UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER-RESOURCES ACTIVITIES IN UTAH

BY THE U.S. GEOLOGICAL SURVEY,

JULY 1, 1985, TO JUNE 30, 1986

Compiled by Joseph S. Gates and Stefanie L. Dragos

Open-File Report 86-533

Salt Lake City, Utah

1987

DEPARTMENT OF THE INTERIOR

DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information
write to:

District Chief
U.S. Geological Survey
Water Resources Division
1016 Administration Building
1745 West 1700 South
Salt Lake City, Utah 84104

Copies of this report can
be purchased from:

U.S. Geological Survey
Books and Open-File Reports
Federal Center, Bldg. 41
Box 25425
Denver, Colorado 80225
[Telephone: (303) 236-7476]

CONTENTS

ILLUSTRATIONS

WATER-RESOURCES ACTIVITIES IN UTAH

BY THE U.S. GEOLOGICAL SURVEY,

JULY 1, 1985, TO JUNE 30, 1986

Compiled by Joseph S. Gates and Stefanie L. Dragos

INTRODUCTION

This report contains summaries of the progress of water-resources studies in Utah by the U.S. Geological Survey, Water Resources Division, Utah District, from July 1, 1985 to June 30, 1986. The program in Utah during this period consisted of 22 projects, and a discussion of each project is given in the main body of the report. Short descriptions are given at the end of the report for six proposed projects to be started on or after July 1986.

The following sections outline the basic mission and program of the Water Resources Division, the organizational structure of the Utah District, the distribution of District funding in terms of source of funds and type of activity funded, and the agencies with which the District cooperates. The last part of the introduction is a list of reports produced by the District from July 1985 to June 1986.

Basic Mission and Program of the Water Resources Division, U.S. Geological Survey

The U.S. Geological Survey, through its Water Resources Division, investigates the occurrence, quantity, distribution, and movement of the surface and underground water that comprise the Nation's water resources, and coordinates Federal water-data acquisition activities.

The mission of the Division is accomplished through programs supported by the U.S. Geological Survey independent of, or in cooperation with, other Federal and non-Federal agencies. These programs involve:

1. Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.

2. Conducting analytical and interpretive water-resource appraisals of the occurrence, availability, and the physical, chemical, and biological characteristics of surface and ground water.

3. Conducting basic problem-oriented research in hydrology to improve the scientific basis for investigations and measurement techniques, and to predict quantitatively the response of hydrologic systems to stress.

4. Disseminating water data and the results of investigations and research through reports, maps, computerized information services, and other forms of public releases.

5. Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground water.

6. Providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies; to licensees of the Federal Power Commission; and to international agencies on behalf of the Department of State.

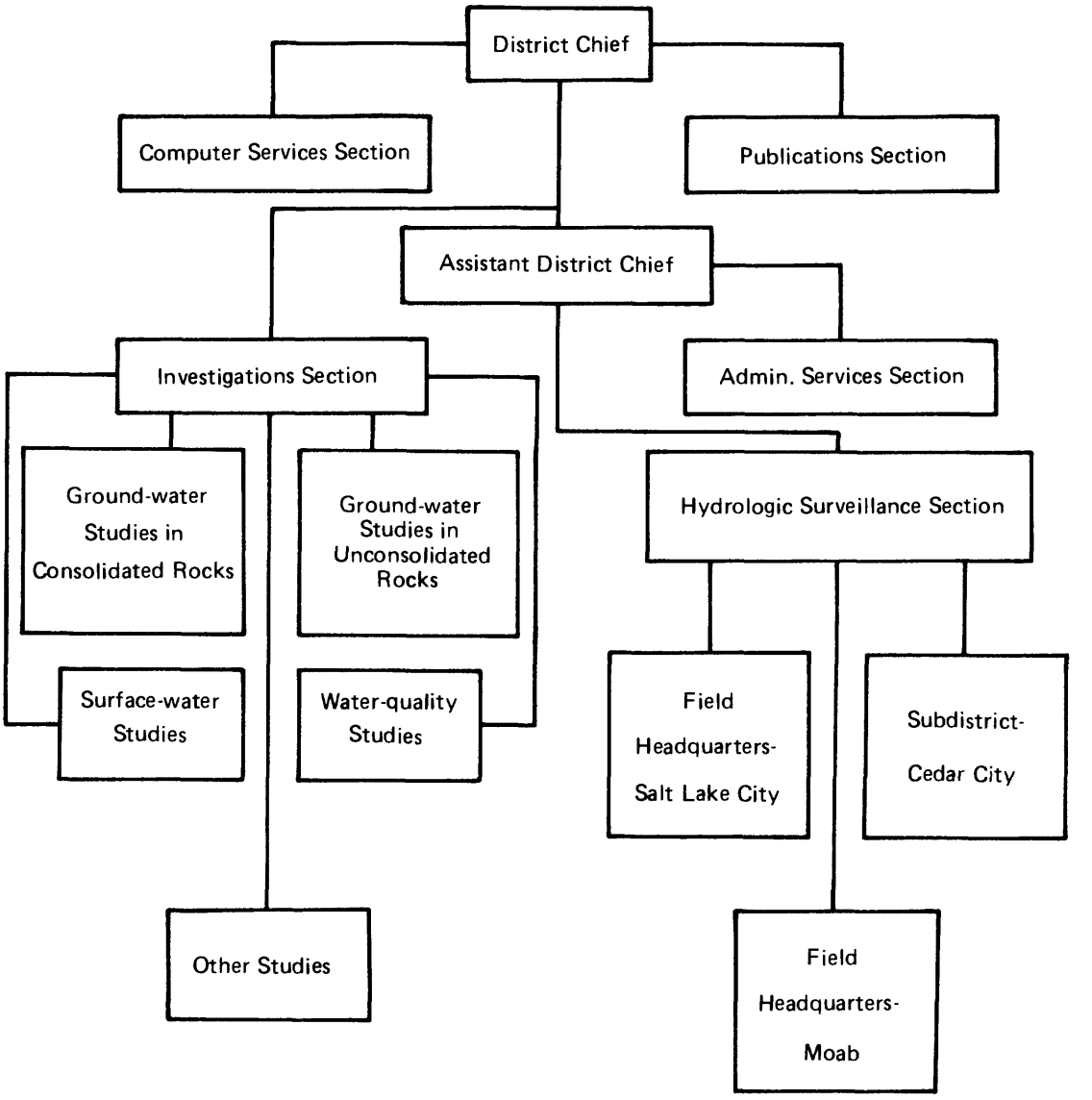
7. Administering the provisions of the Water Resources Research Act of 1984, which includes the State Water Resources Research Institute Program (Section 104) and the National Water Resources Research Grant Program (Section 105).

8. Acquiring information useful in predicting and delineating water-related natural hazards from flooding, volcanoes, mudflows, and land subsidence.

Utah District Organization

The Utah District of the Water Resources Division is organized into five operating sections under the District Chief and Assistant District Chief (see organization chart). Water-resources projects are conducted by the Investigations Section (primarily interpretive studies) and Hydrologic-Surveillance Section (primarily collection of hydrologic data). Responsibility for each project is assigned to a project chief. Support for project work is supplied by the Publications Section, which processes and illustrates reports, and the Computer Services and Administrative Services Sections. The Utah District consists of the District Office in Salt Lake City, a Subdistrict office in Cedar City, and Field Headquarters in Salt Lake City and Moab. The location of these offices and their areas of responsibility are shown in figure 1.

UTAH DISTRICT ORGANIZATION



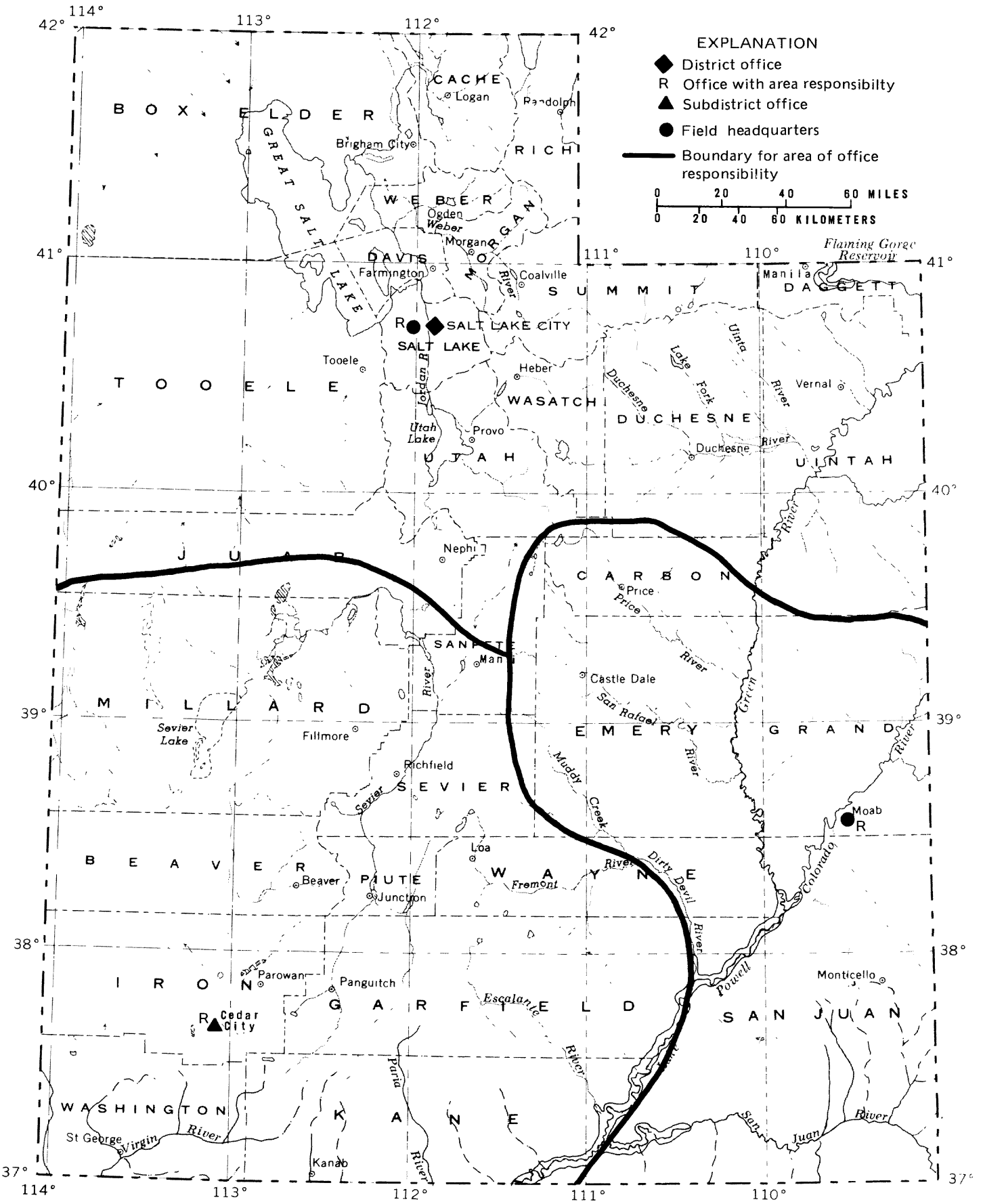
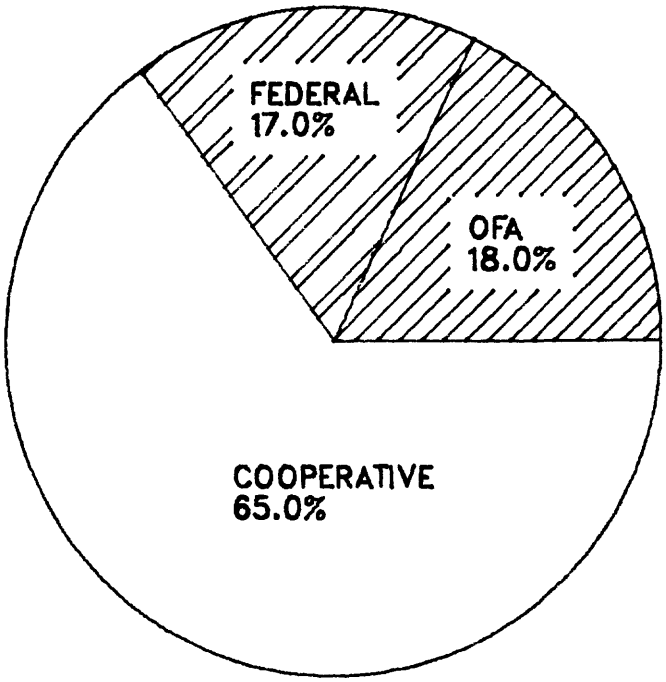


Figure 1.—Location of U. S. Geological Survey, Water Resources Division, offices and general areas of responsibility.

Program Funding and Cooperating Agencies

Funds to support water-resources work done by the Utah District are from three sources. Cooperative-Program funds and services are provided from State and local government agencies and are generally matched by Federal funds on a 50-50 basis. Funds transferred from other Federal agencies (OFA) are part of the OFA Program, and funds appropriated directly to the Geological Survey by the Congress are part of the Federal Program. In fiscal year 1986 the total financial support from these programs for the Utah District was about $3.1 million. The distribution of funds among the three sources was as follows:



In fiscal year 1986 the Utah District pursued two broad categories of studies: (1) collection of hydrologic data, and (2) interpretive studies and areal appraisals. Approximately 50 percent of the program was for collection of hydrologic data and 50 percent for interpretive studies and appraisals. These studies provide water managers and planners with information about the availability and quality of Utah's water resources.

From July 1, 1985 to June 30, 1986, the State and local cooperators for District projects were:

Utah Department of Natural Resources
- Division of Water Rights
- Division of Water Resources
- Division of Wildlife Resources
- Division of Oil, Gas, and Mining
- Geological and Mineral Survey

Utah Department of Transportation

Utah Department of Health, Division of Environmental Health

Bear River Commission
Salt Lake County Division of Flood Control and Water Quality
Central Utah Water Conservancy District
Lower Gunlock Reservoir Corporation

The Federal cooperators were:

Bureau of Land Management
Bureau of Reclamation
Federal Energy Regulatory Commission
Federal Emergency Management Agency
Department of the Army

Reports Released or Published

Reports prepared by or in cooperation with the Utah District can be obtained at the following locations:

Utah District Office: Open-File Reports; Water-Resources Investigations Reports; Hydrologic-Data Reports; Water-Data Reports; and Utah Department of Natural Resources Technical Publications, Cooperative-Investigations Reports, and Water Circulars.

U.S. Geological Survey Public Inquiries Office (125 South State Street, Salt Lake City): U.S. Geological Survey Water-Supply Papers, Professional Papers, and Hydrologic-Investigations Atlases.

Utah Department of Natural Resources, Division of Water Rights: Technical Publications, Water Circulars, Hydrologic-Data Reports, Water-Use Reports.

Utah Department of Natural Resources, Division of Water Resources: Cooperative-Investigations Reports.

The following reports were released to the Open File:

Avery, Charles, 1985, Bedrock Aquifers of eastern San Juan County, Utah: U.S. Geological Survey Open-File Report 85-568.

Cruff, R. W., 1986, Data uses and funding sources for the stream-gaging program in Utah: U.S. Geological Survey Open-File Report 86-51.

Dragos, S. L., 1985, Water-resources activities in Utah by the U.S. Geological Survey, July 1, 1984, to June 30, 1985: U.S. Geological Survey Open-File Report 85-493.

Holmes, W. F., Thompson, K. R., and Enright, Michael, 1985, Water resources of the Park City area, Utah, with emphasis on ground water: U.S. Geological Survey Open-File Report 85-638.

Plantz, G. G., Appel, C. L., Clark, D. W., Lambert, P. M., and Puryear, R. L., 1986, Selected hydrologic data from wells in the East Shore area of the Great Salt Lake, Utah, 1985: U.S. Geological Survey Open-File Report 86-139.

Seiler, R. L., 1986, Selected hydrologic data for Salt Lake Valley, Utah, October 1968 to October 1985: U.S. Geological Survey Open-File Report 86-249.

Seiler, R. L., and Waddell, K. M., 1986, Guide to user modification of a three-dimensional digital ground-water model for Salt Lake Valley, Utah: U.S. Geological Survey Open-File Report 86-307.

Waddell, K. M., Seiler, R. L., and Solomon, D. K., 1986, Chemical quality of ground water in Salt Lake Valley, Utah: U.S. Geological Survey Open-File Report 86-138.

Waddell, K. M., Seiler, R. L., Santini, M., and Solomon, D. K., 1986, Ground-water conditions in Salt Lake Valley, Utah, 1969-83, and predicted effects of increased withdrawals from wells: U.S. Geological Survey Open-File Report 86-237.

The following reports were published:

Lindskov, K. L., 1986, Potential effects of anticipated coal mining on salinity of the Price, San Rafael, and Green Rivers, Utah: U.S. Geological Survey Water-Resources Investigations Report 86-4019.

Mason, J. L., Atwood, J. W., and Beuttner, P. L., 1985, Selected test-well data from the MX-missile siting study, Tooele, Juab, Millard, Beaver, and Iron Counties, Utah: Utah Hydrologic-Data Report 43 (U.S. Geological Survey Open-File Report 85-347).

Plantz, G. G., 1985, Hydrologic reconnaissance of the Kolob, Alton, and Kaiparowits Plateau coal fields, south-central Utah: U.S. Geological Survey Hydrologic Investigations Atlas HA-684.

Price, Don, and Arnow, Ted, 1985, Ground water in Utah--a summary description of the resource and its related physical environment: Utah Department of Natural Resources Water Circular 3.

Price, Don, 1985, Ground water in Utah's densely populated Wasatch Front area—the challenge and the choices: U.S. Geological Survey Water-Supply Paper 2232.

ReMillard, M. D., and others, 1985, Water Resources data for Utah, water-year 1984: U.S. Geological Survey Water-Data Report UT-84-1.

Sandberg, G. W., and Sultz, L. G., 1985, Reconnaissance of the quality of surface water in the upper Virgin River basin, Utah, Arizona, and Nevada, 1981-82: Utah Department of Natural Resources Technical Publication 83.

Seiler, R. L., and others, 1985, Ground-water conditions in Utah, spring of 1985: Utah Division of Water Resources Cooperative-Investigations Report No. 25.

Stephens, D. W., 1985, Why Scofield Reservoir is eutrophic: Effects of nonpoint-source pollutants on a water-supply reservoir in Utah: in Perspectives on nonpoint source pollution, U.S. Environmental Protection Agency report 440/5-85-001, p. 142-164.

Stephens, D. W., and Wangsgard, J. B., 1986, Cluster analysis of phytoplankton data collected from the National Stream Quality Accounting Network in the Tennessee River Basin, 1974-81: U.S. Geological Survey Water-Resources Investigations Report 86-4029.

Waddell, K. M., Dodge, J. E., Darby, D. W., and Theobald, S. W., 1986, Hydrology of the Price River Basin, Utah, with emphasis on selected coal-field areas: U.S. Geological Survey Water-Supply Paper 2246.

Waddell, K. M., Darby, D. W., and Theobald, S. W., 1986, Chemical and physical characteristics of water and sediments in Scofield Reservoir, Carbon County, Utah: U.S. Geological Survey Water-Supply Paper 2247.

Several reports on past projects are not yet released or published but are being completed. The status of these reports, listed by project number, is as follows:

UT 003

Price, Don, and Arnow, Ted, (in press), Program for monitoring the chemical quality of ground water in Utah—summary of data collected through 1984: Utah Department of Natural Resources Technical Publication No. 88.

UT 113

Holmes, W. F., and Kimball, B. A., (in press), Ground water in the southeastern Uinta Basin, Utah and Colorado: U.S. Geological Survey Water-Supply Paper 2248.

UT 129

Price, Don, and Plantz, G. G., (in press), Hydrologic monitoring in the coal fields of central and southern Utah--Summary of data collected during August 1978-September 1984: U.S. Geological Survey Water-Resources Investigations Report 86-4017.

UT 140

Blanchard, P. J., (in press), Ground-water conditions in the Kaiparowits Plateau area, Utah and Arizona, with emphasis on the Navajo Sandstone: Utah Department of Natural Resources Technical Publication No. 81.

UT 156

Avery, Charles, (in press), Bedrock aquifers of eastern San Juan County, Utah: Utah Department of Natural Resources Technical Publication No. 86.

UT 157

McCormack, H. F., Lindskov, K. L., and Stolp, B. J., (in press), Hydrologic maps of the Price 30 X 60 minute quadrangle, Utah: U.S. Geological Survey Water-Resources Investigations Report 84-4227.

UT 158
Holmes, W. F., Thompson, K. R., and Enright, Michael, (in press), Water resources of the Park City area, Utah, with emphasis on ground water: Utah Department of Natural Resources Technical Publication 85.

UT 159
Blanchard, P. J., (in press), Ground-water conditions in the northern Lake Powell area, Utah: Utah Department of Natural Resources Technical Publication 84.

UT 160
Stephens, D. W., Thompson, K. R., and Wangsgard, J. B., (in review), Hydrology and effects of coal mining on water quality of Scofield Reservoir and streams in the Pleasant Valley area, central Utah, water years 1983-84: U.S. Geological Survey Water-Supply Paper.

UT 161
Christensen, R. C., Johnson, E. B., and Plantz, G. G., (in press), Streamflow characteristics of the Colorado River Basin in Utah through September 1981: U.S. Geological Survey Open-File Report 85-421 and Utah Hydrologic-Data Report No. 42.

Christensen, R. C., Johnson, E. B., and Plantz, G. G., (in press), Manual for estimating streamflow characteristics of natural-flow streams, Colorado River Basin in Utah: U.S. Geological Survey Water-Resources Investigations Report 85-4297.

UT 164
Wilberg, D, E., and Stolp, B. J., (in press), Physical characteristics and chemical quality of selected springs in Juab, Millard, Tooele, and Utah Counties, Utah: U.S. Geological Survey Water-Resources Investigations Report 85-4324.

CURRENT PROJECTS

COLLECTION OF HYDROLOGIC DATA

SURFACE-WATER DATA, INCLUDING CANAL-LOSS STUDIES

Number: UT 00-001

Cooperating Agencies: U.S. Bureau of Reclamation; U.S. Bureau of Land Management; U.S. Soil Conservation Service, Federal Energy Regulatory Commission; U.S. Department of the Army; Utah Division of Water Rights; Utah Division of Water Resources; Utah Geological and Mineral Survey; Utah Division of Environmental Health; Bear River Commission; Central Utah Water Conservancy District; Lower Gunlock Reservoir Corporation; Salt Lake County Division of Flood Control and Water Quality.

Staff: R. W. Cruff, Hydrologist, Project Chief (part time)
Other District personnel as assigned

Period of Project: Continuing

Objective: To obtain data on stream discharge or stage and reservoir or lake stage at selected sites throughout Utah (fig. 2).

Approach: Standard methods for the operation and maintenance of gaging stations and for the computation, computer storage, and publication of streamflow records were used.

Progress: Data collection and computation necessary for the publication of records for 195 streamflow stations, 15 reservoirs, and 2 lake-stage stations continued during the year. (See figure 2 for locations of stations.) In addition, monthly measurements were made of rates of flow and density of water moving through the breach in the causeway across Great Salt Lake. Periodic measurements were also made of rates of flow and density of water moving through the culverts through the causeway. The stations are classified as follows:

Current purpose or project related	125
Hydrologic	54
Benchmark or long-term change	12
Regulated	4
Reservoirs (long-term management)	15
Lake stage	2

Gaging stations discontinued were:

North Creek above Ranger Station, near Monticello
White River near Colorado-Utah State Line
Silver Creek near Wanship
East Canyon Creek near Park City

Gaging stations established were:

Blacksmith Fork below Mill Creek, near Hyrum
White River near Watson
Montezuma Creek near Bluff
South Creek near Monticello

Canal-loss studies: Flow measurements were completed on the Davis-Weber and Ogden Valley canal systems and on a reach of the Weber River. A draft of the report was completed and is in review.

Flood report: Assembled data for and began preparation of a report of the 1983 and 1984 floods in the Great Basin.

Boulevard Ridge watershed study: Obtained existing records of data for the Boulevard Ridge watershed, Uintah County.

Plans for Next Year: Continue operation of network. Prepare 1986 water-year records for publication. Complete flood report for the Great Basin. Select canals for the next canal-loss study, and begin seepage measurements. Complete compilation of data, including precipitation data, for the Boulevard Ridge watershed; determine stage/volume relations and flows for two reservoirs; and interpret all data.

Reports:

Cruff, R. W., 1986, Data uses and funding sources for the stream-gaging program in Utah: U.S. Geological Survey Open-File Report 86-51.

ReMillard, M. D., and others, 1985, Water resources data for Utah, water year 1984: U.S. Geological Survey Water-Data Report UT-84-1.

ReMillard, M. D., and others, (in press), Water resources data for Utah, water year 1985: U.S. Geological Survey Water-Data Report UT-85-1.

"Streamflow and reservoir contents in Upper Colorado River Basin" is issued monthly.

Herbert, L. R., Cruff, R. W., Clark, D. W., and Avery, Charles, (in review), Seepage study of the Weber River and the Davis-Weber and Ogden Valley Canals, Davis and Weber Counties, Utah: Utah Department of Natural Resources Technical Publication.

Lindskov, K. L., 1986, Potential effects of anticipated coal mining on salinity of the Price, San Rafael, and Green Rivers, Utah: U.S. Geological Survey Water-Resources Investigations Report 86-4019.

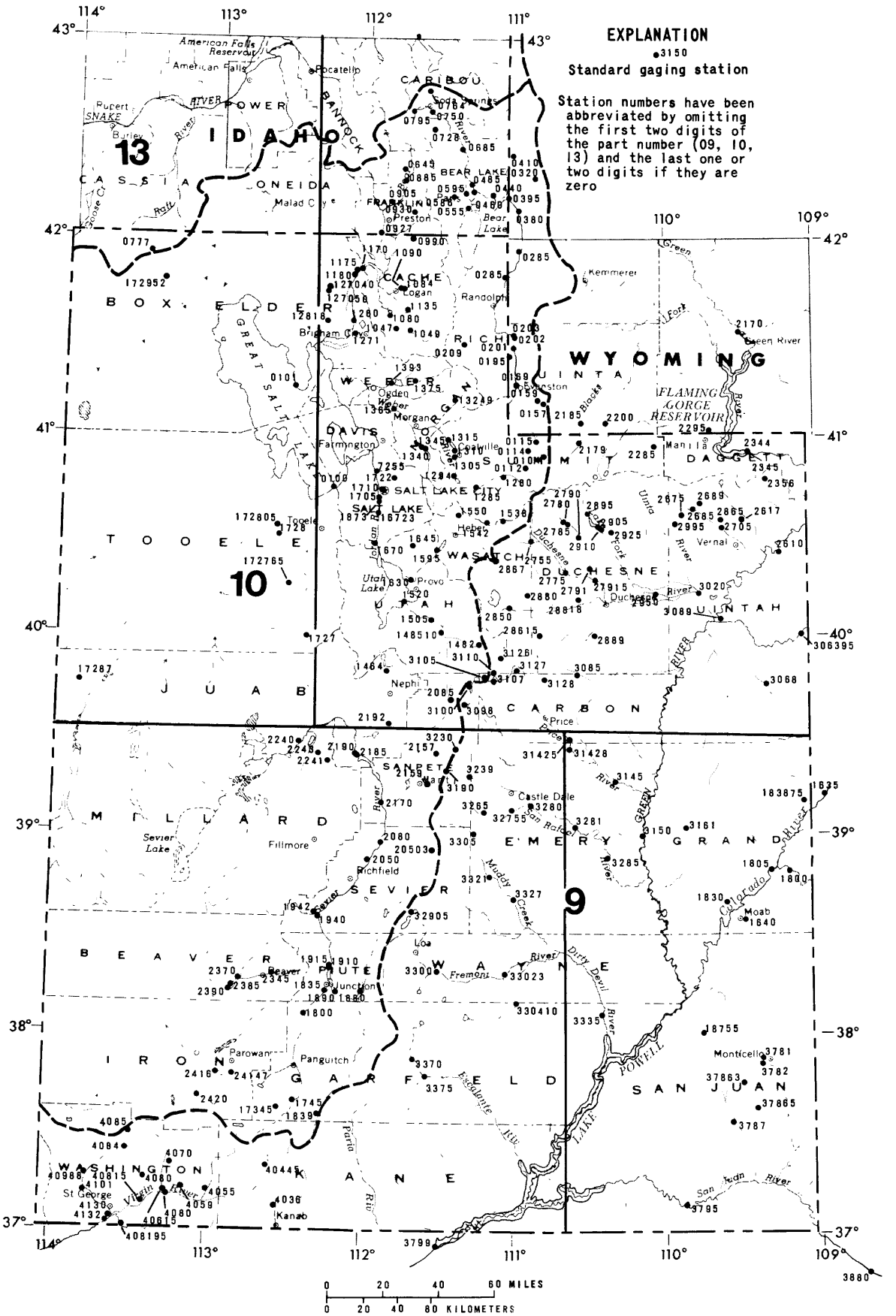


Figure 2.—Location of gaging stations, September 1985.

GROUND-WATER DATA AND GROUND-WATER CONDITIONS IN UTAH

Number: UT 00-002

Cooperating Agencies: Utah Division of Water Rights;
Utah Division of Water Resources;
Utah Division of Wildlife Resources;
Utah Department of Transportation

Staff: L. R. Herbert, Hydrologic Technician, Project Chief (part time)
G. J. Smith, Hydrologic Technician (part time)
J. L. Mason, Hydrologist, Editor of annual ground-water conditions report (part time)
Other District personnel as assigned

Period of Project: Continuing

Objectives: To obtain long-term records of ground-water levels, to determine water-level changes for yearly or other periods, and to determine withdrawals from and status of development of aquifers in the State. To make an annual evaluation of ground-water conditions in Utah.

Approach: Measure water levels annually or semiannually (normally February-March and September) and operate continuous water-level recorders on selected wells. Visit selected pumped irrigation wells, measure discharge, determine the ratio of water produced to energy consumed, and use the ratio along with energy-consumption data to compute total pumpage. Visit selected flowing wells and measure discharge. Obtain estimates of ground water withdrawn from wells for public supply and industrial use from the Utah Division of Water Rights. Obtain additional selected estimates of industrial use of water from wells by interviewing users, or by rating pumps and using the ratio of water produced to energy consumed with energy-consumption records. Determine the number and sizes of new wells drilled annually from well drillers' reports to the Division of Water Rights. Prepare an annual report on ground-water conditions in Utah which includes data, graphs, and maps showing water-level changes, withdrawals from wells, number of wells drilled in defined ground-water basins or areas, and a discussion of ground-water conditions in each basin or area. Store water-level data in computer files and publish selected data in the annual report of water-resources data for Utah.

Progress: Water levels were measured in about 1,100 wells in February or March, of which about 600 also were measured in September. Continuous water-level recorders were maintained on thirty-one wells. Locations of the water-level observation wells are shown in figure 3. During the irrigation season, about 500 pumped irrigation wells were visited; discharge was measured at about one-half of the wells, and the ratio of water production to energy-consumption was determined. Natural flow was measured for about 50 wells during the irrigation season. Number and sizes of new wells drilled were determined. The twenty-third in the series of annual reports on ground-water conditions in Utah was completed.

Plans for Next Year: Collecting, recording, and publishing data on water levels, ground-water withdrawals, and wells drilled will continue. The twenty-fourth in the series of annual ground-water reports will be compiled.

Reports:

ReMillard, M. D., and others, 1985, Water resources data for Utah, water year 1984: U.S. Geological Survey Water-Data Report UT-84-1.

ReMillard, M. D., and others, (in press), Water resources data for Utah, water year 1985: U.S. Geological Survey Water-Data Report UT-85-1.

Water-level-change maps, for the period February or March 1985-February or March 1986, of 15 areas in Utah—Issued April 1 as local press releases and distributed to agencies and interested individuals.

Mason, J. L., and others, 1986, Ground-water conditions in Utah, spring of 1986: Utah Division of Water Resources Cooperative-Investigations Report 26.

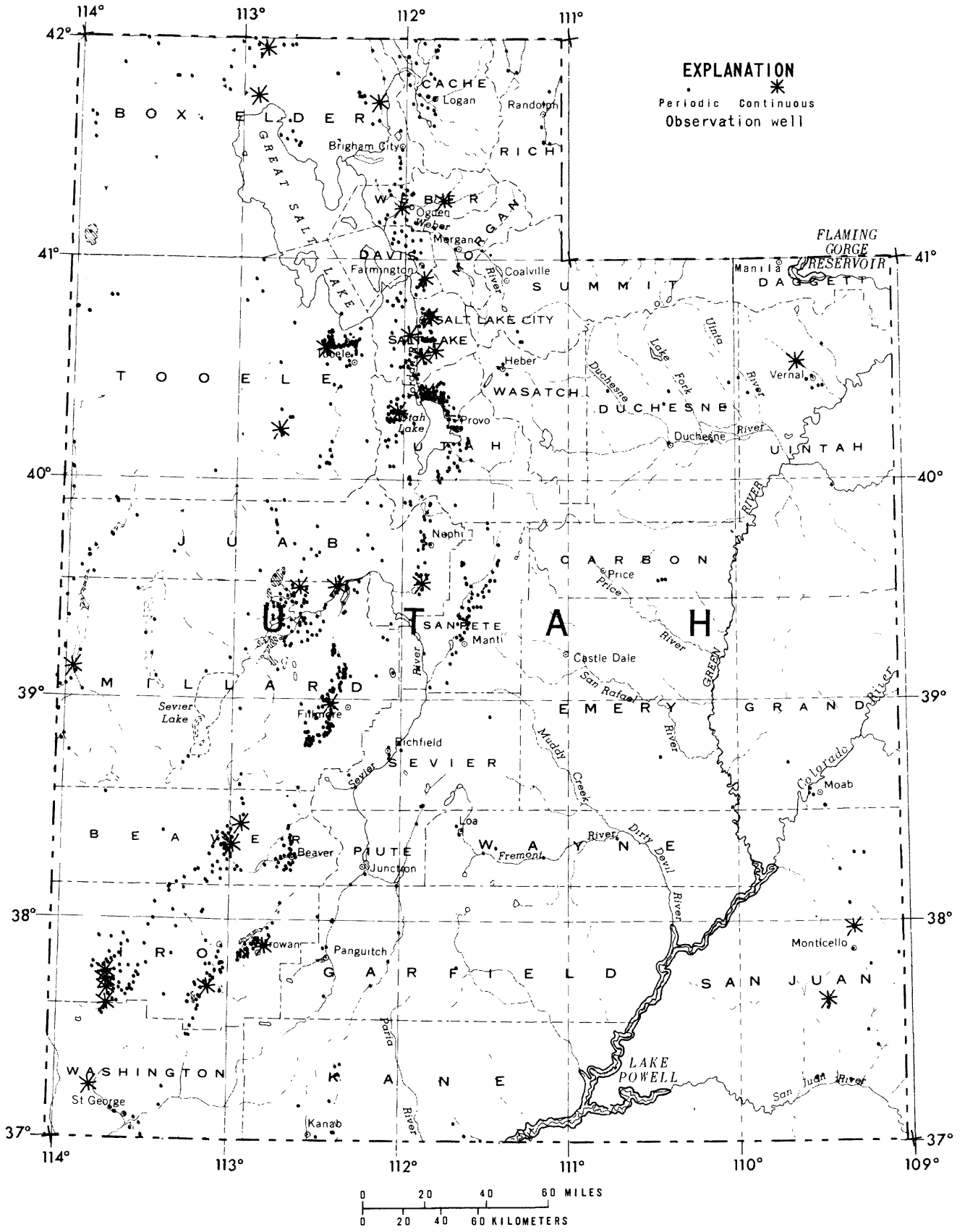


Figure 3.—Location of observation wells where ground-water levels were measured, September 1985.

WATER-QUALITY AND FLUVIAL-SEDIMENT DATA

Number: UT 00-003; UT 00-004

Cooperating Agencies: Utah Division of Water Rights;
Utah Division of Water Resources;
U.S. Bureau of Land Management;
U.S. Bureau of Reclamation;
U.S. Soil Conservation Service

Staff: R. W. Cruff, Hydrologist, Project Chief (part time)
Other District personnel as assigned

Period of Project: Continuing

Objectives: To obtain long-term records of the quality of water at selected stream sites (fig. 4), springs and wells (fig. 5), and of sediment (fig. 4) at selected stream sites; and to obtain shorter-term records for use by other Federal or State agencies.

Approach: Standard methods for the collection and analysis of chemical-quality and fluvial-sediment samples and computer storage and publication of data were used.

Progress: Water-quality data were collected at 24 surface-water sites in Utah. Chemical-quality records were collected daily at 8 stream sites and periodically at 16 stream sites. Specific-conductance values were obtained at an additional 157 stream-gaging stations in Utah. Sediment data were collected daily at 5 sites and periodically at 21 sites. Water-temperature data were obtained daily at 9 stream sites and monthly at 157 stream sites. Data on the quality of ground water were collected at about 190 wells. All water-quality records were compiled for inclusion in the annual water-resources data report.

Plans for Next Year: Continue collecting and processing data and preparing records for publication.

Reports:

Price, Don, and Arnow, Ted, (in press), Program for monitoring the chemical quality of ground water in Utah—summary of data collected through 1984: Utah Department of Natural Resources Technical Publication No. 88.

ReMillard, M. D., and others, 1985, Water resources data for Utah, water year 1984: U.S. Geological Survey Water-Data Report UT-84-1.

ReMillard, M. D., and others, (in press), Water resources data for Utah, water year 1985: U.S. Geological Survey Water-Data Report UT-85-1.

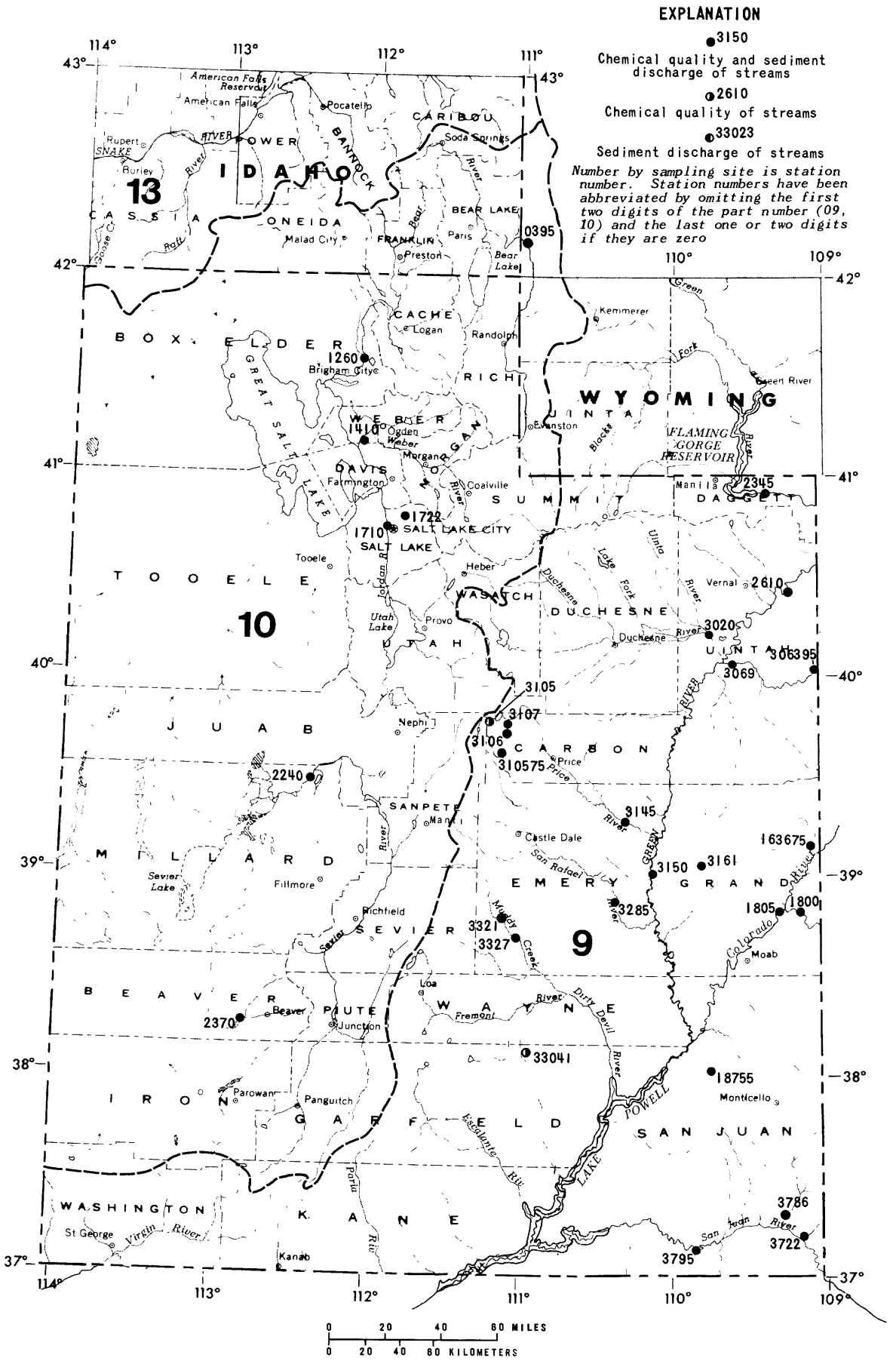


Figure 4.—Location of surface-water quality stations, September 1985

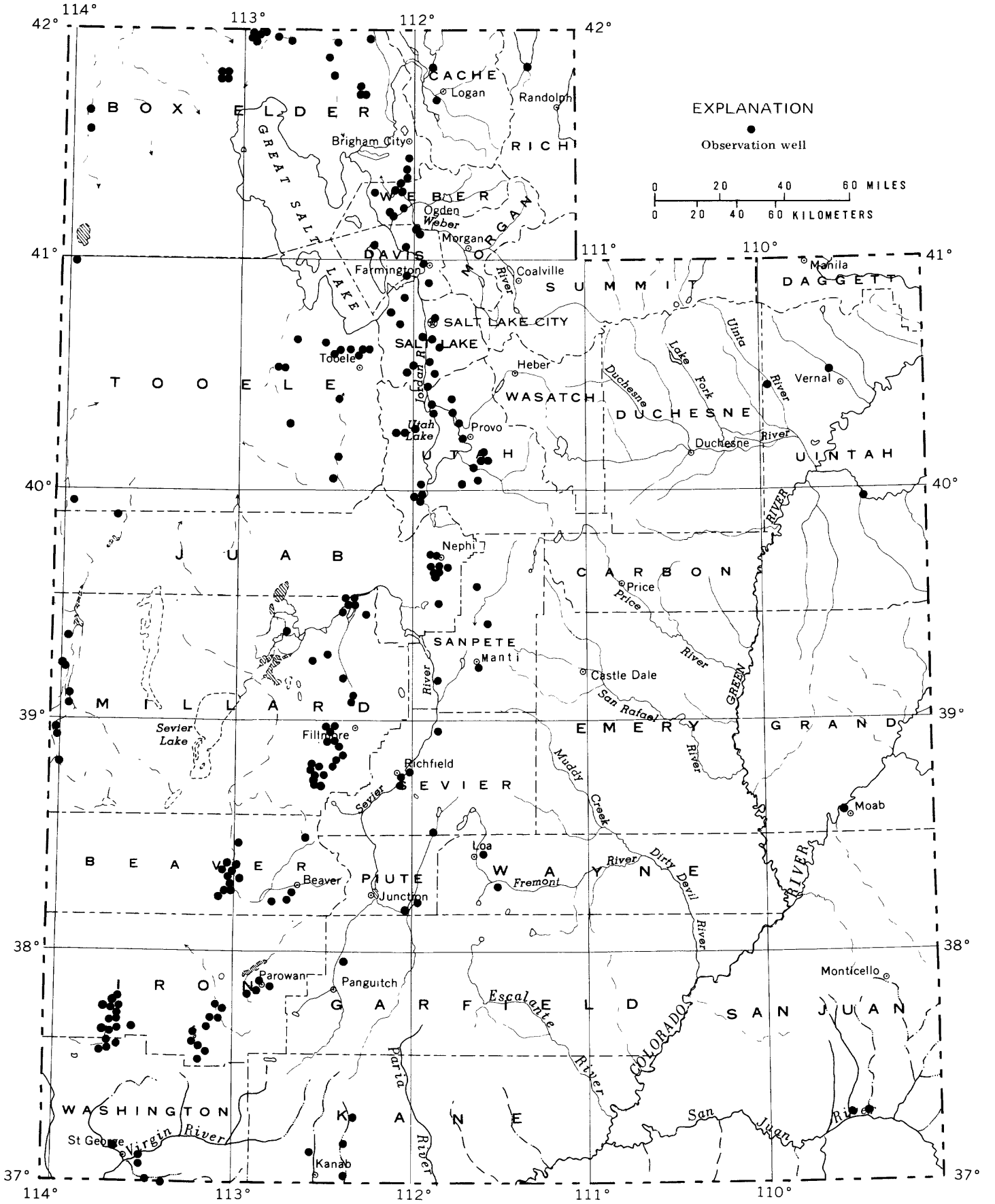


Figure 5.—Location of observation wells where water samples are collected for monitoring ground-water quality, July 1986.

INTERPRETIVE STUDIES

FLOOD MAPPING

Number: UT 00-006

Cooperating Agency: Federal Emergency Management Agency

Staff: R. C. Christensen, Hydrologist,
Project Chief (part time)
E. B. Johnson, Hydrologist (part time)
Other District personnel as assigned

Period of Project: Began May 1983, continuing

Objectives: To delineate the parts of areas selected by the Federal Emergency Management Agency (FEMA) that are subject to inundation by floods of selected recurrence intervals, primarily the 100-year flood. The information is needed by FEMA to assist State and local agencies to control development in the flood-plain areas and to determine rates for the flood-insurance program.

Approach: Determine areas subject to inundation by floods of selected magnitude by ground surveys or photogrammetric methods. Determine frequency relationships using local historical information, gaging-station records, and other applicable information. Determine water-surface profiles at flood stage using step-backwater models or by other acceptable methods and present the results in information releases to FEMA, prepared to their specifications.

Progress: Planning documents were completed for flood studies in Tooele City, part of the Weber River floodplain in Morgan County, and Washington City. Ground surveys were completed for Tooele City and partly done for the Morgan County area. The 100-year flood-frequency relationships were determined for the streams studied in Tooele City and for reaches of the Weber River in Morgan County.

Plans for Next Year: Complete ground surveys in the Morgan County area. For the Tooele City and Morgan County study areas, determine water-surface profiles at the 100-year flood stage, summarize the results of the studies, and send the information to FEMA.

Reports: None.

STATEWIDE WATER USE

Number: UT 00-007

Cooperating Agency: Utah Division of Water Rights

Staff: G. E. Pyper, Hydrologic Technician, Project Chief
M. L. Spencer, Student volunteer (part time)
Brent Johnson, Engineer, Utah Division of Water Rights
Other State and District personnel as assigned

Period of Project: Began July 1977, continuing

Objective: To obtain information about withdrawals and return flows of water for various uses and about consumptive use of water in connection with each type of withdrawal.

Approach: Total water diversions and consumptive use will be determined by field inventory and measurement of surface-water diversions, selected types of ground-water diversions, and verification of user measurements and records. Acreage and crop surveys will be used to aid in estimating consumptive use by irrigation. The results of a pilot study in Tooele Valley will be used to determine the best way to estimate water used for irrigation. State personnel are collecting data on public supply and industrial use; Geological Survey personnel are collecting data on irrigation use.

Progress: Mail surveys were made by the Division of Water Rights to determine water use by about 350 public suppliers and 130 major self-supplied and public-supplied industries. Approximately 25 public suppliers were visited during the year to verify the data. The report on water use during 1984 and 1985 by public suppliers and industry is being prepared. Data are being prepared for entry into the State and National water-use data systems. Work continued on determining water use for irrigation in Utah. Compilation of data for the National 5-year water-use report for 1985 was completed.

Plans for Next Year: Data for public supply and industrial use will continue to be collected and verified. Data will be added to the National water-use data base. Work will continue on determining irrigated acreage and water used for irrigation. Compilation and preparation of data for the 1987 National Water-Summary report will be completed.

Reports:

Johnson, Brent, (in preparation), Utah water-use data, public and industrial water supplies, 1984 and 1985: Utah Department of Natural Resources, Utah Water-Use Report.

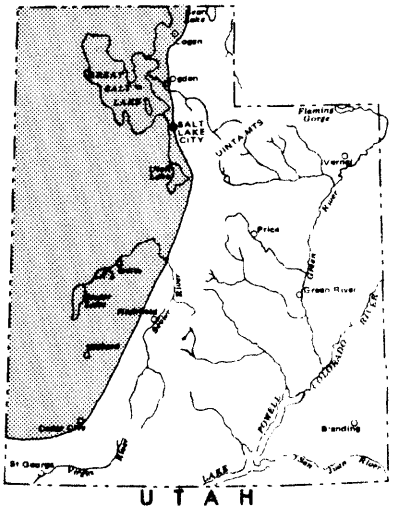
Pyper, G. E., and Baskin, R. L., (in review), Comparison of methods to estimate use of water for irrigation, Tooele Valley, Tooele County, Utah: Utah Department of Natural Resources, Utah Water-Use Report.

GREAT BASIN REGIONAL AQUIFER SYSTEMS ANALYSIS

Number: UT 81-147

Staff: J. L. Mason, Hydrologist, Project Chief
J. S. Gates, Hydrologist (part time)

Period of Project: October 1980 to January 1986



Background and Objectives: This study is one in a series of National studies of regional aquifer systems that together will cover much of the United States. The Great Basin study is headquartered in Carson City, Nevada, with part of the work located in the Utah District office. The overall objective is to assemble hydrologic information and create predictive capabilities necessary for effective management of ground water. The Great Basin is made up of individual basins that have basin-fill aquifers of similar origin, but these aquifers are either not connected hydrologically or have limited connection, sometimes by way of consolidated-rock aquifers underlying the uplands that separate basins and underlying the basins themselves. Specific objectives are to establish common principles governing occurrence, recharge, movement, discharge, and quality of water in the aquifers of the Great Basin, and to construct digital-computer models of the ground-water systems, representative basins, or groups of hydrologically-connected basins. The models will be used to help understand the natural (pre-development) flow and geochemical systems and to predict effects of future development and differences in the effects of various management strategies.

Approach: Computer simulation will be used to analyze the existing hydrogeologic regime and to provide the capabilities of predicting the effects of future development. The simulations will incorporate hydraulic effects and will be initiated early in the study to help determine the overall nature of the flow system, to identify sensitive parameters and data needs, and to determine what segments of the system, if any, can be treated independently. Assembling available hydrogeologic data on the Great Basin is an important part of the work, and collection of new data needed for successful simulation may require fieldwork. The present distribution of water quality throughout the area will be described using available and project-collected data. These data will be used to interpret the water-quality distribution in terms of the original flow pattern and geochemical processes, and an effort will be made to predict water-quality changes in response to future development, waste disposal, or artificial recharge.

Progress: A report describing the digital-computer model of the Milford area has been completed and is in the review and revision process. An open-file report of test drilling and data collected in the Sevier Lake area is in preparation.

Plans for Next Year: None.

Reports:

Bedinger, M. S., Reed, J. E., Gates, J. S., and Harrill, J. R., (in review), Potential for regional ground-water flow with applications in the Basin and Range Province: To be submitted for publication in the Geological Society of America Bulletin.

Mason, J. L., Atwood, J. W., and Buettner, P. L., 1985, Selected test-well data from the MX-missile siting study, Tooele, Juab, Millard, Beaver, and Iron Counties, Utah: Utah Hydrologic-Data Report No. 43.

Harrill, J. R., Gates, J. S., and Thomas, J. M., (in review), Major ground-water flow systems in the Great Basin area of Nevada, Utah, and adjacent states: U.S. Geological Survey Hydrologic Investigations Atlas.

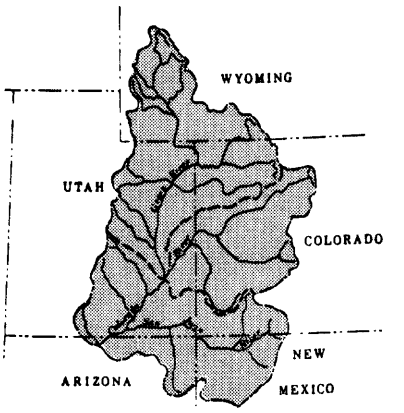
Mason, J. L., (in review), Simulated alternatives for ground-water withdrawals and their effects on the basin-fill aquifer in the Milford area, southwestern Utah.

Mason, J. L., (in preparation), Test drilling to determine ground-water flow direction near Sevier Lake, Millard County, Utah.

REGIONAL AQUIFER SYSTEMS ANALYSIS-MESOZOIC SANDSTONE AQUIFERS IN THE UPPER COLORADO RIVER BASIN

Number: UT 81-154

Staff: G. W. Freethey, Hydrologist,
Project Chief
B. E. Thomas, Hydrologist
G. E. Cordy, Hydrologist
J. F. Weigel, Hydrologist
S. Kelly, Hydrologic Technician (part time)



Period of Project: October 1981 to September 1986

Objectives: This study is one of the series of National studies of regional aquifer systems that together will cover much of the United States. In the Upper Colorado River Basin, aquifers that are truly regional include the complex of thick sandstones of Jurassic and Triassic age and carbonate and sandstone aquifers of Mississippian and Permian age. This study will target the thick sandstones of the Mesozoic System and locally related aquifers of lesser extent. The study is intended to (1) provide a basin-wide data base; (2) define and quantify recharge, occurrence, movement, discharge, and quality of ground water; (3) model the system(s) in order (a) to understand the natural (pre-development) flow and geochemical system(s) and (b) to evaluate or predict the effects of future development and differences in these effects due to various management strategies.

Approach: Computer simulation will be the main tool used to analyze the hydrogeologic regimen of the Mesozoic-aquifers system. The results of prior local, areal, and regional studies will be collected and combined, and basic data from those studies will be updated. Concurrently, subregional-flow models will be constructed in order to test provisional hypotheses and show areas where additional data are needed. Following will be a period of data collection, during which the models will be updated as field data are obtained. Final analyses will incorporate consideration of the effects of development on the ground-water flow regimen and storage, on surface-water flow, and on possible water-quality changes that would accompany development. Results of the study will appear as a planning document, data report(s), hydrologic atlases, model documentation, and a final interpretive report.

Progress: New maps showing thickness, areal extent, lithofacies changes, potentiometric contours, and thickness of saturated zones have been prepared for five aquifer units and five confining units in the Mesozoic System. Hydrologic data from aquifer tests, drill-stem tests, specific-capacity tests, and laboratory analyses of rock samples have been compiled and analyzed to yield hydrologic properties. A report describing the ground-water system in the Mesozoic rocks of the Upper Colorado Region is in review, and is planned for publication as a Professional Paper. A report containing hydrologic and

lithologic data and computed properties is in review. Ground-water flow models have been constructed for three subregions within the study area. Two of the reports of modeling are being printed and the third is in review. A report that includes water-level data for aquifers and confining layers in Mesozoic rock is in preparation. Reports summarizing modeling and geochemical studies done during the project are in preparation and are planned for publication as Professional Papers.

Plans for Next Year: All reports will be completed and processed for publication and distribution.

Reports:

Freethey, G. W., and Cordy, G. E., (in review), Analysis of the ground-water flow system in the Mesozoic rocks of the Upper Colorado River Basin--excluding the San Juan basin--in Colorado, Utah, Wyoming, Arizona, and New Mexico: U.S. Geological Survey Professional Paper.

Freethey, G. W., Kimball, B. A., Wilberg, D. E., and Hood, J. W., 1984, General hydrogeology of aquifers of Mesozoic age, Upper Colorado River Basin--excluding the San Juan basin--Colorado, Utah, Wyoming, and Arizona: U.S. Geological Survey Open-File Report 84-716 (pending publication as a Hydrologic Investigations Atlas).

Kimball, B. A., (in preparation), Mixing and chemical reaction of ground water in the Navajo Sandstone aquifer, Dirty Devil River basin, Utah: AWRA journal article.

Kimball, B. A., (in review), Geochemical indications of mixing between Paleozoic and Mesozoic aquifer waters, Montezuma Canyon area, Utah: U.S. Geological Survey Water-Supply Paper.

Kimball, B. A., (in preparation), Geochemistry of the principal aquifers in the Upper Colorado River Basin: U.S. Geological Survey Professional Paper.

Taylor, O. J., (in preparation), Synthesis of ground-water information in the Upper Colorado River Basin—excluding the San Juan basin--in Colorado, Utah, Wyoming, and Arizona: U.S. Geological Survey Professional Paper.

Thomas, B. E., 1985, Simulation analysis of water-level changes in the Navajo Sandstone due to changes in the altitude of Lake Powell near Wahweap Bay, Utah and Arizona: U.S. Geological Survey Water-Resources Investigations Report 85-4207.

Thomas, B. E., (in review), Simulation analysis of the ground-water system in Mesozoic rocks in the Four Corners area, Utah, Colorado, Arizona, and New Mexico: U. S. Geological Survey Water-Supply Paper.

Weigel, J. F., (in review), Selected hydraulic and lithologic data of the Mesozoic formations in the Upper Colorado River Basin in Colorado, Utah, Wyoming, and Arizona: U.S. Geological Survey Water-Resources Investigations Report.

Weigel, J. F., (in review), Selected water-level data of Mesozoic formations in the Upper Colorado River Basin in Arizona, Colorado, Utah, and Wyoming: U.S. Geological Survey Water-Resources Investigations Report.

Weiss, E. J., 1986, Ground-water flow in the Navajo Sandstone in parts of Emery, Grand, Carbon, Wayne, Garfield, and Kane Counties, southeast Utah: U.S. Geological Survey Water-Resources Investigations Report 86-4012.

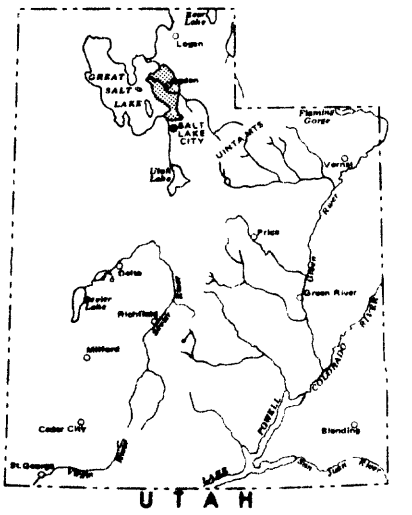
Weiss, E. J., [ed.], (in preparation), Summary of ground-water flow modeling for the Upper Colorado River Basin Regional Aquifer-Systems Analysis: U.S. Geological Survey Professional Paper.

GROUND-WATER HYDROLOGY OF THE EAST SHORE AREA

Number: UT 83-162

Cooperating Agency: Utah Division of Water Rights

Staff: D. W. Clark, Hydrologist, Project Chief
C. L. Appel, Hydrologist (part time)
G. G. Plantz, Hydrologic Technician
P. M. Lambert, Hydrologist
R. L. Puryear, Hydrologic Field Assistant (part time)



Period of Project: July 1983 to June 1986

Objectives: (1) To assess current conditions in terms of recharge, movement, and discharge of ground water, water levels, ground-water quality, and volumes of water in storage. (2) To increase knowledge and understanding of the ground-water system of the East Shore area and how it functions. (3) To construct a digital-computer model of the system that can simulate past and current conditions in the area and possible effects of changes in discharge and recharge.

Approach: (1) Update well data, including water-level and water-quality data, and put them in computer storage. (2) Conduct a comprehensive inventory of ground-water discharge, including that from wells; to drains, and streams; by evapotranspiration by phreatophytes; and to Great Salt Lake. (3) Estimate recharge, where feasible, from streams, irrigation, precipitation, and by subsurface flow from consolidated rock. (4) Conduct aquifer tests to add to knowledge on hydraulic characteristics of the basin fill. (5) Construct three-dimensional digital models covering the area to simulate ground-water flow and effects of changes in the system. (6) Prepare basic-data and model reports, and an interpretive report for publication by the Utah Department of Natural Resources.

Progress: Continued monthly water-level measurements in about 50 wells through September 1985. Measured or estimated discharge from about 250 flowing wells. Conducted seepage studies on several small streams to determine ground-water recharge. Remeasured discharge from a series of selected drains. Completed the basic-data report and the final interpretive report including a section on the construction and application of a three-dimensional numerical ground-water model.

Plans for next year: Complete the report on the ground-water model of the Bountiful area. Interpret the geophysical data from the Great Salt Lake seismic study and prepare an open-file report.

Reports:

Plantz, G. G., Appel, C. L., Clark, D. W., Lambert, P. M., and Puryear, R. L., 1986, Selected hydrologic data from wells in the East Shore area of the Great Salt Lake, Utah, 1985: U.S. Geological Survey Open-File Report 86-139 and Utah Hydrologic-Data report No. 45.

Clark, D. W., Appel, C. L., Lambert, P. M., and Puryear, R. L., (in review), Ground-water resources of the East Shore area of the Great Salt Lake, Utah, and simulated effects of ground-water withdrawals: Utah Department of Natural Resources Technical Publication.

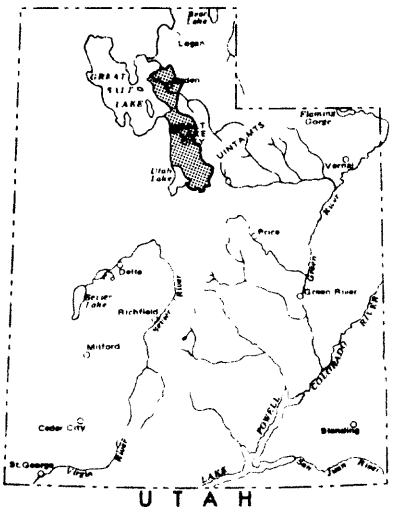
Clark, D. W., (in preparation), The ground-water system and simulated effects of ground-water withdrawals in the Bountiful area, Davis County, Utah.

Lambert, P. M., (in preparation), Seismic-reflection survey of the basin fill under Great Salt Lake east of Antelope and Fremont Islands: U.S. Geological Survey Water-Resources Investigations Report.

FLOOD CHARACTERISTICS OF URBAN WATERSHEDS

Number: UT 84-165

Cooperating Agency: Utah Department of Transportation



Staff: K. L. Lindskov, Hydrologist, Project Chief (part time)
K. R. Thompson, Hydrologist, (part time)
G. G. Plantz, Hydrologic Technician (part time)
M. L. Palmer, Hydrologic Technician (part time)
G. Herbold, Hydrologic Technician (part time)
Other District personnel as assigned

Period of Project: July 1984 to September 1987

Objectives: (1) Obtain hydrologic data for 12 representative urban watersheds to define frequency relations of peak flow and volumes of flood flow. The results will be used to determine the impacts of urban development on floods along the Wasatch Front (Salt Lake, Davis, and parts of Utah and Weber Counties). (2) Develop methods for determining peak flow and volumes of flood flow for selected recurrence intervals for ungaged urban watersheds. (3) Document increases or decreases in peak flow between the canyon mouth and the stream mouth for major streams that receive most of their flow from mountain snowmelt, flow through the urban areas, and are tributary to the Jordan River, Utah Lake, and the Great Salt Lake. This will provide methods for estimating snowmelt runoff combined with the thunderstorm runoff contributed by the areas between the canyon mouth and the stream mouth.

Approach: Floodflow and rainfall data will be obtained at sites in 12 representative urban watersheds for 3 years. The data for about 20 storms will be used to calibrate an urban rainfall-runoff model for each site. The model will be used, along with synthetic rainfall data, to compute peak flow of selected frequencies. After the data collection and computation of peak flows are complete, various techniques will be investigated for transferring the information from gaged to ungaged sites. One possible method would be to relate peak flows to basin and climatic characteristics using multiple-regression techniques. Case histories will be compiled by comparing peak flow at canyon mouths with peak flow at points where selected larger streams empty into the Jordan River, Utah Lake, and the Great Salt Lake. This will enable modification of the snowmelt peak flow as measured at the canyon mouth.

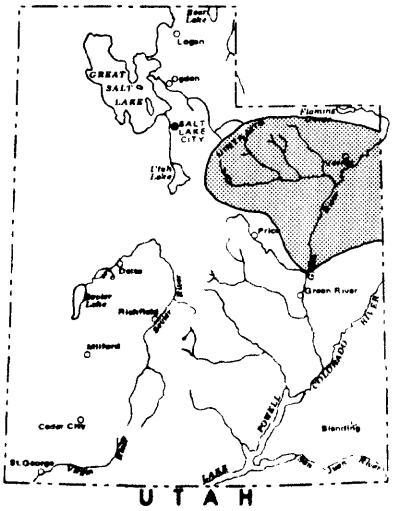
Progress: Data collection continued at eleven watersheds that were selected and instrumented in 1984 to record runoff and rainfall. Data for the 1984 and 1985 water years have been filed for input to a rainfall-runoff model. A hydrograph model was calibrated and tested for one watershed and preliminary work was completed for the modeling effort for the other watersheds.

Plans for Next Year: Through September, maintain the 12 urban-stream sites that have been instrumented for measuring flood runoff, review the records monthly, and process the data for input to a rainfall-runoff model. Determine basin characteristics and urban-development factors for urban watersheds. Complete calibration of an urban-rainfall-runoff model for each of 11 watersheds. Compute flood-frequency relations for each of the 11 watersheds using results from the calibrated models coupled with synthetic rainfall data for selected frequencies. Develop relations between peak flows of selected frequencies and basin characteristics probably by using multiple-regression techniques. Complete a draft of the report summarizing the results of the modeling, computation of flood-frequency relations for the 11 watersheds and development of relations for estimating peak flow of selected frequencies for ungaged water sheds.

Reports: None.

DEPTH TO BASE OF MODERATELY SALINE GROUND WATER, UINTA BASIN

Number: UT 84-166



Cooperating Agency: Utah Division of Oil, Gas, and Mining

Staff: L. W. Howells, Hydrologist, Project Chief
M. S. Longson, Hydrologic Technician (part time)

Period of Project: April 1984 to June 1986

Objectives: To determine the depth to the base of ground water containing 10,000 milligrams per liter or less of dissolved solids in the Uinta Basin; to portray the depth on maps (northern and southern Uinta Basin); and to prepare a report including the two maps, tables of ground-water data used in preparing the maps, a discussion of how the maps were prepared, and a brief summary of the basin's hydrogeology. This will aid the State in determining criteria to protect ground water from contamination during exploration for and production of oil and gas.

Approach: The files of the Utah Division of Oil, Gas, and Mining, Utah Division of Water Rights, U.S. Geological Survey, Bureau of Land Management, and oil companies will be searched to locate data on ground-water quality, borehole-geophysical logs that could be interpreted to indicate ground-water quality, and geologic information related to hydrogeology. A map of the Greater Altamont-Bluebell oil-field will be prepared first to develop techniques. Empirical relations between water quality and formation resistivity (from resistivity logs) will be developed. Maps showing contours of the depth to the base of water with 10,000 milligrams per liter or less of dissolved solids will be prepared using water samples, empirical relations between resistivity and water quality, theoretical determination of water quality from resistivity data, and geologic information. Cross sections will be prepared from the maps to illustrate complex changes in water quality.

Progress: Analyses of selected geophysical well logs from the Greater Altamont-Bluebell oil field, as well as the rest of the Uinta Basin, have been completed. Maps showing the altitude of the base of moderately saline water have been prepared. The report is in preparation.

Plans for Next Year: Completion and publication of the report.

Reports:

Howells, Lewis, Longson, M. S. and Hunt, G. L., (in review), The base of moderately saline water in the Uinta Basin, Utah: Utah Department of Natural Resources Technical Publication.

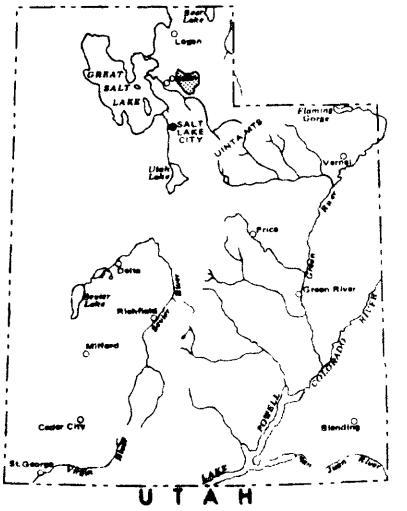
WATER RESOURCES OF OGDEN VALLEY, WEBER COUNTY, WITH EMPHASIS ON GROUND WATER

Number: UT-84-167

Cooperating Agency: Utah Division of Water Rights

Staff: Charles Avery, Hydrologist, Project Chief
Other District personnel as assigned

Period of Project: July 1984 to June 1987



Objectives: Assess current conditions in Ogden Valley in terms of recharge, movement, and discharge of ground water, surface-water and ground-water relationships, ground water in storage, and general water quality. Gain a better understanding of the hydrologic system and its operation, and estimate the effects of potential changes in discharge from the ground-water reservoir. Conduct a reconnaissance of ground-water occurrence in the drainage basin upstream from Ogden Valley.

Approach: Conduct a well and spring inventory in Ogden Valley, including collection of water-level, discharge and specific-capacity, and water-quality data. Inventory wells and major springs, and determine the general occurrence of ground water in the upstream drainage basin. This information will be placed in the WATSTORE data base. Conduct a survey of ground-water discharge in Ogden Valley, including that from wells, springs, base flow in streams, and evapotranspiration by phreatophytes. Also estimate by various methods the discharge from the artesian aquifer to Pineview Reservoir, and attempt to estimate the effects of stage changes in the reservoir on this discharge. Estimate recharge to Ogden Valley, where possible, including that from streams, irrigation, precipitation, and subsurface flow from consolidated rocks bounding the valley. Establish an observation-well network, including wells near surface-water bodies. Use surface geophysics to map the base of the valley fill. Conduct aquifer tests to more precisely determine the hydraulic characteristics of the valley fill. Construct a digital-computer model of the valley to help understand ground-water flow and effects of changes in the system.

Progress: Periodic data collection was continued. A seepage study of the Ogden Valley canal was conducted as part of the canal-loss studies under project UT-001. Seepage studies were also made on a number of smaller ditches and canals. Mass measurements of the yearly high ground-water levels were made during the late spring-early summer of 1985 and 1986. Distribution of

phreatophytes was mapped from high-altitude infrared photographs. Five short-term aquifer tests were conducted at domestic wells and a six-day aquifer test was conducted in the Ogden City well field. Water from twenty-five wells and six springs was sampled for chemical analysis. An electrical-resistivity survey of 35 soundings was conducted. Steady-state calibration of the computer model was obtained.

Plans for next year: Measurement of seepage from the ground-water system to Pineview Reservoir will be made using seepage meters placed on the bottom of the reservoir. Calibration of transient conditions of the computer model will be completed. Simulation of the effect on the hydrologic system of possible variations in recharge due to climatic variations will be made by the computer model. The report of the results of this study will be written and reviewed.

Reports:

Herbert, L. R., Cruff, R. W., Clark, D. W., and Avery, Charles, (in review), Seepage study of the Weber River and the Davis-Weber and Ogden Valley Canals, Davis and Weber Counties: Utah Department of Natural Resources Technical Publication.

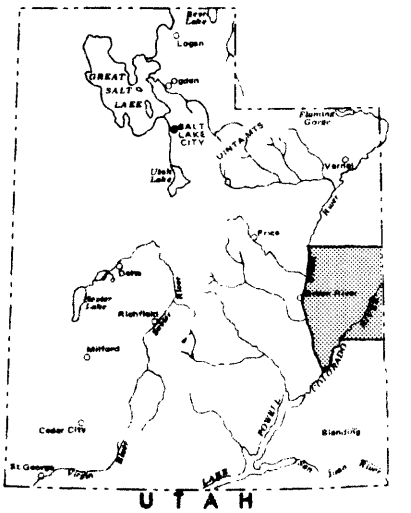
GROUND-WATER CONDITIONS IN GRAND COUNTY AND NORTHWESTERN SAN JUAN COUNTY, WITH EMPHASIS ON THE ENTRADA, NAVAJO, AND WINGATE SANDSTONES

Number: UT 84-168

Cooperating Agency: Utah Division of Water Rights

Staff: P. J. Blanchard, Hydrologist, Project Chief
Other District personnel as assigned

Period of Project: July 1984 to June 1987



Objectives: (1) To increase knowledge and understanding of the ground-water system(s) in Grand County, including areas and rates of recharge, movement, and areas and rates of discharge. (2) To determine the hydrologic characteristics of the aquifers. (3) To determine the chemical quality of ground water. (4) To estimate the hydrologic effects of increased development of energy resources and related withdrawals of ground water. The upland areas of northern Grand County (Book and Roan Cliffs) will be investigated in less detail than the lower areas in southern Grand County.

Approach: (1) Inventory wells, springs, and exploration holes and enter data into computer storage. Wells and springs in the Entrada-Navajo-Wingate sequence will have first priority. (2) Estimate recharge to the ground-water system(s) from precipitation, streams, and interformational movement. (3) Prepare potentiometric-surface maps to help define ground-water movement. (4) Estimate discharge from the ground-water system(s) by wells, springs, evapotranspiration, seepage to streams, and by interformational movement. (5) Determine aquifer characteristics from aquifer tests and laboratory analysis of shallow-core and outcrop samples. (6) Estimate the amount of usable water in storage based on aquifer-thickness data from well logs and estimates of saturated thickness from measured water levels in wells. (7) Determine the chemical quality of ground water by analyzing water samples from wells and springs, and attempt to identify the sources of constituents in the water. Investigate natural contamination of fresh ground water by saline ground water from the Paradox Formation. (8) Attempt to determine (a) the hydrologic effects of increased energy-resource extraction, and (b) the effects of related ground-water withdrawals on the quantity and quality of ground water. (9) Construct a digital model of the area or parts of the area, if the data base is adequate and modeling is judged to be feasible, to simulate past and current water levels and predict future water-level changes. (10) Drill one to three test holes in areas where data are deficient, if funds are available; or reenter abandoned oil-tests to obtain water-level and water-quality data.

Progress: Oil-test holes have been inventoried to determine the feasibility of re-entry to obtain additional hydrologic information. None were found for which re-entry was economically and technically feasible. Well and spring inventory has continued and is near completion. A seepage study was conducted on Mill Creek and its tributaries. An eight-day aquifer test was conducted in the City of Moab well field.

Plans for next year: Complete well and spring inventory. Analyze collected data, prepare report.

Reports:

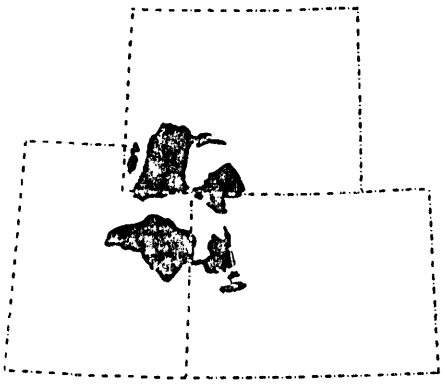
Blanchard, P. J., (in preparation), Ground-water conditions in Grand County and parts of northern San Juan County, Utah, with emphasis on the Entrada, Navajo, and Wingate Sandstones: Utah Department of Natural Resources Technical Publication.

SUMMARY OF THE GEOLOGICAL SURVEY'S OIL-SHALE HYDROLOGY PROGRAM IN COLORADO, UTAH, AND WYOMING

Number: UT 85-169

Staff: Don Price, Hydrologist,
Project Chief

Period of Project: October 1984 to September 1986



Objective: To highlight significant results of hydrologic studies under the Geological Survey's oil-shale hydrology program in generally nontechnical language.

Approach: Compile a draft of a report utilizing contributions from personnel in the Colorado, Utah, and Wyoming Districts. The project chief is responsible for (1) compiling several sections of the report, including sections dealing with the physical setting and water resources of the southeastern Uinta Basin oil-shale area; (2) coordination of the preparation of sections dealing with the physical setting and water resources of the adjacent oil-shale areas in Colorado and Wyoming from coauthors in the Colorado and Wyoming Districts; and (3) assembling, editing, and processing the report. The report will be compiled and assembled during Fiscal Year 1985. Review, revision, and other processing will be done during Fiscal Year 1986.

Progress: The manuscript was completed, received technical review, and was revised in response to the reviewers' comments.

Plans for Next Year: After an editorial review, submit the manuscript for approval as a U.S. Geological Survey Professional Paper.

Reports:

Price, Don, Ellis, S. R., and Wilson, J. F., Jr., (in review), Water for an oil-shale industry--summary of the U.S. Geological Survey's hydrologic-study program for the major oil-shale areas of Colorado, Utah, and Wyoming, 1974-86: U.S. Geological Survey Professional Paper.

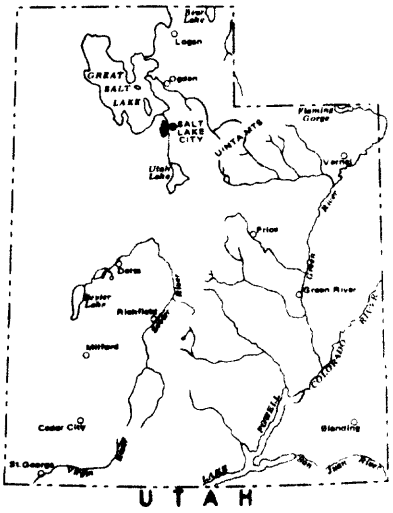
RECONNAISSANCE OF DECKER LAKE, SALT LAKE COUNTY

Number: UT 85-170

Cooperating Agency: Salt Lake County Division of Flood Control and Water Quality

Staff: D. W. Stephens, Hydrologist, Project Chief (part time)
K. R. Thompson, Hydrologist (part time)
J. B. Wangsgard, Hydrologic Technician (part time)

Period of Project: April 1985 to September 1986



Objectives: Quantify the range of nonstorm inflows, outflow, and water quality of Decker Lake. Quantify the range of storm inflows and outflow and effects of storm loads of nutrients, metals, and sediment on the lake's water quality.

Approach: Inflow and discharge will be measured whenever water-quality samples are collected. This will include nonstorm and storm samples at four inflow points and the outflow channel. Nonstorm samples will be collected monthly from May through September. Samples from five storms will be collected as flow-weighted composites from the inflow points and the outflow channel and a point sample from the lake. Analyses will be made of major trace metals, hardness, nitrogen and phosphorus species, oil and grease, and suspended sediment. Samples for bacterial enumeration will be collected for processing by the Salt Lake City-County Health Dept. During July, pesticide analyses and a gas-chromatograph/flame-ionization detector scan for toxic organic compounds will be done on several water samples. Sediment cores will be used in laboratory experiments to determine leaching rates for various trace metals and nutrients.

Progress: All sample collection has been completed. Initial data analysis indicates large quantities of trace metals and solids in the inflow with a substantial reduction in suspended material as it flows through the lake. Retention time for the major inflow (Ridgeland Canal) is typically less than 5 hours. The reconnaissance water-analysis and sediment-sample data did not indicate significant quantities of hazardous organic compounds. Sediment accumulation since the completion of the facility in 1969 has been 26,000 cubic yards in the east pond and 70,000 cubic yards in the west pond.

Plans for next year: None.

Reports:

Stephens, D. W., (in preparation), Sediments and water quality in Decker Lake storm-water retention pond: U.S. Geological Survey Water-Resources Investigations Report.

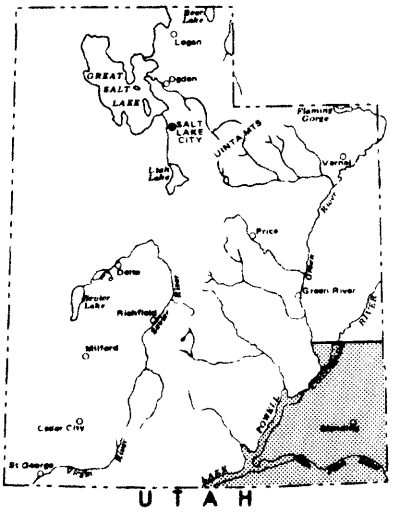
DEPTH TO BASE OF MODERATELY SALINE GROUND WATER, SAN JUAN COUNTY

Number: UT 84-171

Cooperating Agency: Utah Division of Oil, Gas, and Mining

Staff: L. W. Howells, Hydrologist, Project Chief
S. J. Nelson, Hydrologic Technician (part time)
J. C. Nellis, Hydrologic Technician (part time)

Period of Project: February 1985 to March 1987



Objectives: To determine the depth to the base of ground water containing 10,000 milligrams per liter or less of dissolved solids in San Juan County; to portray the depth on a map or maps; and to prepare a report including the map(s), tables of ground-water data used in preparing the map(s), a discussion of how the map(s) were prepared, and a brief summary of the county's hydrogeology. This will aid the State in determining criteria to protect ground water from contamination during exploration for and production of oil and gas.

Approach: The files of the Utah Division of Oil, Gas, and Mining, Utah Division of Water Rights, U.S. Geological Survey, Bureau of Land Management, and oil companies will be searched to locate data on ground-water quality, borehole-geophysical logs that could be interpreted to indicate ground-water quality, and geologic information related to hydrogeology. Empirical relations between water quality and formation resistivity (from resistivity logs) will be developed. Maps showing contours of the depth to the base of water with 10,000 milligrams per liter or less of dissolved solids will be prepared using water samples, empirical relations between resistivity and water quality, theoretical determination of water quality from resistivity data, and geologic information. Cross sections will be prepared from the maps to illustrate horizontal changes in water quality.

Progress: Collection of file data has been completed. More than half of the data has been compiled and entered into a computer-data file. Interpretation of geophysical well logs has begun.

Plans for Next Year: Complete the compilation of data and add them to the computer files. Complete interpretation of geophysical well logs and preparation of map(s) showing depth to base of moderately saline water. Prepare report.

Reports: None.

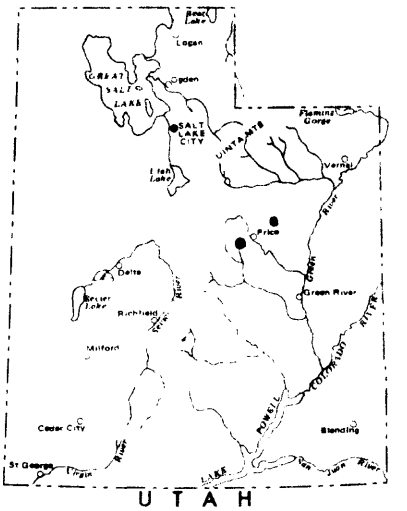
HYDROLOGIC EVALUATION OF THE CASTLE VALLEY RIDGE AND ALKALI CREEK COAL-LEASE AREAS

Number: UT 85-173

Cooperating Agency: U.S. Bureau of Land Management

Staff: R. L. Seiler, Hydrologist, Project Chief (part time)
R. L. Baskin, Hydrologic Technician (part time)

Period of Project: March 1985 to January 1987



Objectives: In order to allow the U.S. Bureau of Land Management to evaluate hydrologic conditions for an environmental-impact statement for the Castle Valley Ridge and Alkali Creek coal-lease areas, the following objectives have been defined: (1) Determine aquifer characteristics, the degree of aquifer-stream interconnection, areas and types of recharge and discharge (including spring discharge and its variability), ground-water movement (including influences of geologic structure on movement), and ground-water quality and storage. (2) Determine the pre-mining variability in quantity and quality of streamflow and sediment loads. (3) Estimate potential effects of proposed coal mining on the hydrologic system.

Approach: The hydrologic system of the two areas will be defined using information from previous studies supplemented with site-specific data collected through September 1986. Information obtained will include data on quantity and quality of spring discharge and streamflow, water levels in and aquifer tests of wells, discharges of nearby mines, geologic features such as faults and fracturing, and evapotranspiration along stream channels. Most springs and wells will be inventoried. Two sets of base-flow measurements will be obtained on all perennial streams to determine losing and gaining reaches. Periodic water-quality and suspended-sediment samples will be obtained for laboratory analysis. Pre-mining quantity and quality of streamflow and ground-water movement and quality will be documented for possible postmining comparison studies.

Progress: Field inventory and collection of data on water quality, sediment, and stream and spring discharge were completed. Data were tabulated and copies of the tables of chemical analyses were provided to the Bureau of Land Management. Aquifer data from test wells on Castle Valley Ridge were collected and analyzed.

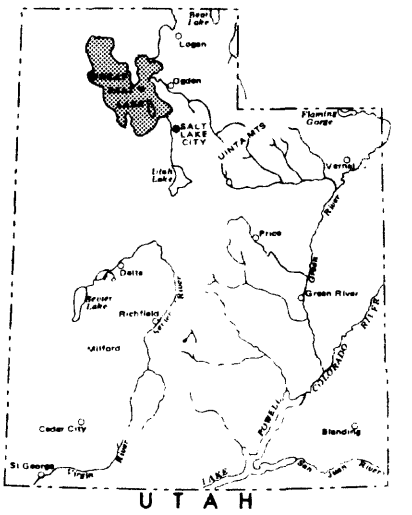
Plans for Next Year: Complete collection of aquifer data from Alkali Creek test drilling. Complete report.

Reports:

Seiler, R. L., and Baskin, R. L., (in preparation), Hydrology of Alkali Creek and Castle Valley Ridge coal-resource areas, Central Utah: U.S. Geological Survey Water-Resources Investigations Report.

HYDROLOGIC ATLAS OF THE GREAT SALT LAKE

Number: UT 85-174



Staff: Ted Arnow, Hydrologist, Project Chief (part time)
D. W. Stephens, Hydrologist (part time)

Period of Project: April 1985 to September 1986

Objective: To describe the water-level and water-quality fluctuations of Great Salt Lake from 1847 to the present and to discuss natural and man-related causes of the changes.

Approach: Prepare a Hydrologic Atlas describing and illustrating the changes in the lake since 1847.

Progress: A draft report has been completed and is awaiting the final update using the 1986 peak of 4211.85 feet. Most illustrations are in final form.

Plans for next year: None

Report:

Arnow, Ted, and Stephens, D. W., (in review), Hydrologic atlas of Great Salt Lake: U.S. Geological Survey Hydrologic Investigations Atlas.

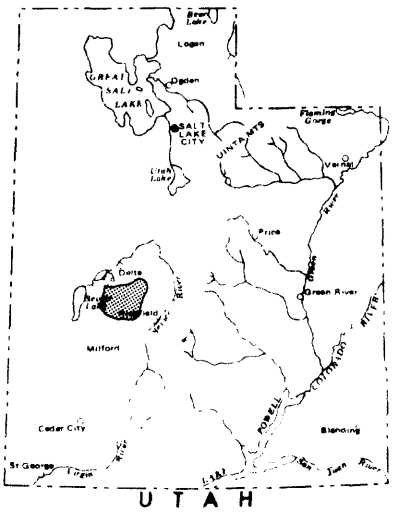
GROUND-WATER HYDROLOGY OF PARVANT VALLEY AND ADJACENT AREAS

Number: UT-85-175

Cooperating Agency: Utah Division of Water Rights

Staff: W. F. Holmes, Hydrologist, Project Chief
M. Enright, Hydrologic Technician
S. A. Thiros, Hydrologist (part time)

Period of Project: July 1985 to June 1988



Objectives: (1) Improve understanding of the ground-water system and how it functions, including directions of movement, aquifer coefficients, locations and amounts of recharge and discharge, ground-water quality, and amount of water in storage. (2) Provide an assessment of the current state of the ground-water system by determining the changes in water levels and water quality due to increased withdrawals for irrigation, changes in the amounts and locations of recharge and discharge, and recirculation of ground water pumped for irrigation. (3) Project the effects of continued large ground-water withdrawals on water levels and water quality.

Approach: (1) Input existing ground-water data into computer storage. (2) Collect data on discharge of ground water from wells, springs, drains, and to streams, and estimate discharge by phreatophytes and subsurface outflow. (3) Estimate recharge from streams, unconsumed irrigation water, precipitation, and subsurface inflow from consolidated rocks. (4) Determine the relationship between ground-water withdrawals and increasing concentrations of dissolved solids. (5) Conduct aquifer tests and reanalyze data from past tests. (6) Construct a three-dimensional digital model to provide a method of evaluating the components of the flow system and their interactions and to simulate past and present ground-water flow conditions. (7) Project the effects of potential changes in recharge and discharge on the various components of the system using the ground-water model. (8) Prepare a basic-data report for release to the open file, an interpretive report for publication by the Utah Department of Natural Resources, and document the ground-water model in an open-file report.

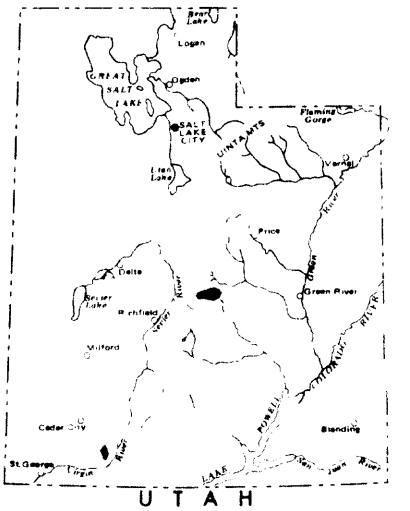
Progress: A planning document was prepared. Existing data have been assembled and computer storage of data has started. A water-level monitoring network has been established. Water-quality samples have been collected from about 50 ground-water sites. A dye study in the basalt aquifer was started. Design and calibration of a steady-state ground-water model was begun. Water levels in and discharge of several hundred wells were measured in March 1986.

Plans for next year: Continue to compile data and enter them into computer storage. Continue to collect data on water levels, water quality, and ground-water recharge and discharge. Complete steady-state and transient calibration of the ground-water model. Begin work on basic-data report.

Reports: None

HYDROLOGIC EVALUATION OF THE QUITCHUPAH, PINES, AND L. C. HOLDING COAL-LEASE AREAS

Number: UT 85-176



Cooperating Agency: U.S. Bureau of Land Management

Staff: R. L. Seiler, Hydrologist, Project Chief (part time)
B. J. Stolp, Hydrologist (part time)

Period of Project: October 1985 to September 1987

Objectives: Characterize the pre-mining aspects of the local hydrology of two coal-lease areas which have been designated by the Bureau of Land Management as priority areas in their coal-leasing program. Resulting data and evaluations will be used in environmental-impact statements. Aspects of hydrology to be included are: (1) Average streamflow, variability in flow, quality, and fluvial-sediment production. (2) Geologic units and their water-bearing characteristics and identification of geologic structure that may influence hydrology; and, in the L. C. Holding lease, general stability of local geologic units in relation to sediment production, road construction, and mining. (3) Recharge, movement, and discharge of ground water; ground-water quality; and ground water in storage. (4) Potential effects on the pre-mining hydrologic system of coal mining in and near the coal-lease areas. In the L. C. Holding lease area, this will include (a) potential post-mining fluvial-sediment production, (b) stability of geologic units during road construction and of overburden during underground coal-mining (to evaluate the potential for land subsidence), (c) potential effects on the downstream surface-water habitat of the woundfin minnow, and (d) potential effects on the hydrology of alluvial valleys and flood plains if they or underlying aquifers are disrupted by mining.

Approach: (1) Measure streamflow in and near the lease areas periodically and correlate flow with that for nearby gaging stations. Estimate average and peak flows using regression relations developed in prior Bureau of Land Management-U.S. Geological Survey studies. Sample streamflow for chemical analysis and periodically for suspended-sediment concentration. (2) Field evaluation of water-bearing characteristics of geologic units and hydrologic effects of geologic structure (supplementing available geologic maps with limited field investigations). Test holes will be drilled and tested in each of the three lease areas if funds and suitable test locations are available. Tests will include determining the water level in each hole, taking a water sample, and attempting to determine hydraulic conductivity of the aquifers. In the L. C. Holding lease area, map the extent of underlying alluvial

aquifers. Obtain data on stability of geologic units, especially those above the coal beds. Obtain consulting help from Geologic Division on stability of geologic units. (3) Identify sources of ground-water recharge, and points or areas of discharge. Make seepage studies on streams to identify areas of ground-water recharge and discharge. Make a complete inventory of springs and wells in and near the lease areas. Use available ground-water-level data to estimate direction of movement. Obtain hydrologic data from nearby existing coal mines in hydrologically similar areas. Sample water from springs and wells for chemical analysis. Estimate saturated thickness of geologic units and the volume of ground-water in storage. (4) Using available hydrologic, mine-plan, mine-production, and mining-method data, make qualitative estimates of the potential hydrologic effects of mining.

Progress: Literature search for data from and studies of the L. C. Holding area has been completed and field data collection is underway. Literature search and compilation of available data for the Quitchupah-Pines area has begun and collection of field data will begin soon.

Plans for Next Year: Complete data collection, including a complete spring and well inventory and seepage studies on selected stream reaches, and determine if test drilling is feasible.

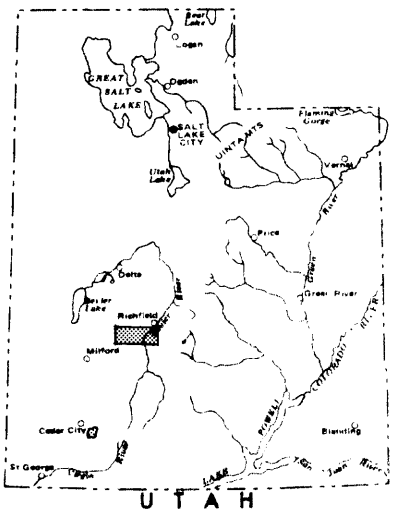
Reports: None.

HYDROLOGY OF THE PAIUTE INDIAN RESERVATION LANDS, SOUTHWESTERN UTAH

Number: UT 86-178

Staff: D. W. Stephens, Hydrologist, Project Chief (part time)

Period of Project: April 1986 to September 1987



Objectives: To inventory the water resources of the five parcels of land in the new Paiute Indian Reservation in terms of the occurrence and availability of surface and ground water. This inventory will include: (1) determination of surface-water resources, if any, in the area, including average annual streamflow, variability in flow, and the potential for production of fluvial sediment; (2) quality of surface water and its variability; (3) geologic units present and their water-bearing characteristics, and identification of geologic structure that may influence local hydrology; (4) recharge, movement, and discharge of ground water; and ground water in storage; and (5) ground-water quality.

Approach: The study will be done using the following techniques and collecting the following data: (1) periodically measure streamflow in and near the parcels of land and correlate flow with that of nearby gaging stations, if possible. Estimate average and peak flows using established equations. Measurements of channel geometry may be used to estimate streamflow characteristics. Sample surface water for chemical analysis and determination of suspended-sediment concentrations. (2) Limited field evaluation of water-bearing characteristics of geologic units and hydrologic effects of geologic structure (to supplement available geologic maps). (3) Identify sources of ground-water recharge, direction of ground-water movement, and points or areas of discharge. Make seepage studies of streams to identify areas of ground-water recharge and discharge if perennial stream reaches exist and are suitable for measurement. Make a complete inventory of springs and wells in and near the five parcels of land. Use ground-water levels to estimate direction of movement. Sample water from springs and wells for chemical analysis. Estimate saturated thickness of geologic units and the volume of ground water in storage. (4) Identify areas where ground or surface water could be developed for use.

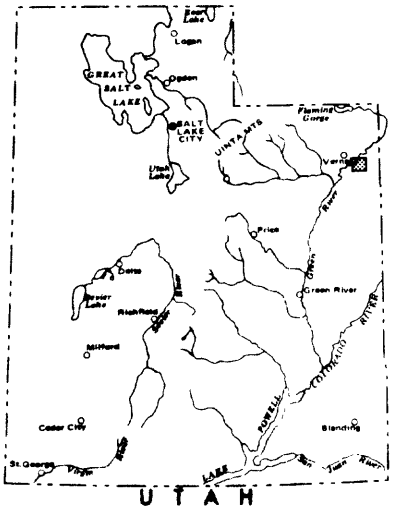
Progress: Reservation land parcels were located, and literature on springs and geothermal resources has been searched.

Plans for next year: Complete data collection and write report.

Reports: None.

IRRIGATION-DRAINAGE PROBLEMS AT STEWART LAKE WATERFOWL-MANAGEMENT AREA

Number: UT 86-179



Cooperating Agencies: U.S. Bureau of Reclamation
U.S. Fish and Wildlife Service

Staff: D. W. Stephens, Hydrologist, Project Chief (part time)
Bruce Waddell, U.S. Fish and Wildlife Service (part time)
Jerry Miller, U.S. Bureau of Reclamation (part time)
J. F. Weigel, Hydrologist (part time)

Period of Project: April 1986 to September 1987

Objectives: Determine if concentrations of trace elements or pesticides derived from inflow of irrigation-drainage water to the Stewart Lake area are sufficiently large in the area's water, sediments, or biota to adversely affect the health of humans, fish, and other wildlife, and other water uses.

Approach: Water samples will be collected during early and late irrigation seasons on all inflows to the lake. The outflow and adjacent Ashley Creek will be sampled, and possibly waterfowl, fish, and sediment samples from the Green River will be collected in late August. All samples will be analyzed for most trace metals and pesticides which may be used in the immediate area.

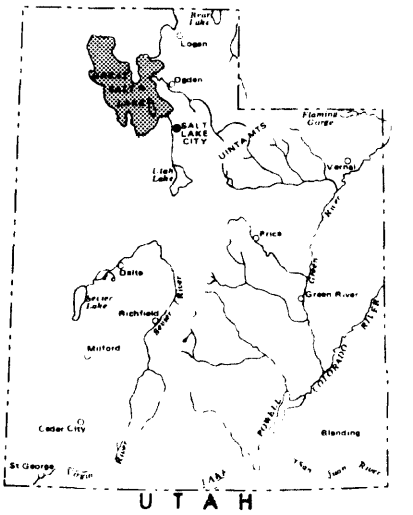
Progress: Initial water samples were collected and a general reconnaissance of all drains in the area was completed in June 1986.

Plans for next year: Complete water, sediment, and biota sampling, assemble and interpret data, and write report.

Reports: None.

PROPOSED PROJECTS

A. MODEL FOR PREDICTING THE WATER AND SALT BALANCE OF GREAT SALT LAKE FOR SELECTED LAKE LEVELS



Cooperating agency: Utah Division of State Lands and Forestry

Staff: K. M. Waddell, Hydrologist, Project Chief
D. W. Stephens, Hydrologist (part time)
G. Herbold, Hydrologic Technician (part time)

Period of Project: January 1986 to December 1987

Problem: Waddell and Bolke (1973) developed a model for predicting the water and salt balance for Great Salt Lake. The model was used by State agencies to determine the effects of different widths of culverts through the railroad causeway dividing the lake on the difference in elevation of the lake north and south of the causeway. The model also was used to design a breach that was cut through the causeway in 1984 to alleviate flooding along the shores of the south part of the lake. The model was used extensively during the 1970's by State agencies as well as salt companies to determine the effects of causeway modifications on the salt balance between the two parts of the lake. Because of (1) the high lake levels (which submerged the culverts through the causeway) during the 1980's, and (2) modifications of the causeway which affected its brine-conveyance properties, the model no longer meets the constraints defined by Waddell and Bolke. Since development of the model, considerable data have been collected that can be used to partially verify and or modify the model for the higher lake levels and the affected brine-conveyance properties of the causeway.

Objectives: To update the model so that it can be used to predict the water and salt balance between the north and south parts of the lake for variable amounts of freshwater inflow. An attempt will be made to incorporate in the model variation of stratification in the south part of the lake.

Approach: The equations used for the causeway breach will be taken from Holley and Waddell (1976) and new equations for stratified flows through the submerged culverts will be developed. The causeway fill flows will be updated by adapting either the Sutra transport model (Voss, 1984), two-constituent solute-transport model (Sanford and Konikow, 1985), or the salt-water interface model of Pinder and Cooper (1970). To calibrate the fill-flow model it will be necessary to estimate flow through the causeway fill indirectly by setting that flow as the unknown variable, and calculating the values using the equations which describe the water and salt balance for the north and south parts of the lake.

Data collected by the Utah Geological and Mineral Survey indicate the deep stratified layer in the south part of the lake remained relatively stable during 1962-83 but began to change when the causeway was breached in 1984. Determining the effects of different variables on stratification patterns will begin by plotting time trends of density for each sampling section and then contrasting the trends for other parameters that affect the water and salt balance of the lake.

Plans for next year: Compile data on flow through the breach and determine whether existing equations describe flow. Compile data on temporal variation in stratification in the south part. Prepare table of lake elevation, area, and volume. Select causeway-fill flow model and calibrate it. Compute salt loads using data from samples collected by the Utah Geological and Mineral Survey.

References cited:

Holley, E. R., and Waddell, K. M., 1976, Stratified flow in Great Salt Lake culvert: Journal of the Hydraulics Division, American Society of Civil Engineers, v. 102, no. HY7, Proceedings Paper 12250, July 1976, p. 969-985.

Pinder, G. F., and Cooper, H. H., Jr., 1970, A numerical technique for calculating the transient position of the saltwater front: Water Resources Research, v. 6, no. 3, p. 875-882.

Sanford, W. E., and Konikow, L. F., 1985, A two-constituent solute-transport model for ground water having variable density: U.S. Geological Survey Water-Resources Investigations Report 85-4279.

Voss, C. I., 1984, A finite-element simulation model for saturated-unsaturated, fluid-density-dependent ground-water flow with energy transport or chemically-reactive single-species solute transport: U.S. Geological Survey Water-Resources Investigations Report 84-4369.

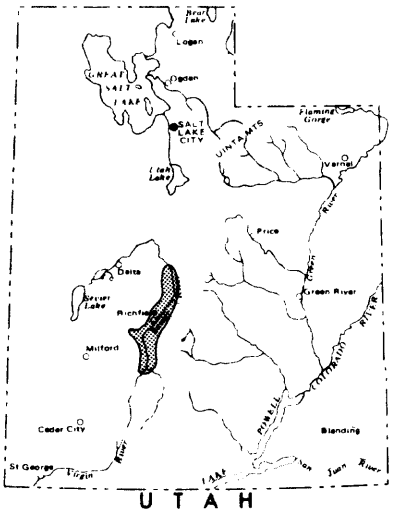
Waddell, K. M., and Bolke, E. L., 1973, The effects of restricted circulation on the salt balance of Great Salt Lake, Utah: Utah Geological and Mineral Survey Water-Resources Bulletin 18.

B. EFFECTS OF IRRIGATION AND NATURAL SOURCES OF SALT ON SURFACE- AND GROUND-WATER QUALITY IN THE CENTRAL SEVIER VALLEY

Cooperating Agency: Utah Division of Water Rights

Staff: D. W. Clark, Hydrologist, Project Chief
P. M. Lambert, Hydrologist

Period of Project: July 1986 to June 1990



Problem: The Sevier River is the most intensively used stream in Utah--by the time the river reaches its terminus at Sevier Lake, its water probably has been used for irrigation several times. Most of the diversions occur in the Central Sevier Valley; and, at least partly because of these diversions, the dissolved-solids concentration of the water at the lower end of this reach is from three to five times or more greater than that in the upper Sevier basin. However, the drainage of this reach also includes outcrops of salt-bearing rocks and probable occurrence of these same rocks directly under unconsolidated alluvium, which constitute natural sources of dissolved solids in the river.

State and local water-management agencies would like to know more about the hydrologic system of the Central Sevier Valley; relations between surface and ground water; and how both the use of water, most of which is for irrigation, and natural sources of dissolved solids affect surface- and ground-water quality. These agencies need this information to better manage the water resources of the entire Sevier River basin, and to determine what actions would affect the chemical quality of ground and surface water.

Objectives: To assess the current state of the hydrologic system of the Central Sevier Valley, in terms of surface-water flow, ground-water levels, and water quality. To quantify the hydrologic system in terms of surface-water runoff and ground-water recharge, movement and discharge, and to determine the relations between surface and ground water. To determine the factors that result in an increase in dissolved solids in surface and ground water along the valley. To estimate the effects of continued and increased ground-water withdrawals on the hydrologic system, including water quality.

Approach: Update our data on streamflow, ground-water levels, and surface- and ground-water quality. Refine previous estimates of ground-water recharge and discharge, especially recharge from irrigation and discharge by seepage to the Sevier River. Sample ground and surface water to define in detail the

changes which occur in water quality. Construct a digital model (or models) of the valley's ground- and surface-water system (or a representative part of the system) to define surface-water/ground-water relations. Construct a series of shallow wells near selected river reaches to determine quality of ground-water seepage to the river and to obtain the gradient from the aquifer to the stream. Conduct seepage studies during low flow combined with sampling to better define quality and quantity of inflow to the river. Analyze ground water for isotopes to help determine sources of recharge, and to differentiate recharge by irrigation, precipitation, and inflow from adjacent areas. Employ geochemical models (such as salt-routing models) in an attempt to quantitatively characterize changes in water quality. A solute-transport model of a representative section of the valley (or a cross-sectional transport model) may also be used to study changes in ground-water quality. Use the analytical techniques employed to further estimate the effects of continued and increased ground-water withdrawals on the hydrologic system, including water quality.

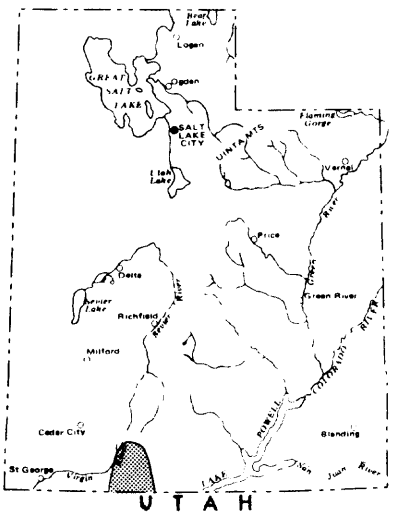
Plans for next year: Prepare planning document. Assemble well records and well logs; prepare base maps; compile surface-water flow and water-quality data. Begin fieldwork to include inventory of wells constructed since the previous study of the area, establish an observation-well network, and plan canal-loss studies. Begin recharge and discharge studies.

C. AVAILABILITY OF GROUND WATER IN THE ALTON COAL-FIELD, WESTERN KANE COUNTY

Cooperating Agency: Utah Division of Oil, Gas, and Mining

Staff: G. W. Freethey, Hydrologist, Project Chief

Period of Project: October 1986 to September 1987



Problem: Wells in the Navajo Sandstone are presently used as a water supply by rural residents of western Kane County for domestic use, irrigation, and stock-watering. Numerous perennial springs furnish water for wildlife in the area and for public supply in Fredonia, Arizona (about 4 miles south of the Arizona-Utah State line). Utah International, Inc., a coal mining company, has requested a water-use permit to withdraw approximately 6,000 gallons per minute for 33 years from the Navajo Sandstone to use to slurry coal for transport out of the area. Hydrologic data defining steady-state conditions are meager, and the conceptualization of the system documented in previous reports is questioned by Utah International. More data are being collected by the coal company in an effort to define more accurately the hydrologic system of the Navajo Sandstone and its enclosing rocks. This includes the hydrologic properties, thickness, and lateral extent of the tongue of Kayenta Formation that is interbedded with the Navajo.

Objectives: (1) To assist the Utah Division of Oil, Gas, and Mining in determining the most plausible concept of the hydrologic system in the Alton area (including hydrologic boundaries, the direction of ground-water flow, the hydrologic conditions along major and minor fault zones, the quantity and location of recharge to and discharge from the system, and the vertical connection between the upper and lower parts of the Navajo Sandstone that are separated by a tongue of the Kayenta Formation). (2) To specify the possible impacts that the relatively large proposed increase in ground-water withdrawal from the Navajo will have on the ground-water system.

Approach: The results of previous investigations and new information regarding aquifer properties, direction of ground-water flow, and the effect of faulting on ground-water movement will be reviewed and analyzed to determine the most plausible conceptualization of the ground-water system. An existing multi-layered ground-water flow model will be used to help evaluate this updated conceptualization, and to test model sensitivity to possible variations in recharge and discharge boundaries. Model sensitivity to

horizontal and vertical variability in the hydrologic properties of the Navajo Sandstone, the confining layers that form its upper and lower boundary, and the tongue of the Kayenta Formation that possibly divides the Navajo into upper and lower aquifer systems will also be examined.

Plans for next year: Use available data to define the components of the ground-water flow system. Use a three-dimensional ground-water flow model to help evaluate various flow-system concepts. Prepare a report summarizing the most likely concept of the flow system.

D. PREDICTING SCOUR AT BRIDGE CROSSINGS ON STREAMS IN UTAH

Cooperating Agency: Utah Department of Transportation

Staff: B. E. Thomas, Hydrologist, Project Chief
G. G. Plantz, Hydrologic Technician (part time)

Period of Project: October 1986 to December 1989

Problem: Predicting potential scour at bridges across streams is essential to proper design, construction, and maintenance of bridges in Utah. Several formulas for predicting scour are presently being used, but there is a large range in scour depths predicted when using different formulas--from zero to 30 feet for the same site. Thus, the Utah Department of Transportation needs improved methods for predicting scour depth when designing bridges.

Objectives: The objectives of the project are (1) to obtain flow and scour data during floods at selected sites, (2) to evaluate formulas presently being used to predict scour, and (3) possibly develop new formulas that apply to streams in Utah.

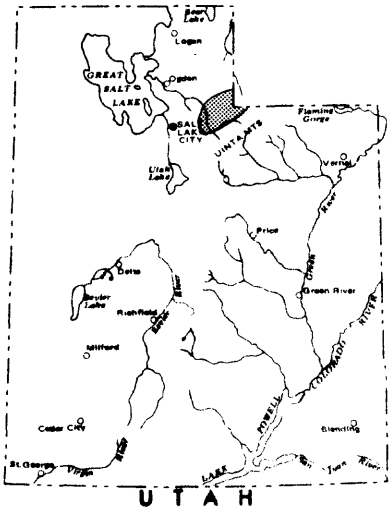
Approach: About 10-15 potential sites will be selected on streams that are not undergoing long-term channel adjustments such as streams that are aggrading or degrading with time. The stability of the channels for appreciable distances upstream and downstream of the study sites will be evaluated before the site is selected. Where possible, the sites will be near existing gaging stations where discharge and velocity observations are available and where sufficiently-high river stages are likely to occur; if not, gaging stations will be installed. The number of gaging stations that could be constructed using funds from the project would be limited to about four to six, depending on channel conditions and type of gage deemed desirable. If DCP's (data collection platforms) are presently available at any sites, they will be used to determine when flooding is occurring. At sites without DCP's, observers will be hired to call when rainfall exceeds a predetermined amount or when the streams reach high stage.

If floods yield enough data during this project, the objectives will be met fully. If average rainfall occurs, data should be obtained for about two floods at 5-6 sites per year. The data obtained at each site should include at least the following (1) scour depth, stream velocity, and geometry of piers; (2) river stage and discharge; (3) water temperature and suspended-sediment concentration; and (4) channel geometry and bed-material properties. Cross sections and photographs will be obtained at each site at the beginning of the project and bridge-design plans available from the Utah Department of Transportation will be utilized. Much of the data will be obtained after a

flood recedes. These data will include channel and pier geometry and bed-material properties. Bed-material samples will be obtained at three or four representative places to evaluate average conditions. At some sites, a chain will be attached to the upstream end of piers about 1-2 feet below the existing bed. Hopefully, during flooding the chain will drop to the depth of maximum scour. During floods, standard stream-gaging equipment will be used to obtain additional data. Sounding equipment will be used to define the limits of scour. Several velocity observations will be made near the piers. Suspended-sediment samples will be obtained near the piers and near the middle of the stream away from the piers. Existing formulas presently used for predicting scour will be evaluated with the data collected during the project. If none of the existing formulas give satisfactory results, an attempt will be made to develop new methods of estimation.

Plans for next year (pending approval and funding): Prepare a planning document, including a work plan and an annotated outline of a proposed report. Select 10-15 potential sites for data collection and instrument 5-6 sites at which data will be obtained during the first year.

E. DEPTH TO BASE OF MODERATELY SALINE WATER, OVERTHRUST BELT OF NORTH-CENTRAL UTAH



Cooperating Agency: Utah Division of Oil, Gas, and Mining

Staff: L. W. Howells, Hydrologist, Project Chief
Other District personnel as assigned

Period of Project: April 1987 to March 1989

Problem: The Utah Division of Oil, Gas, and Mining needs to know the depth to the base of potentially treatable, and thus usable, water (defined as containing less than 10,000 milligrams per liter dissolved solids) in the Overthrust Belt oil and gas exploration and production area. The State needs this information to set criteria to protect usable ground water during exploration, production of oil and gas, and injection of produced brine.

Objectives: To determine the depth to the base of moderately saline water in the Overthrust Belt; and to portray the depth on one or more maps. To summarize anything about the hydrogeology of the area that can be inferred from the map or maps.

Approach: Compile all available data on ground-water quality in the area, including data from petroleum companies. Assemble available borehole-geophysical logs and interpret a representative set of logs to determine the base of moderately saline water. Cross-sections of water quality versus depth will be prepared where necessary to portray changes. Evaluate the use of digital data from logs and log-interpretation computer programs to determine water quality.

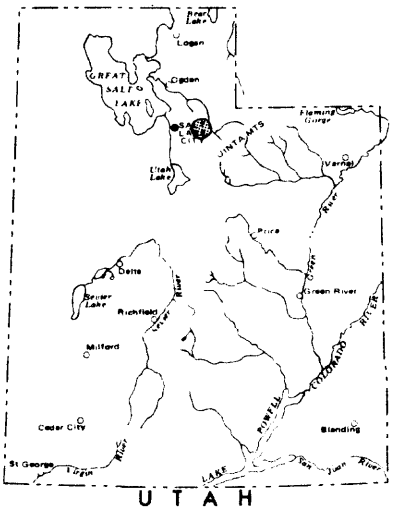
Plans for next year (pending approval and funding): Prepare project plan. Compile all data on ground-water quality and enter into a computer file. Select and obtain borehole-resistivity logs for analysis.

F. GROUND-WATER CONDITIONS IN THE MILL-TAILINGS AREAS AND GEOCHEMISTRY OF GROUND WATER IN AND NEAR PARK CITY

Cooperating Agency: Utah Division of Environmental Health

Staff: Vacancy, Hydrologist, Project Chief
Vacancy, Hydrologist or Hydrologic Technician (part time)

Period of project: October 1986 to September 1989



Problem: The Prospector Square area is a commercial and residential development constructed on 150 acres that was a disposal area for tailings from a metals-ore mining operation. The tailings contain locally large concentrations of toxic metals, and the State would like to know what hazards the tailings present in terms of contamination of ground water and local surface water. In addition, the State would like an evaluation of ground-water conditions in three other mill-tailings areas in and near Park City, and an evaluation of the effects of all mine workings in the Park City mining district on the geochemistry of ground water in and near Park City.

Objectives: To determine ground-water conditions in the unconsolidated deposits under the mill tailings in the Prospector Square area and to estimate the effects of the tailings on ground-water quality. Specifically, to determine direction of ground-water movement (in three dimensions), hydraulic properties of the unconsolidated deposits and tailings, and quality of ground water. To determine, in less detail, ground-water movement and quality and hydraulic properties of water-bearing material in three other mill-tailings areas in and near Park City. To evaluate the effects of past mining activity in the Park City mining district on ground-water geochemistry.

Approach: Drill and complete about 10 test holes (approximately 30 feet deep) upgradient from, within, and downgradient from the Prospector Square tailings area. Drill one of the test holes to about 50 feet, complete as a production well, and pump for about 10 days for an aquifer test. Measure water levels in all test holes monthly in order to obtain seasonal changes in water levels and hydraulic gradients. Collect samples from all wells seasonally for chemical analysis. Drill about eight test holes (30-50 feet deep) at each of the other three tailings areas, measure water levels for one to two years, and collect and analyze four water samples per test-hole for a year. Sample and analyze (including analysis for a complete suite of metals) water from about 30 mine workings. Attempt to determine the geologic source of all water in each mine working sampled, and estimate the factors governing the quality of water from the mine workings.

Plans for next year (pending approval and funding): Prepare project plan. Assemble available hydrogeologic data on the tailings areas and on water quality in the entire Park City area. Prepare test-drilling contract, supervise drilling, and plan aquifer test. Begin water-quality sampling from mine workings.