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HYDROLOGIC STUDIES OF THE U.S. GEOLOGICAL SURVEY IN MAJOR COAL-RESOURCE AREAS OF UTAH THROUGH 1980

By Gregory C. Lines

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ILLUSTRATIONS
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INTRODUCTION

Increased interest in coal has created greater interest in water, both for environmental and water-supply reasons. This report summarizes hydrologic studies conducted in and near the major coal fields of Utah (fig. 1) by the U.S. Geological Survey through 1980. It is intended as a reference for those people dealing with coal-related hydrologic problems.

Published reports and reports in preparation at the time of this compilation are summarized in an annotated bibliography. The 47 reports in the annotated bibliography deal with many components of the hydrologic system. Most of the reports are interpretive in nature, but some contain only hydrologic data. The reports deal with such varied subjects as the magnitude and frequency of floods, availability of ground water, and hydrologic impacts of coal mining.

Seven hydrologic studies that are active in 1980 in Utah coal-resource areas are described. In addition to these seven studies, that part of the Geological Survey statewide data-collection network in the vicinity of the major coal fields is described.

The hydrologic studies are conducted and reports prepared, for the most part, by personnel of the Water Resources Division, Utah District. Most of the studies and data-collection programs are in cooperation with other Federal, State, and local agencies. Utah Power and Light Co. provides stream-flow data collected at one gaging station.

ANNOTATED BIBLIOGRAPHY

Annotated reports are listed alphabetically by author or, where coauthored, by first-named author. When an author has more than one report, the listing is chronological. When an author has more than one report in a given year, a, b, c, ... are added. Where reports are still in preparation, 1980 is shown in parentheses. Titles, the publication media, and contents of reports that are in preparation are preliminary and may change. The study area for each report is shown on plate 1.

Units of measure are those used in the original report. Abbreviations are those in common use and include ft (feet), mi^2 (square miles), gal/min (gallons per minute), ft^3/s (cubic feet per second), acre-ft (acre-feet), acre-ft/mi^2 (acre-feet per square mile), and mg/L (milligrams per liter), and ^oF (degrees Fahrenheit).

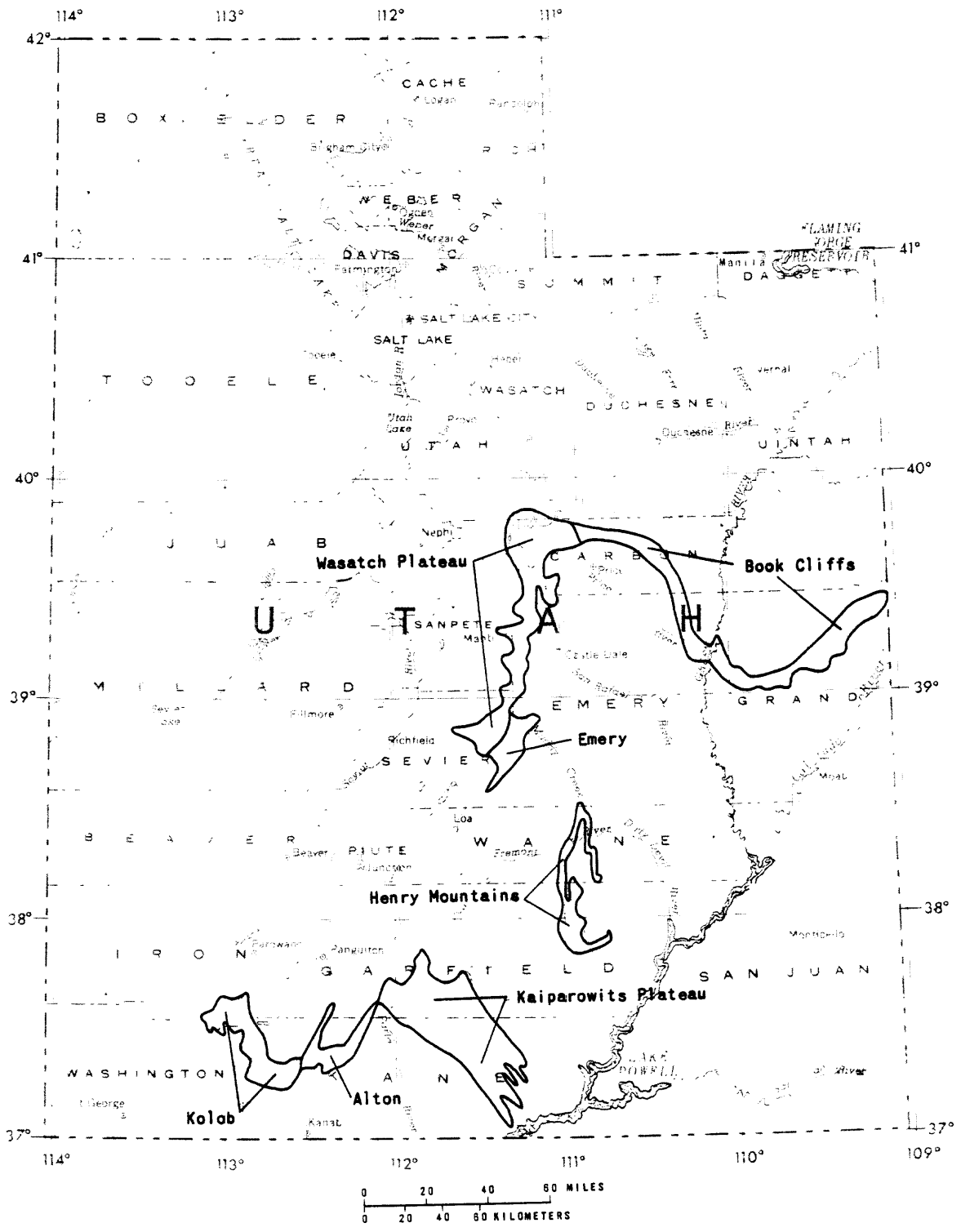

Figure 1.— The major coal fields of Utah.

Publications of the Geological Survey that are still in print may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20420. Reports that are out of print at the time of this compilation are marked with an asterisk (*) preceding the year of publication. Reports that are out of print and unavailable for purchase may be examined at the U.S. Geological Survey, Public Inquiries Office, 8102 Federal Building, 125 South State Street, Salt Lake City, Utah.

Geological Survey open-file reports are, for the most part, available only for inspection at the U.S. Geological Survey, Water Resources Division, Room 1016 Administration Building, 1745 West 1700 South, Salt Lake City, Utah. However, open-file reports that have been duplicated as Utah Basic-Data Releases or Utah Hydrologic-Data Reports are free on request from the U.S. Geological Survey, Water Resources Division, or from the Utah Division of Water Rights; however, supplies are limited.

Berwick, V. K.
1962. Floods in Utah, magnitude and frequency: U.S. Geological Survey Circular 457, 24 p.

Procedures are described for estimating the magnitude and frequency of floods for gaged or ungaged sites. From the relation of annual floods to the mean annual flood, a composite frequency curve was derived for recurrence intervals ranging from 1.1 to 50 years. For regions of similar hydrologic characteristics, curves were developed by multiple correlation to express the relation of mean annual flood to drainage area and to mean altitude of the basin. It was concluded that results could be applied to most areas of Utah.

Butler, Elmer
1971. (and Cruff, R. W.). Floods in Utah, magnitude and frequency characteristics through 1969: U.S. Geological Survey open-file report, 34 p.

A method is presented for estimating the magnitude of flood peaks with 5-, 10-, 25-, and 50-year recurrence intervals on streams that are not affected by regulation or diversion. Multiple-regression techniques were used to relate the peak discharge for the 5- and 10-year recurrence intervals at gaging stations to various physiographic and climatic characteristics in four regions of the State. The peak discharges for the 25- and 50-year recurrence intervals were related to the peak discharge with a 10-year recurrence interval.

Connor, J. G.

*1958. (Mitchell, C. G., and others). A compilation of chemical quality data for ground and surface waters in Utah: Utah State Engineer Technical Publication 10, 276 p.

Report is a compilation of all available information that existed on chemical quality of ground and surface waters in Utah. Data in the report were supplied by a number of Federal, State, and local agencies. Chemical analyses of water from wells and springs collected through 1957 are tabulated and grouped by counties. Chemical analyses of surface water collected at stations on a daily or weekly basis during the 1955 water year are tabulated, and data prior to 1955 are summarized. For daily or weekly water-quality stations that were discontinued prior to the 1955 water year, the latest annual record is shown, and prior record is summarized.

Cordova, R. M.

1963. Hydrogeologic reconnaissance of part of the headwaters area of the Price River, Utah: Utah Geological and Mineralogical Survey Water-Resources Bulletin 4, 26 p.

Availability and quality of ground water in 33 mi^2 of the northern Wasatch Plateau are evaluated. Spring and well data indicated that there were several aquifers in geologic units that overlie the coal-bearing Blackhawk Formation of Cretaceous age. Hydraulic properties of aquifers were determined from laboratory and field tests. It was concluded that development of ground water on a large scale could be accomplished only by the use of wells. However, any newly developed supply from wells could cause diminution of spring discharges and streamflow. Most ground water in the area was found to be of suitable chemical quality for municipal and industrial use.

1980. Ground-water conditions in the upper Virgin River and Kanab Creek basins area, Utah, with emphasis on the Navajo Sandstone: U.S. Geological Survey Open-File Report 80-524, 99 p. (to be duplicated as Utah Department of Natural Resources Technical Publication 70).

The Navajo Sandstone of Triassic(?) and Jurassic age, the most important bedrock aquifer in the area, was estimated to contain 200 million acre-ft of recoverable water. Aquifers occur in geologic units other than the Navajo, including coal-bearing rocks of Cretaceous age. It was concluded that water enters the aquifers by infiltration of precipitation and seepage from streams in the headwaters of the Virgin River and Kanab Creek. Potentiometric-surface data indicated that water moved from areas of recharge generally southward toward areas of natural discharge in the lower reaches of major streams. Chemical quality of ground water was found to vary both areally and by geologic source. The hydrologic impacts of possible increased ground-water withdrawals for the development of coal are evaluated.

Covington, H. R.

1972a. Map showing length of freeze-free season in the Salina Quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-591-E, scale 1:250,000.

This map is one of a series that defines the geology, mineral resources, and hydrology of the Salina Quadrangle. This map shows average number of days between the last spring freeze (32°F or below) and the first autumn freeze.

1972b. Map showing springs in the Salina Quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-591-G, scale 1:250,000.

About 450 springs are located on the map. Where data were available, discharge of springs and dissolved-solids concentrations of spring waters are indicated.

1972c. (and Williams, P. L.). Map showing normal annual and monthly precipitation in the Salina Quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-591-D, scale 1:250,000.

Average annual precipitation during 1931-60 is contoured on the map. Average monthly precipitation at some climatological stations is shown on graphs.

1972d. (and Williams, P. L.). Surface water map of the Salina Quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-591-F, scale 1:250,000.

Average annual discharge and monthly discharges at gaging stations in the area are shown on graphs.

Danielson, T. W.

(1980a). (and Hood, J. W.). Recharge to the Navajo Sandstone in the lower Dirty Devil River basin, Utah: to be released as a U.S. Geological Survey Water-Resources Investigation (in review).

Annual recharge to the Navajo Sandstone from perennial streams and from precipitation on the outcrop in the study area is estimated. Methods used to estimate the amount of recharge included: (1) neutron emitting and receiving equipment to determine soil moisture, (2) laboratory experiments to determine moisture retention and unsaturated hydraulic conductivity of cores obtained from the Navajo outcrop, (3) tensiometers to measure soil suction, and (4) correlation of the isotopes deuterium and oxygen-18 in precipitation and ground water to determine areas of recharge. Carbon-14 dating of ground water and discharge measurements on perennial streams to determine losing and gaining reaches were used to identify areas of recharge.

(1980b). (ReMillard, M. D., and Fuller, R. H.). Hydrology of the coal-resource areas in the upper drainages of Huntington and Cottonwood Creeks, central Utah: to be released as a U.S. Geological Survey open-file report (in review).

The hydrologic system in this important coal-resource area of the Wasatch Plateau is described. Data were collected from about 140 springs that issue from several water-bearing zones in rocks of Cretaceous and/or Tertiary age. Most springs that discharged more than about 50 gal/min were associated with faulting. During 1979, water entered underground coal mines mainly through joints, faults, and holes in mine roofs. Discharge from mines ranged from zero to about 1,100 gal/min.

Large differences in surface runoff in the study area are described. Chemical quality of surface water, as well as quality of water from springs and mines, is described.

Possible effects of underground coal mining and associated mine dewatering on the hydrologic system are evaluated. It was concluded that discharge-recession curves for springs showed promise as a method of detecting changes in the ground-water system caused by mining.

Eychaner, J. H.
1976. Estimating runoff volumes and flood hydrographs in the Colorado River Basin, southern Utah: U.S. Geological Survey Water-Resources Investigations 102-76, 18 p.

Hydrographs of 364 floods from 18 continuous-record gaging stations were used to define a single relation of flood volume to peak discharge; the standard error of estimate was 82 percent. Using a mean dimensionless hydrograph, a method is presented to derive a synthetic hydrograph for basins of 5 to 300 mi^2 and flood peaks of 1 to 7,000 ft^3/s. A method also is presented to estimate the reduction in culvert or bridge size that could be realized with the use of storage upstream from the structure.

Feltis, R. D.
*1966. Water from bedrock in the Colorado Plateau of Utah: Utah State Engineer Technical Publication 15, 82 p.

The general occurrence, availability, and chemical quality of water in bedrock aquifers are described. Hydrologic data (including chemical analyses of water) from 534 wells, test holes, springs, and mines are listed in tables.

Fields, F. K.
1975. Estimating streamflow characteristics for streams in Utah using selected channel-geometry parameters: U.S. Geological Survey Water-Resources Investigations 34-74, 19 p.

Channel-geometry parameters were related to mean annual streamflow and flood discharges with 25- and 50-year recurrence intervals. It was found that channel width and depth between depositional bars could be used to estimate mean annual flows of perennial and ephemeral streams with standard errors of 34 and 73 percent. The 25- and 50-year floods on perennial and ephemeral streams could be estimated from the channel width between depositional bars with standard errors ranging from 28 to 43 percent.

Goode, H. D.
1977. (and Olson, Eric). Reconnaissance appraisal of the water resources of the Henry Mountains coal field, Wayne and Garfield Counties, Utah, 1975-77: University of Utah Research Report, Salt Lake City, Utah. Prepared for the U.S. Department of Interior, July 1977.

Availability and quality of water are assessed. It was concluded that the Navajo Sandstone was the most probable source of large quantities of water. It was estimated that the Navajo contained about 50,000 acre-ft of ground water per square mile and that each year 20,000 to 30,000 acre-ft could be withdrawn from the Navajo in the study area with properly spaced wells. Sources of smaller quantities of water also are identified. Records of wells and springs and chemical analyses of water are listed in tables.

Graham, M. J.
1981. (Tooley, J. E., and Price, Don). Preliminary hydrologic evaluation of the North Horn Mountain coal-resource area, Utah: U.S. Geological Survey Open-File Report 81-141, 33 p.

A generalized hydrologic description of this undeveloped coal-resource area is presented. Preliminary data indicated that most reaches of tributaries to Cottonwood and Ferron Creeks on North Horn Mountain were ephemeral and that the dissolved-solids concentration of surface water averaged less than 500 mg/L. Estimates of peak discharge (100-year flood) were made for several of the ephemeral streams. It was concluded that most ground water in North Horn Mountain probably was stored in perched aquifers overlying the coal. Numerous springs and seeps issued from the perched aquifers, but the spring waters usually were consumed by evapotranspiration short distances from the sources. It also was concluded that a regional aquifer exists in the Star Point Sandstone below the coal and sometimes in the coal-bearing Blackhawk Formation, both of Cretaceous age. Dissolved-solids concentrations of ground water ranged from less than 500 to about 1,000 mg/L. Potential impacts of coal development on the water resources are evaluated.

Hackman, R. J.
1972. (and Williams, P. L.). Map showing drainage basins and historic cloudburst floods in the Salina Quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-591-N, scale 1:250,000.

This map shows sites of historic cloudburst floods.

Hood, J. W.
1979a. (and Danielson, T. W.). Aquifer tests of the Navajo Sandstone near Caineville, Wayne County, Utah: Utah Department of Natural Resources Technical Publication 66, 69 p.

Report summarizes laboratory determinations of grain size, sorting, carbonate content, horizontal and vertical hydraulic conductivity, and porosity of cores obtained from the Navajo Sandstone. Aquifer characteristics determined from tests that utilized discharging wells also are discussed. Possible effects of long-term pumping from the Navajo on aquifer potentiometric surfaces and chemical quality of water are evaluated.

1979b. (and Danielson, T. W.). Bedrock aquifers in the lower Dirty Devil River basin area, Utah, with special emphasis on the Navajo Sandstone: U.S. Geological Survey Open-File Report 79-1163, 85 p. (to be duplicated as Utah Department of Natural Resources Technical Publication 68).

Occurrence, availability, and chemical quality of water in bedrock aquifers are described. Annual ground-water recharge in the study area was estimated to average 34,000 acre-ft, of which 5,000 acre-ft was estimated to recharge the Navajo Sandstone. Recoverable fresh to moderately saline water stored in bedrock aquifers was estimated at 210 million acre-ft, of which 89 million acre-ft was estimated to be stored in the Navajo. Effects of pumping from the Navajo on the amount of water held in storage in the aquifer and on the flow of streams are evaluated.

Iorns, W. V.

*1964. (Hembree, C. H., Phoenix, D. A., and Oakland, G. L.). Water resources of the Upper Colorado River Basin--basic data: U.S. Geological Survey Professional Paper 442, 1036 p.

This report contains hydrologic data through 1957 and supplements the technical report (Iorns and others, 1965) described below. It contains (1) tables of flow duration, (2) all available sediment and surface-water chemical-quality data either in summarized form or analyses of individual samples, (3) chemical analyses and related geologic data for about 1,000 samples of ground water, (4) isohyetal maps of seasonal and annual precipitation, and (5) an inventory of all surface-water records in the basin.

*1965. (Hembree, C. H., and Oakland, G. L.). Water resources of the Upper Colorado River Basin--technical report: U.S. Geological Survey Professional Paper 441, 370 p.

The surface-water resources of the region in 1957 are described, and the effects of environmental factors (both natural and human) on these resources are explained. The report is composed of five chapters. The first chapter contains the introduction and summary; the second, the techniques and criteria used in appraising the surface-water resources are explained; and in the last three, the surface-water resources of the Grand, Green, and San Juan divisions are described. The divisions are further divided into sub-basin units, and the effects of climate, topography, geology, vegetation, and the activities of man on the surface-water resources are identified locally.

King, N. J.

*1953. (and Mace, M. M.). Sedimentation in small reservoirs on the San Rafael Swell, Utah: U.S. Geological Survey Circular 256, 21 p.

Sediment yields were estimated from volumes of sediment that had accumulated in 15 small reservoirs during periods ranging from 7 to 14 years. Adjustments were made for reservoir spillages and trap efficiencies. After also adjusting for differences in precipitation during the different time periods, it was concluded that sediment yield varied because of topography and character of the surface mantle (both of which were related to rock type).

Annual sediment yield from basins underlain by conglomerates, limestones, and resistant sandstones averaged 0.3 acre-ft/mi^2; from basins underlain by friable sandstone, 1.2 acre-ft/mi^2; and from basins underlain by shale, 2.6 acre-ft/mi^2.

Lines, G. C.

(1980). (and Morrissey, D. J.). Hydrology of the Ferron sandstone aquifer and effects of proposed surface-coal mining in Castle Valley, Utah, with a section on Stratigraphy by T. A. Ryer and a section on Leaching of overburden by R. H. Fuller: to be released as a U.S. Geological Survey open-file report and duplicated as a U.S. Geological Survey Water-Supply Paper (in review).

Availability and chemical quality of water in the Ferron Sandstone Member of the Mancos Shale of Cretaceous age are evaluated. To aid in estimating drilling depths to reach and fully penetrate the aquifer, structure-contour and thickness maps for the Ferron are included. Records of wells and springs and chemical analyses of water from the Ferron are listed in tables.

The impacts of a proposed surface coal mine in the Emery area on the water resources are evaluated. Techniques used in the evaluation included a three-dimensional digital-computer model of the Ferron sandstone aquifer (Morrissey and others, 1980) and laboratory experiments that simulated leaching of overburden.

1981. (and Plantz, G. G.). Hydrologic monitoring in coal fields of central Utah, August 1978-September 1979: to be released as a U.S. Geological Survey Water-Resources Investigations 81-138 (in press).

Report describes monitoring of surface-water quantity and quality at 12 gaging stations downstream from mined and leased areas in the Wasatch Plateau, Book Cliffs, and Emery coal fields. The hydrologic setting of the region is described, and mining and lease activities in each of the 12 monitored basins are summarized. Where possible, hydrologic impacts of coal mining are evaluated. Identified impacts include: (1) increases in streamflow downstream from mines that discharge water, (2) degradation of surface-water quality, (3) removal of ground water from storage, (4) changes in the natural ground-water flow system, and (5) the possible diminution of spring flows in natural ground-water discharge areas.

Marine, I. W.

*1962. Water-supply possibilities at Capitol Reef National Monument, Utah: U.S. Geological Survey Water-Supply Paper 1475-G, p. 201-208.

The Coconino Sandstone of Permian age and the Fremont River both were identified as possible sources of potable water supply at the monument.

*1963. Ground-water resources of the Bryce Canyon National Park area, Utah, with a section on The drilling of a test well: U.S. Geological Survey Water-Supply Paper 1475-M, p. 441-486.

Water-supply possibilities at the park are evaluated. It was concluded that future water needs at the park could be met by developing springs that issue from the Straight Cliffs and Wahweap Sandstones, both of Cretaceous age.

It also was concluded that future water needs could be met by drilling one or more wells that would penetrate aquifers in the Wasatch Formation of Tertiary age and in the Straight Cliffs and Wahweap Sandstones. The report describes the construction of a well in these aquifers that was pumped at a rate of 200 gal/min.

Morrissey, D. J.

1980. (Lines, G. C., and Bartholoma, S. D.). Three-dimensional digital-computer model of the Ferron sandstone aquifer near Emery, Utah: U.S. Geological Survey Water-Resources Investigations 80-62, 101 p.

Report describes the calibration of a three-dimensional finite-difference computer model of the Ferron sandstone aquifer in the Emery coal field. The model was used to predict the effects of proposed surface mining and the resulting mine dewatering on potentiometric surfaces of the aquifer. Included in the report are table listings of the computer program, the input data for steady-state calibration, and the input data for transient predictive simulations.

Mundorff, J. C.

*1968. Fluvial sediment in Utah, 1905-65, a data compilation: Utah Department of Natural Resources Information Bulletin 20, 400 p.

Report contains, in tabular form, all available data on fluvial sediment in Utah for the period 1905-65.

1971. Nonthermal springs of Utah: Utah Geological and Mineralogical Survey Water-Resources Bulletin 16, 70 p.

Data are presented for about 4,500 nonthermal springs in the State of Utah, many of which are in coal-resource areas.

1972. Reconnaissance of chemical quality of surface water and fluvial sediment in the Price River basin, Utah: Utah Department of Natural Resources Technical Publication 39, 55 p.

Chemical characteristics of water in the Price River and in tributary streams during 1969-70 are described. It was concluded that degradation of chemical quality of water in the Price River was due to both geologic and human factors.

1979. Reconnaissance of chemical quality of surface water and fluvial sediment in the Dirty Devil River basin, Utah: Utah Department of Natural Resources Technical Publication 65, 132 p.

Water-quality data were collected at 104 stream sites during 1975-76. Differences in surface-water quality in the basin were attributed to the geologic environment, evapotranspiration, and the return flow from irrigated gypsum-bearing soils formed on shales. Numerous water-quality data are listed in tables.

1980. (and Thompson, K. R.). Reconnaissance of the quality of surface water in the San Rafael River basin, Utah: U.S. Geological Survey Open-File Report 80-574, 54 p. (to be duplicated as a Utah Department of Natural Resources Technical Publication).

Water in mountain streams in the study area during 1977-78 nearly always contained less than 500 mg/L of dissolved solids. The chemical quality of surface water deteriorated downstream from the mountains where the streams crossed a belt of land 10 to 15 miles wide where the gypsum-bearing Mancos Shale crops out. This same area contained nearly all the intensive irrigation in the San Rafael River basin. Numerous chemical analyses of surface water from sites throughout the basin are listed in tables.

Price, Don

1972a. Map showing general availability of ground water in the Salina Quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-591-M, scale 1:250,000.

Yields that could be expected from properly located and constructed wells are indicated on this map. The map was compiled using data from aquifers that in most places are less than 1,000 feet below the land surface.

1972b. Map showing general chemical quality of ground water in the Salina Quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-591-K, scale 1:250,000.

Ranges of dissolved-solids concentrations of ground water at depths less than 1,000 feet are indicated on this map. In areas where data were lacking, dissolved-solids concentrations were inferred from geologic data.

1973. (and Waddell, K. M.). Selected hydrologic data in the Upper Colorado River Basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-477, 2 sheets, scale 1:2,500,000.

The availability and chemical quality of ground water and the chemical quality of surface water in the 110,000 mi^2 of the basin are summarized on maps and in tables. The maps are highly generalized and are intended to provide the reader with only a general understanding of the geology, groundwater conditions, and chemical quality of water in the basin as a whole.

1977a. Map showing general availability of ground water in the Kaiparowits coal-basin area, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-1033-B, scale 1:125,000.

Map is one of a series that describes the geology and related natural resources of the Kaiparowits area. Expected sustained yields of individual wells and expected depth to ground water are shown on the map. Hydrologic data collected at 26 springs are listed in a table.

1977b. Map showing general chemical quality of ground water in the Kaiparowits coal-basin area, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-1033-A, scale 1:125,000.

Chemical analyses of water from about 40 springs, 20 coal-test holes, and 7 water wells were used to compile the map that shows the dissolved-solids concentration of ground water. All the water samples were from depths of less than 1,000 ft.

1978. Map showing principal drainage basins, principal runoff-producing areas, and selected streamflow data in the Kaiparowits coal-basin area, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-1033-E, scale 1:125,000.

Surface-water data-collection sites and major drainage divides in the area are identified. Streamflow in the area is characterized by graphs and diagrams depicting average monthly, average annual, and peak discharges.

1979. Map showing general chemical quality of surface water in the Kaiparowits coal-basin area, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-1033-F, scale 1:125,000.

Dissolved-solids concentrations of water in streams, lakes, and reservoirs for periods other than during direct snowmelt and storm runoff are shown on the map. The map is based on about 130 chemical analyses of water collected at about 40 sites throughout the area during low-runoff periods during 1972-75.

1980. Map showing general chemical quality of surface water in the Alton-Kolob coal-fields area, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-1235-A, scale 1:125,000.

Minimum dissolved-solids concentrations of surface water that generally occurred during high-runoff periods and maximum concentrations that generally occurred during low-runoff periods are shown on the map.

1981. Map showing general chemical quality of ground water in the Alton-Kolob coal-fields area, Utah: to be released as U.S. Geological Survey Miscellaneous Investigations Map I-1235-B, scale 1:125,000 (in press).

The map shows the concentration of dissolved solids in ground water at depths less than about 1,000 ft. The lowest concentrations of dissolved solids generally occurred in aquifers in the high plateau areas where concentrations generally were less than 500 mg/L. Water at shallow depths in the outcrop area of the Navajo Sandstone also contained less than 500 mg/L of dissolved solids.

Sandberg, G. W.

1979. Hydrologic evaluation of the Alton reclamation-study site, Alton coal field, Utah: U.S. Geological Survey Open-File Report 79-346, 53 p.

The report describes the general hydrologic conditions at a reclamation-study site where surface coal mining has been proposed. Hydrologic data in the report include: (1) summaries of water and sediment discharges at four gaging stations during water years 1976 and 1977, (2) chemical analyses of ground and surface waters, (3) precipitation at three sites in the study area during 1974-77, and (4) water-level hydrographs for three observation wells.

Sumsion, C. T.

1979. Selected coal-related ground-water data, Wasatch Plateau-Book Cliffs area, Utah: U.S. Geological Survey Open-File Report 79-915 (duplicated as Utah Hydrologic-Data Report 32), 25 p.

Hydrologic data in the tables of the report include: (1) records of test holes, wells, and springs, (2) lithologic logs of test holes and wells, (3) water-level measurements, (4) records of discharge from coal mines, and (5) chemical analyses of ground water. Most data were collected during 1976-78.

Waddell, K. M.

1976. Water-resources investigations of the U.S. Geological Survey in selected coal-energy areas of Utah: U.S. Geological Survey open-file report, 21 p.

The locations of 116 gaging stations operated by the U.S. Geological Survey during 1975 on streams in the vicinity of Utah coal fields are shown. At 18 of the stations chemical-quality data were obtained, and at 14 stations samples were collected for suspended-sediment concentrations. Locations of 170 observation wells at which water levels were monitored and 16 wells from which water samples were collected for chemical analysis also are shown. Five hydrologic studies in Utah coal areas that were active in 1975 also are briefly described.

1978. (Vickers, H. L., Upton, R. T., and Contratto, P. K.). Selected hydrologic data, 1931-77, Wasatch Plateau-Book Cliffs coal-fields area, Utah: U.S. Geological Survey Open-File Report 78-121 (duplicated as Utah Basic-Data Release 31), 33 p.

Hydrologic data in the report include: (1) records of selected water wells and springs, (2) data for water discharged from selected coal mines, (3) water levels in observation wells, (4) drillers' logs of selected wells, (5) chemical analyses of water from selected wells, springs, mines, and stream sites, and (6) mineralogic and grain-size determinations of streambed and formation samples.

1979. (Contratto, P. K., Sumsion, C. T., and Butler, J. R.). Hydrologic reconnaissance of the Wasatch Plateau-Book Cliffs coal-fields area, Utah: U.S. Geological Survey Open-File Report 79-988, 85 p. (to be duplicated as U.S. Geological Survey Water-Supply Paper 2068).

Hydrologic data obtained during the reconnaissance in 1975-77 were correlated with long-term data. Maps were prepared that show average annual precipitation, average streamflow, temperature of stream water, chemical quality of surface and ground waters, sediment yield, and geology. The report also describes the hydrology of the Emery coal field. Several approaches for hydrologic monitoring in the coal areas are suggested.

Waring, G. A.

1935. Ground water in part of southeastern Utah and southwestern Colorado with a chapter on Moab and Spring Valleys by M. M. Knechtel: U.S. Geological Survey open-file report, 119 p.

Hydrology of the area is summarized with special emphasis on the ground-water resource. Wells and springs are located on maps. Data from the wells and springs, including some chemical analyses of water, are listed in tables.

ACTIVE HYDROLOGIC STUDIES IN 1980

Seven hydrologic studies by the Geological Survey are active in and near the major coal-resource areas of Utah in 1980. Areas of six of the studies are shown in figure 2; surface-water monitoring sites for the seventh study, UT 77-129 (Hydrologic monitoring in coal-resource areas), also are shown.

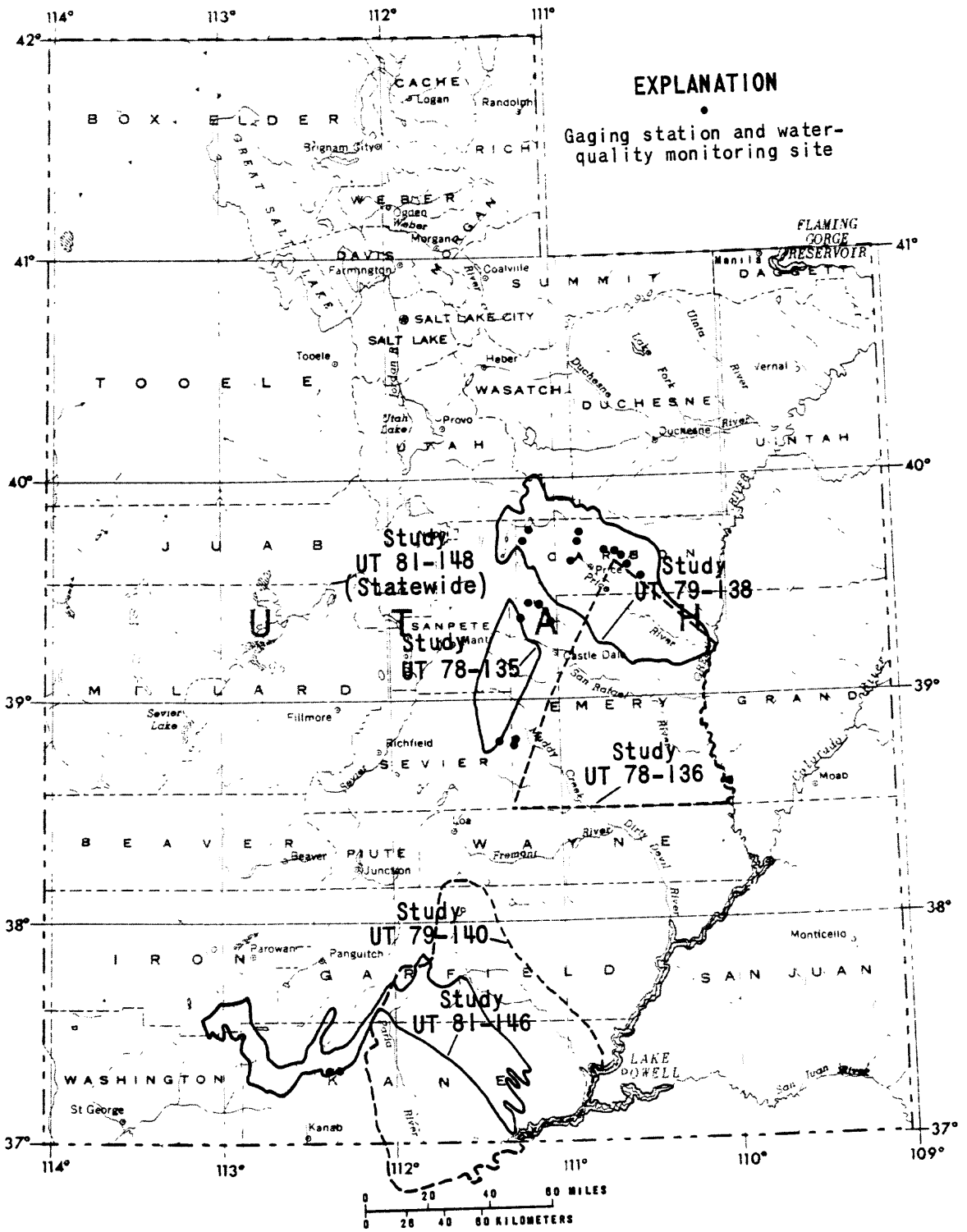

Figure 2.— Areas of active hydrologic studies in and near the major coal-resource areas of Utah and location of surface-water monitoring sites for study UT 77-129, October 1980.

Hydrologic Monitoring in Coal-Resource Areas

(UT 77-129)

The Geological Survey in August 1978 began monitoring of surface-water quantity and quality at 12 gaging stations downstream from mines and leased areas in the Wasatch Plateau, Book Cliffs, and Emery coal fields. Objectives of this continuing study are to define the surface-water hydrology and to detect and document changes in the quantity and quality of surface water that may result from coal mining.

In October 1979, four gaging stations were added to the monitoring network in the Wasatch Plateau and Book Cliffs coal fields. One gaging station in the Wasatch Plateau and two stations in the Alton coal field were added to the network in October 1980. Location of gaging stations in the monitoring network are shown in figure 2.

In addition to determination of daily streamflow at each of the 19 gaging stations in the monitoring network, water samples are collected monthly to determine concentrations of major dissolved chemical constituents and suspended sediment. Also, water samples are collected quarterly to determine concentrations of nitrogen and phosphorus nutrients, and trace metals. Six times a year the periphyton and phytoplankton in the water are identified. Determinations are made annually for concentrations of radiochemicals in the water and for the amount of coal in streambed material.

The monitoring network also includes discharge measurements twice a year during periods of base flow at 74 other sites, generally upstream from gaging stations. At 15 of the 74 base-flow measurement sites, water samples are collected in August of each year to determine concentrations of major dissolved chemical constituents.

A report that presents the results of the first 14 months of monitoring is in preparation; see Lines and Plantz (1981) in the annotated bibliography. Biennial reports are planned.

Hydrology of the Central Wasatch Plateau

(UT 78-135)

In June 1978, the Geological Survey in cooperation with the U.S. Bureau of Land Management began a 40-month hydrologic study of the central part of the Wasatch Plateau in central Utah. (See fig. 2.) The study objectives are to: (1) define the extent and characteristics of aquifers and chemical quality of ground water above, within, and immediately below coal-bearing rocks, (2) determine the existing seasonal variation in the quantity and quality of surface water, (3) estimate volumes of runoff and peak flows of streams resulting from 24-hour storms with recurrence intervals of 10 and 25 years and estimate the peak flows resulting from the 2- and 100-year storms, (4) determine the location and sources of water supply for significant domestic, agricultural, industrial, and other uses, and (5) predict, where possible, the hydrologic impacts of underground coal mining.

A preliminary report was prepared by Graham, Tooley, and Price (1981) for the northern part of the study area. That report, based on preliminary data, is cited in the annotated bibliography. The final interpretive report and a hydrologic-data report for the study are scheduled for completion by September 1981.

Water in Bedrock in the Northern San Rafael Swell

(UT 78-136)

In July 1978, in cooperation with the Utah Division of Water Rights, the Geological Survey began a 3-year study of ground water in bedrock aquifers in the northern part of the San Rafael Swell, with emphasis on the Navajo Sandstone. The study area (fig. 2) is near the Wasatch Plateau, Book Cliffs, and Emery coal fields.

Study objectives are to determine or estimate: (1) potential well yields from aquifers in geologic units older than the Mancos Shale of Cretaceous age, (2) the long-term capability of the aquifers to yield water of usable chemical quality, and (3) the probable effects of ground-water withdrawals on the surface-water supply of the Colorado River system. Implicit in these objectives is a general definition of the hydrologic system, including water quality, in the study area.

The final interpretive report for this study is scheduled for completion by June 1981.

Hydrology of the Price River Basin

(UT 79-138)

A 3-year hydrologic study of the Price River basin was begun by the Geological Survey in October 1978 in cooperation with the U.S. Bureau of Land Management. The study area, shown in figure 2, includes the northern part of the Wasatch Plateau coal field and most of the Book Cliffs coal field.

The study objectives are to determine the effects of present and proposed underground coal mining on: (1) surface-water quantity and quality and stream aquatic life, and (2) ground-water recharge, movement, discharge, and quality.

A hydrologic-data report and an interpretive report are scheduled for completion by September 1981.

Ground-Water Conditions in the Kaiparowits Area

(UT 79-140)

A study of ground water, mainly in the Navajo Sandstone, was begun by the Geological Survey in July 1979 in cooperation with the Utah Division of Water Rights. The area of this 3-year study, shown in figure 2, is in and adjacent to the Kaiparowits Plateau coal field in southern Utah.

Similar to the study of bedrock aquifers in the northern San Rafael Swell (UT 78-136), the objectives are to determine or estimate (1) potential well yields and quality of ground water and (2) the potential hydrologic effects of increased ground-water withdrawals that may be associated with future coal development. The effects of Lake Powell on the Navajo Sandstone also are to be evaluated.

The final interpretive report is scheduled for completion by June 1982.

Hydrology of the Kaiparowits Plateau, Alton, and Kolob Coal Fields

(UT 81-146)

The Geological Survey began a 3-year hydrologic study of the major coal fields in southern Utah in October 1980. (See fig. 2.) The study is in cooperation with the U.S. Bureau of Land Management.

The main objective of the study is to define the hydrologic system, namely: (A) the seasonal variations in surface-water quantity and quality, and (B) the extent, characteristics, and recharge-discharge relationships of aquifers and the quality of ground water above, within, and directly below coal-bearing rocks. The second objective is to predict qualitatively, where possible, the effects of coal mining on the water resources.

An interpretive report is scheduled for completion by September 1983.

Flood-Plain Mapping of Public Lands in Utah

(UT 81-148)

In October 1980, the Geological Survey began a 2-year study of flood-plain mapping of public lands in Utah, with emphasis on coal-lease areas. The study is in cooperation with the U.S. Bureau of Land Management.

The study objectives are to describe the hydraulic and hydrologic factors that must be considered when preparing flood-plain maps and to provide methods for delineating flood plains that will allow formulation of land-use plans.

A manual is scheduled for completion by September 1982 that will outline procedures for flood-plain mapping, including the preparation of profiles of both historic and theoretical floods.

STATEWIDE DATA-COLLECTION NETWORK

In addition to surface-water monitoring sites that are designed specifically for monitoring in coal-resource areas (UT 77-129), surface water is monitored statewide in cooperation with a number of State and Federal agencies. As part of the statewide network, there were 70 gaging stations operated in October 1980 in the vicinity of major coal fields. Water quality was monitored at 15 sites (fig. 3).

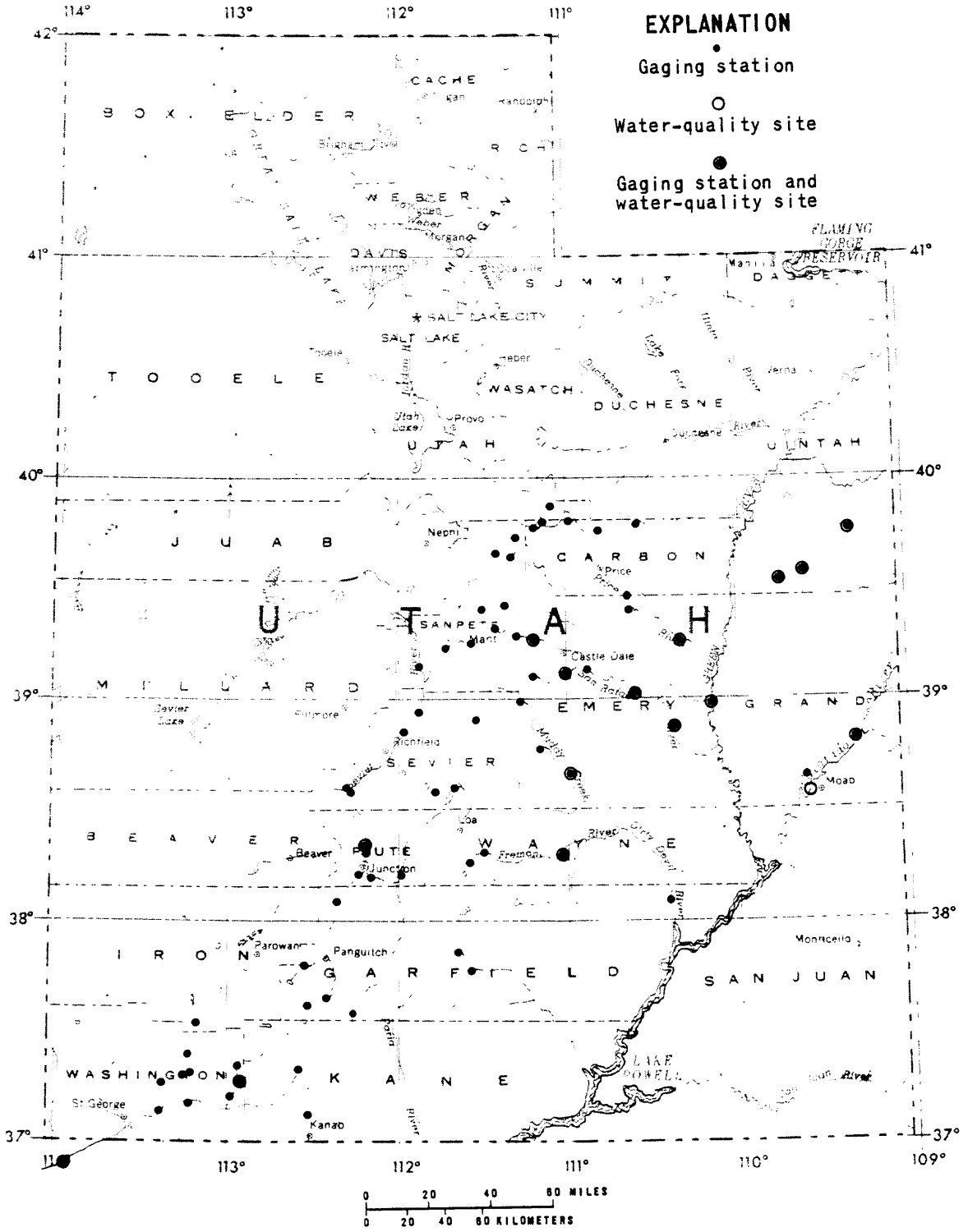

Figure 3.—Surface-water monitoring sites in the vicinity of the major coal-resource areas of Utah that are part of the statewide network, October 1980.

Ground water also is monitored statewide in cooperation with several State agencies. During 1980 in the vicinity of major coal fields, water levels were measured in 155 wells, and water samples were obtained from 28 wells for chemical analyses. (See fig. 4.) Most of the observation wells are in areas where ground water is used for irrigation, and most of the wells tap sand and gravel aquifers along streams or in basin fill.

Data from the statewide networks are published in numerous Geological Survey Water-Supply Papers and annual Water-Data Reports. For complete references and availability of these basic-data reports, the reader is referred to "Bibliography of U.S. Geological Survey Water-Resources Reports for Utah", compiled by B. A. LaPray and L. S. Hamblin, and published in 1980 as Utah Department of Natural Resources Information Bulletin 27.

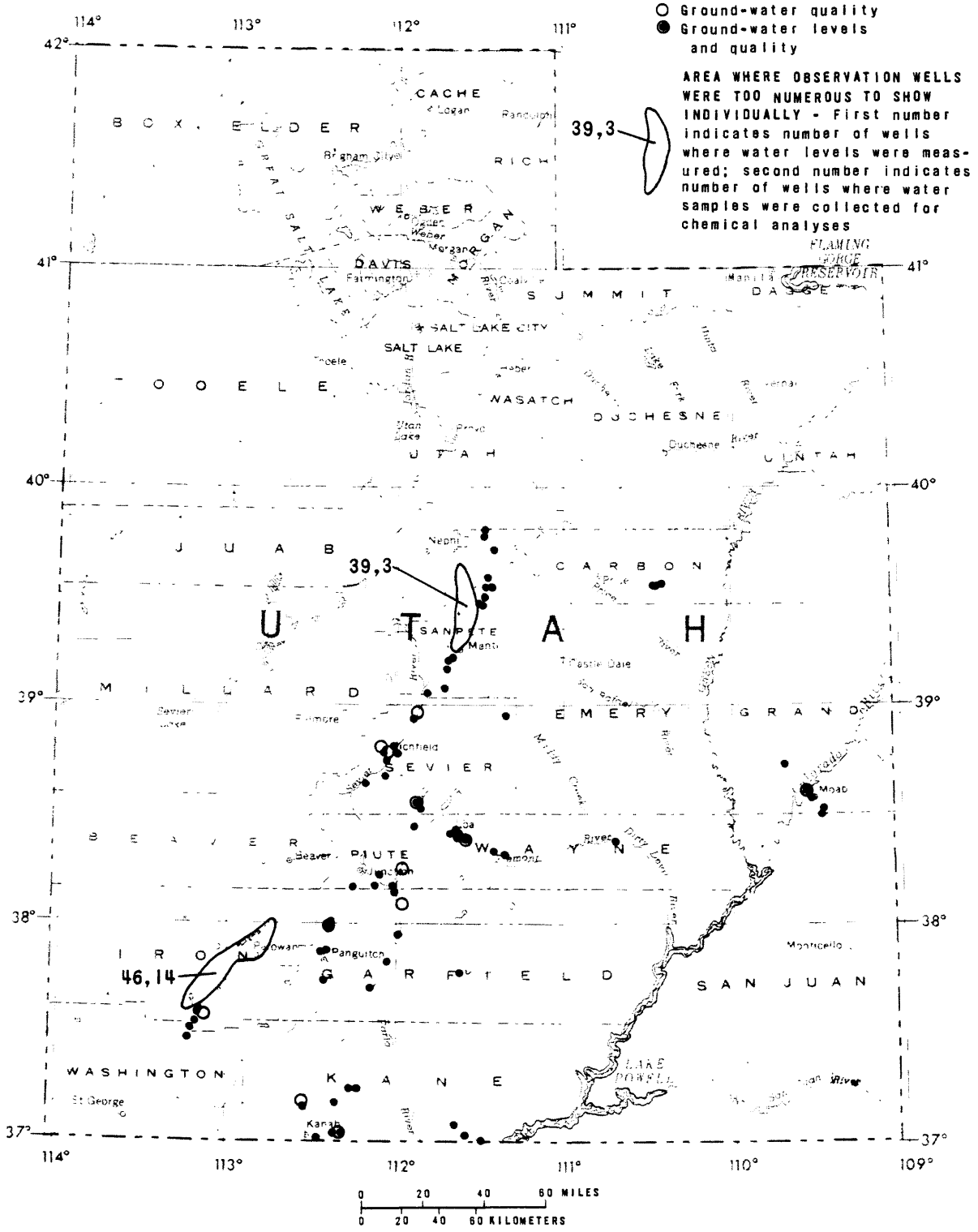

Figure 4.—Ground-water monitoring sites in the vicinity of the major coal-resource areas of Utah that are part of the statewide network, 1980