheney Reservoir at Cheney		6	27S	4W	BR	WWD	
144795	N. Fk. Ninnescah R. at Cheney Dam	C,R	6	27S	4W	DW	WWD	
14485	S. Fk. S. Fk. Ninnescah R. nr Pratt	H	26	28S	14W	BR	KWRB	
1452	S. Fk. Ninnescah R. nr Murdock	C,P	34	28S	5W	R	KWRB	
1455	Ninnescah R. nr Peck	C,R	10	30S	1W	BDR	CE T	
1457	Slate Creek at Wellington	H	23	32S	1W	BR	KWRB	

Table 1.--Complete-record surface-water gaging stations--Continued

Ident. no. 07-	Station name	Station purpose	Location Sec.	T.	R.	Type of gage	Coop. or support	Remarks
1465	Arkansas R. at Arkansas City	C,P	35	34S	3E	BDRT	CBR CE T	
14657	Cole Cr. nr DeGraff	H	21	24S	6E	BDR	KWRB	A
14707	Whitewater R. at Towanda	C,P	8	26S	4E	BDR	KWRB	
1478	Walnut R. at Winfield	C	33	32S	4E	BDRT	CE T	
1490	Medicine Lodge R. nr Kiowa	B,P	36	34S	11W	BR	KWRB	
1515	Chikaskia R. nr Corbin	P	36	33S	3W	BDR	KWRB	
15559	Cimarron R. nr Elkhart	H	4	34S	42W	BR	KWRB	
15601	N. Fk. Cimarron R. at Richfield	H	16	32S	41W	BR	KWRB	
1561	Sand Arroyo Cr. nr Johnson	H	25	29S	41W	BR	KWRB	A
15622	Bear Cr. nr Johnson	H	12	28S	41W	BR	KWRB	
1575	Crooked Cr. nr Nye	B,H	1	35S	27W	BR	KWRB	
157740	Cimarron River nr Buttermilk	H	3	35S	20W	DR	CE T	
1579	Cavalry Cr. at Coldwater	C,H	14	32S	19W	BR	KWRB	
157940	Bluff Creek nr Buttermilk	H	3	35S	20W	BR	CE T	
1659	Toronto Lake nr Toronto		36	26S	13E	R	CE T	
1660	Verdigris R. nr Coyville	C,R	8	27S	14E	DR	CE T	
1665	Verdigris R. nr Altoona	C,R	29	29S	16E	DR	CE T	
1675	Otter Cr. at Climax	B,H	8	27S	11E	DR	KWRB	
1680	Fall River Lake nr Fall River		3	28S	12E	R	CE T	
1685	Fall R. nr Fall River	C,R	2	28S	12E	DR	CE T	
1695	Fall R. at Fredonia	C,R	24	29S	14E	DR	CE T	
1698	Elk R. at Elk Falls	C	3	31S	11E	BDR	KWRB	
17005	Elk City Lake nr Independence		9	32S	15E	R	CE T	
17006	Elk R. bl Elk City Lake	C,R	9	32S	15E	BDR	CE T	
1705	Verdigris R. at Independence	C,R	32	32S	16E	BDRT	CE T	
1707	Big Hill Cr. nr Cherryvale	C,H	7	32S	18E	BDR	CE T	
1720	Caney R. nr Elgin	C	16	35S	10E	BDR	KWRB	
1794	Council Grove Lake nr Council Grove		10	16S	8E	BR	CE T	
1795	Neosho R. at Council Grove	C,R	14	16S	8E	DR	CE T	
17973	Neosho R. nr Americus	C,R	24	18S	10E	BDRT	CE T	
179794	Marion Lake nr Marion		27	19S	3E	BR	CE T	
179795	Cottonwood R. bl Marion Lake	C,R	27	19S	3E	BCDR	CE T	
1804	Cottonwood R. nr Florence	C,R	10	21S	5E	BDR	CE T	
1805	Cedar Cr. nr Cedar Point	C,H	25	21S	5E	DR	KWRB	
18225	Cottonwood R. nr Plymouth	C,R	13	19S	9E	BDR	CE T	

Table 1.--Complete-record surface-water gaging stations--Continued

Ident. no. 07-	Station name	Station purpose	Location Sec.	T.	R.	Type of gage	Coop. or support	Remarks
18245	John Redmond Res. nr Burlington		9	21S	15E	BR	CE T	
18251	Neosho R. at Burlington	C,R	26	21S	15E	BDR	CE T	
1830	Neosho R. nr Iola	C,R	9	25S	18E	BCDRT	CE T	
1835	Neosho R. nr Parsons	C,R	33	31S	21E	BDRTW	KWRB	
1840	Lightning Cr. nr McCune	B	7	32S	22E	BDR	KWRB	
1843	Cherry Creek at Hallowell	C	21	33S	22E	BDR	KDHE	
18604	Cow Creek near Weir	C	33	31S	25E	BDR	KDHE	

Table 2.--Partial-record surface-water gaging stations

Crest-Stage Gage

Ident. no. 06-	Station name	Location Sec.	T.	R.	Coop. or support	Remarks
	Missouri River Basin					
8137	Tennessee Cr. trib. nr Seneca	2	3S	12E	KDOT	
8157	Buttermilk Cr. nr Willis	30	3S	18E	KDOT	
81826	White Clay Cr. at Atchison	1	6S	20E	CE KC	
8448	S. Fk. Sappa Cr. trib. nr Goodland	36	8S	39W	KDOT	A
8451	Long Branch Draw nr Norcatur	6	2S	25W	KDOT	
8460	Beaver Cr. at Ludell	30	2S	32W	KWRB	A
8462	Beaver Cr. trib. nr Ludell	2	3S	32W	KDOT	A
8476	Prairie Dog Cr. trib. at Colby	6	8S	33W	KDOT	AB
8482	Prairie Dog Cr. trib. nr Norton	26	2S	23W	KDOT	
8561	West Cr. nr Talmo	36	4S	3W	KDOT	
85632	Elk Cr. at Clyde	26	5S	1W	CE KC	
8568	Moll Cr. nr Green	8	8S	4E	KDOT	
8605	Hackberry Cr. nr Gove	1	13S	29W	KWRB	A
8630	Smoky Hill R. at Pfeifer	30	15S	16W	CE KC	
8634	Big Cr. trib. nr Ogallah	11	13S	22W	KDOT	
8637	Big Cr. trib. nr Hays	7	14S	17W	KDOT	
8643	Smoky Hill R. trib. at Dorrance	12	14S	12W	KDOT	AB
8647	Spring Cr. nr Kanopolis	24	15S	8W	KDOT	AB
86649	Dry Cr. at Mentor	24	15S	3W	CE KC	
8668	Saline R. trib. at Collyer	32	11S	25W	KDOT	A
8683	Coon Cr. trib. nr Luray	19	10S	12W	KDOT	
8684	Wolf Cr. nr Lucas	33	11S	11W	KWRB	
8689	Bullfoot Cr. trib. nr Lincoln	30	12S	7W	KDOT	AB
86995	Mulberry Cr. nr Salina	9	14S	3W	CE KC	
8703	Gypsum Cr. nr Gypsum	15	16S	1W	KWRB	C
8726	Oak Cr. at Bellaire	15	3S	12W	KDOT	
8733	Ash Cr. trib. nr Stockton	18	7S	18W	KDOT	
8745	East Limestone Cr. nr Ionia	21	4S	9W	KDOT	
8758	Limestone Cr. nr Glen Elder	15	6S	9W	KWRB	
87712	Mud Cr. at Abilene	17	13S	2E	CE KC	

Table 2.--Partial-record surface-water gaging stations--Continued

Ident. no. 06-	Station name	Location Sec.	T.	R.	Coop. or support	Remarks
8775	Turkey Cr. nr Abilene	26	14S	2E	KWRB	
8785	Lyon Cr. nr Woodbine	31	13S	5E	CE KC	CE
8792	Clark Cr. nr Junction City	14	12S	6E	KWRB	
879815	Wildcat Cr. at Manhattan	14	10S	7E	KWRB	
87982	Kansas R. at Manhattan	--	10S	8E	CE KC	CE
8841	Mulberry Cr. trib. nr Haddam	10	3S	1E	KDOT	
8843	Mill Cr. trib. nr Washington	5	3S	4E	KDOT	AB
8847	Big Blue R. nr Blue Rapids	21	4S	7E	CE KC	CE
8849	Robidoux Cr. at Beattie	20	2S	9E	KDOT	
88549	Black Vermillion R. at Frankfort (Hwy 99)	16	4S	9E	CE KC	D
8865	Fancy Cr. at Winkler	2	7S	5E	KWRB	
8872	Cedar Cr. nr Manhattan	19	9S	8E	KDOT	
8876	Kansas R. trib. nr Wamego	14	10S	10E	KDOT	
8880	Vermillion Cr. nr Wamego	20	8S	11E	CE KC	
88803	Vermillion Cr. nr Louisville	12	9S	10E	CE KC	
8883	Rock Cr. nr Louisville	14	9S	9E	KWRB	
8884	Kansas R. at Maple Hill	1	11S	12E	CE KC	D
8889	Blacksmith Cr. trib. nr Valencia	10	12S	14E	KDOT	
88955	Indian Cr. nr Topeka	5	11S	16E	CE KC	
88963	Shunganunga Cr. at Topeka	6	12S	16E	KC CE	
89105	Stone House Cr. at Williamstown	30	11S	19E	KDOT	
89165	Naismith Cr. at Lawrence	12	13S	19E	KWRB	
89185	Stranger Cr. at Easton	19	8S	21E	CE KC	D
8928	Turkey Cr. at Merriam	13	12S	24E	KWRB	
89294	Turkey Cr. at Kansas City	27	11S	25E	KWRB	
89295	Kansas R. at Kansas City	14	11S	25E	CE KC	BCE
9114	Marais des Cygnes R. at Quenemo	22	17S	17E	CE KC	CE
9123	Dragoon Cr. trib. nr Lyndon	6	16S	16E	KDOT	
9137	Middle Cr. nr Princeton	13	18S	19E	KDOT	
91425	S. Fk. Pottawatomie Cr. trib. nr Garnett	7	21S	20E	KDOT	
9145	Pottawatomie Cr. at Lane	34	18S	21E	CE KC	D
9151	Big Bull Cr. at Paola	17	17S	23E	CE KC	
9167	Middle Cr. nr Kincaid	11	23S	20E	KDOT	
9171	Marmaton R. nr Bronson	3	25S	21E	KDOT	
9174	Marmaton R. trib. nr Fort Scott	9	26S	24E	KDOT	

Table 2.--Partial-record surface-water gaging stations--Continued

Ident. no. 07-	Station name	Location Sec.	T.	R.	Coop. or support	Remarks
		Arkansas River Basin				
1386	Whitewoman Cr. trib. nr Selkirk	34	17S	39W	KDOT	A
1390	Arkansas R. at Garden City	--	24S	32W	KWRB	CE
1397	Arkansas R. trib. nr Dodge City	11	27S	25W	KDOT	AB
1403	Whitewoman Cr. nr Bellefont	33	24S	21W	KDOT	AB
1406	Pawnee R. trib. nr Kalvesta	12	23S	28W	KDOT	A
1416	Long Branch Cr. nr Ness City	32	18S	23W	KDOT	A
1418	Otter Cr. nr Rush Center	15	19S	18W	KDOT	
1421	Rattlesnake Cr. trib. nr Mullinville	20	28S	19W	KDOT	AB
1427	Salt Cr. nr Partridge	22	23S	7W	KDOT	
1431	Cheyenne Cr. trib. nr Claflin	28	18S	11W	KDOT	
1436	Little Arkansas R. nr Little River	8	19S	6W	KWRB	
14422	Chisholm Cr. at 69th St. N., Wichita	4	26S	1E	WDPW	C
14423	W. Br. Chisholm Cr. at 61st St. N., Wichita	17	26S	1E	WDPW	C
14424	N. Fk. Chisholm Cr. at 45th St. N., Wichita	27	26S	1E	WDPW	C
14432	Gypsum Cr. at Gilbert St., Wichita	29	27S	2E	WDPW	C
144323	Fabrique Br. Gypsum Cr. at Harry St., Wichita	36	27S	1E	WDPW	AB
144325	Gypsum Cr. at Oliver St., Wichita	2	28S	1E	WDPW	C
14433	Dry Cr. at Lincoln St., Wichita	25	27S	1E	WDPW	AB
14434	Dry Cr. at Pawnee Ave., Wichita	2	28S	1E	WDPW	AB
144494	Cowskin Cr. trib. at Westfield Drive, Wichita	20	27S	1W	WDPW	C
144495	Cowskin Cr. trib. at Clearwater Road, Wichita	30	27S	1W	WDPW	C
14452	Big Slough Cr. at Ridge Road, Wichita	33	26S	1W	WDPW	C
14453	Spring Cr. at Woodlawn St., Wichita	29	29S	2E	WDPW	C
1449	S. Fk. Ninnescah R. trib. nr Pratt	27	27S	13W	KDOT	
1453	Clear Cr. nr. Garden Plain	33	27S	3W	KDOT	AB

Table 2.--Partial-record surface-water gaging stations--Continued

Ident. no. 07-	Station name	Location Sec.	T.	R.	Coop. or support	Remarks
1458	Antelope Cr. trib. nr Dalton	11	32S	1E	KDOT	
14702	Whitewater R. trib. nr Towanda	26	25S	3E	KDOT	
14799	Cedar Cr. trib. nr Cambridge	26	31S	7E	KDOT	
1481	Grouse Cr. nr Dexter	31	32S	7E	KWRB	
1516	Rush Cr. nr Harper	21	32S	7W	KDOT	AB
1559	N. Fk. Cimarron R. trib. nr Elkhart	9	33S	42W	KDOT	
1566	Cimarron R. trib. nr Moscow	20	31S	34W	KDOT	
1567	Cimarron R. trib. nr Satanta	17	32S	33W	KDOT	
1571	Crooked Cr. nr Copeland	36	28S	30W	KDOT	A
1574	Crooked Cr. trib. at Meade	2	32S	28W	KDOT	
1577	Kiger Cr. nr Ashland	3	33S	24W	KDOT	
1662	Sandy Cr. nr Yates Center	26	25S	14E	KDOT	
1708	Mud Cr. nr Mound Valley	9	33S	18E	KDOT	
1717	Spring Branch nr Cedar Vale	7	34S	9E	KDOT	
1718	Cedar Cr. trib. nr Hooser	7	34S	8E	KDOT	
1803	Spring Cr. trib. nr Florence	32	21S	5E	KDOT	
1815	Middle Cr. nr Elmdale	13	19S	6E	KWRB	
1826	N. Big Cr. nr Burlington	27	22S	15E	KDOT	
1832	Neosho R. nr Chanute	4	27S	18E	CE T	CE
1838	Limestone Cr. nr Beulah	28	30S	23E	KDOT	
18407	Deer Cr. nr Hallowell	28	32S	22E	KDHE	B
18422	Cherry Cr. nr West Mineral	29	32S	23E	KDHE	B
18424	Little Cherry Cr. nr West Mineral	32	32S	23E	KDHE	B
1845	Labette Cr. nr Oswego	11	33S	20E	KWRB	
18601	Second Cow Cr. at Pittsburg	25	30S	24E	KDHE	B
18605	Brush Cr. nr Weir	31	31S	25E	KDHE	B

Table 2.--Partial-record surface-water gaging stations--Continued

Low-Flow Gage

Ident. no. 07-	Station name	Location Sec.	T.	R.	Coop. or support	Remarks
		Arkansas River Basin				
14124	Pickerel Cr. nr Larned	33	21S	15W	KWRB	
14220	Rattlesnake Cr. nr Haviland	10	27S	17W	KWRB	
14227	Rattlesnake Cr. trib. nr Hopewell	29	25S	15W	KWRB	
14254	Wild Horse Cr. nr St. John	9	23S	13W	KWRB	
14265	Peace Cr. nr Sylvia	4	23S	10W	KWRB	
14267	Peace Cr. nr Sterling	7	22S	8W	KWRB	
14274	Salt Cr. nr Hutchinson	1	23S	7W	KWRB	
14459	N. Fk. Ninnescah R. nr Sylvia	27	24S	10W	KWRB	
14462	N. Fk. Ninnescah R. ab Silver Cr. nr Arlington	25	25S	8W	KWRB	
14464	Silver Cr. nr Landon	8	26S	9W	KWRB	
14466	Silver Cr. nr Arlington	28	25S	8W	KWRB	
14468	Goose Cr. nr Arlington	4	26S	8W	KWRB	
14474	Red Rock Cr. nr Castleton	5	25S	6W	KWRB	
14489	S. Fk. Ninnescah R. at Pratt	3	28S	13W	KWRB	
14513	S. Fk. Ninnescah R. nr Calista	1	27S	9W	KWRB	
14522	Smoot's Cr. nr Murdock	6	28S	5W	KWRB	
14820	Mule Cr. nr Wilmore	3	32S	16W	KWRB	
14858	Turkey Cr. nr Croft	27	29S	15W	KWRB	
14860	Medicine Lodge R. at Sun City	2	31S	15W	KWRB	
14890	Elm Cr. at Medicine Lodge	12	32S	12W	KWRB	
1512	Chikaskia R. nr Zenda	34	29S	9W	KWRB	
15129	Sand Cr. nr Zenda	27	30S	9W	KWRB	

Table 3.--Ground-water-level observation wells

County	Well number	Water-level notes
Allen	24S 18E 28CDD	Q
Barber	31S 15W 19BDB	A
	32S 11W 30BBA	Q
	32S 12W 04DBC	Q
	33S 11W 28CBB	Q
	34S 15W 17ADA	A
	35S 15W 11CB	A
Barton	18C 15W 28CCC3	Q
Bourbon	25S 24E 36AAC	Q
Cherokee	33S 25E 09DAD	Q
	34S 25E 13BAC	B
Cheyenne	03S 37W 19BBC	Q
	03S 39W 32BDB	Q
	05S 38W 22ACB	Q
	05S 40W 14BCD	Q
	05S 42W 14CBC	Q
Clark	30S 23W 06AAA	Q
	33S 22W 30CBC	Q
Clay	06C 01E 02BCD	Q
	06S 02E 29DAC	Q
	08S 02E 02CCA	Q
Cloud	05S 02W 01BAC	Q
Comanche	31S 18W 19ACB	Q
Crawford	29S 23E 24DBA	Q
	30S 24E 19ADD	Q
Decatur	01S 29W 19BDD	Q
	02S 29W 24BCC	Q
	03S 29W 12BBA	Q
	04S 26W 08DDD	Q
Douglas	12S 19E 13ADA	Q
	12S 20E 07CBC	Q
	12S 20E 17CCB	R
	13S 21E 05DBB	Q
	15E 19E 15AAD	Q
Edwards	23S 19W 22CCC	Q
	24S 17W 24DDD	Q
	24S 18W 36DDC	Q
	24S 19W 34ADD	Q
	25S 16W 31DAD	Q
	25S 18W 09AAA	Q
	25S 18W 33CDC	Q
	26S 19W 12ABB2	Q
Ellis	14S 18W 12AAD	Q
	14S 18W 12ABB	Q
Ellsworth	17S 09W 20BCD	Q
	17S 09W 21BCC	Q
	17S 09W 21BCC2	Q
	17S 09W 28CBB	Q
	17S 09W 28CBB2	Q
	17S 09W 31AAB	Q
	17S 09W 31AAB2	Q
	17S 09W 31ADC	Q
Finney	21S 32W 20CBC	Q
	21S 34W 14DBB	Q
	22S 27W 14ADC	Q
	22S 33W 22BAA	Q
	22S 33W 36AAA2	Q
	22S 34W 26ADD	Q
	23S 27W 12CCC	Q
	23S 33W 17BBB	Q
	23S 33W 28CDC	Q
	23S 34W 21DDC	R
	24S 31W 27CCB	Q
	24S 32W 03DAC	Q
	24S 33W 09CCD	R
	24S 33W 09CCD2	R
	24S 33W 22DCA	Q
	24S 33W 28DAA	Q
	25S 32W 31DD	Q
	25S 33W 05ABD	Q
	25S 33W 09ABD	Q
	25S 33W 15DAC	Q
	25S 33W 17DBD	Q
	25S 33W 35DBD	Q
	25S 34W 06AAA	Q
	25S 34W 10ABB	Q
	25S 34W 34DBD	Q
	26S 33W 26ABB	Q

Table 3.--Ground-water-level observation wells--Continued

County	Well number	Water-level notes
Ford	25S 22W 20AAA	Q
	25S 22W 27CCD	Q
	25S 23W 11CCC	B
	25S 23W 12BBB	Q
	25S 23W 14ADD	Q
	26S 21W 17DBC	Q
	26S 21W 23ADA	Q
	26S 23W 10DAD	Q
	26S 24W 29DDD	Q
	26S 24W 31DDA	Q
	26S 24W 32CBA	Q
	26S 24W 32DDA	Q
	26S 24W 33CDA	Q
	26S 25W 34BBB	Q
	26S 26W 32DCC	Q
	27S 23W 24BCB	Q
	27S 24W 03BBD	Q
	27S 24W 03CDD	R
	27S 24W 04BBC	Q
	27S 24W 09AAD	M
	27S 24W 16BDB	Q
	28S 24W 08DCC	Q
	28S 25W 06ABB	Q
	28S 26W 13CAA	Q
	29S 21W 05BBB	Q
	29S 26W 29ABB	Q
Geary	11S 06E 27CBB	Q
Gove	11S 26W 04CDC	Q
	11S 27W 16AAA	Q
	11S 27W 26BCC	Q
	11S 29W 04DAD	Q
	11S 30W 27ABB	Q
Graham	06S 23W 12CCB	A
	06S 24W 28BAB	Q
	06S 24W 35DDD	Q
	06S 25W 28CBC	Q
	08S 23W 24BBD	Q
Grant	27S 35W 17ADD	Q
	27S 37W 04ABB	Q
	27S 38W 15BBB	Q
	27S 38W 23CB	Q
	27S 38W 32BCC	R
Grant (continued)	28S 36W 21CDD	Q
	28S 37W 02BBB3	Q
	28S 38W 07BBB	Q
	28S 38W 12DDD	Q
	28S 38W 17AAA	Q
	28S 38W 33BD3	Q
	29S 35W 06BAA	Q
	29S 38W 35CCD	Q
	30S 36W 01BBB	Q
	30S 36W 32BBC	Q
	30S 37W 03DBA	Q
	30S 37W 20CBC	Q
Gray	24S 28W 36ACA	Q
	24S 30W 15CCC	Q
	26S 29W 35CCC	Q
	27S 27W 25CCD	Q
	27S 30W 23BB	Q
	28S 30W 17BBA	Q
	28S 30W 24BAB	Q
	29S 28W 28CDC	Q
	29S 29W 10BBB	Q
Greeley	16S 39W 02BDC	Q
	16S 39W 22DCB	Q
	16S 40W 18DBA	Q
	16S 41W 20BAD	Q
	17S 39W 02BAA	Q
	17S 39W 22ABB	Q
	17S 40W 15CCB	Q
	17S 40W 31BBA	Q
	17S 42W 27CBB	Q
Hamilton	24S 40W 17BBB	Q
	26S 42W 17CB	Q
	26S 42W 22CDB	Q
Harvey	24S 02W 16BAA	Q
Haskell	27S 33W 29DAA	Q
	27S 34W 16DDD3	Q
	28S 32W 18BBB	Q
	28S 32W 24BCC	Q
	28S 33W 21BCC	Q
	29S 32W 26CBB2	Q

Table 3.--Ground-water-level observation wells--Continued

County	Well number	Water-level notes
Haskell (continued)	29S 33W 28BCB	Q
	29S 34W 11ADD	Q
	30S 31W 15ABB	Q
	30S 32W 11BBB	Q
	30S 32W 31BAB	Q
	30S 33W 30CBD	Q
	30S 34W 05BBB	Q
	30S 34W 30ADD2	Q
Hodgeman	21S 22W 12BCB	Q
	22S 22W 13CCC	Q
	22S 23W 31ADD	Q
	22S 24W 14BBC	Q
	22S 24W 15BDA	Q
	22S 24W 16ADB2	Q
	22S 24W 24DDD	A
	22S 24W 25DDC	Q
	22S 24W 26DDA	A
	22S 24W 35DAC	Q
	23S 22W 07DAA	Q
	23S 23W 04AAD	Q
	23S 23W 04DCA	A
	23S 23W 12ABD	A
	23S 24W 11DAA	Q
	23S 24W 28BCC	Q
	23S 25W 22DBB	Q
	23S 26W 07CCC	Q
	24S 23W 06AAB	Q
	24S 26W 35CBC	Q
Jackson	06S 15E 27BAB	Q
Jefferson	11S 16E 25CBA	Q
	11S 17E 21ADA	Q
	11S 17E 27BBC	Q
	11S 18E 08DAC	Q
	11S 18E 20ACC	Q
	11S 19E 27BCC	Q
	11S 19E 29CCA	Q
Johnson	11S 23E 33BDD	Q
	12S 22E 21CCC	Q
	12S 22E 25BCC	Q
	12S 22E 29BBD	Q
Kearny	23S 35W 12CCC	Q
	23S 37W 04ABC	Q
	24S 35W 13CCC2	Q
	25S 35W 02BAA	Q
	25S 35W 17AAA	Q
	25S 35W 26BAB	Q
	25S 36W 28BBD	Q
	25S 37W 15ABA2	Q
	26S 36W 04BDA	Q
Kingman	27S 10W 03DDD	Q
	28S 07W 29CDD	Q
	30S 05W 12CCA	Q
Kiowa	27S 17W 21ACC	Q
	27S 18W 13AAA	Q
	27S 18W 18DCD	Q
	27S 20W 26ABD	Q
	28S 19W 10ADB	Q
	29S 18W 02ACC	Q
Labette	31S 21E 15CCC2	Q
Lane	17S 28W 26ABB	Q
	17S 30W 13CBB	Q
	18S 27W 13CCC	Q
	18S 30W 02AAA	Q
Leavenworth	12S 22E 21BCD	Q
	12S 22E 22CAA	Q
Logan	11S 32W 04ACD	Q
	11S 32W 19AAB	Q
	11S 36W 06ADD2	Q
McPherson	17S 03W 04BBB	Q
	17S 03W 17DDD	Q
	17S 04W 34AAA	Q
	17S 05W 07CBB	Q
	17S 05W 25AAA	Q
Meade	30S 27W 22CDD	Q
	30S 27W 32DDD	Q
	30S 30W 28ABB	Q

Table 3.--Ground-water-level observation wells--Continued

County	Well number	Water-level notes
Meade (continued)	32S 28W 04ADD	Q
	33S 28W 29BCB	Q
	33S 30W 35CB	Q
Morton	31S 39W 33BCC	Q
	31S 40W 29ABB	Q
	31S 43W 14DDC	Q
	32S 42W 21BCC	Q
	33S 40W 27CCC	Q
	33S 41W 03AAD	Q
	35S 40W 03BBB	Q
Ness	18S 21W 31CAA	Q
	19S 23W 01CCB	Q
	19S 23W 08CBB	Q
	20S 22W 20CCC	Q
	20S 23W 32CDA	Q
Osborne	06S 12W 23CDC	Q
	07S 12W 28ABA	Q
	07S 15S 08CCC2	Q
	07S 15W 10CCC	Q
Pawnee	21S 18W 32DAA	Q
	21S 19W 30BCC	Q
	21S 20W 29BBB	Q
	22S 15W 03AAA	Q
	22S 15W 03AAA2	Q
	22S 16W 06BBA	Q
	22S 16W 23AAA	Q
	22S 17W 18AAD	Q
	22S 19W 07AAA	Q
	22S 19W 10BBA	Q
	23S 16W 35CCD	Q
	23S 18W 28DAD	O
Phillips	04S 18W 23CDC	Q
Potta-watomie	09S 11E 19CDB	Q
	09S 11E 27CAA	Q
	09S 11E 31DCC	Q
	09S 11E 32ADC	Q
	09S 11E 34CAB	R
	09S 11E 35DDD	Q
Pottawatomie (continued)	10S 08E 12CBB	Q
	10S 08E 14CBA	Q
	10S 10E 10DBC	Q
	10S 11E 01CBC	R
	10S 11E 03BCA	Q
	10S 11E 04ACB	Q
	10S 12E 07BBC	Q
Pratt	26S 12W 34CDC	Q
	26S 12W 34CDC2	Q
	26S 13W 34BCB	Q
	26S 14W 17DCB	Q
	27S 12W 13ADD	Q
	27S 14W 12DDD	Q
	29S 13W 13AAA	Q
Rawlins	03S 33W 03DCC	Q
	03S 36W 17CCC	Q
	04S 36W 06BBB	Q
	05S 33W 29BDA	Q
Reno	22S 06W 33BAB	Q
	23S 06W 31DCB	Q
	23S 09W 35CCC	Q
	26S 10W 18CDC	Q
Republic	01S 03W 01CCA	Q
Rice	18S 09W 04BCC	Q
	18S 09W 04BCC2	Q
	18S 10W 24BBB	Q
	202 09W 12DDA	Q
Riley	10S 07E 34BAA2	Q
	10S 07E 35DBB	Q
	10S 08E 23CDC	Q
	10S 09E 17BDD	Q
	10S 09E 19BBA	Q
	11S 07E 01BCC	Q
Rooks	07S 17W 24BBB	Q
	07S 19W 23CDB	Q
Rush	18S 17W 14BCC	A

Table 3.--Ground-water-level observation wells--Continued

County	Well number	Water-level notes
Rush (continued)	18S 17W 14CCC	Q
	18S 17W 14CDC	A
	18S 17W 15DAA	Q
	18S 17W 22AAD	Q
	18S 17W 15DAA	Q
	18S 17W 22AAD	Q
	18S 17W 23BCC	Q
	18S 18W 22DDD	A
	18S 18W 27AAC	Q
	18S 18W 27CCB	A
	18S 19W 20ADD	Q
	18S 20W 14CCC	Q
	18S 20W 19AAD	Q
Saline	16S 02W 18BBB	Q
	16S 03W 23DDD	Q
Scott	16S 33W 19CBB	Q
	17S 32W 27BBB	Q
	17S 34W 06BCB	Q
	18S 32W 17ABA	Q
	18S 33W 05CCC	Q
	18S 33W 26DAD2	Q
	18S 34W 25BBD	Q
	19S 32W 06CCB	Q
	19S 32W 32ACB	Q
	19S 33W 15DBD	Q
	19S 33W 19CBB2	Q
	20S 32W 07CBA	Q
	20S 33W 09BBB	R
	20S 33W 21ABD	Q
Sedgwick	25S 01W 26DBD	Q
	26S 01W 19ABA	Q
	26S 01W 31CCC	Q
	26S 01W 31CCC2	Q
	26S 02W 02DDD	Q
	26S 02W 02DDD2	Q
	26S 02W 07AAA	Q
	26S 02W 07AAA2	Q
	26S 02W 10BBB	Q
	26S 02W 10DAA	Q
	26S 02W 14BAA	Q
	262 02W 14DDD	Q
	26S 02W 15CBC	Q
	26S 02W 15DBB	Q
Sedgwick (continued)	26S 02W 22ABA	Q
	26S 02W 23CCC	Q
	26S 02W 24DDD	Q
	26S 02W 29AAA	Q
	26S 02W 24DDD	Q
	26S 02W 29AAA	Q
	28S 01W 11BCB	Q
	28S 01W 11CCD	Q
	28S 01W 15ACA	Q
	28S 01W 36ADC	Q
Seward	31S 31W 08BCC	Q
	32S 32W 14BBB	Q
	32S 33W 21CDB	Q
	34S 33W 07CCB	Q
	35S 34W 10BBB	Q
Shawnee	11S 12E 01ABA	Q
	11S 13E 04ADA	Q
	11S 14E 13BBB	Q
	11S 14E 15ABB	Q
	11S 14E 18CBB	Q
	11S 14E 22CCC	Q
	11S 14E 24BBB	Q
	11S 15E 13DBC	Q
	11S 15E 14ADB	Q
	11S 15E 16DCA	R
	11S 15E 23DBD2	Q
	11S 15E 24DBD	Q
	11S 16E 19DDD	Q
	11S 16E 29ACA	Q
Sheridan	06S 30W 13BAA	Q
	07S 26W 19BBC	Q
	07S 28W 08BDC	Q
	07S 29W 27CCC	Q
	08S 30W 13DAA	Q
	09S 30W 35BBB	Q
	10S 30W 08DDD	Q
Sherman	06S 42W 02AAA	Q
	07S 37W 04BBC	Q
	07S 40W 36BAB	Q
	07S 41W 10BBA	Q
	08S 39W 15CCC	Q
	08S 40W 12DBA	Q

Table 3.--Ground-water-level observation wells--Continued

County	Well number	Water-level notes
Sherman (continued)	08S 40W 20CCC	Q
	08S 40W 25AAC	Q
	08S 42W 31DCD	Q
	09S 39W 19CCC	Q
	09S 40W 29BBB	Q
	09S 42W 08AAA	Q
	09S 42W 14AAA	Q
Stafford	21S 13W 27DDD2	Q
	22S 13W 29DAD	Q
	23S 13W 08CCB	Q
	23S 14W 30BBB	Q
	24S 13W 30BCB	Q
	25S 11W 23DDD	Q
	25S 13W 03BBB	Q
	25S 13W 16ACC	Q
Stanton	27S 39W 27BBA	Q
	27S 40W 21DAA	Q
	27S 42W 31CCC	Q
	28S 39W 14BBC	Q
	28S 39W 36ABB	Q
	28S 40W 12DDD2	Q
	29S 41W 13ACC	Q
	29S 42W 24CCC	Q
	30S 40W 24CDC	Q
	30S 43W 34BBB	Q
Stevens	31S 35W 19CCC	Q
	31S 36W 02CDD	Q
	31S 37W 22BCC	Q
	32S 35W 8DDD	Q
	33S 38W 20DDB	Q
	34S 35W 18BCA	Q
	34S 38W 02CDB	Q
Thomas	06S 32W 34CBC	Q
	06S 34W 01DDD	Q
	06S 34W 17CBC	Q
	06S 35W 26ACB	Q
	07S 31W 26CCC	Q
	07S 36W 17CCC	Q
	08S 32W 27DAB	Q
	08S 33W 34BBC	Q
Thomas (continued)	08S 34W 01BAC	R
	08S 36W 18ABA2	Q
	09S 32W 27BCD	Q
	09S 33W 26DAD	Q
	10S 33W 06BBC	Q
Trego	12S 23W 20CCC	Q
Wabaunsee	10S 10E 15DCC	Q
	10S 12E 29ADD	Q
Wallace	11S 38W 35CCC2	Q
	11S 42W 08DDC	Q
	13S 39W 33BBB	Q
	13S 42W 10BAC	Q
	14S 42W 14BDB	Q
	15S 38W 28DBB	Q
	15S 39W 02BCD	Q
	15S 39W 08ACC	Q
	15S 39W 26ACC	Q
	15S 40W 03BAB	Q
	15S 40W 26CAB	Q
	15S 41W 10BAB	Q
	15S 41W 36DDB	Q
Washington	05S 01E 20ADA	Q
	05S 01E 31DDD	Q
Wichita	16S 35W 20CCC	Q
	16S 37W 13BBC	Q
	16S 37W 30ACB	Q
	16S 38W 10ABB	Q
	17S 35W 30CBB	Q
	17S 36W 33BCB	Q
	17S 37W 28CCC	Q
	18S 35W 14DCD	Q
	18S 37W 21BBB	Q
	18S 38W 20ACC2	Q
Wyandotte	11S 24E 14BDA	Q
	11S 24E 31DAB	Q
	11S 24E 32ABA2	Q
	11S 25E 20BAB2	Q

Table 4.--Surface-water-quality stations

Missouri River Basin

Ident. no. 06-	Station name	Sampling purpose (frequency code)	Coop. or support	Remarks
81557	Wolf R. 3 mi south of Hiawatha	SED(9)	SCS	
815578	Wolf R. at Hiawatha	SED(9),CHEM(1), METAL(1), METALB(1), PEST(1), PESTB(1)	SCS	
8156	Wolf R. nr Hiawatha	SED(9)	SCS	
8158	Wolf R. at Leona	SED(9)	SCS	
81588	Wolf R. nr Sparks	SED(9),CHEM(1),METAL(1), METALB(1),PEST(1),PESTB(1)	SCS	
8447	S. Fk. Sappa Cr. nr Brewster	SED(12)	KWRB	
8465	Beaver Cr. at Cedar Bluffs	SED(12),BED(2)	KWRB	
8469	Prairie Dog Cr. ab Norton Res	SED(12)	KWRB	
84795	Norton Res. nr Norton	CHEM(1),COLI(4),FIELD(8)	WPRS	
8538	White Rock Cr. nr Burr Oak	SED(12)	KWRB	
8566	Republican R. at Clay Center	CHEM(12),BIOL(7),TOC(12), METAL(4),COLI(12),FIELD(12), OBS(13)	NASQAN	MONITOR
8585	N. Fk. Smoky Hill R. nr McAllaster	SED(12)	KWRB	
8615	Cedar Bluff Res. nr Ellis	CHEM(1),COLI(4),FIELD(8)	WPRS	
8635	Big Cr. nr Hays	SED(12)	KWRB	
8639	N. Fk. Big Cr. nr Victoria	SED(12)	KWRB	
8670	Saline R. nr Russell	SED(12)	KWRB	
8695	Saline R. at Tescott	SED(12),BED(2)	KWRB	
8710	N. Fk. Solomon R. at Glade	SED(12)	KWRB	
8719	Deer Cr. nr Phillipsburg	SED(12)	KWRB	
8725	N. Fk. Solomon R. at Portis	CHEM(8),FIELD(8)	WPRS	
8730	S. Fk. Solomon R. at Webster Res.	SED(12)	KWRB	
87346	S. Fk. Solomon R. at Woodston	CHEM(8),FIELD(8)	WPRS	
8737	Kill Cr. nr Bloomington	SED(12)	KWRB	

Table 4.--Surface-water-quality stations--Continued

Ident. no. 06-	Station name	Sampling purpose (frequency code)	Coop. or support	Remarks
8740	S. Fk. Solomon R. at Osborne	CHEM(8),FIELD(8)	WPRS	
8759	Solomon R. nr Glen Elder	CHEM(1),COLI(4),FIELD(8)	WPRS	
87644	Solomon R. nr Minneapolis	CHEM(12),FIELD(12),COLI(4)	WPRS	
8769	Solomon R. at Niles	SED(12),BED(2)	KDHE	
8776	Smoky Hill R. at Enterprise	CHEM(12),BIOL(7),TOC(12) METAL(4),SED(12),BED(2) COLI(12),FIELD(12), OBS(13),PEST(4)	NASQAN EPA KWRB	MONITOR
87965	Kings Cr. nr Manhattan	CHEM(12),METAL(2),RAD(1), PEST(1),COLI(12),FIELD (12)	BENCH-MARK	
8844	Little Blue R. nr Barnes	SED(12)	KWRB	
8870	Big Blue R. nr Manhattan	CHEM(12),BIOL(7),TOC(12), METAL(4),SED(12),COLI(12), FIELD(12),OBS(13)	NASQAN	
8875	Kansas R. at Wamego	SED(12),BED(2)	KWRB	
8910	Kansas R. at Lecompton	SEDPT(12),BED(12)	CE KC	
8920	Stranger Cr. nr Tonganoxie	SED(12)	KWRB	
89235	Kansas R. at DeSoto	CHEM(12),BIOL(7),TOC(12), METAL(4),SEDPT(12),BED (12),COLI(12),FIELD(12), OBS(13), PEST(4)	CE KC	
9119	Dragoon Cr. nr Burlingame	SED(12)	KWRB	
9140	Pottawatomie Cr. nr Garnett	SED(12)	KWRB	
915977 to 9170	(4 coal-hydrology sites)	CHEM(12),METAL(12),FIELD (12),PEST(4),RAD(4), BED(4),BIO(4),COAL(4), SED(9),CHEMB(4)		Selected sites for monitor
88958 to 8897	(6 Topeka Urban Runoff sites)	BIOL(6)(9),COLI(6)(9), CHEM(9),METAL(9),SED(9), BED(9),FIELD(9)		Selected sites for monitor
6 Lat-Long	(coal-hydrology sites)	CHEM(12),METAL(12),FIELD(12), PEST(4),RAD(4),BED(4),BIO(4), COAL(4),SED(9),CHEMB(4)		Selected sites for monitor
24 Lat-Long	(Topeka Urban Runoff sites)	BIOL(6)(9),COLI(6)(9), CHEM(9),METAL(9),SED(9) BED(9),FIELD(9)		Selected sites for monitor
14 Lat-Long	(coal-hydrology sites)	CHEM(4),METAL(4),FIELD(4), PEST(4),RAD(4),BED(4),BIO(4), COAL(4),SED(9),CHEMB(4)		Selected sites for monitor

Table 4.--Surface-water-quality stations--Continued

Ident. no. 06-	Station name	Sampling purpose (frequency code)	Coop. or Support	Remarks
----	Six mile Cr. Trib. 5 mi NE of Auburn lat 38'57°18" long 95'46°40"	SED(9),CHEM(1)	SCS	
----	Six mile Cr. Trib. 4 mi NE of Auburn lat 38'56°32" long 95'46°40"	SED(9),CHEM(1)	SCS	
----	Wakarusa R. 4 mi W of Auburn lat 38'53°50° long 95'52°53"	SED(9),CHEM(1)	SCS	
----	Wakarusa R. 5 mi W of Auburn lat 38'53°51" long 95'54°29"	SED(9),CHEM(1)	SCS	
----	Pony Cr. nr Reserve lat 40'00°01" long 95'37°40"	SED(9),CHEM(2),METAL(1), METALB(1),PEST(1), PESTB(1)	SCS	
----	Pony Cr. nr Morrill lat 39'57°56" long 95'41°34"	SED(9),CHEM(2),METAL(1), METALB(1),PEST(1), PESTB(1)	SCS	
----	Pony Cr. nr Sabetha lat 39'57°10" long 95'46°08"	SED(9),CHEM(2),METAL(1), METALB(1),PEST(1), PESTB(1)	SCS	
----	Pony Cr. at Sabetha lat 39'55°51" long 95'47°16"	SED(9),CHEM(2),METAL(1), METALB(1),PEST(1),PESTB(1)	SCS	

Table 4.--Surface-water-quality stations--Continued

Ident. no. 07-	Station name	Sampling purpose (frequency code)	Coop. or support	Remarks
		Arkansas River Basin		
1375	Arkansas R. nr Coolidge	CHEM(12),BIOL(7),TOC(12), METAL(4),PEST(4), COLI(12),FIELD(12), SED(12)	NASQAN	MONITOR
1380	Arkansas R. at Syracuse	SED(12),BED(2),	KWRB	
13865	Whitewoman Cr. nr Leoti	SED(12),BED(12)	KWRB	
1398	Mulberry Cr. nr Dodge City	SED(12)	KWRB	
1400	Arkansas R. nr Kinsley	SED(12),BED(2)	KWRB	
1412	Pawnee R. nr Larned	SED(12)	KWRB	
1419	Walnut Cr. at Albert	SED(12),BED(2)	KWRB	
1423	Rattlesnake Cr. nr Macksville	SED(12)	KWRB	
14286	Cow Cr. nr Claflin	SED(12)	KWRB	
1429	Blood Cr. nr Boyd	SED(12)	KWRB	
1433	Cow Cr. nr Lyons	SED(12)	KWRB	
14333	Arkansas R. nr Hutchinson	SED(12),BED(2)	KWRB	
143665	Little Ark. R. at Alta Mills	SED(12)	KWRB	
1442	Little Ark. R. at Valley Ctr.	SED(12)	CE T	1,6
14478	N. Fk. Ninnescah R. at Cheney Res.	SED(12),BED(2)	KWRB	
14491	S. Fk. Ninnescah R. at Pratt	SED(12)	KWRB	
1452	S. Fk. Ninnescah R. nr Murdock	SED(12),BED(2)	KWRB	
1455	Ninnescah R. nr Peck	SED(12),BED(2)	KWRB	
1457	Slate Creek at Wellington	SED(12)	KWRB	
1465	Arkansas R. at Arkansas City	CHEM(12),BIOL(7),TOC(12), METAL(4),RAD(6)(9)(2), PEST(4),SED(12),BED(2) COLI(12),FIELD(12), OBS(13)	CE T-NASQAN-KWRB	
14707	Whitewater R. at Towanda	SED(12)	KWRB	
1478	Walnut R. at Winfield	SED(12)	KWRB	
15601	N. Fk. Cimarron R. at Richfield	SED(12)	KWRB	
15622	Bear Cr. nr Johnson	SED(12), BED(12)	KWRB	
1575	Crooked Cr. nr Nye	SED(12)	KWRB	
1579	Cavalry Cr. at Coldwater	SED(12),BED(2)	KWRB	
1675	Otter Cr. at Climax	SED(12)	CE T	1,4
1698	Elk R. at Elk Falls	SED(12)	CE T	1,5

Table 4.--Surface-water-quality stations--Continued

Ident. no. 07-	Station name	Sampling purpose (frequency code)	Coop. or support	Remarks
1707	Big Hill Cr. nr Cherryvale	SED(12)	CE T	1
1795	Neosho R. at Council Grove	SED(12)	CE T	1,2
17973	Neosho R. nr Americus	SED(12)	CE T	1,8
179795	Cottonwood R. bl Marion Lake	SED(12)	CE T	1,2
18225	Cottonwood R. nr Plymouth	SED(12)	CE T	1,2
1835	Neosho R. nr Parsons	CHEM(12),BIOL(7),TOC(12), METAL(4),SED(12), COLI(12),FIELD(12)	NASQAN-KWRB	MONITOR
1840	Lightning Cr. nr McCune	SED(12)	KWRB	

Table 5.--Ground-water-quality sampling sites

County	Well number
Allen	24S 17E 26BBD
	24S 20E 35CDD
	25S 18E 07AAB
	26S 18E 13CBC
Anderson	20S 20E 05ADD
	21S 18E 05DCA2
	22S 20E 18AAA
Atchison	05S 20E 18CDC
	06S 17E 31DAA
	06S 18E 22BCD
	07S 18E 24BAA
Barber	
	32C 12W 05DBD
	33S 11W 33ABB
	34S 10W 16CAB
	35S 12W 08BAC
Barton	18S 15W 30ACA
	19S 12W 05DDC
	19S 12W 13ADA
	20S 13W 30CAB
	20S 14W 27BCA
Bourbon	23S 22E 29AAA
	24S 23E 04DB
	26S 25E 35CCB
Brown	01S 17E 07CBC
	02S 18E 14CAD
	03S 17E 30BBB
Butler	23S 07E 10BBB
	24S 04E 29DBA2
	25S 06E 23DDB
	26S 04E 08DCD
	27S 04E 22BAC
	28S 05E 32CDC
	29S 07E 07DDA

County	Well number
Chase	19S 08E 20AAA
	19S 09E 26DAA
	20S 07E 27DAA
	22S 08E 05CCA
Chautauqua	32S 10E 19DDD
	34S 10E 16DDC
	35S 13E 17BBA
Cherokee	32S 25E 07AAA
	33S 22E 19DAA
	34S 23E 02ABA
	35S 25E 04CCC
Cheyenne	01S 38W 09ABB
	04S 39W 15CCA
	04S 41W 16DAA
	05S 38W 22ACB
	05S 42W 14CBC
Clark	30S 23W 05DBB
	31S 23W 07BBA
	32S 23W 26DDD
	33S 22W 30CBC
	34S 25W 36BAD
Clay	
	07S 04E 20ADC
	08S 02E 11ADB
	10S 01E 17DCC
	10S 04E 06BCD
Cloud	05S 01W 26ABD
	05S 05W 22DAD
	06S 01W 10CCB
	08S 05W 14ACD
Coffey	19S 15E 13AAB
	21S 15E 16CDD
	22S 14E 30AAA
Comanche	31S 19W 24AAB
	32S 19W 12DA
	32S 20W 18AAA
	33S 19W 36DAA

Table 5.--Ground-water-quality sampling sites--Continued

County	Well number
Cowley	
	31S 04E 06BDD
	34S 03E 26BDA
Crawford	27S 22E 35BBB
	28C 22E 21CCC
	31S 22E 08CD
Decatur	
	01S 30W 34DDD
	03S 29W 31DCC
	04S 27W 17DAC
	04S 28W 02BBA
Dickinson	11S 02E 36AAA
	12S 04E 31AAD
	13S 01E 23ACD
	14S 03E 35ABA
	15S 01E 05DDD
Doniphan	02S 19E 18BCB
	03S 19E 18DAA
	03S 21E 06BCC
	04S 20E 23CDD
Douglas	12S 20E 19AAA
	13S 19E 23DAA
	13S 21E 05DBB
	14S 19E 21BBB
	14S 20E 18ABB
Edwards	24S 18W 36DCC
	25S 20W 07CAA
	26S 19W 12ABC
Elk	28S 10E 36BDB
	31S 11E 26CCC
	31S 12E 36BDA
Ellis	11S 17W 11CCA
	13S 18W 09CBB
	14S 16W 21CBB
	14S 18W 25AAB
	15S 18W 33BAA
Ellsworth	14S 07W 26DCC
	15S 08W 20BCD
	16S 06W 12ABB
	17S 09W 16DAB
Finney	21S 32W 08ABD
	23S 31W 03DCC
	23S 33W 17BBB
	24S 33W 19DBD
	24S 34W 05AAB
Ford	26S 23W 10DAD
	26S 25W 33BAD
	27S 22W 13CCD
	27S 23W 24BBB
	28S 25W 06ABB
	29S 21W 07ADC
Franklin	15S 18E 34BAA
	17S 21E 21CCC
	18S 18E 08ADA
Geary	10S 05E 18DCC
	12S 04E 23CDC
	12S 05E 01BBA3
	12S 06E 06BCAC
Gove	11S 26W 04CDC
	11S 29W 10AAA
	12S 28W 12DDD
	13S 27W 25ABB
	13S 29W 04BAC2
Graham	06S 25W 33BCC
	07S 21W 02BCC3
	08S 21W 17ACB
	08S 23W 13CD
	08S 25W 14DCC
Grant	27S 35W 17ADD
	27S 37W 26BCB
	27S 38W 23CB
	28S 37W 30BBD

Table 5.--Ground-water-quality sampling sites--Continued

County	Well number
Grant (continued)	29S 35W 06BAA
	30S 38W 13CCC
Gray	24S 29W 18CCB
	26S 17W 18ADC
	27S 28W 05AAA
	27S 30W 23BB
	29S 28W 28CDC
Greeley	16S 39W 22DCB
	16S 41W 20BAD
	17S 40W 15CCB
	20S 41W 02ADD
Greenwood	22S 13E 20DDC
	25S 13E 30CCA
	26A 10E 04CCC
Hamilton	21S 40W 31CCC
	22S 41W 33DCD
	23S 42W 19CBB
	24S 39W 30BBD
	24S 40W 07CCC
	26S 41W 20BBD
Harper	31S 05W 25DCC
	32S 07W 02CDA
	32S 08W 20BDD
	34S 09W 18BBB
	35S 05W 11CCC2
Harvey	22S 01W 30DCC
	23S 01W 32BBC
	23S 03W 29DBD
	24S 02W 02AAC
	24S 02W 23BBB
Haskell	27S 31W 24CDC
	27S 32W 06CBB
	29S 34W 36CBC
	30S 33W 02AAB
	30S 34W 13ABC
Hodgeman	21S 22W 03ABB
	22S 24W 34CDC
	23S 23W 06CAB
	24S 23W 34AAD
Jackson	07S 13E 10BBB
Jefferson	08S 17E 09AAA
	09S 17E 18CBB
	09S 19E 34CCC
	11S 16E 13CBD
Jewell	02S 09W 23BAC
	03S 06W 21CAB
	04S 08W 25DAB2
Johnson	12S 24E 05DCD
	13S 21E 26CCD
Kearny	21S 37W 02CDD
	23S 35W 25BBB2
	23S 37W 28CCB
	26S 37W 21DDD
Kingman	27S 10W 32DCC
	28S 06W 12CDD
	29S 07W 26ADB
	30S 05W 12CCA
	30S 09W 10ADC
Kiowa	27S 19W 30BBD
	27S 20W 26ABD
	28S 16W 02CCA
	28S 18W 19CCB
	28S 19W 31BBB
Labette	33S 18E 10BBB
	33S 20E 09DDD
Lane	16S 29W 26CCC
	17S 27W 20CCC
	18S 28W 18ACC
	18S 30W 02AAA
	20S 29W 03CCB

Table 5.--Ground-water-quality sampling sites--Continued

County	Well number
Leavenworth	11S 21E 10CBA
	12S 21E 30CBB
Lincoln	10S 07W 12ACA
	11S 07W 32ACC
	12S 06W 15AAC
	12S 09W 08AAC
	13S 07W 33DCC
Linn	19S 21E 23CCC
	20S 22E 32CDD2
	20S 24E 03BAB
	22S 24E 14DCC
	23S 25E 07DAA
Logan	11S 36W 06DBB
	12S 33W 33BBD
	13S 35W 23ACD
	13S 36W 20CCB2
	15S 35W 06BAC
Lyon	16S 13E 20DBA
	18S 11E 23BAD
	21S 10E 26CDC
	21S 13E 27AAB
McPherson	17S 03W 17DBD
	17S 05W 23DAB
	18S 03W 14BDD
	19S 03W 29DBA2
	20S 02W 11BAA
	21S 03W 02DCD
Marion	19S 01E 04ACC
	20S 01E 33ABB
	21S 01E 07BAA
	21S 02E 26CBC
Marshall	01S 09E 01DBC
	02S 06E 35AAA
	04S 06E 16DAC
	05S 09E 28ADD
	05S 09E 28DAA
Meade	30S 26W 07BBB
Meade (continued)	31S 30W 16BBC
	33S 29W 32AAD
	35S 30W 10CDB
Miami	15S 21E 35ABB
	16S 23E 25DBC
Mitchell	06S 09W 26CAD
	07S 07W 12BAC
	07S 10W 22CCA
	08S 08W 31DCC
	09S 09W 07DCB
Montgomery	31S 13E 26ACC
	33S 16E 18BDD
	33S 16E 33DCC
Morris	14S 06E 34AAC
	14S 08E 07DAC
	14S 09E 31DDC
	16S 05E 14BCB
Morton	31S 40W 29ABB
	32S 42W 14CCC
	33S 43W 22DAA
	34S 42W 20DD2
Nemaha	02S 12E 16BBB
	02S 14E 21AAB2
	04S 14E 09BCB
Neosho	27S 17E 36BBC
	28S 19E 14CDC
Ness	17S 25W 07ABC
	17S 25W 08BB3
	18S 24W 36ADB
	19S 23W 01CCB
	20S 23W 32BBC

Table 5.--Ground-water-quality sampling sites--Continued

County	Well number
Norton	
	01S 21W 35DDC
	02S 23W 36CAA
	05S 23W 16ABA
	05S 25W 28BDD
Osage	15S 14E 21CDD
	15S 15E 06ABB
	15S 15E 29BCC
	17S 16E 33DDD
Osborne	06S 12W 06CBB
	07S 11W 17BAB
	07S 15W 11ADD
	10S 15W 18AAA
Ottawa	09S 03W 17DAA
	10S 02W 33BCA
	11S 01W 22CCC
	12S 03W 01DBA2
	12S 05W 15ADD
Pawnee	20S 16W 15BCB
	22S 16W 03CBC
	22S 16W 23CDA
	22S 19W 10BBB
Phillips	
	04S 16W 27CCA
	04S 18W 23DCA
	04S 20W 34CAB
Pottawatomie	07S 07E 23BBA
	07S 09E 34CCD
	10S 09E 09CDC
	10S 12E 09ADB4
Pratt	26S 14W 17DCB
	28S 13W 01BDB
	28S 14W 02CDC
	29S 14W 23BBA
Rawlins	01S 36W 03DBB
	02S 36W 13DDD
	03S 36W 17CCC
	05S 31W 20BCC
Reno	22S 04W 12DDD2
	23S 06W 06BCB
	24S 09W 10BCC
	25S 04W 05DAD
	26S 08W 32ABB
Republic	01S 02W 33DCD
	01S 03W 02CCB
	03S 04W 20DAB
	04S 01W 16ACC
Rice	18S 10W 32ADB
	19S 09W 31DAB
	20S 08W 23ABA
	21S 09W 08BAB
Riley	07S 06E 28AAA
	09S 05E 01BCB
	10S 07E 32DBD
	10S 09E 17BDD
Rooks	06S 18W 26AAC
	07S 18W 24BAD
	08S 20W 31ACB
	09S 18W 35CCD
	09S 19W 34BBD
Rush	16S 17W 16DCD
	17S 20W 30CCB
	18S 16W 23AAA2
	18S 20W 20DBB
	19S 17W 23BBD
Russell	11S 12W 07DDB
	11S 14W 07CAA
	14S 11W 07CAB
	15S 12W 02BAA
	15S 15W 03DCD
Saline	
	14S 03W 25BAD
	14S 04W 13DDD
	15S 02W 26DDD
	15S 05W 04ABB
Scott	17S 32W 05ABB

Table 5.--Ground-water-quality sampling sites--Continued

County	Well number
Scott (continued)	17S 33W 07BBB
	17S 34W 06BCB
	18S 32W 14BBB
	19S 31W 20BAD
Sedgwick	25S 01E 01ABB
	25S 01W 07BAA
	27S 02W 32BBB
	29S 01E 08CBB
	29S 02W 23DDA
Seward	31S 32W 03DAD
	32S 32W 14BBB
	33S 33W 02A
	35S 34W 10BBB
Shawnee	10S 15E 17CDD
	12S 16E 25CBB
Sheridan	06S 27W 08DCB
	06S 27W 19DAB
	06S 30W 14CCD
	08S 28W 09ABC
	09S 30W 35BBB
	10S 28W 17BDD
Sherman	
	07S 40W 06ADB
	08S 37W 32ABB
	08S 39W 17DCD
Smith	03S 11W 04AAC
	03S 15W 20DCC
	04S 14W 35CCB
	05S 13W 07AAA
Stafford	
	23S 13W 33BDB
	24S 15W 15CDA
	25S 11W 01BCB
	25S 15W 30ABC
Stanton	27S 39W 13ACB
	28S 39W 31BCC
	29S 42W 24CCC
	30S 39W 23BBB
	30S 43W 28DCD
Stevens	31S 35W 26DCC
	32S 37W 10DCC
	33S 38W 06AAB
	34S 35W 07BCC
	35S 36W 01AAA
Sumner	31S 01E 04BDC
	31S 02E 02BBB2
	32S 04W 09CCC4
	33S 02E 06BBA
	33S 03W 14CBB
	35S 03W 17AAD
Thomas	06S 32W 04CCC
	07S 36W 15ACB
	08S 34W 06CBC
	09S 31W 22ABD
	09S 34W 36DDD
Trego	
	12S 22W 08BAB
	13S 25W 32CBB
	14S 22W 36ADD
	15S 21W 05ABB
Wabaunsee	
	14S 08E 02AAA
	14S 10E 03BAB
Wallace	13S 40W 14ADC
	15S 38W 07BBB
Washington	02S 03E 32ABB
	02S 05E 09BDA
	04S 02E 08DCC
	04S 05E 09CAA2
	05S 02E 12CBA

Table 5.--Ground-water-quality sampling sites--Continued

County	Well number
Wichita	16S 35W 31DBA
	16S 37W 30ACB
	18S 35W 34ABB
	18S 37W 03CCC
	20S 38W 17CBD
Wilson	27S 14E 25BBB
	27S 16E 23DAA
	30S 16E 15BCC
Woodson	24S 16E 34ABB
	25S 14E 16CCB
	25S 15E 08DAD
Wyandotte	10S 23E 30BBC
	11S 23E 17CCA
	12S 23E 06CBC

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