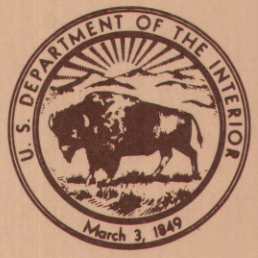
WATER-RESOURCES INVESTIGATIONS IN KANSAS-FISCAL YEAR 1978

U.S. GEOLOGICAL SURVEY

Open-File Report 79-561



UNITED STATES
DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

WATER-RESOURCES INVESTIGATIONS IN KANSAS--FISCAL YEAR 1978

By H. E. McGovern and L. J. Combs

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Lawrence, Kansas

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WATER-RESOURCES INVESTIGATIONS

IN

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H. E. McGovern and L. J. Combs

INTRODUCTION

Water-resources investigations of the U.S. Geological Survey in Kansas consist of collecting water-resources data for present and future use in planning and managing the State's resource by Federal, State, and local agencies. Interpretive hydrologic investigations also are made, generally in cooperation with other agencies, to describe the framework of hydrologic systems, to analyze all available data, to collect additional data required for specific needs, and to present information directed toward the solution of existing or potential water problems. In addition, some studies are directed toward the research and development of new techniques of collecting and analyzing water-resources data for use in Kansas.

The water-resources data and the results of investigations are published or released either by the U.S. Geological Survey or by the cooperating agencies. Some aspects of water-resources investigations that are of general scientific interest are published in the journals of technical and scientific organizations. Requests for information regarding water-resources data and for publications resulting from past and present investigations 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

Subdistrict Chief
U.S. Geological Survey
Water Resources Division
206 Fulton Terrace
Garden City, Kansas 67846

Subdistrict Chief
U.S. Geological Survey
Water Resources Division
211 W. Iron St., Rm. 209
Salina, Kansas 67401

COOPERATING AGENCIES

The collection of much of the water-resources data and the investigation of most interpretive hydrologic studies in Kansas are done as part of cooperative programs with Federal, State, and local agencies. The collection and analysis of some water-resources data are done as part of the U.S. Geological program for the collection of basic records. Those agencies cooperating with the U.S. Geological Survey during the fiscal year 1978 are:

Kansas Geological Survey;
Kansas Water Resources Board;
Kansas State Board of Agriculture;
Kansas Department of Health and Environment;
Kansas Department of Transportation;
Kansas-Oklahoma Arkansas River Commission;
Southwest Kansas Groundwater Management District No. 3;
Western Kansas Groundwater Management District No. 1;
Northwest Kansas Groundwater Management District No. 4;
City of Wichita;
U.S. Department of Agriculture, Soil Conservation Service;
U.S. Department of Army, Corps of Engineers;
U.S. Department of Housing and Urban Development,
Federal Insurance Administration;
U.S. Department of Interior, Bureau of Reclamation;
U.S. Department of Interior, Fish and Wildlife Service;
U.S. Environmental Protection Agency.

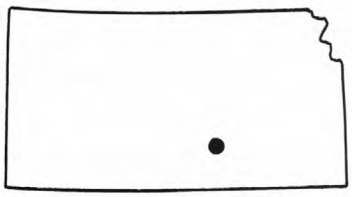
INTERPRETIVE HYDROLOGIC INVESTIGATIONS, FISCAL YEAR 1978

Interpretive investigations are made by the U.S. Geological Survey generally as part of a cooperative program with other Federal, State, and local water agencies. These investigations are made to describe the framework of hydrologic systems, to assess the State's water resources, to define existing or potential problems related to the quantity or quality of water, and to provide information to other planning agencies for optimum resources development and management.

Surface-water investigations are directed toward the collection and analysis of long-term continuous records on streamflow and volume of water in storage to provide data for operation and management. Various basin and stream-channel characteristics, relations of rainfall to runoff, interrelation of ground-water and surface-water movement, and effects of stream regulation are analyzed to improve methods of evaluating the quantity, quality, and availability of surface-water supplies. Studies also are made to determine flood frequencies, to delineate flood-prone areas, to determine low-flow frequencies, and to evaluate the effects of sediment on channel regimen.

Geohydrologic investigations are made to determine the source, availability, quantity, and quality of ground water in the principal aquifer systems and to evaluate the long-range effects of withdrawals for irrigation, industrial, and municipal supplies. Studies also are made to determine the potential for large-scale injection and storage of liquid wastes in deep saltwater aquifers. Mathematical models are prepared to simulate ground-water systems and interrelated ground- and surface-water systems for evaluating various plans of future development and management.

Water-quality investigations are directed toward collection and interpretation of data to define the physical, chemical, and biological characteristics of surface and ground water. These investigations provide information on the origin, transport, and characteristics of solutes and fluvial sediments in streams; the chemical characteristics of water in the principal aquifers; the areal and temporal changes in water quality; and the suitability of surface and ground water for municipal, industrial, and agricultural use.



Local or Areal

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. O. Peek

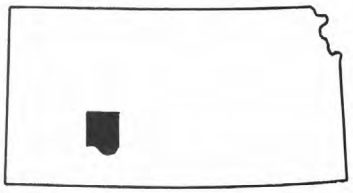
Problem -- The effects of urbanization on flood-frequency discharges in Kansas are unknown. Sprawling urbanization in Wichita and vicinity has caused increased concern for the effect of urbanization on design discharges. Data on the magnitude and frequency of flood flows are needed in designing urban-drainage systems.

Objective -- Collect rainfall and runoff data from drainage basins having varying degrees of urbanization in the Wichita area. Derive a method of estimating the relation of peak discharges to frequencies that is applicable to basins, with various degrees of urbanization, in the area.

Approach -- Collect rainfall-runoff data in basins where the land use and percentage of impervious surface can be determined. Define 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 -- A report on evaluation of a method for determining the relation of peak discharge of rainfall was prepared and is awaiting publication as an open-file report.

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



PROJECT TITLE: Ground water in the Dakota Formation in Ford and Hodgeman Counties, Kansas
PROJECT NUMBER: KS-049
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: D. H. Lobmeyer

Problem -- The development of ground water for irrigation in Ford and Hodgeman Counties is spreading more rapidly than the supply available in the Ogallala Formation; therefore, many new wells are now being completed in the Dakota Formation. Because the aquifer in the Dakota is artesian (confined), the withdrawals of ground water have caused large declines in head. Current information on the extent and effects of ground-water development from the Dakota is needed by State and local planning, management, and administrative agencies.

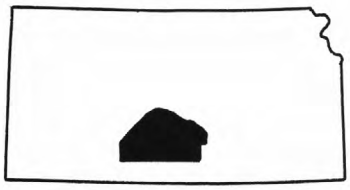
Objective -- Determine the extent of ground-water development from the Dakota Formation in Ford and Hodgeman Counties; determine the effects of development on the potentiometric surface; and provide information to the State and local agencies for wise planning of future ground-water use.

Approach -- Compile all available geohydrologic data from wells in the Dakota; drill test holes to aid in describing the physical character of the formation; collect data from pumping tests of irrigation wells, information on water-level changes, and water-use data to determine the hydrologic characteristics of the aquifer; and determine the extent and effects of withdrawals on the hydrologic system.

Progress -- Completed revision of project report where necessary in response to technical review; submitted report and obtained Director's approval for release as an open-file report pending formal publication.

Plans -- Prepare final copy of report for formal publication in Kansas Geological Survey Irrigation Series.

Reports published or released -- See number 11 in "List of Reports... ."



PROJECT TITLE: Geohydrology of the Great Bend Prairie, south-central Kansas
PROJECT NUMBER: KS-051
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: L. E. Stullken

Problem -- Rapidly expanding development of ground water in the Great Bend Prairie area may cause significant water-level declines. The decrease of water in storage resulting from increased withdrawals may reduce well yields and the economic return from irrigation development. Withdrawals also may cause local deterioration in the chemical quality of the ground water by inducing migration of naturally occurring saline water.

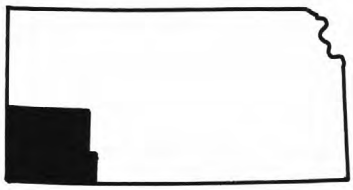
Objective -- Determine the geohydrologic character of the aquifer system in the Great Bend Prairie, the quantity and quality of ground water in storage, the extent and effects of present ground-water development, and the possible effects of increased withdrawals on the quantity and quality of water in the system. Provide State and local water agencies with information needed for future planning and management.

Approach -- Compile all available data from existing wells; drill additional wells and collect pumping-test data to define the physical and hydraulic character of the aquifer system; determine the quantity of water in storage; relate water-level changes to natural recharge and discharge; and collect water-use data to determine the extent and effects of present ground-water development. Collect water-quality data to locate the source and movement of saline ground water. Determine the possible effects of increased withdrawals on the quantity and quality of water in the aquifer system.

Progress -- Completed final copy of project report.

Plans -- Project completed.

Reports published or released -- See number 4 in "List of Reports... . "



PROJECT TITLE: Geohydrology of southwestern Kansas
PROJECT NUMBER: KS-054
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: E. D. Gutentag

Problem -- Current geohydrologic data are needed for a regional assessment of the rapid development of ground water for irrigation from the complex, multi-aquifer system in southwestern Kansas. A compilation of information describing the geology, hydrology, and water quality of the system and a determination of the extent and effects of present ground-water development are needed by State and local water agencies for future planning and management.

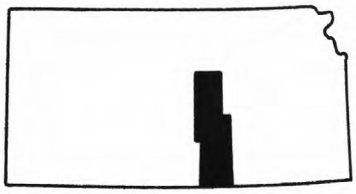
Objective -- Compile geohydrologic data from previous studies and collect additional data, as necessary, to describe the general operation of the multi-aquifer system; determine the quantity of water in storage and the effects of natural recharge and discharge; define the various chemical quality of waters within the system; and determine the extent and effects of existing ground-water development, principally for irrigation.

Approach -- Compile all available data and drill additional wells to determine the geohydrologic character of the multiaquifer system and the chemical quality of associated waters. Compile data on the location, source of water supply, annual withdrawal, and acres irrigated for all large-yielding wells. Determine the potentiometric surface, saturated thickness, and specific yield of the unconsolidated alluvial deposits and determine the extent and effects of annual pumpage on water levels, well yields, and water quality.

Progress -- Completed revisions as necessary in response to technical review.

Plans -- Submit project report for Director's approval to publish in Kansas Geological Survey Irrigation Series; prepare final copy of project report for formal publication.

Reports published or released -- See number 6 in "List of Reports... ."



PROJECT TITLE: Discharge of saline water from the Wellington Formation into freshwater aquifers in central Kansas
PROJECT NUMBER: KS-073
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: A. J. Gogel

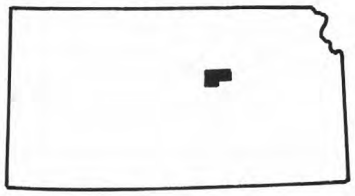
Problem -- Degradation of freshwater aquifers and streams in central Kansas has occurred locally as a result of natural saline-water discharge from the Wellington Formation. Although this occurrence is well known, little documented information is available on the cause, areal extent, and severity of 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 -- Digital flow model has been constructed and calibrated to aid in understanding the hydrologic system. Report has been written and is now undergoing review.

Plans -- Publish report and complete project.



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

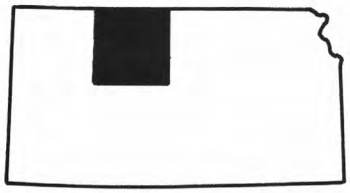
Problem -- The chemical quality of water in the Smoky Hill River is degraded by the natural inflow of saline water from Permian rocks. The saline inflow increases the concentration of chlorides to more than 250 milligrams per liter at downstream municipal and industrial intakes. Water from storage in reservoirs, which probably will be needed for water supply in the future, is currently being released to dilute the existing 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 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 ground-water and surface-water samples for analysis to determine the hydrologic and chemical relations of water in Permian rocks, alluvium, and the river. Construct and test a digital model of the existing river-aquifer system for use in predicting results of proposed schemes for the control or alleviation of the saline-water pollution.

Progress -- Completed a digital model of the ground-water flow in the hydrologic system. Final report is nearly complete and is being prepared for review.

Plans -- Complete report, submit for review, and revise, as necessary, for improvement of 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

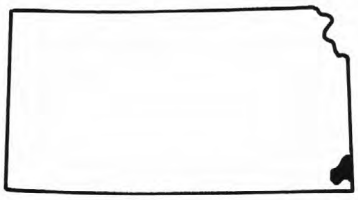
Problem -- Inflow to reservoirs from ground- and surface-water sources in north-central Kansas has been decreasing. The reservoirs were constructed to provide water for irrigation, municipal supplies, recreation, and water-quality control and to provide storage for flood control and the administration 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 the availability of ground water from principal aquifers in Norton, Phillips, Smith, Graham, Rooks, Osborne, Trego, Ellis, and Russell Counties; the availability of surface-water runoff to major streams in the area; the interrelationship between ground and surface water in the geohydrologic system; and 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 ground-water and surface-water supplies.

Progress -- Compiled data from high-yield wells and test wells to define the geohydrology of the stream-aquifer systems and constructed steady-state digital models of the North and South Fork Solomon River valleys and Prairie Dog Creek valley.

Plans -- Construct a transient-flow model of the South Fork Solomon River valley and maps of water level and saturated thickness in the Ogallala Formation. Prepare reports on the model studies of the selected river valleys.



PROJECT TITLE: Quality of water in streams draining mined areas in southeastern Kansas
PROJECT NUMBER: KS-076
COOPERATING AGENCY: Kansas Department of Health and Environment
PROJECT CHIEF: A. M. Diaz

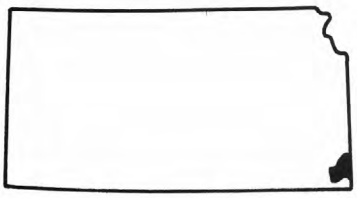
Problem -- Information is needed to establish "benchmark" or baseline data on flow and current water-quality characteristics of streams draining areas in southeastern Kansas that have been deep-shaft and strip mined for coal, lead, and zinc; to determine water-quality degradation associated with mining 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 -- Streamflow and water-quality data collection continued as scheduled at 18 sites in the project area. Field activities were coordinated with project KS-081 for collection of ground-truth data to compare with remote-sensing data at about 30 sites in the Cherry Creek basin. Rating curves for streamflow and chemical parameters were developed from available data. Results from statistical analysis of the data indicate a high degree of correlation between major chemical parameters and specific conductance or streamflow. Because of this, the sampling program for the project has been realigned to include a reduced frequency of sampling for the third year of the project.

Plans -- Continue operation of data-collection network and complete data analysis and interpretation. Prepare a final report.



PROJECT TITLE: Effects of mining and land reclamation on hydrology of southeastern Kansas
PROJECT NUMBER: KS-081
COOPERAITNG AGENCY: Kansas Geological Survey
PROJECT CHIEF: A. M. Diaz

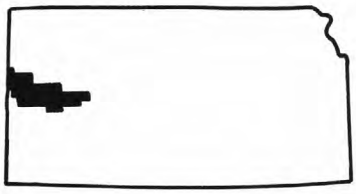
Problem -- Effects of past and present mining of coal, lead, and zinc in southeastern Kansas have caused degradation of streams draining the mined areas. Quantitative measures of degradation and identification of source areas are needed to assess the effectiveness of pollution-control measures, the possible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

Progress -- Multispectral remote-sensing data were obtained by a contractor. Concomitant ground-level data were obtained from field measurements and chemical analyses of water samples from 30 sites in Cherry Creek drainage area. Preliminary review and analysis of the remote-sensing data were begun.

Plans -- Complete data analysis and interpretation and prepare a report.



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 significantly 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 schemes to conserve ground water through efficient use.

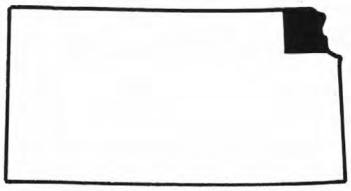
Objective -- Compile and maintain a comprehensive hydrologic-data base; provide a detailed description of the geohydrologic system; and construct and calibrate a digital model of the system's operation. Apply models to "critical areas," designated by the Management District, to analyze the effects of 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 models to test effects of management schemes on irrigation efficiency and conservation of ground water.

Progress -- Soil-moisture blocks, tensiometers, and neutron-access tubes were installed. Additional data on soil moisture, solar radiation, maximum and minimum temperatures, and relative humidity were collected during the growing season. Data on present and historical pumpage were collected. Five observation wells with recorders were installed along Ladder Creek to monitor ephemeral stream recharge. A steady-state digital model was completed. Two aquifer tests were made. A mass water-level measurement was made in the surrounding area.

Plans -- Complete the monitoring of fields where irrigators will schedule water application according to the moisture needs indicated by the soil-moisture blocks. Complete the data collection on pumpage, precipitation, solar radiation, soil moisture, maximum and minimum temperatures, and relative humidity. Construct and test a digital model of the intensive study area. Compile and analyze the data and prepare a report.

Reports published or released -- See numbers 16 and 17 in "List of Reports... ."



PROJECT TITLE: Fluvial sediment and water quality in selected SCS watersheds of northeastern Kansas
PROJECT NUMBER: KS-083
COOPERATING AGENCY: Soil Conservation Service
PROJECT CHIEF: C. D. Albert

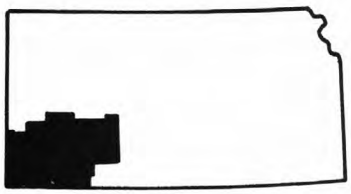
Problem -- A practical definition is needed for sediment-transport conditions from small drainage areas in Kansas. The Soil Conservation Service (SCS) is especially interested in the environmental impact of land-treatment practices on sediment yield and the chemical quality of water in areas with flow-way 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 selected sites in northeastern Kansas; define the relation of streamflow parameters to sediment concentrations and partical 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 -- Rainfall runoff was sparse during most of the year, and the relation of generally low flows to sediment concentrations and chemical quality were not significant. An ancillary study to define bacteria counts of inflow to an existing impoundment for planning use was devised, and numerous samples were collected by cooperating personnel. Results indicate that sports involving body contact with the water may be restricted for a period of time after rainfall runoff, and that treatment of water for consumptive use should be mandatory at all times.

Plans -- Continue collection of samples at eight sites in northeast Kansas and four sites in the upper Wakarusa River drainage. Chemical and sediment samples will be analyzed and results processed for the annual Water-Resources Data report.



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 -- Provide a complete, comprehensive hydrologic-data base for the Management District. Establish a system of providing current information on large-yield wells, amount and distribution of withdrawals, location and acreage of irrigated land, hydraulic characteristics of the unconsolidated aquifer system, configuration of the water table, and annual changes in saturated thickness. Provide data for storage and analysis in a computer program that will be useful in management planning and administration of water rights.

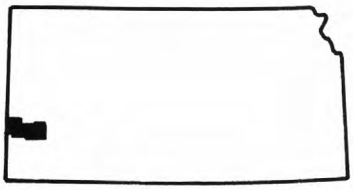
Objective -- Develop and maintain a complete, comprehensive hydrologic-data base for the area within the Southwestern Kansas Groundwater Management District. Provide current storage, retrieval, and analyses of the data for use principally by the District and by the Division of Water Resources, Kansas State Board of Agriculture, in 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 designed aquifer tests on selected wells, and assist District in measuring and monitoring ground-water withdrawals for irrigation. Establish a continuing data-collection program, with assistance from the District, to monitor water levels, inventory new wells, perform aquifer tests, and monitor ground-water withdrawals. 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 -- All irrigation wells in Hodgeman County were located and inventoried. Data were compiled and a map was prepared showing the saturated thickness of the unconsolidated deposits in the 13-county area of southwestern Kansas; completed revisions of map, where necessary, in response to technical review; submitted map to Director for approval for release as an open-file report.

Plans -- Investigate a small area of about 30 to 60 square miles where data points are scarce to evaluate the feasibility of increasing data density for preparation of saturated thickness maps for the entire 13-county area of southwestern Kansas. Prepare a report on the use of a radial-flow model for the 9 square-mile area used by GWMD No. 3 to evaluate new applications for ground-water withdrawal.

Reports published or released -- See numbers 16 and 18 in "List of Reports... ."



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

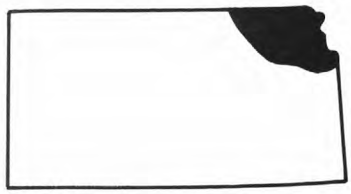
Problem -- Flow of the Arkansas River between the Colorado-Kansas State line and the Kearny-Finney County line in Kansas has continued to decrease in recent years. Consequently, the availability of surface water for diversion at the headgates of irrigation ditches has been inadequate to meet demands. 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 schemes designed to optimize conjunctive use of ground water and surface water.

Progress -- Accomplishments include the (1) installation of 24 observation wells adjacent to the river channel, (2) installation of 2 streamflow-gaging stations and 6 continuous recorders on ground-water observation wells, (3) 4 mass measurements of water levels in about 100 wells, (4) inventory of all large-yielding wells, (5) analyses of the potential for stream depletion and well interference resulting from additional ground-water development, and (6) collection and interpretation of water-use, climatologic, geologic, and hydrologic data pertinent to development of a digital model.

Plans -- Continue the collection and interpretation of data pertinent to model development and analysis. Complete development of a digital model of the stream-aquifer system between the Colorado-Kansas State line and the Bear Creek Fault. Prepare a report to describe the geohydrology of the study area and to document the model calibration and analysis.



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

Problem -- Drought conditions have existed in Kansas for several years. Many municipalities in northeastern Kansas, which use surface-water reservoirs as a source of water supply, experienced water shortages during this period. Some glacial deposits of Pleistocene age that occur in northeastern Kansas yield sufficient quantities of water to serve as a source of supply. Most of the water-yielding deposits are in bedrock valleys that have not been adequately delineated.

Objective -- Locate the major glacial aquifers in northeastern Kansas and determine the recharge, discharge, and amount of water in each major aquifer. Define the chemical quality of water from the major aquifers and determine the concentrations of the principal chemical constituents.

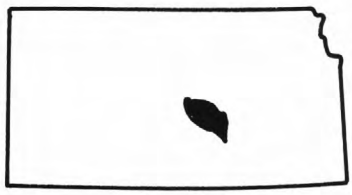
Approach -- Major aquifers will be located by drilling, geologic mapping, and geophysical exploration.

Discharge, recharge, and amount of water will be determined by summation of discharge from wells and hydrologic analysis, including digital modeling.

Chemical constituents of water from major aquifers of Pleistocene age will be determined from analysis of representative water samples. Chemical analyses will be by Kansas Department of Health and Environment.

Progress -- Review of published and unpublished data from files of the U.S. and Kansas Geological Surveys in the 16-county area is nearly completed. Drillers' water-well records were field checked for location and elevation. Landsat images for the study area are being analyzed for possible use in locating buried valleys. Several weeks of augering were done in Nemaha County, and brief field investigations were made in most of the counties.

Plans -- Begin computer entry of existing bedrock, glacial deposit, and water-level data. Produce contour maps of data. Continue drilling program and begin geophysical investigations. Perform laboratory analyses of Pleistocene sediments. Collect water-quality samples and existing water-quality information. Collect data on water levels and water usage from deposits in buried valleys.



PROJECT TITLE: Salt-water contamination of the "Equus beds" area, central Kansas
PROJECT NUMBER: KS-092
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: J. M. McNellis

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 of increased ground-water withdrawals, such as increased depth to water and reduced well yields, with special emphasis on contamination resulting from movement of saline water within the aquifer.

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

Progress -- Collected historical pumping, aquifer-test, well, and quality-of-water data. Compiled well-location map. Contacted local municipalities and State agencies for additional hydrologic data.

Plans -- Continue collection and analysis of the data. Drill observation wells in areas from which little or no data are available. Construct digital model of the geohydrologic system.

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 -- Studies completed and transmitted to Federal Insurance Administration are: cities of Lecompton, Rossville, Riley, St. Marys, Baldwin, Lawrence, and Wichita.

Plans -- Complete studies for communities of Americus, Eudora, Manhattan, Ogden, Perry, Wamego, and for Douglas, Lyon, and Riley Counties.

Reports published or released -- See numbers 21-27 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

Problem -- 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 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 acting as a repository of 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 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 -- Testing and measurement of several hundred wells have been completed by the cooperator. Preliminary design of a State-level computerized water-use data base is well underway.

Plans -- Efforts to create a State-level water-use data base have been given a high priority by State officials. An intensive design-programming-data capture effort will be made; the objectives are to begin adding data to the State-level data base by July 1, 1979, and to prepare a State water-use report by late 1980.

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, observed and synthesized, and to 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 published (see number 29 in "List of Reports... ") for 60 crest-stage gage stations, including 10 rainfall-runoff sites. Three crest-stage gages, including one rainfall-runoff site, were discontinued at the beginning of the year and four rainfall-runoff sites were relocated. Long-term synthesis for one previously calibrated rainfall-runoff site was made.

Plans -- Operation of 60 crest-stage gages, including 10 rainfall-runoff sites, will be continued. The long-term synthesis of previously calibrated rainfall-runoff sites will be completed and a report prepared on the results of calibration and synthesis for stations in eastern Kansas.

PROJECT TITLE: Streamflow characteristics, Kansas
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 -- Completed and published summary of streamflow statistics for the Arkansas River basin in Kansas. Prepared data for use in a report on streamflow statistics for the Missouri River basin in Kansas. Assembled data for potential ground-water recharge reservoir sites.

Plans -- Complete report on streamflow statistics for the Missouri River basin in Kansas. Prepare report on low-flow frequencies of streams in Kansas.

Reports published or released -- See number 9 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 Eleventh Annual Report -- Fiscal Year 1978 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: Development of numerical techniques and models for hydrologic studies
PROJECT NUMBER: KS-044
COOPERATING AGENCY: Kansas Geological Survey
PROJECT CHIEF: C. D. McElwee

Problem -- Development of numerical techniques and models for the analysis of complex hydrologic problems in Kansas is needed to improve methods of water-resources planning and management and to aid in decision-making processes by State and local water agencies.

Objective -- Develop numerical techniques and models, which are amenable to solution by digital computer, that will provide the methods needed for analyzing the operation of hydrologic systems, predicting the effects of manmade changes in hydrologic systems, and optimizing the development of water resources in specific areas.

Approach -- Formulate original research and continuously evaluate new developments in the field of numerical modeling. Test and calibrate techniques resulting from research and from new developments in modeling to provide the Kansas District with applicable methods for using the digital computer to analyze hydrologic problems.

Progress -- Completed a report on evaluating the sensitivity of the Theis equation to transmissivity and storage and to an automated fit in pump-test data and submitted the report for review.

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

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 require 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 -- Data were compiled from numerous meetings, hearings, and conferences at the request of various State and local water agencies: primarily the Kansas Water Resources Board, the Advisory Council on Groundwater Management Districts, non-point source pollution (208) planning studies, the Governor's Task Force on Water, and the Legislative Committee on Water. Responded to approximately 800 public inquiries for geohydrologic data.

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: 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 -- Completed final report and submitted for technical and editorial review.

Plans -- Complete suggested revisions, as necessary, for improving accuracy and clarity and submit report for Director's approval to publish in Kansas Geo-Geological Survey Ground-Water Series.

PROJECT TITLE: Numerical models of streamflow in Kansas
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 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 -- A calibration of the streamflow model has been made, and the model has been used to make preliminary estimates of the change in flow of the South Fork Solomon River.

Plans -- Make further calibrations and uses of the modified streamflow model. Investigate the possibilities of simplified rainfall-runoff models for some basins. Apply the detailed streamflow model to Beaver Creek. Prepare a report of the results.

Reports published or released -- See number 10 in "List of Reports... ."

PROJECT TITLE: Flood-hazard mapping in Kansas
PROJECT NUMBER: KS-062
COOPERATING AGENCY: None
PROJECT CHIEF: C. V. Burns

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 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 -- Updated stream-basin characteristics for about 230 stations and entered data in computer file. Released flood-prone area maps for the Bennington, Culver, Glasco, Mayfield, Minneapolis S., and Wellington quadrangles (Kansas).

Plans -- Prepare additional flood-prone area maps as funding becomes available.

PROJECT TITLE: Evaluation of the ground-water quality network in Kansas
PROJECT NUMBER: KS-077
COOPERATING AGENCY: Kansas Department of Health and Environment
PROJECT CHIEF: C. D. Albert

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, detecting pollution of the principal aquifers in the State, and 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 -- Data have been obtained at 455 wells in the statewide water-quality network. Data determined at these sites include water temperature, specific conductance, pH, and inorganic constituents; organic constituents also are determined at selected sites. Available data show that amounts of total solids, selenium, nitrate, manganese, and iron exceed drinking-water standards in a number of wells.

Plans -- Continue evaluation of data and continue sampling, principally for inorganic, organic, and radio-chemical information. Evaluate analyses of municipal wells in the network for historical significance. Continue preparation of progress report.

PROJECT TITLE: Potential for liquid-waste injection into the Arbuckle Group in Kansas
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, but little is known about the regional geohydrology and the potential effects of contamination to freshwater aquifers.

Objective -- Determine the general regional geohydrology of the Arbuckle Group; assess the potential for large-scale injection and storage of liquid wastes in the rocks; and evaluate the potential effects of proposed liquid-waste injection on freshwater aquifers.

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. Observation wells will be installed 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 available drill-stem test data of tests run in the Arbuckle and several overlying units have been collected, analyzed, and plotted on maps. Potentiometric surfaces derived from this data are being mapped. Available chemical-quality data are being used to adjust potentiometric surfaces for variations in the density of water from the Arbuckle.

Transmissivity values also have been determined from the drill-stem test data. Values for storage coefficients have been estimated for radioactive wireline logs. Liquid-waste injection data have been procured from the Kansas Department of Health and Environment. A contract has been written and is being processed for the drilling of three test holes into the Arbuckle and the installation of observation wells. These wells will range in depth from 2,600 to 5,000 feet.

Plans -- Continue mapping of potentiometric surfaces and construct transmissivity and storage-coefficient maps. Construct digital flow model of Arbuckle. Complete test drilling and install three observation wells.

PROJECT TITLE: Availability and chemical quality of ground water from sandstone aquifers in southwestern 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 southwestern 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 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 -- Eleven weeks of test drilling have been completed by the Kansas Geological Survey using a rotary drill. Thirteen test holes have been drilled in six counties along the eastern part of the project area. Footage drilled amounts to about 5,800 feet. Sixteen observation wells have been installed, and water-level measurements have begun.

Plans -- Complete the test-drilling and hydraulic-testing program to assist in the interpretation of geophysical logs. Obtain additional data on water levels, chemical quality, and water-bearing characteristics of the sandstone-aquifer system. Prepare maps delineating tops and thicknesses of the geologic formations associated with the sandstone aquifers.

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 affect 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 -- Fieldwork and laboratory analyses have been completed. Preliminary computer analyses have been completed, and preparation of the final report is proceeding.

Plans -- Computer analyses will be used to develop power-function equations that relate mean discharge and various flood discharges to characteristics of channel geometry and sediment. The project will be terminated with completion of the final report.

Reports published or released -- See number 15 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: E. R. Hedman

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 analysis 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 -- Much of the necessary field investigation, including collection of channel-material samples, was completed for the Neosho, Cottonwood, and North Fork Ninnescah Rivers. As indicated by previous examination of data from regulated streams, preliminary inspection of all available data shows that channel geometry changes in a consistent manner downstream from the various reservoirs. Channel widths above the reservoirs tend to be significantly greater than channel widths below the reservoirs (relative to discharge).

Plans -- Data collection and particle-size analyses will be completed. Data analysis will be completed, and a report will be prepared.

Reports published or released -- See number 14 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 limitation 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 -- Much of the data have been assembled. Multiyear low-flow frequency curves have been developed for selected gaged sites in southeastern Kansas.

Plans -- Determine carry-over storage requirements from data at selected gaging stations using multiyear low-flow frequency curves and compare those results with values obtained using the probability-routing method. Based on the comparison and other considerations, one of the methods will be selected for use in the project. The selected method will be used to calculate carry-over storage requirements for gaged sites in Kansas less than 100 square miles. A concurrent period of record for all stations will be used in the computations.

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 -- Initial data collection and testing are complete. A preliminary report of the the first year's progress is in preparation.

Plans -- Expand data collection to intensive study of a ground-water management district. Install and test newly developed instrumentation, such as a running-time meter and an electronic totaling meter, that are being developed by the U.S. Geological Survey Instrument Development Laboratory.

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 the hydraulic characteristics than those available from previous studies. The files of the U.S. Geological Survey, Kansas Geological Survey, and Division of Water Resources of 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 scheduled to begin in the next fiscal year.

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 -- Compiled aquifer-test data from project files and from published reports in the U.S. Geological Survey office. A computer program obtained from the Kansas Geological Survey has been modified to test and facilitate the analysis of pumping-test data. A few aquifer tests have been analyzed.

Plans -- Analyze aquifer-test data using both analytical and numerical methods.

PROJECT TITLE: High Plains regional aquifer-system analysis, western Kansas
PROJECT NUMBER: KS-094
COOPERATING AGENCY: None
PROJECT CHIEF: Hayes F. Grubb

Problem -- The Ogallala aquifer system is the principal source of water for municipal, industrial, and irrigation uses in western Kansas. Severe water-level declines resulting from large-scale development have had a significant impact on the economic future of this predominantly agricultural region. A comprehensive knowledge of the aquifer system is needed to evaluate water-management alternatives that have been proposed for maintenance of the aquifer's capacity to sustain current withdrawals. A geohydrologic data base and computer models of the ground-water system are needed to evaluate the response of the aquifer to future schemes of ground-water management in western Kansas. The information acquired will provide the elements needed for a data base and a ground-water model for the High Plains regional aquifer-system analysis.

Objective -- Describe the geohydrology of the Ogallala aquifer and associated hydrologic units in western Kansas; develop the Kansas portion of the regional water-resources data storage and retrieval system; design and develop local digital computer models of the Kansas portion of the High Plains aquifer system; define selected ground-water management alternatives to demonstrate the applicability of the models.

Approach -- Compile maps of the following aquifer properties from existing data: average hydraulic conductivity; average specific yield; soil type; altitude of the base; altitude of potentiometric surfaces for 1960, 1965, 1970, and 1975; and altitude of potentiometric surface of underlying aquifers. Digitize maps and store data in computer-based data file. Reconstruct historical pumpage based on information regarding number and location of wells, irrigated acreage, crop demand, and energy consumed for pumping water. Estimate recharge of the Ogallala aquifer from existing climatological data, soil properties, land-use data, stream-transmission losses, and applied irrigation water. These data will be used to construct models of local ground-water flow. The models will be used to assess the hydrologic impact of selected alternatives for ground-water management.

Progress -- Four stream gages were installed, two on Bear Creek and two on Whitewoman Creek, to determine aquifer recharge due to stream-channel transmission losses; evaluation of aquifer-test data in northwestern Kansas was begun; E. D. Gutentag presented a paper on water-level declines in western Kansas to the Mid-Continent Research and Development Council; and about 400 topographic maps at a scale of 1:24,000 were acquired to complete map coverage of the project area.

Plans -- Compile maps of aquifer properties; collect data on stream-channel transmission losses; intiate collection of ground-water pumpage data; begin compilation of crop acreages, climatological data, and energy-consumption data.

PROJECT TITLE: Channel-geometry investigations for the Kansas River bank stabilization study
PROJECT NUMBER: KS-095
COOPERATING AGENCY: U.S. Department 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 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. 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 -- Numerous channel-geometry measurements have been made on the Kansas River and on the lower parts of the Smoky Hill and Solomon Rivers. Additional channel-width measurements have been made from low-altitude aerial photographs. Samples of bed and bank sediment have been collected at suitable measurement sites, generally at bridge crossings. Suspended-sediment data for nine sites affected by reservoir regulation have been separated into groups for periods before, during, and after dam construction. Curves for sediment rating, flow duration, and sediment duration have been constructed to determine successive changes in sediment discharge. Similar data, not separated into groups, have been made for 15 sites unaffected by reservoir regulation. Currently, the data collected are providing detailed indications of downstream changes in channel geometry and stability.

Plans -- Continue channel measurements, sediment sampling, laboratory analyses, and computer studies. Investigate relation of discharge to downstream changes in channel-geometry and sediment characteristics. Analyze the sediment data to identify areal variations in sediment yield within the Kansas River basin, both before and after the regulation of streamflow by major reservoirs. Prepare a progress report in 1979 on results attained.

LIST OF REPORTS PUBLISHED OR RELEASED
DURING 1978 FISCAL YEAR

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2. Carswell, W. J., Jr., 1978a, Hydrologic data for Soldier Creek basin, Kansas: U.S. Geological Survey Water-Resources Investigation 78-87, 26 p.

3. _____1978b, Description of data-collection system and synopsis of selected hydrologic data for Soldier Creek basin, Kansas: U.S. Geological Survey Open-File Report 78-678, 80 p.

4. Fader, S. W., and Stullken, L. E., 1978, Geohydrology of the Great Bend Prairie, south-central Kansas: Kansas Geological Survey Irrigation Series 4, 19 p.

5. Gillespie, J. B., Hargadine, G. D., and Stough, M. J., 1977, Artificial-recharge experiments near Lakin, western Kansas: Kansas Water Resources Board Bulletin 20, 91 p.

6. Gutentag, E. D., Lobmeyer, D. H., and Slagle, S. E., 1978, Map showing saturated thickness of the unconsolidated aquifer, southwestern Kansas, January 1975: U.S. Geological Survey Open-File Report 78-80, 1 pl.

7. Hauth, L. D., and Carswell, W. J., Jr., 1978, Floods in Kansas City, Missouri and Kansas, September 12-13, 1977: U.S. Geological Survey Water-Resources Investigations 78-63, 36 p.

8. Jenkins, E. D., and Pabst, M. E., 1977, Water-resources reconnaissance of Ness County, west-central Kansas: Kansas Geological Survey Irrigation Series 3, 26 p.

9. Jordan, P. R., 1978a, Statistical summary of streamflow data for Kansas streams in the Arkansas River basin: Kansas Water Resources Board Technical Report 14A, 206 p.

10. _____1978b, Loss of high flows by seepage from stream channels in Kansas: Kansas Water Resources Board Kansas Water News, Irrigation Issue, v. 21, nos. 1 and 2, p. 30-34.

11. Lobmeyer, D. H., and Weakly, E. C., 1978, Water in the Dakota Formation, Hodgeman and northern Ford Counties, southwestern Kansas: U.S. Geological Survey Open-File Report 78-886, 78 p.

12. McElwee, C. D., and Yukler, M. R., 1978, Sensitivity of groundwater models with respect to variations in transmissivity and storage: American Geophysical Union Journal Water Resources Research, v. 14, no. 3, p. 451-459.

13. Osterkamp, W. R., 1978a, Effect of channel sediment on width-discharge relations, with emphasis on streams in Kansas: Kansas Water Resources Board Bulletin 21, 25 p.

14. _____1978b, Gradient, discharge, and particle-size relations of alluvial channels in Kansas, with observations on braiding: American Journal of Science, v. 278, November 1978, p. 1253-1268.

15. _____Bed- and bank-sampling procedure at channel-geometry sites: National Conference on Environmental Measurements Proceedings (in press).

16. Pabst, M. E., 1978a, January 1978 water levels, and data related to water-level changes since 1940 or 1950, western Kansas: U.S. Geological Survey Open-File Report 78-409, 179 p.

17. _____1978b, Map showing percentage decrease in saturated thickness of unconsolidated aquifer, 1950-78, in west-central Kansas: U.S. Geological Survey Open-File Report 78-874, 1 pl.

18. _____1978c, Map showing saturated thickness of the unconsolidated aquifer, southwestern Kansas, January 1978: U.S. Geological Survey Open-File Report 78-969, 4 pl.

19. Pabst, M. E., and Gutentag, E. D., 1977, Water-level changes in west-central Kansas, 1950-77: Kansas Geological Survey Journal, October 1977, 18 p.

20. Shelton, L. R., 1978, Artificial substrate retriever: Water Resources Division Bulletin, July-September 1978, p. 19-22.

21. U.S. Geological Survey, 1978, Flood insurance study, City of Lecompton, Kansas: Flood Insurance Administration, U.S. Department of Housing and Urban Development.

22. _____1978, Flood insurance study, City of Riley, Kansas: Flood Insurance Administration, U.S. Department of Housing and Urban Development.

23. _____Flood insurance study, City of Baldwin, Kansas: Flood Insurance Administration, U.S. Department of Housing and Urban Development (in press).

24. _____Flood insurance study, City of Lawrence, Kansas: Flood Insurance Administration, U.S. Department of Housing and Urban Development (in press).

25. _____Flood insurance study, City of Rossville, Kansas: Flood Insurance Administration, U.S. Department of Housing and Urban Development (in press).

26. _____Flood insurance study, City of St. Marys, Kansas: Flood Insurance Administration, U.S. Department of Housing and Urban Development (in press).

27. _____Flood insurance study, City of Wichita, Kansas: Flood Insurance Ad-Administration, U.S. Department of Housing and Urban Development (in press).

28. _____1978, Water resources data for Kansas, water year 1977: U.S. Geological Survey Water-Data Report KS-77-1, 618 p.

29. _____1978, Water-resources investigations in Kansas, fiscal year 1977: U.S. Geological Survey, Kansas District, 80 p.

30. _____Water-resources investigations in Kansas, 1977: U.S. Geological Survey, Water Index Folder (in press).

COLLECTION OF WATER-RESOURCES DATA

Hydrologic-data stations are maintained at selected locations throughout Kansas as a water-resources-data network for obtaining records of stage, discharge, chemical quality, and sediment yield of streams; stage, content, and chemical quality of lakes and reservoirs; and water levels and chemical quality of ground water.

All hydrologic data collected in Kansas are published annually in a combined report identified as "U.S. Geological Survey Water-Data Report KS-78-1"; the report number denotes the two-letter State abbreviation, the last two digits of the water year, and the volume number. 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, VA 22161.

All hydrologic data collected also are stored in both a current and historical file in the U.S. Geological Survey's National Water-Data Storage and Retrieval System (WATSTØRE). 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 services are available from the Kansas District office in Lawrence, Kansas.

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 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.

A statewide network of wells is maintained, as part of the Federal-State program, for monitoring water levels and determining water quality from the principal aquifers. Samples are analyzed to detect pollution in areas of existing drinking-water supplies and to determine the adequacy with respect to standards imposed by the Safe Drinking Water Act.

Surface-Water Data

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. Complete-record stations (shown in figure 1 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 2 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	279
Complete-record	145
Partial-record	
Crest-stage	111
Low-flow	23
Lake and reservoir stations	21

Surface-Water-Quality Data

Surface-water-quality stations are maintained to monitor long-term and short-term trends related to changes in streamflow, reservoir operation, and local or regional pollution. Data are collected on a routinely scheduled basis (generally near surface-water gages) at 72 complete-record streamflow stations and 2 lakes (shown in figure 3 and listed in table 3).

Water-quality samples collected on a routine basis at 37 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 interpretative hydrologic investigations.

Water samples are collected on a routine basis at 97 stations for analysis and determination of suspended-sediment discharge. In addition, measurements are made of the particle-size distribution of suspended sediment and bed material.

Ground-Water Data

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.

Water levels are measured in 462 observation wells (shown in figure 4 and listed in table 4) 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 1,200 wells are measured 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.

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

Ground-Water-Quality Data

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.

Collection and analysis of water samples from 458 wells (shown in figure 5 and listed in table 5) were made as part of a statewide network for determining the existing chemical characteristics of ground water in the principal aquifers and for detecting pollution. Samples have been collected in prior years from 19 additional wells (not shown in figure 5) that also are considered a part of the statewide network.

Other samples of ground water from various geologic formations at specific locations are analyzed for interpretive hydrologic investigations.

Explanation of Table Symbols

Cooperators of Supporting Programs

KWRB	Kansas Water Resources Board
KDHE	Kansas Department of Health and Environment
KDOT	Kansas Department of Transportation
KSBA	Kansas State Board of Agriculture
WDPW	City of Wichita, Department of Public Works
WWD	City of Wichita, Water Department
A CE	Albuquerque District, U.S. Army Corps of Engineers
KC CE	Kansas City District, U.S. Army Corps of Engineers
T CE	Tulsa District, U.S. Army Corps of Engineers
SCS	Soil Conservation Service
EPA	U.S. Environmental Protection Agency
ARCA	Arkansas River Compact Administration
CBR	Federal Collection-of-Basic-Records Program
MRB	Missouri River Basin Program, Federal
USBR	U.S. Bureau of Reclamation, Region 7
USFW	U.S. Fish and Wildlife Service
GWMD1	Western Kansas Groundwater Management District No. 1
GWMD2	Equus Beds Groundwater Management District No. 2
GWMD3	Southwest Kansas Groundwater Management District No. 3

Surface-Water Gaging Stations

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 station 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

Type of Gage

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

Remarks

A - Also a precipitation station
B - Operated by Tulsa District, Corps of Engineers
C - Operated by Tulsa District, Corps of Engineers, records computed by U.S. Geological Survey
D - Equipped with digital stage recorder
E - Equipped with A-35 recorder
F - Equipped with wire-weight
G - Equipped with bubble gage

Surface-Water-Quality Stations

Sampling Purpose

C - Chemical analysis, principally for concentrations of selected inorganic and organic constituents
P - Physical measurements, principally field determinations of temperature, specific conductance, pH, etc.
B - Biological analysis, generally to define selected biological or microbiological properties
S - Sediment analysis, principally for concentrations or particle size of suspended sediment and bed material

Frequency of Sampling

1. Regularly scheduled daily or monthly
2. Periodically scheduled quarterly, semiannually, seasonally, or annually

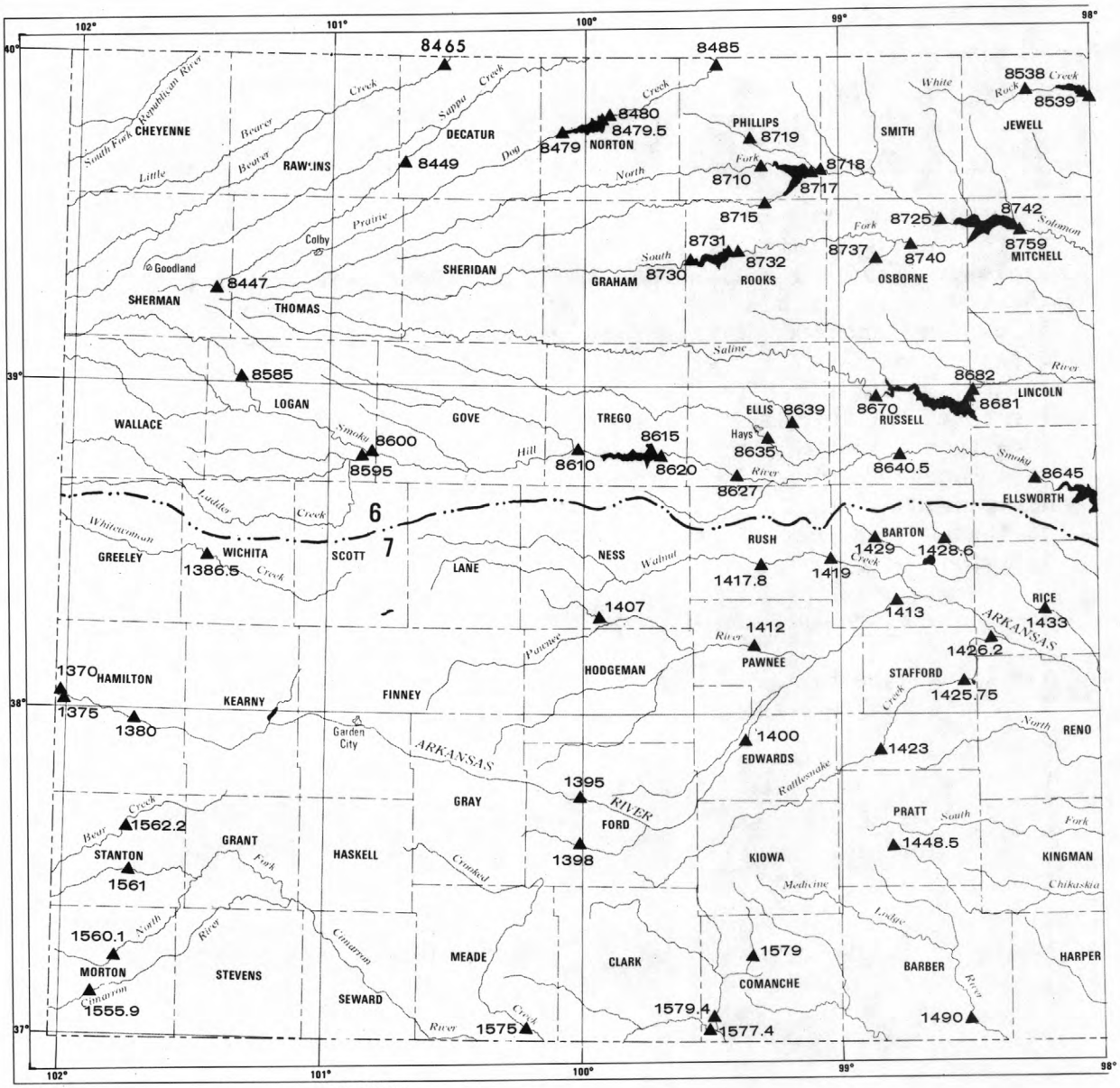
Ground-water observation wells

Well Numbers

Well numbers in this listing indicate the locations of wells according to the land subdivisions system of the U.S. Bureau of Land Management. An example of a typical well number is 26-21W-17DBC. 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 letter denotes the quarter-quarter section or 40-acre tract; and the third letter denotes the quarter-quarter-quarter section or 10-acre tract. The quarter sections, quarter-quarter sections, etc., are designated A, B, C, 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.

Frequency of Measurement

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



EXPLANATION

▲ 1720
Complete-record 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

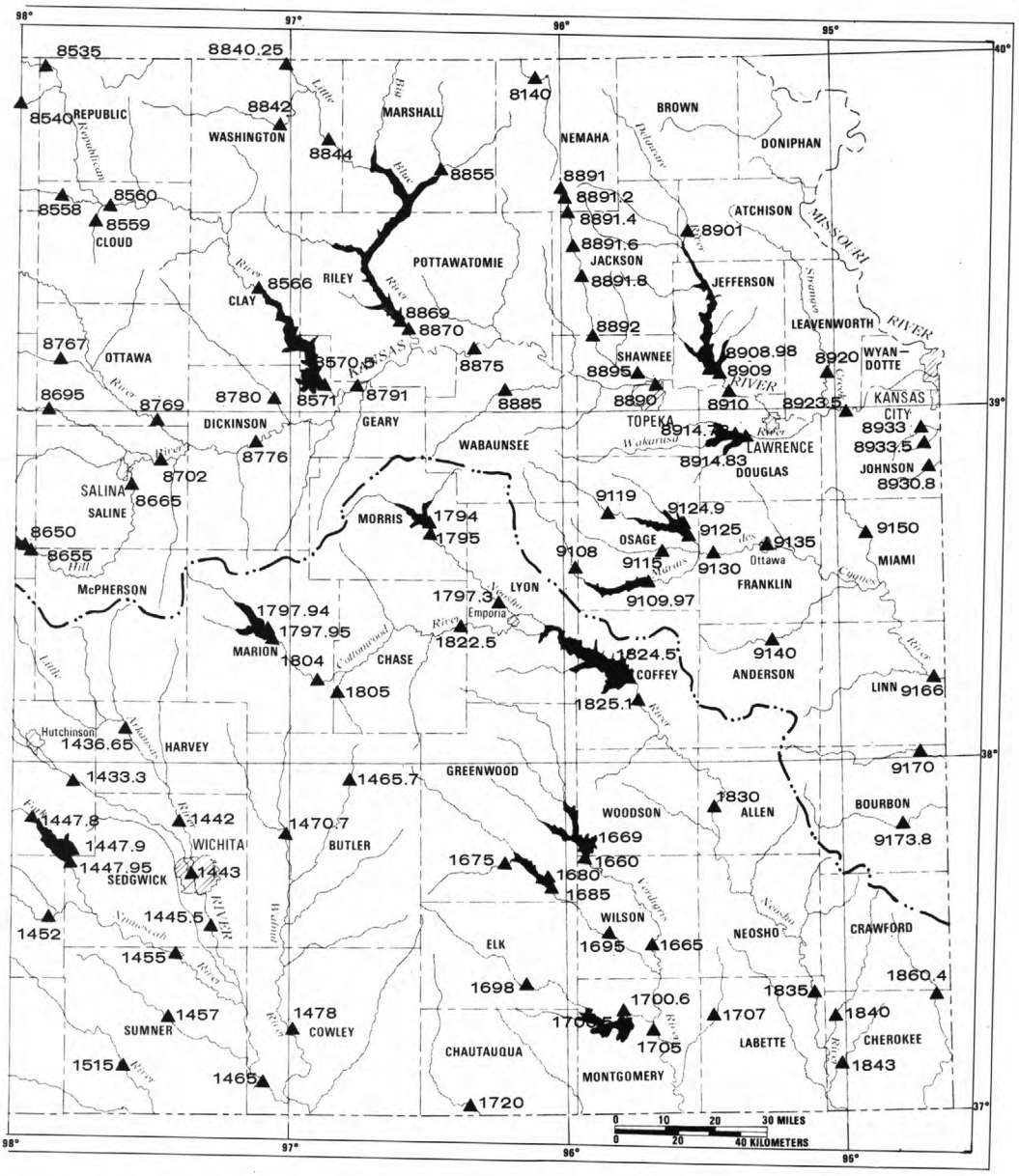


Figure 1.—Map of Kansas showing location of complete-record surface-water gaging stations, 1978 water year.

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

Missouri River Basin

Ident. no. 06-	Station	Station purpose	Location			Type of gage	Coop. or support	Remarks
			Sec.	T.	R.			
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	KC CE	
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	KC CE	
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	KC CE	
8566	Republican R. at Clay Center	C,R	17	8S	3E	BDRT	CBR	
85705	Milford Lake nr Junction City		20	11S	5E	RT	KC CE	
8571	Republican R. bl Milford Dam	C,R	--	--	--	BCDRT	KC CE	
8585	N. Fk. Smoky Hill R. nr McAllaster	P	17	12S	36W	BR	KWRB	A
8595	Ladder Cr. bl Chalk Cr. nr Scott City	P	34	14S	32W	BDR	CBR	
8600	Smoky Hill R. at Elkader	B	34	14S	32W	BD	KC CE	A
8610	Smoky Hill R. nr Arnold	C,P	29	14S	24W	BDR	KC CE	
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	KC CE	
8645	Smoky Hill R. at Ellsworth	C,R	20	15S	8W	BDR	KC CE	
8650	Kanopolis Lake nr Kanopolis		3	17S	6W	BR	KC CE	

Table 1.--Complete-record surface-water gaging stations (continued).

Ident. no. 06-	Station	Station purpose	Location Sec.	T.	R.	Type of gage	Coop. or support	Remarks
8655	Smoky Hill R. nr Langley	C,R	35	16S	6W	BDRT	KC CE	
8665	Smoky Hill R. nr Mentor	C,R	29	14S	2W	BDRT	KC CE	
8670	Saline R. nr Russell	B,C,P	34	12S	14W	BDR	KWRB	
8681	Wilson Lake nr Wilson		36	12S	11W	RT	KC CE	
8682	Saline R. at Wilson Dam	C,R	25	12S	11W	BDRT	KC CE	
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	KC CE	
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	KC CE	
8730	S. Fk. Solomon R. ab Webster Res.	C,P	8	8S	20W	BDR	KC CE	
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	
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	USBR	
8759	Solomon R. nr Glen Elder	C,R	2	7S	9W	BCDRW	KWRB	
8767	Salt Cr. nr Ada	C	36	10S	5W	BDR	KWRB	
8769	Solomon R. at Niles	C,R	31	12S	1W	BDRT	KC CE	
8776	Smoky Hill R. at Enterprise	C,R	20	13S	3E	BDRT	KC CE	
8780	Chapman Cr. nr Chapman	H	1	12S	3E	BDR	KWRB	
8791	Kansas R. at Ft. Riley	C,R	33	11S	6E	BDRT	KC CE	
8842	Mill Cr. at Washington	H	1	3S	3E	BDR	KWRB	
8844	Little Blue R. nr Barnes	C,P	22	3S	5E	BDR	KC CE	
8855	Black Vermillion R. nr Frankfort	C	20	4S	9E	BDR	KC CE	
8869	Tuttle Creek Lake nr Manhattan		24	9S	7E	BR	KC CE	
8870	Big Blue R. nr Manhattan	C,R	30	9S	8E	BDRT	KC CE	
8875	Kansas R. at Wamego	C,R	9	10S	10E	BDRT	KC CE	
8885	Mill Cr. nr Paxico	C	27	11S	11E	BDRT	KWRB	
8890	Kansas R. at Topeka	C,R	28	11S	16E	BDRT	KC CE	

Table 1.--Complete-record surface-water gaging stations (continued).

Ident. no. 06-	Station	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	KC CE	
8895	Soldier Cr. nr Topeka	C	14	11S	15E	BDR	KC CE	
8901	Delaware R. nr Muscotah	B,C	16	6S	17E	BDRT	KC CE	
890898	Perry Lake nr Perry		9	11S	18E	R	KC CE	
8909	Delaware R. bl Perry Dam	C,R	9	11S	18E	CR_2	KC CE	
8910	Kansas R. at Lecompton	C,R	34	11S	18E	BDRT	KC CE	
891478	Clinton Lake nr Lawrence		8	13S	19E	B	KC CE	
891483	Wakarusa R. bl Clinton Dam	C,R	15	13S	19E	BDRT	KC CE	
8920	Stranger Cr. nr Tonganoxie	B,C	7	11S	22E	BDRT	KC CE	
89235	Kansas R. at DeSoto	C,R	28	12S	22E	BDRT	KWRB	
89308	Blue R. nr Stanley	C	19	14S	25E	BDR	KC CE	
8933	Indian Cr. at Overland Park	C,H	6	13S	25E	BDR	KWRB	
89335	Tomahawk Cr. nr Overland Park	C	21	13S	25E	BDR	KC CE	
9108	Marais des Cygnes R. nr Reading	C	15	17S	13E	BDR	KC CE	
910997	Melvern Lake nr Melvern		1	18S	15E	R	KC CE	
9115	Salt Cr. nr Lyndon	B,C,H	34	16S	16E	BDR	KWRB	
9119	Dragoon Cr. nr Burlingame	C,H	27	15S	14E	BDR	KC CE	
91249	Pomona Lake nr Quenemo		19	16S	17E	R	KC CE	
9125	Hundred and Ten Mile Cr. nr Quenemo	C,R	20	16S	17E	BCDRT	KC CE	
9130	Marais des Cygnes R. nr Pomona	C,R	7	17S	18E	BDRT	KC CE	
9135	Marais des Cygnes R. nr Ottawa	C,R	36	16S	19E	BDRT	KC CE	
9140	Pottawatomie Cr. nr Garnett	C	6	20S	20E	BDR	KWRB	
9150	Big Bull Cr. nr Hillsdale	C	20	16S	23E	BCDR	KC CE	
9166	Marais des Cygnes R. nr Kansas-Missouri State line, Kansas	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	KC CE	

Table 1.--Complete-record surface-water gaging stations (continued).

Arkansas River Basin

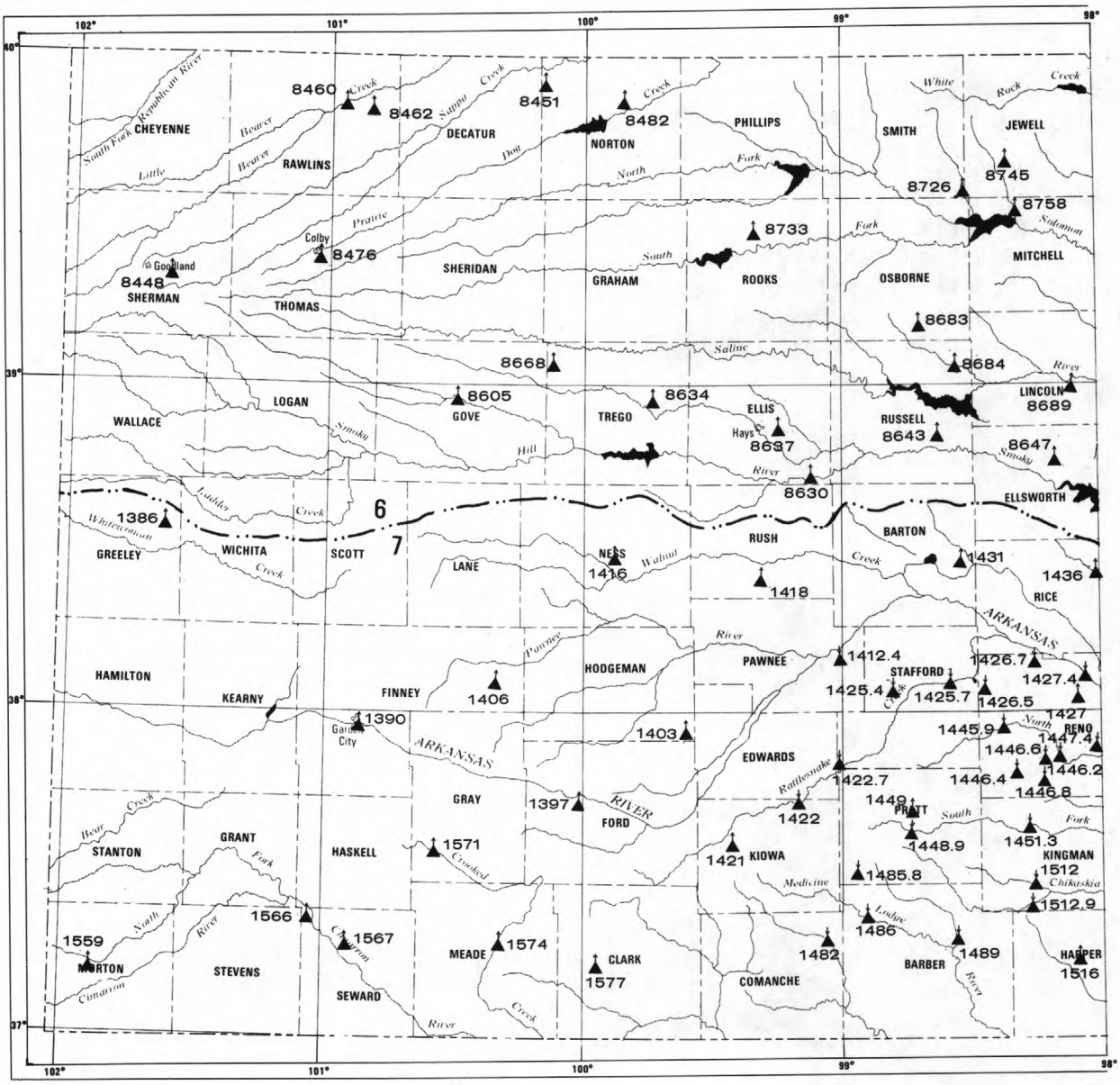
Ident. no. 07-	Station	Station purpose	Location Sec.	T.	R.	Type of gage	Coop. or support	Remarks
1370	Frontier Ditch nr Coolidge	C	21	23S	43W	RRT	CBR	
1375	Arkansas R. nr Coolidge	C,R	26	23S	43W	BDT	CBR ARCA	
1380	Arkansas R. at Syracuse	C,R	18	24S	40W	BDRT	KWRB	A
13865	Whitewoman Cr. nr Leoti	C,H	23	18S	38W	BR	KWRB	A
1395	Arkansas R. at Dodge City	C,R	35	26S	25W	BDRT	A CE	
1398	Mulberry Cr. nr Dodge City	H	24	28S	25W	BR	KWRB	
1400	Arkansas R. nr Kinsley	C,R	26	24S	19W	BDRT	A CE	
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	A CE	
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	USSFW	
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	T CE	
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	T CE	
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	CBR	
1457	Slate Creek at Wellington	H	23	32S	1W	BR	KWRB	

Table 1.--Complete-record surface-water gaging stations (continued).

Ident. no. 07-	Station	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 T CE	
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	T CE	
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	
15774	Cimarron R. nr Buttermilk	H	3	35S	20W	DR	T CE	
1579	Cavalry Cr. at Coldwater	C,H	14	32S	19W	BR	KWRB	
15794	Bluff Cr. nr Buttermilk	H	3	35S	20W	BR	T CE	
1659	Toronto Lake nr Toronto		36	26S	13E	R	T CE	B
1660	Verdigris R. nr Coyville	C,R	8	27S	14E	DR	T CE	C
1665	Verdigris R. nr Altoona	C,R	29	29S	16E	DR	T CE	C
1675	Otter Cr. at Climax	B,H	8	27S	11E	DR	KWRB	
1680	Fall River Lake nr Fall River		3	28S	12E	R	T CE	
1685	Fall R. nr Fall River	C,R	2	28S	12E	DR	T CE	C
1695	Fall R. at Fredonia	C,R	24	29S	14E	DR	T CE	C
1698	Elk R. at Elk Falls	C	3	31S	11E	BDR	KWRB	
17005	Elk City Lake nr Independence		9	32S	15E	R	T CE	B
17006	Elk R. bl Elk City Lake	C,R	9	32S	15E	BDR	T CE	C
1705	Verdigris R. at Independence	C,R	32	32S	16E	BDRT	T CE	C
1707	Big Hill Cr. nr Cherryvale	C,H	7	32S	18E	BDR	T CE	C
1720	Caney R. nr Elgin	C	16	35S	10E	BDR	T CE	C
1794	Council Grove Lake nr Council Grove		10	16S	8E	BR	T CE	B
1795	Neosho R. at Council Grove	C,R	14	16S	8E	DR	T CE	
17973	Neosho R. nr Americus	C,R	24	18S	10E	BDRT	T CE	
179794	Marion Lake nr Marion		27	19S	3E	BR	T CE	B
179795	Cottonwood R. bl Marion Lake	C,R	27	19S	3E	BCDR	T CE	
1804	Cottonwood R. nr Florence	C,R	10	21S	5E	BDR	T CE	
1805	Cedar Cr. nr Cedar Point	C,H	25	21S	5E	DR	T CE	
18225	Cottonwood R. nr Plymouth	C,R	13	19S	9E	BDR	T CE	

Table 1.--Complete-record surface-water gaging stations (concluded).

Ident. no. 07-	Station	Station purpose	Location Sec.	T.	R.	Type of gage	Coop. or support	Remarks
18245	John Redmond Res. nr Burlington		9	21S	15E	BR	T CE	B
18251	Neosho R. at Burlington	C,R	26	21S	15E	BDR	T CE	
1830	Neosho R. nr Iola	C,R	9	25S	18E	BCDRT	T CE	
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	



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

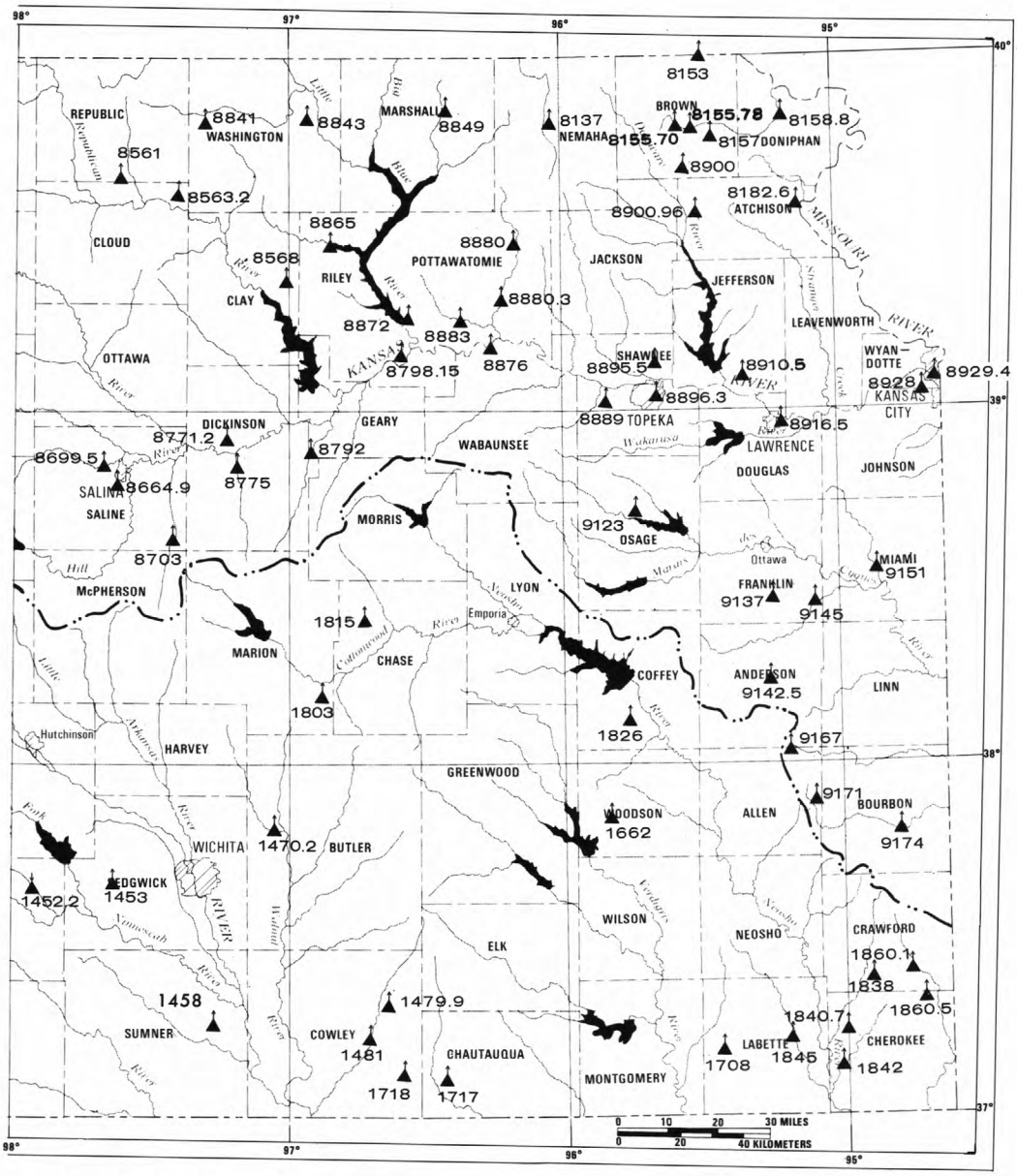


Figure 2.—Map of Kansas showing location of partial-record surface-water gaging stations, 1978 water year.

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

Crest-Stage Gage

Ident. no. 06-	Station	Location Sec.	T.	R.	Coop. or support	Remarks
8137	Tennessee Cr. trib. nr Seneca	2	3S	12E	KDOT	
8153	Walnut Cr. at Reserve	7	1S	17E	SCS	
8157	Buttermilk Cr. nr Willis	30	3S	18E	KDOT	
81588	Wolf River nr Sparks	4	3S	20E	SCS	
81826	White Clay Cr. at Atchison	1	6S	20E	KC CE	
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 (southwest of town)	6	8S	33W	KDOT	AD
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	KC CE	
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	KC CE	
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	AD
8647	Spring Cr. nr Kanopolis	24	15S	8W	KDOT	AD
86649	Dry Cr. at Mentor	24	15S	3W	KC CE	
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	AD
86995	Mulberry Cr. nr Salina	9	14S	3W	KC CE	
8703	Gypsum Cr. nr Gypsum	15	16S	1W	KWRB	E
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	

Table 2.--Partial-record surface-water gaging stations (continued).

Ident. no. 06-	Station	Location Sec.	T.	R.	Coop. or support	Remarks
8758	Limestone Cr. nr Glen Elder	15	6S	9W	KWRB	
87645	Solomon R. at Minneapolis	--	11S	4W	KC CE	F
87712	Mud Cr. at Abilene	17	13S	2E	KC CE	
8775	Turkey Cr. nr Abilene	26	14S	2E	KWRB	
8785	Lyon Cr. nr Woodbine	31	13S	5E	KC CE	EG
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	KC CE	EG
8841	Mulberry Cr. trib. nr Haddam	10	3S	1E	KDOT	
8843	Mill Cr. trib. nr Washington	5	3S	4E	KDOT	AD
8847	Big Blue R. nr Blue Rapids	21	4S	7E	KC CE	EG
8849	Robidoux Cr. at Beattie	20	2S	9E	KDOT	
88549	Black Vermillion R. at Frankfort (Hwy 99)	16	4S	9E	KC CE	F
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	KC CE	
88803	Vermillion Cr. nr Louisville	12	9S	10E	KC CE	
8883	Rock Cr. nr Louisville	14	9S	9E	KWRB	
8884	Kansas R. at Maple Hill	1	11S	12E	KC CE	F
8889	Blacksmith Cr. trib. nr Valencia	10	12S	14E	KDOT	
88955	Indian Cr. nr Topeka	5	11S	16E	KC CE	
88963	Shunganunga Cr. at Topeka	6	12S	16E	KC CE	
8900	Little Delaware R. nr Horton	24	4S	16E	SCS	D
890096	Little Grasshopper Cr. nr Muscotah	10	6S	17E	SCS	
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	KC CE	F
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	KC CE	DEG
9114	Marais des Cygnes R. at Quenemo	22	17S	17E	KC CE	EG
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	

Table 2.--Partial-record surface-water gaging stations (continued).

Ident. no. 06-	Station	Location			Coop. or support	Remarks
		Sec.	T.	R.		
9145	Pottawatomie Cr. at Lane	34	18S	21E	KC CE	F
9151	Big Bull Cr. at Paola	17	17S	23E	KC CE	
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	Location Sec.	T.	R.	Coop. or support	Remarks
1386	Whitewoman Cr. trib. nr Selkirk	34	17S	39W	KDOT	A
1390	Arkansas R. at Garden City	--	24S	32W	KWRB	EG
1397	Arkansas R. trib. nr Dodge City	11	27S	25W	KDOT	AD
1403	Whitewoman Cr. nr Bellefont	33	24S	21W	KDOT	AD
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	AD
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	E
14423	W. Br. Chisholm Cr. at 61st St. N., Wichita	17	26S	1E	WDPW	E
14424	N. Fk. Chisholm Cr. at 45th St. N., Wichita	27	26S	1E	WDPW	E
14432	Gypsum Cr. at Gilbert St., Wichita	29	27S	2E	WDPW	E
144323	Fabrique Br. Gypsum Cr. at Harry St., Wichita	36	27S	1E	WDPW	AD
144325	Gypsum Cr. at Oliver St., Wichita	2	28S	1E	WDPW	E
14433	Dry Cr. at Lincoln St., Wichita	25	27S	1E	WDPW	AD
14434	Dry Cr. at Pawnee Ave., Wichita	2	28S	1E	WDPW	AD
144494	Cowskin Cr. trib. at Westfield Drive, Wichita	20	27S	1W	WDPW	E
144495	Cowskin Cr. trib. at Clearwater Road, Wichita	30	27S	1W	WDPW	E
14452	Big Slough Cr. at Ridge Road, Wichita	33	26S	1W	WDPW	E
14453	Spring Cr. at Woodlawn St., Wichita	29	29S	2E	WDPW	E
1449	S. Fk. Ninnescah R. trib. nr Pratt	27	27S	13W	KDOT	
1453	Clear Cr. nr Garden Plain	33	27S	3W	KDOT	AD

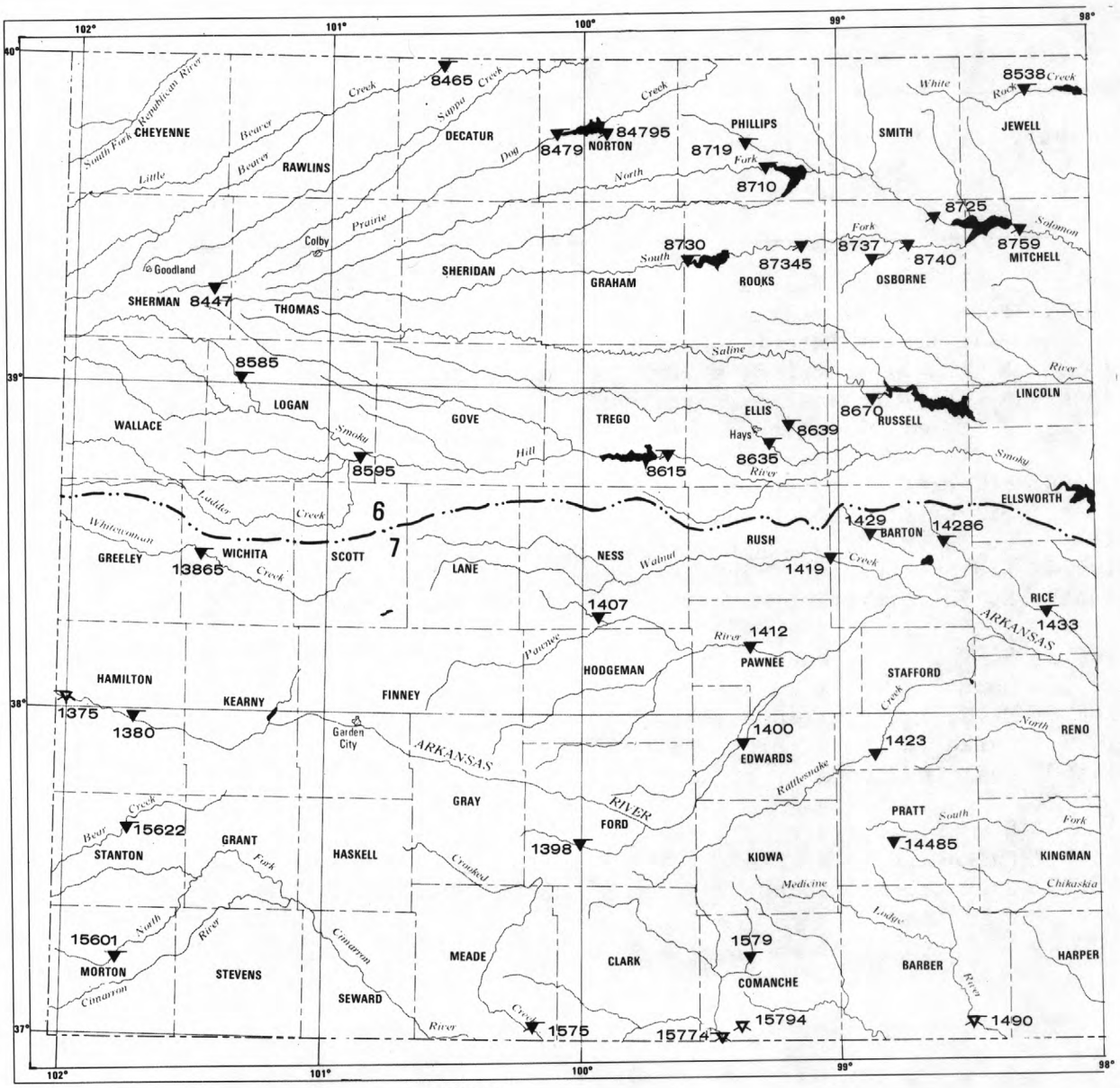
Table 2.--Partial-record surface-water gaging stations (continued).

Ident. no. 07-	Station	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	AD
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	
1838	Limestone Cr. nr Beulah	28	30S	23E	KDOT	
18407	Deer Cr. nr Hallowell	28	32S	22E	KDHE	D
18422	Cherry Cr. nr West Mineral	29	32S	23E	KDHE	D
18424	Little Cherry Cr. nr West Mineral	32	32S	23E	KDHE	D
1845	Labette Cr. nr Oswego	11	33S	20E	KWRB	
18601	Second Cow Cr. at Pittsburg	25	30S	24E	KDHE	D
18605	Brush Cr. nr Weir	31	31S	25E	KDHE	D
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	
14257	Rattlesnake Cr. ab Little Salt Marsh nr Hudson	31	22S	11W	KWRB	

Table 2.--Partial-record surface-water gaging stations (concluded).

Low-Flow Gage

Ident. no. 07-	Station	Location Sec.	T.	R.	Coop. or support	Remarks
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	



EXPLANATION

▼ Chemical ▼ Biological ▽ Monitor
▼ Temperature ▼ Sediment

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

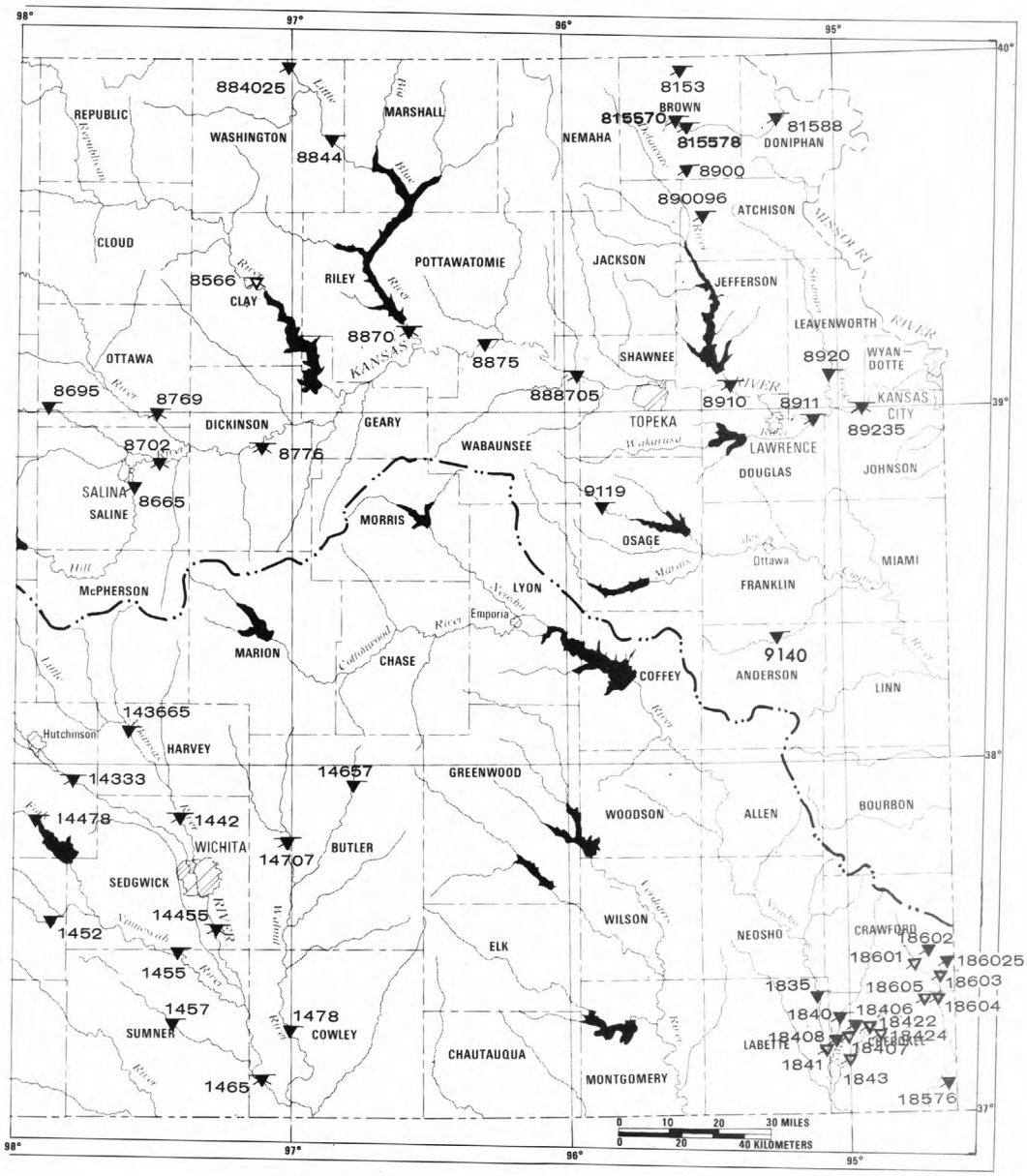


Figure 3.—Map of Kansas showing location of surface-water-quality stations, 1978 water year.

Table 3.--Surface-water-quality stations.

Missouri River Basin

Ident. no. 06-	Station name	Sampling purpose	Frequency	Coop. or support
8153	Walnut Cr. at Reserve	C,P,S	2	SCS
81588	Wolf R. nr Sparks	C,P,B,S	2	SCS
8447	S. Fk. Sappa Cr. nr Brewster	P,S	1	KWRB
8465	Beaver Cr. at Cedar Bluffs	P,S	2	KWRB
8479	Prairie Dog Cr. ab Norton Res.	P,S	1	KWRB
84795	Norton Res. nr Norton	C,P,B	2	USBR
8538	White Rock Cr. nr Burr Oak	P,S	1	KWRB
8566	Republican R. at Clay Center	C,P,B	1	CBR
8585	N. Fk. Smoky Hill R. nr McAllaster	P,S	1	KWRB
8595	Ladder Cr. bl Chalk Cr. nr Scott City	P,S	1	KWRB
8615	Cedar Bluff Res. nr Ellis	C,P,B	2	USBR
8635	Big Cr. nr Hays	P,S	1	KWRB
8639	N. Fk. Big Cr. nr Victoria	P,S	1	KWRB
8665	Smoky Hill R. nr Mentor	C,P	1	KDHE,KWRB
8670	Saline R. nr Russell	P,S	1	KWRB
8695	Saline R. at Tescott	P,S	1	KWRB
8702	Smoky Hill R. at New Cambria	C,P	1	KDHE,KWRB
8710	N. Fk. Solomon R. at Glade	P,S	1	KWRB
8719	Deer Cr. nr Phillipsburg	P,S	1	KWRB
8725	N. Fk. Solomon R. at Portis	C,P	2	USBR
8730	S. Fk. Solomon R. ab Webster Res.	P,S	1	KWRB
87345	S. Fk. Solomon R. at Woodston Divrs.	C,P	2	USBR
8737	Kill Cr. nr Bloomington	P,S	1	KWRB
8740	S. Fk. Solomon R. at Osborne	C,P	2	USBR
8759	Solomon R. nr Glen Elder	C,P,B	2	USBR
8769	Solomon R. at Niles	C,P,S	1	KDHE,KWRB
8776	Smoky Hill R. at Enterprise	C,P,B,S	1	CBR,KWRB
8844	Little Blue R. nr Barnes	P,S	1	KWRB
8870	Big Blue R. nr Manhattan	C,P,B,S	1	CBR
8875	Kansas R. at Wamego	P,S	1	KWRB

Table 3.--Surface-water-quality stations (continued).

Ident. no. 06-	Station name	Sampling purpose	Frequency	Coop. or support
888705	Kansas R. at Willard	C,P,B	1	EPA
890096	Little Grasshopper Cr. at Muscotah	C,P,S	2	SCS
8910	Kansas R. at Lecompton	C,P,B,S	1	KC CE,EPA
8911	Kansas R. at Eudora	C,P,B	1	EPA
8920	Stranger Cr. nr Tonganoxie	P,S	1	KWRB
89235	Kansas R. at DeSoto	C,P,B,S	1	KC CE,CBR
9119	Dragoon Cr. nr Burlingame	P,S	1	KWRB
9140	Pottawatomie Cr. nr Garnett	P,S	1	KWRB

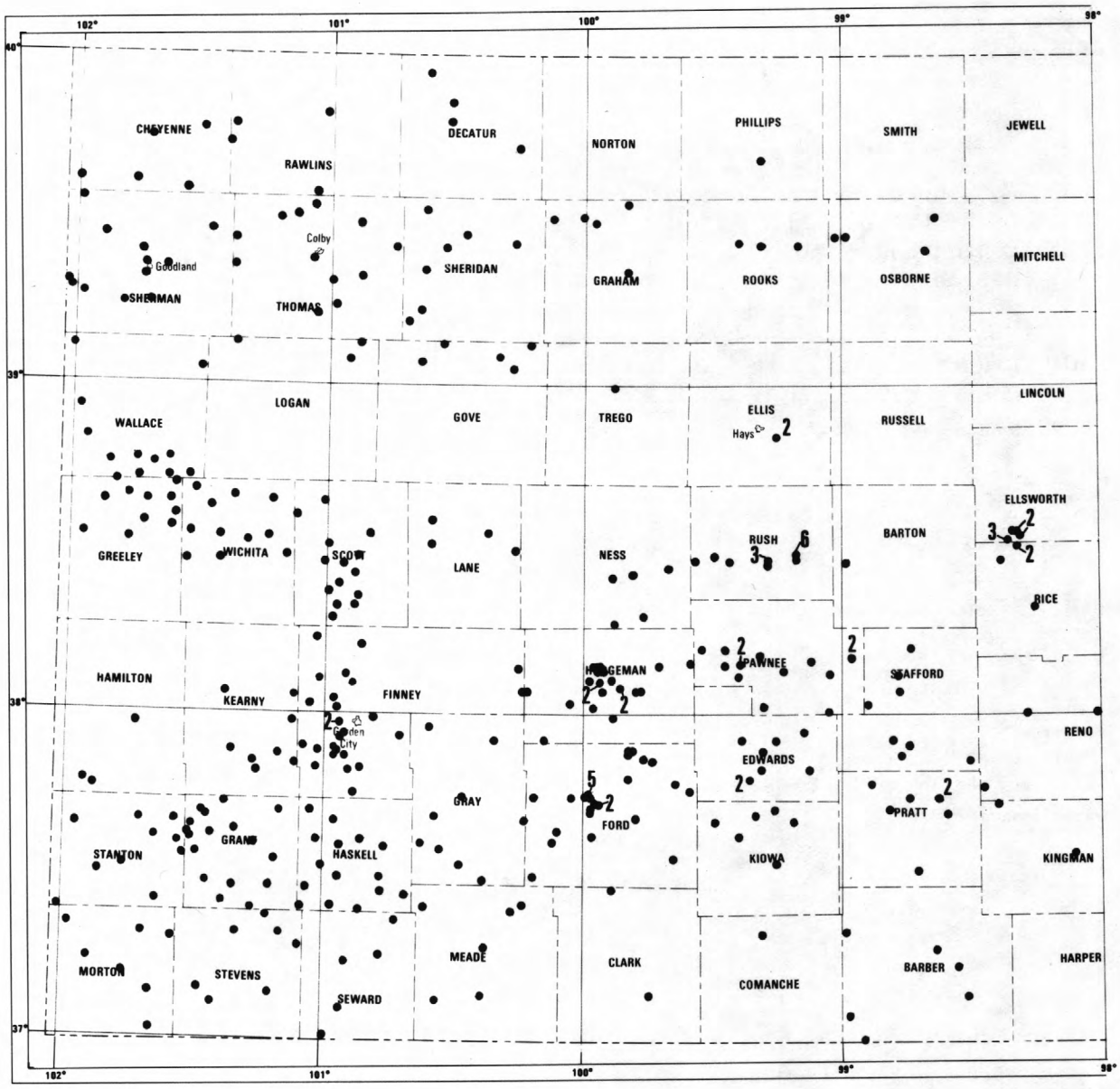
Table 3.--Surface-water-quality stations (continued).

Arkansas River Basin

Ident. no. 07-	Station name	Sampling purpose	Frequency	Coop. or support
1375	Arkansas R. nr Coolidge	C,P,B	1	CBR
1380	Arkansas R. at Syracuse	P,S	1	KWRB
13865	Whitewoman Cr. nr Leoti	P,S	1	KWRB
1398	Mulberry Cr. nr Dodge City	P,S	1	KWRB
1400	Arkansas R. nr Kinsley	P,S	1	KWRB
1407	Guzzler's Gulch nr Ness City	P,S	1	KWRB
1412	Pawnee R. at Larned	P,S	1	KWRB
1419	Walnut Cr. at Albert	P,S	1	KWRB
1423	Rattlesnake Cr. nr Macksville	P,S	1	KWRB
14286	Cow Cr. nr Claflin	P,S	1	KWRB
1429	Blood Cr. nr Boyd	P,S	1	KWRB
1433	Cow Cr. nr Lyons	P,S	1	T CE,KWRB
14333	Arkansas R. nr Hutchinson	C,P,B,S	1	EPA,KWRB
143665	Little Arkansas R. at Alta Mills	P,S	1	KWRB
1442	Little Arkansas R. at Valley Center	C,P,B,S	1	T CE,EPA
14455	Arkansas R. at Derby	C,P,B	1	EPA
14478	N. Fk. Ninnescah R. ab Cheney Res.	P,S	1	KWRB
14485	S. Fk. S. Fk. Ninnescah R. nr Pratt	P,S	1	KWRB
1452	S. Fk. Ninnescah R. nr Murdock	P,S	1	KWRB
1455	Ninnescah R. nr Peck	P,S	1	KWRB
1457	Slate Cr. at Wellington	P,S	1	KWRB
1465	Arkansas R. at Arkansas City	C,P,B,S	1	T CE,CBR,KWRB
14657	Cole Cr. nr DeGraff	P,S	1	KWRB
14707	Whitewater R. at Towanda	P,S	1	KWRB
1478	Walnut R. at Winfield	P,S	1	KWRB
1490	Medicine Lodge R. nr Kiowa	C,P,S	1	T CE
15601	N. Fk. Cimarron R. at Richfield	P,S	1	KWRB
15622	Bear Cr. nr Johnson	P,S	1	KWRB
1575	Crooked Cr. nr Nye	P,S	1	KWRB
15774	Cimarron R. nr Buttermilk	C,P	1	T CE
1579	Cavalry Cr. at Coldwater	P,S	1	KWRB
15794	Bluff Cr. nr Buttermilk	C,P	1	T CE
1795	Neosho R. at Council Grove	P,S	1	T CE
17973	Neosho R. nr Americus	P,S	1	T CE
179795	Cottonwood R. bl Marion Lake	P,S	1	T CE

Table 3.--Surface-water-quality stations (concluded).

Ident. no. 07-	Station name	Sampling purpose	Frequency	Coop. or support
1804	Cottonwood R. nr Florence	P,S	1	T CE
1805	Cedar Cr. nr Cedar Point	P,S	1	T CE
18225	Cottonwood R. nr Plymouth	P,S	1	T CE
18251	Neosho R. at Burlington	P,S	1	T CE
1835	Neosho R. nr Parsons	C,P,S	1	KWRB
1840	Lightning Cr. nr McCune	C,P,S	1	KWRB
1843	Cherry Cr. at Hallowell	C,P,S	1	KDHE
18604	Cow Cr. nr Weir	C,P,S	1	KDHE



EXPLANATION

● Observation well

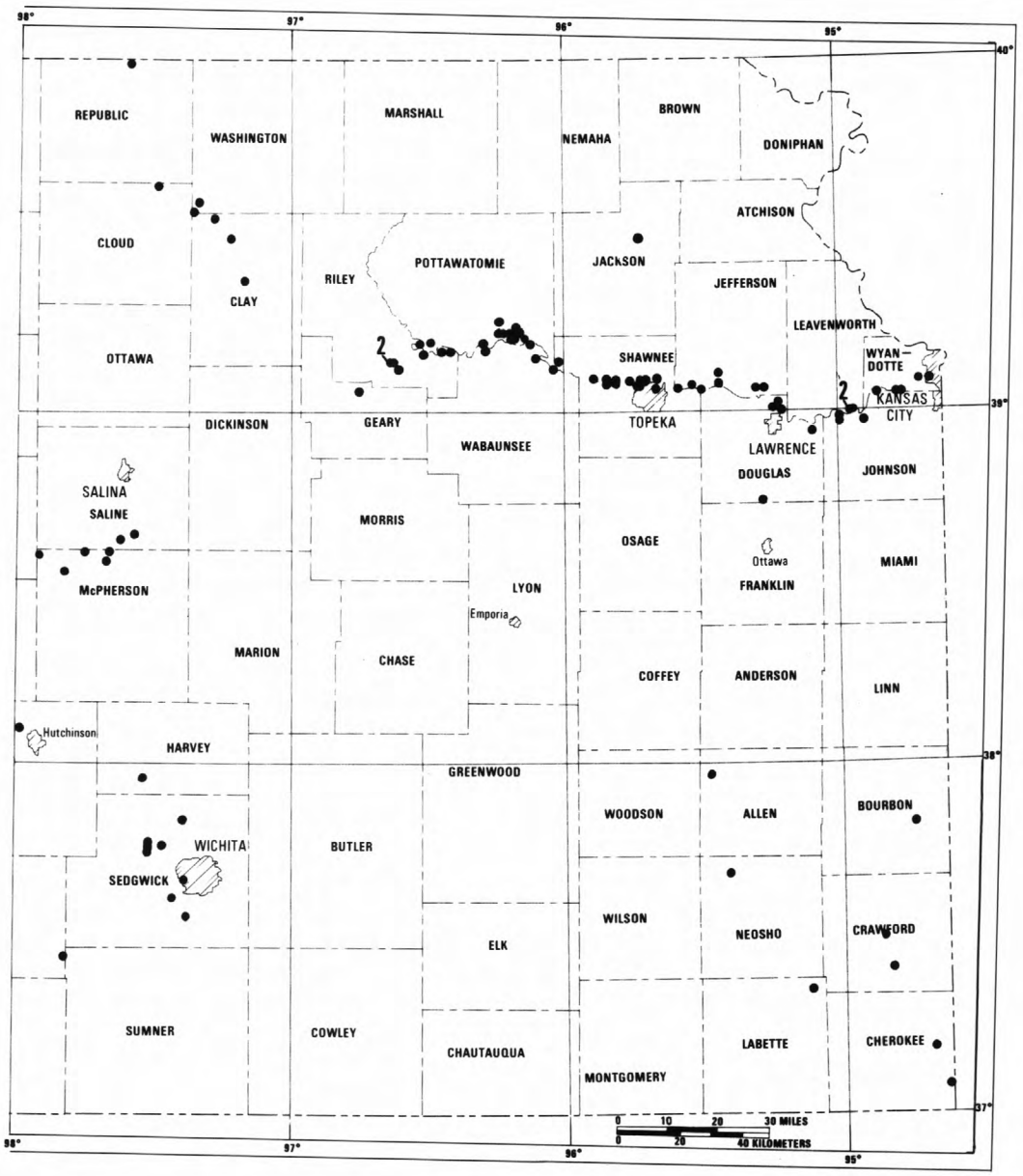


Figure 4.—Map of Kansas showing location of observation wells, 1978 water year.

Table 4.--Ground-water-level observation wells.

COUNTY	WELLS		
Allen	Q 24-18E-28CDD		
Barber	A 31-15W-19BDB	Q 32-12W-4DBC	A 34-15W-17ADA
	Q 32-11W-30BBA	Q 33-11W-28CBB	A 35-15W-11CB
Barton	Q 18-15W-28CCC3		
Bourbon	Q 25-24E-36AAC		
Cherokee	Q 33-25E-9DAD	R 34-25E-13BAC	
Cheyenne	Q 3-37W-19BBC	Q 5-38W-22ACB	Q 5-42W-14CBC
	Q 3-39W-32BDB	Q 5-40W-14BCD	
Clark	Q 30-23W-6AAA	Q 33-22W-30CBC	
Clay	Q 6-1E-2BCD	Q 6-2E-29DAC	Q 8-2E-2CCA
Cloud	Q 5-2W-1BAC		
Comanche	Q 31-18W-19ACB		
Crawford	Q 29-23E-24DBA	Q 30-24E-19ADD	
Decatur	Q 1-29W-19BDD	Q 3-29W-12BBA	Q 4-26W-8DDD
	Q 2-29W-24BCC		
Douglas	Q 12-19E-13ADA	R 12-20E-17CCB	Q 15-19E-15AAD
	Q 12-20E-7CBC	Q 13-21E-5DBB	
Edwards	Q 23-19W-22CCC	Q 24-19W-34ADD	Q 25-18W-33CDC
	Q 24-17W-24DDD	Q 25-16W-31DAD	Q 26-19W-12ABB
	Q 24-18W-36DDC	Q 25-18W-9AAA	Q 26-19W-12BAA
Ellis	Q 14-18W-12AAD	Q 14-18W-12ABB	
Ellsworth	Q 17-9W-20BCD	Q 17-9W-28CBB	Q 17-9W-31AAB2
	Q 17-9W-21BCC	Q 17-9W-28CBB2	Q 17-9W-31ADC
	Q 17-9W-21BCC2	Q 17-9W-31AAB	
Finney	Q 21-32W-20CBD	R 23-34W-21DDC	Q 25-33W-9ABD
	Q 21-34W-14DBB	Q 24-31W-27CCB	Q 25-33W-15DAC
	Q 22-27W-14ADC	Q 24-32W-3DAC	Q 25-33W-17DBD
	Q 22-33W-22BAA	R 24-33W-9CCD	Q 25-33W-35DBD
	Q 22-33W-36AAA2	R 24-33W-9CCD2	Q 25-34W-6AAA
	Q 22-34W-26ADD	Q 24-33W-22DCA	Q 25-34W-10ABB
	Q 23-27W-12CCC	Q 24-33W-28DAA	Q 25-34W-34DBD
	Q 23-33W-17BBB	Q 25-32W-31DD	Q 26-33W-26ABB
	Q 23-33W-28CDC	Q 25-33W-5ABD	

Table 4.--Ground-water-level observation wells (continued).

COUNTY	WELLS		
Ford	Q 25-22W-20AAA	Q 26-24W-31DDA	Q 27-24W-4BBC
	Q 25-22W-27CCD	Q 26-24W-32CBA	M 27-24W-9AAD
	R 25-23W-11CCC	Q 26-24W-32DDA	M 27-24W-16BDA
	Q 25-23W-12BBB	Q 26-24W-33CDA	Q 28-24W-8DCC
	Q 25-23W-14ADD	Q 26-25W-34BBB	Q 28-25W-6ABB
	Q 26-21W-17DBC	Q 26-26W-32DCC	Q 28-26W-13BDD
	Q 26-21W-23ADA	Q 27-23W-24BCB	Q 29-21W-5BBB
	Q 26-23W-10DAD	Q 27-24W-3BBD	Q 29-26W-29ABB
	Q 26-24W-29DDD	R 27-24W-3CDD	
Geary	Q 11-6E-27CBB		
Gove	Q 11-26W-4CDC	Q 11-27W-36BCC	Q 11-30W-27ABB
	Q 11-27W-16AAA	Q 11-29W-4DAD	
Graham	A 6-23W-12CCB	Q 6-24W-35DDD	Q 8-23W-24BBD
	Q 6-24W-28BAB	Q 6-25W-28CBC	
Grant	Q 27-35W-17ADD	Q 28-37W-2BBB3	Q 29-38W-35CCD
	Q 27-37W-4ABB	Q 28-38W-7BBB	Q 30-36W-1BBB
	Q 27-38W-15BBB	Q 28-38W-12DDD	Q 30-36W-32BBC
	Q 27-38W-23CB	Q 28-38W-17AAA	Q 30-37W-3DBA
	R 27-38W-32BCC	Q 28-38W-33BD3	Q 30-37W-20CBC
	Q 28-36W-21CDD	Q 29-35W-6BAA	
Gray	Q 24-28W-36ACA	Q 27-27W-25CCD	Q 28-30W-24BAB
	Q 24-30W-15CCC	Q 27-30W-23BB	Q 29-28W-28CDC
	Q 26-29W-35CCC	Q 28-30W-17BBA	Q 29-29W-10BBB
Greeley	Q 16-39W-2BDC	Q 16-41W-20BAD	Q 17-40W-15CCB
	Q 16-39W-22DCB	Q 17-39W-2BAA	Q 17-40W-31BBA
	Q 16-40W-18DBA	Q 17-39W-22ABB	Q 17-42W-27CBB
	Q 16-40W-26ADA		
Hamilton	Q 24-40W-17BBB	Q 26-42W-17CB	Q 26-42W-22CDB
Harvey	Q 24-2W-16BAA		
Haskell	Q 27-33W-29DAA	Q 28-34W-15DAB	Q 30-32W-11BBB
	Q 27-34W-16DDD3	Q 29-32W-26CBB2	Q 30-32W-31BAB
	Q 28-32W-18BBB	Q 29-33W-28BCB	Q 30-33W-30CBD
	Q 28-32W-24BCC	Q 29-34W-11ADD	Q 30-34W-5BBB
	Q 28-33W-21BCC	Q 30-31W-15ABB	Q 30-34W-30ADD

Table 4.--Ground-water-level observation wells (continued).

COUNTY	WELLS		
Hodgeman	Q 21-22W-12BCB	A 22-24W-26DDA	A 23-23W-12ABD
	Q 22-22W-13CCC	A 22-24W-32AAB	Q 23-24W-11DAA
	Q 22-23W-31ADD	Q 22-24W-34CDC	Q 23-24W-28BCC
	Q 22-24W-14BBC	Q 22-24W-35DAC	Q 23-25W-22DBB
	Q 22-24W-15BDA	Q 23-22W-7DAA	Q 23-26W-7CCC
	Q 22-24W-16ADB2	Q 23-23W-4AAD	Q 24-23W-6AAB
	A 22-24W-24DDD	A 23-23W-4DCA	Q 24-26W-35CBC
	Q 22-24W-25DDC		
Jackson	Q 6-15E-27BAB		
Jefferson	Q 11-16E-25CBA	Q 11-18E-8DAC	Q 11-19E-27BCC
	Q 11-17E-21ADA	Q 11-18E-20ACC	Q 11-19E-29CCA
	Q 11-17E-27BBC		
Johnson	Q 11-23E-33BDD	Q 12-22E-25BCC	Q 12-22E-29BBD
	Q 12-22E-21CCC		
Kearny	Q 23-35W-12CCC	Q 25-35W-2BAA	Q 25-36W-28BBD
	Q 23-37W-9ADD	Q 25-35W-17AAA	Q 25-37W-15ABA2
	Q 24-35W-13CCC2	Q 25-35W-26BAB	Q 26-36W-4BDA
Kingman	Q 27-10W-3DDD	Q 28-7W-29CDD	Q 30-5W-12CCA
Kiowa	Q 27-17W-21ACC	Q 27-18W-18DCD	Q 28-19W-10ADB
	Q 27-18W-13AAA	Q 27-20W-26ABD	Q 29-18W-2ACC
Labette	Q 31-21E-15CCC2		
Lane	Q 17-28W-26ABB	Q 18-27W-13CCC	Q 18-30W-2AAA
	Q 17-30W-13CBB		
Leavenworth	Q 12-22E-21BCD	Q 12-22E-22CAA	
Logan	Q 11-32W-4ACD	Q 11-32W-19AAB	Q 11-36W-6ADD2
McPherson	Q 17-3W-4BBB	Q 17-4W-34AAA	Q 17-5W-25AAA
	Q 17-3W-17DDD	Q 17-5W-7CBB	
Meade	Q 30-27W-22CDD	Q 30-30W-28ABB	Q 33-28W-29BC
	Q 30-27W-32DDD	Q 32-28W-4ADD	Q 33-30W-35CB
Morton	Q 31-39W-33BCC	Q 32-42W-21BCC	Q 33-41W-3AAD
	Q 31-40W-29ABB	Q 33-40W-27CCC	Q 35-40W-3BBB
	Q 31-43W-14DDC		
Neosho	Q 27-18E-23BCC		

Table 4.--Ground-water-level observation wells (continued).

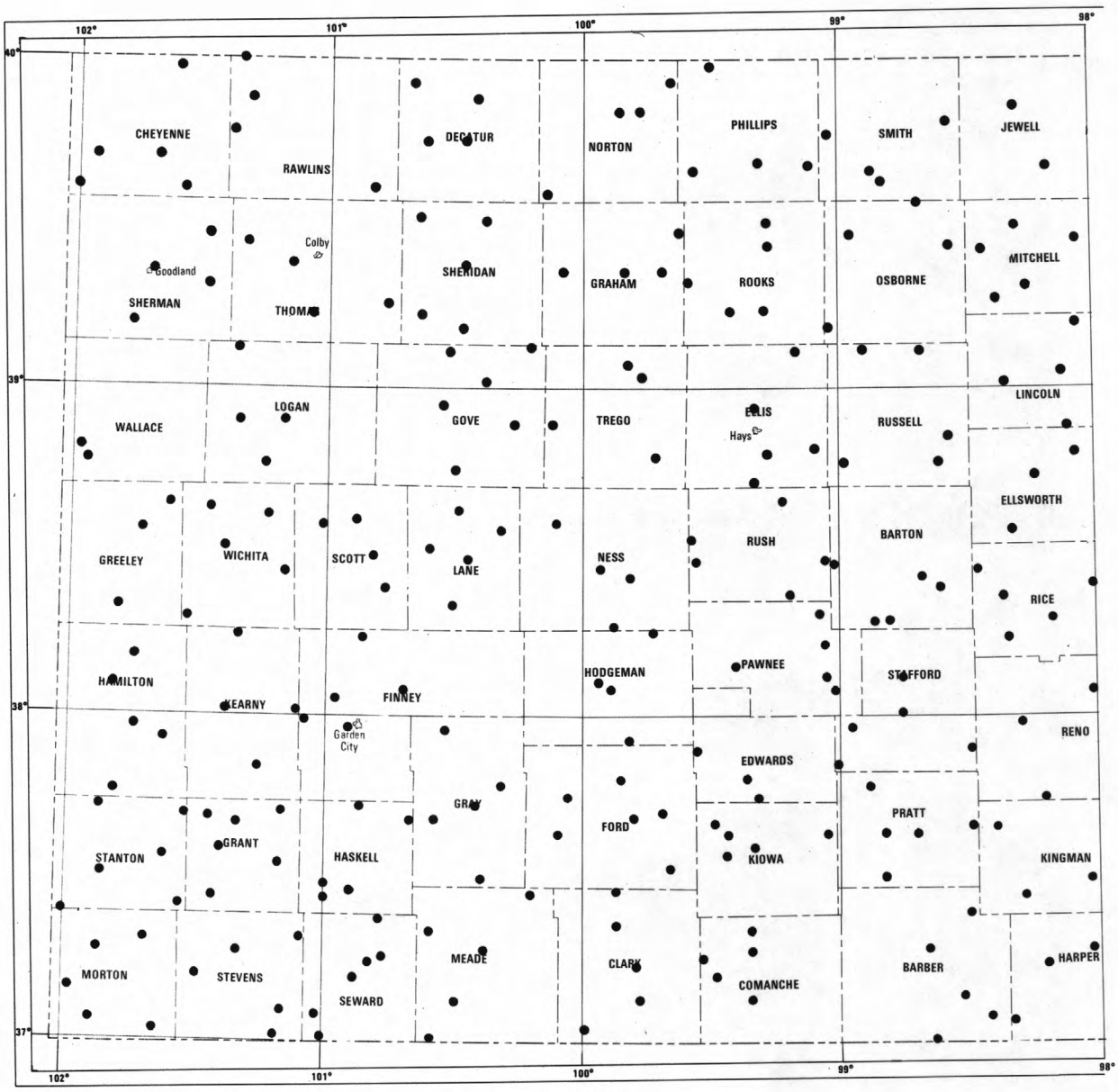
COUNTY	WELLS		
Ness	Q 18-21W-31CAA	Q 19-23W-8CBB	Q 20-23W-32CDA
	Q 19-23W-1CCB	Q 20-22W-20CCC	
Osborne	Q 6-12W-23CDC	Q 7-15W-8CCC2	Q 7-15W-10CCC
	Q 7-12W-28ABA		
Pawnee	Q 21-18W-32DAA	Q 22-16W-6BBA	Q 22-19W-10BBA
	Q 21-19W-30BCC	Q 22-16W-23AAA	Q 22-19W-10BBB
	Q 21-20W-29BBB	Q 22-17W-18AAD	Q 23-16W-35CCD
	Q 22-15W-3AAA1	Q 22-19W-7AAA	Q 23-18W-28DAD
	Q 22-15W-3AAA2		
Phillips	Q 4-18W-23CDC		
Pottawatomie	Q 9-11E-19CDB	Q 9-11E-34CAB	R 10-11E-1CBC
	Q 9-11E-27CDA	Q 9-11E-35DDD	Q 10-11E-3BCA
	Q 9-11E-31DCC	Q 10-8E-12CBB	Q 10-11E-4ACB
	Q 9-11E-32ADC	Q 10-8E-14CBA	Q 10-12E-7BBC
	Q 9-11E-33BCD	Q 10-10E-10DBC	
Pratt	Q 26-12W-34CDC1	Q 26-14W-17DCB	Q 27-14W-12DDD
	Q 26-12W-34CDC2	Q 27-12W-13ADD	Q 29-13W-13AAA
	Q 26-13W-34BCB		
Rawlins	Q 3-33W-3DCC	Q 4-36W-6BBB	Q 5-33W-29BCA
	Q 3-36W-17CCC		
Reno	Q 22-6W-33BAB	Q 23-9W-35CCC	Q 26-10W-18CDC
	Q 23-6W-31DCB		
Republic	Q 1-3W-1CCA		
Rice	Q 18-9W-4BCC	Q 18-10W-24BBB	Q 20-9W-12DDA
	Q 18-9W-4BCC2		
Riley	Q 10-7E-34BAA2	Q 10-8E-23CDC	Q 10-9E-19BBA
	Q 10-7E-35DBB	Q 10-9E-17BDD	Q 11-7E-1BCC
Rooks	Q 7-17W-24BBB	Q 7-18W-27BBB	Q 7-19W-23CDB
Rush	Q 18-17W-14BCC	Q 18-17W-22AAD	A 18-18W-27CCB
	A 18-17W-14CCC	Q 18-17W-23BCC	Q 18-19W-20ADD
	A 18-17W-14CDC	A 18-18W-22DDD	Q 18-20W-14CCC
	Q 18-17W-15DAA	Q 18-18W-27AAC	Q 18-20W-19AAD
Saline	Q 16-2W-18BBB	Q 16-3W-23DDD	

Table 4.--Ground-water-level observation wells (continued).

COUNTY	WELLS		
Scott	Q 16-33W-19CBB	Q 18-33W-26DAD2	Q 19-33W-29CBB2
	Q 17-32W-27BBB	Q 18-34W-25BBD	Q 20-32W-7CBA
	Q 17-34W-6BCB	R 19-32W-6CCB	R 20-33W-9BBB
	Q 18-32W-17ABA1	Q 19-32W-32ACB	Q 20-33W-21ABD
	Q 18-33W-5CCC	Q 19-33W-15DBD	
Sedgwick	Q 25-1W-26DBD	Q 26-2W-15CBC	Q 28-1W-15ACA
	Q 26-1W-19ABA	Q 26-2W-22ABA	Q 28-1W-36ADC
	Q 26-2W-10BBB	Q 27-1W-26DDD	
Seward	Q 31-31W-8BCC	Q 32-33W-21CDB	Q 35-34W-10BBB
	Q 32-32W-14BBB	Q 34-33W-7CCB	
Shawnee	Q 10-13E-31BAA	Q 11-14E-22CCC	Q 11-15E-23DBD2
	Q 11-12E-1ABA	Q 11-14E-24BBB	Q 11-15E-24DBD
	Q 11-14E-13BBB	Q 11-15E-13DBC	Q 11-16E-19DDD
	Q 11-14E-15ABB	Q 11-15E-14ADB	Q 11-16E-29ACA
	Q 11-14E-18CBB	R 11-15E-16DCA	
Sheridan	Q 6-30W-13BAA	Q 7-29W-27CCC	Q 9-30W-35BBB
	Q 7-26W-19BBC	Q 8-30W-13DAA	Q 10-30W-8DDD
	Q 7-28W-8BDC		
Sherman	Q 6-42W-2AAA	Q 8-39W-15CCC	Q 9-39W-19CCC
	Q 7-37W-4BBC	Q 8-40W-12DBA	Q 9-40W-29BBB
	Q 7-40W-36BAB	Q 8-40W-25AAC	Q 9-42W-8AAA
	Q 7-41W-10BBA	Q 8-42W-31DCD	Q 9-42W-14AAA
Stafford	Q 21-13W-27DDD2	Q 23-14W-30BBB	Q 25-13W-3BBB
	Q 22-13W-29DAD	Q 24-13W-30BCB	Q 25-13W-16ACC
	Q 23-13W-8CCB	Q 25-11W-23DDD	
Stanton	Q 27-39W-27BBA	Q 28-39W-36ABB	Q 29-42W-24CCC
	Q 27-40W-21DAA	Q 28-40W-12DDD2	Q 30-40W-24CDC
	Q 27-42W-31CCC	Q 29-41W-13ACC	Q 30-43W-34BBB
	Q 28-39W-14BBC		
Stevens	Q 31-35W-19CCC	Q 32-35W-2CBB	Q 33-38W-20DDB
	Q 31-36W-2CDD	Q 33-36W-26DDD	Q 34-38W-2CDB
	Q 31-37W-22BCC		
Thomas	Q 6-32W-34CBC	Q 7-31W-26CCC	R 8-34W-1BAC
	Q 6-34-1DDD	Q 7-36W-17CCC	Q 8-36W-18ABA2
	Q 6-34W-17CBC	Q 8-32W-27DAB	Q 9-33W-26DAD
	Q 6-35W-26ACB	Q 8-33W-34BBC	Q 10-33W-6BBC
Trego	Q 12-23W-20CCC		

Table 4.--Ground-water-level observation wells (concluded).

COUNTY	WELLS		
Wabaunsee	Q 10-10E-15DCC	Q 10-12E-29ADD	
Wallace	Q 11-38W-35CCC2	Q 15-38W-28DBB	Q 15-40W-3BAB
	Q 11-42W-8DDC	Q 15-39W-2BCD	Q 15-40W-26CAB
	Q 13-42W-10BAC	Q 15-39W-8ACC	Q 15-41W-10BAB
	Q 14-42W-14DBD	Q 15-39W-26ACC	Q 15-41W-36DDB2
Washington	Q 5-1E-20ADA	Q 5-1E-31DDD	
Wichita	Q 16-35W-20CCC	Q 17-35W-30CBB	Q 18-35W-14DCD
	Q 16-37W-13BBC	R 17-36W-33BCB	Q 18-37W-21BBB
	Q 16-37W-30ACB	Q 17-37W-28CCC	Q 18-38W-20ACC2
	Q 16-38W-10ABB	Q 17-38W-21BBB	
Wyandotte	Q 11-24E-14BDA	Q 11-24E-32ABA2	Q 11-25E-20BAB2
	Q 11-24E-31DAB		



EXPLANATION

● Ground-water-quality sampling site

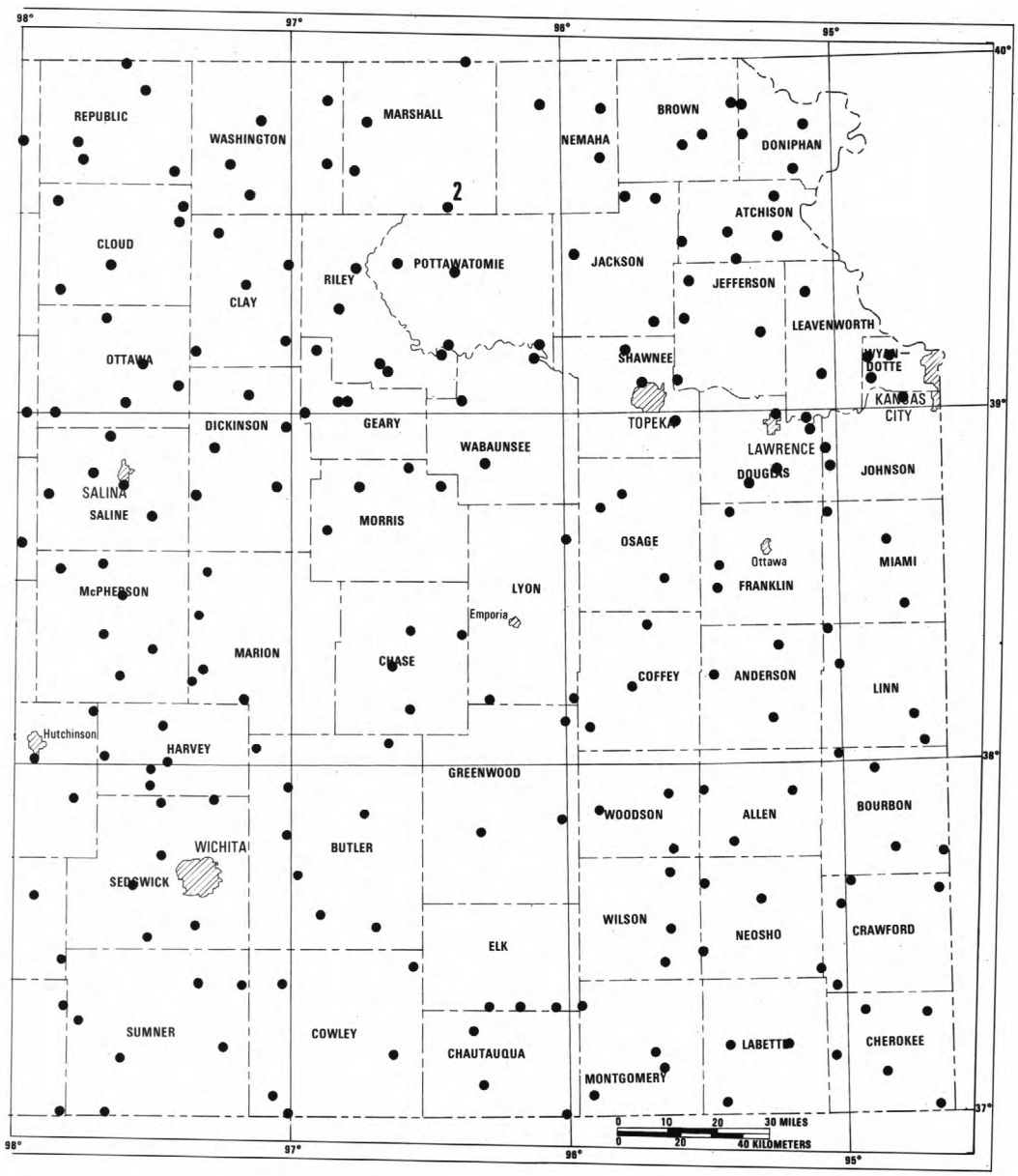


Figure 5.—Map of Kansas showing location of ground-water-quality sampling sites, 1978 water year.

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

COUNTY	WELL NUMBER
Allen	24S 17E 35DCC
	24S 20E 35CDD
	26S 18E 13CBC
Anderson	20S 20E 05ADD
	21S 18E 05DCA2
	22S 20E 18AAA
Atchison	05S 20E 18CDC
	06S 17E 31DAA
	06S 18E 22BCD
	06S 20E 29BBB
	07S 18E 24BAA
Barber	30S 11W 34BBC
	32S 12W 05DBD
	33S 11W 28CBB
	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 24E 29BBB
	26S 25E 35CCB
Brown	03S 17E 14BAA
	03S 17E 30BBB
Butler	23S 03E 17ACC
	23S 07E 10BBB
	24S 04E 29DBA2
	25S 06E 23DDB
	26S 04E 08DCD
	27S 04E 22BAC
	28S 05E 32CDC
	29S 07E 07DDA
Chase	19S 08E 20AAA
	19S 09E 26DAA
	20S 07E 27DAA
	22S 08E 05CCA
Chautauqua	32S 10E 19DDD
Chautauqua (continued)	34S 10E 16DDC
	35S 13E 17BBA
Cherokee	32S 23E 06DDA
	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 05CBB
	31S 23W 07BBA
	32S 23W 26DDD
	33S 23W 36AAA
	34S 25W 36BAD
Clay	06S 01E 24BCB
	07S 04E 20ADC
	08S 02E 11ADB
	10S 01E 17DCC
	10S 04E 06BCD
Cloud	05S 01W 26ABD
	05S 05W 22DAD
	06S 01W 10CCB
	07S 03W 21BAD
	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
	33S 20W 03BAC
Cowley	30S 08E 21CAC
	31S 04E 06BDD
	33S 07E 14ADC
	34S 03E 26BDA
	35S 04E 17BCC

Table 5.--Ground-water-quality sampling sites (continued).

COUNTY	WELL NUMBER
Crawford	27S 22E 35BBB
	28S 22E 21CCC
	28S 25E 03AAA
	31S 22E 08CD
Decatur	01S 30W 34DDD
	02S 28W 13ABA
	03S 28W 32BCA
	03S 29W 31DCC
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 21E 05DBB
	14S 19E 32CCC
	14S 20E 18ABB
Edwards	25S 20W 07CAA
	26S 18W 32BBB
	26S 19W 12ABC
Elk	31S 10E 34DDC
	31S 11E 34ABA
	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 28ABB
	17S 09W 16DAB
Finney	21S 32W 08ABD
	23S 31W 03DCC
	23S 33W 17BBB
	24S 33W 14BCB
Finney (continued)	24S 34W 05AAB
Ford	26S 23W 10DAD
	26S 25W 33BCA
	27S 22W 13CDD
	27S 23W 24BBB
	28S 25W 06ABB
	29S 21W 07ADC
Franklin	15S 18E 34BAA
	17S 18E 21CCC
	18S 18E 08ADA
Geary	10S 05E 18DCC
	12S 04E 23CDC
	12S 05E 01BBA2
	12S 06E 06BCAC
Gove	11S 26W 04CDC
	11S 29W 10AAA
	12S 28W 12DDD
	13S 27W 25ABB
	13S 29W 04BAC2
	15S 29W 13CCB
Graham	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
	29S 35W 06BAA
	30S 38W 13CCC
Gray	24S 29W 18CCB
	26S 27W 18ADC
	27S 28W 05AAA
	27S 30W 23BB
	29S 28W 28CDC
Greeley	16S 39W 22DCB
	17S 40W 15CCB
	20S 41W 02ADD
Greenwood	22S 13E 20DDC

Table 5.--Ground-water-quality sampling sites (continued).

COUNTY	WELL NUMBER
Greenwood (continued)	25S 13E 30CCA
	26S 10E 04CCC
Hamilton	21S 40W 31CCC
	22S 41W 33DCD
	24S 39W 30BBD
	24S 40W 07CBB
	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 13ACC
Hodgeman	21S 22W 03BBA
	22S 24W 34CDC
	23S 23W 06CAB
	24S 23W 34AAD
Jackson	05S 15E 17AAA
	05S 16E 20DDA
	07S 13E 10BBB
	09S 16E 20CAA
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
	14S 21E 12ADA

COUNTY	WELL NUMBER
Kearny	21S 37W 02CDD
	23S 35W 25BBB2
	23S 37W 28CCB
	25S 36W 28BBD
Kingman	27S 10W 32DCC
	28S 06W 12CDD
	29S 07W 25BCC
	30S 05W 12CCA
	30S 09W 10ADC
Kiowa	27S 20W 26ABD
	28S 16W 02CCA
	28S 18W 19CCB
	28S 19W 05AAC
	28S 19W 31BBB
Labette	33S 18E 10BBB
	33S 20E 09DDD
	35S 18E 04CCC
Lane	16S 29W 26CCC
	17S 27W 20CCC
	18S 28W 18ACC
	18S 30W 02AAA
	20S 29W 03CCB
Leavenworth	08S 21E 19BAA
	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 32CDD
	22S 24E 14DCC
	23S 25E 07DAA
Logan	11S 36W 06DBB
	13S 35W 23ACD
	13S 36W 20CCB2
Lyon	16S 13E 20DBA
	21S 10E 26CDC
	21S 13E 27AAB

Table 5.--Ground-water-quality sampling sites (continued).

COUNTY	WELL NUMBER
McPherson	17S 03W 17DBD
	17S 05W 23DAB
	18S 03W 14BDD
	19S 03W 29DBA2
	20S 02W 11BAA
	21S 03W 02DCD
Marion	17S 01E 27CCB
	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
	31S 30W 16BBC
	32S 28W 04ABB4
	33S 29W 32AAD
	35S 30W 10CDB
Miami	15S 21E 35ABB
	16S 23E 25DBC
	18S 24E 33CCC
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
	34S 14E 30BCB
Morris	14S 06E 34AAC
	14S 08E 07DAC
	14S 09E 31DDC
	16S 05E 14BCB
Morton	31S 40W 29ABB
	32S 42W 14CCC
	33S 43W 22DAA
Morton (continued)	34S 42W 20DD2
	35S 40W 03BBB
Nemaha	02S 12E 16BBB
	02S 14E 21AAB2
	04S 14E 09BCB
Neosho	27S 17E 36BBC
	28S 19E 14CDC
	30S 17E 02DDD
	30S 21E 26BAB
Ness	17S 25W 08BB3
	18S 24W 36ADB
	19S 23W 01CCB
	20S 23W 32BBC
Norton	01S 21W 35CBB
	02S 22W 35BBB
	02S 23W 36CAA
	05S 25W 28BDD
Osage	15S 14E 21CDD
	15S 15E 06ABB
	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
	21S 16W 14ADC
	22S 16W 23CDA
	22S 19W 10BBB
	23S 15W 06BBD
Phillips	01S 19W 08DCD
	04S 16W 27CCA
	04S 18W 23DCA
	04S 20W 34CAB

Table 5.--Ground-water-quality sampling sites (continued).

COUNTY	WELL NUMBER
Pottawatomie	07S 07E 23BBA
	07S 09E 34CCD
	10S 09E 09CDC
	10S 12E 09ADB4
Pratt	26S 14W 17DCB
	27S 11W 35DAD
	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
	23W 06W 06BCB
	23S 06W 25CBD
	24S 09W 10BCC
	25S 04W 05DAD
	26S 08W 32ABB
Republic	01S 02W 33DCD
	01S 03W 02CCB
	03S 04W 20DAB
	04S 01W 16ACC
	04S 04W 04DBB
Rice	18S 10W 32ADB
	19S 06W 17ABB2
	19S 09W 31DAB
	20S 08W 23ABA
	21S 09W 08BAB
Riley	07S 06E 28AAA
	09S 05E 01BCB
	10S 07E 32DBD
	10S 09E 17BDD
	11S 07E 04CBD
Rooks	06S 18W 26AAC
	07S 18W 24BAD
	08S 20W 31ACB
	09S 18W 35CCD
	09S 19W 34BDB
Rush	16S 17W 16DCD
	17S 20W 30CCB
Rush (continued)	18S 16W 23AAA2
	18S 20W 20DCA
	19S 17W 27ADD
Russell	11S 12W 07DDB
	11S 14W 07CAA
	14S 11W 07CAB
	15S 12W 02BAA
	15S 15W 03DCD
Saline	13S 03W 09DA
	14S 03W 25BAD
	14S 04W 13DDD
	15S 02W 26DDD
	15S 05W 04ABB
Scott	17S 32W 05ABB
	17S 33W 07BBB
	18S 32W 14BBB
	19S 31W 20BAD
Sedgwick	25S 01E 01ABB
	25S 01W 07BAA
	26S 01W 31AAC
	27S 02W 32BBB
	29S 01E 08CBB
	29S 02W 23DDA
Seward	31S 32W 03DAD
	32S 32W 14BBB
	32S 32W 20BBB
	33S 33W 02A
	34S 34W 16DAA
	35S 34W 10BBB
Shawnee	10S 15E 17CDD
	11S 15E 23DBD2
	12S 16E 25CBB
Sheridan	06S 27W 19DAB
	06S 30W 14CCD
	08S 28W 09ABC
	09S 30W 35BBB
	10S 28W 17BDD
Sherman	07S 37W 05CCB
	08S 37W 32ABB
	08S 39W 17DCD
	10S 40W 10ADC

Table 5.--Ground-water-quality sampling sites (concluded).

COUNTY	WELL NUMBER
Smith	03S 11W 04AAC
	03S 15W 20DCC
	04S 14W 35CCB
	05S 13W 07AAA
Stafford	22S 13W 21DDB
	23S 13W 33BDB
	24S 15W 15CDA
	25S 11W 01BCB
	25S 15W 30ABC
Stanton	27S 39W 13ACB
	27S 42W 11DBB
	28S 39W 31BCC
	29S 42W 24CCC
	30S 39W 23BBC
	30S 43W 33DCD
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	07S 36W 15ACB
	08S 34W 06CBC
	09S 31W 22ABD
	09S 34W 36DDD
Trego	11S 23W 26BCB
	12S 22W 08BAB
	13S 25W 32CBB
	14S 22W 36ADD
Wabaunsee	10S 12E 28CCC
	12S 09E 02DCD
	14S 10E 03BAB
Wallace	14S 42W 22BDD
	15S 42W 02BBB
Washington	02S 03E 32ABB
	02S 05E 09BDA
	04S 02E 08DCC
	04S 05E 09CAA2
	05S 02E 12CBA
Wichita	16S 35W 31DBA
	16S 37W 30ACB
	18S 35W 34ABB
	18S 37W 03CCC
Wilson	27S 16E 23DAA
	29S 16E 14ABB
	30S 16E 15BCC
Woodson	24S 16E 34ABB
	25S 14E 16CCB
	16S 16E 25BBC
Wyandotte	10S 23E 25CBB
	10S 23E 30BBC
	11S 23E 17CCA

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