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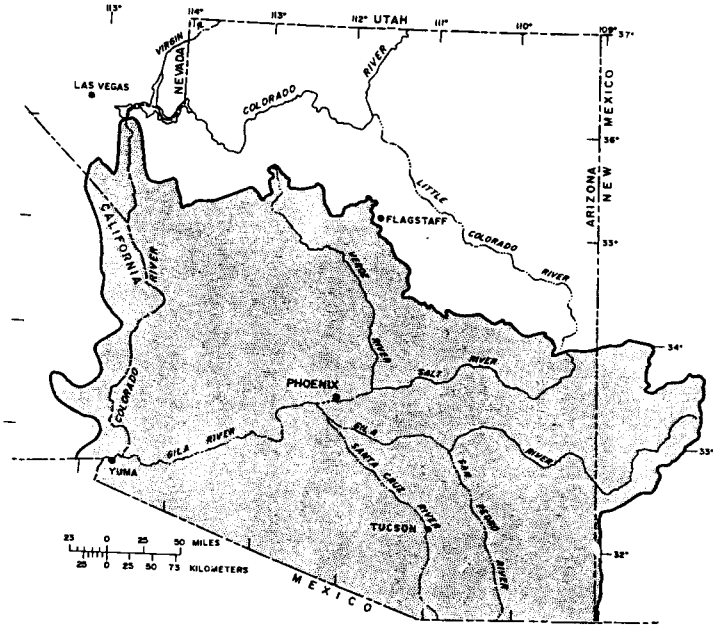
USGS BEGINS SOUTHWEST ALLUVIAL BASIN AQUIFER-SYSTEM ANALYSIS

The U.S. Geological Survey (USGS) Water Resources Division has begun a comprehensive study of groundwater basins in southern Arizona, in parts of adjacent states and in Mexico (See Map).



Area (shaded) of study in the western part of the Southwest Alluvial Basins, Regional Aquifer-System Analysis. Some area in Mexico also will be included; the extent depends on hydrologic boundaries.

"The overall objectives of this (project) are compatible with those of ongoing and planned regional aquifer studies by the Geological Survey throughout large parts of the U.S.," explained Thomas W. Anderson, project chief.

"The purpose of this (project) is to develop and calibrate, to the extent possible, ground-water models of the various basins and of the regional flow system. The products of this effort are for use by local and regional water-resources management entities," Anderson said.

"These models will be available for examining the effects of various management alternatives on the available resources and, as such tools, will rely upon local input to their design in an attempt to maximize their utility and benefits," Anderson noted.

To secure this input, "a liaison committee will be established so that lines of communication are available between members of the study team and interested and concerned members of the water-resources management community," Anderson explained.

"Included on this committee will be selected representatives of federal, state and local interests who, in turn, can inform others in hydrology and correlative fields of the status and plans of the (project) through their regular meetings, newsletters, etc.," Anderson said.

This project, "West Part of the Southwest Basins, Regional Aquifer-System Analysis," will be four years in duration, dating from October 1978, and will have a total budget of about $2 million. Some 80,000 square miles in Arizona, New Mexico, California and Nevada are included in the project region. Because some of the hydrologic system extends across the international boundary into Mexico, some area in that country also may be included in the project.

The USGS, in cooperation with the Arizona Water Commission, has subdivided southern Arizona into 44 groundwater basins. The degree of development of the basins varies from essentially none to highly developed. If the degree of development were to be categorized as high, moderate, or low, about 30 percent would be considered high, 45 percent would be considered moderate, and 25 percent would be low.

Groundwater development in these basins generally has resulted in groundwater mining, or overdraft, because not enough recharge occurs to sustain large, areal concentrations of high consumptive use. Annual groundwater withdrawal in highly developed basins has been estimated to range up to 30 times the present annual rate of replenishment, considering both natural and artificially modified recharge. Long-term water-level declines of more than 400 feet have occurred since development began in some areas.

The problem facing the project staff is developing understanding of the regional aquifer system and its operation. In the arid Southwest, optimum use of available water resources will be increasingly important as development continues. Developing management tools that incorporate available knowledge of the hydrologic system and that have been calibrated to duplicate known cause-and-effect relations will provide a means of evaluating various management alternatives and a technical basis for decision making. Studying the entire region as one system and then superimposing more detailed studies of individual basins will provide a perspective not presently available to local water-resources managers. Many studies have been completed on parts of this regional system, usually by single basin or even by small areas within basins, but no studies have addressed the entire region to assess the interbasin effects of development, nor to assess the magnitude of total regional resources.

Aside from the large areal extent of this regional aquifer system, there are many problems that will be encountered in such a study. These problems include those associated with the hydrology of the system and those associated with actually performing a study of the system. The hydrology problems are discussed in the following paragraphs.

1. The bedrock flow system, and the degree to which it impedes or facilitates interbasin water transfers, and the contribution or recharge it provides by both runoff and underflow to the alluvial valley fill must be determined.
2. Amounts of water in storage and the distribution in the system of this stored water must be determined, considering both predevelopment–or steady-state–and present conditions.
3. The spatial variation of water quality during predevelopment–or steady-state–flow conditions must be defined, the temporal and spatial variation of water quality within the stress-modified flow system must be defined; and the existence of, or potential for, the downgradient transfer of poor-quality water must be determined.
4. The effects of cultural development on the system must be identified. Examples of such problems are:
   a) Groundwater mining has caused land subsidence, which is linked to sediment compaction and concurrent storage capacity reduction in the system; and
   b) That part of the applied irrigation that is recharging the aquifer system may be transporting deleterious chemicals, thereby impairing the quality of the groundwater.

Study-related problems are discussed in the following paragraphs.

1. Data availability ranges from good at shallow depths within highly developed areas to practically none in lightly developed areas, to none at depth within developed basins, and to none at depth in interbasin areas.
2. Data sources vary greatly. Accompanying data compatibility problems involve completeness, accuracy and representativeness.
3. Coordinating and cooperating efforts will be required in those areas where the international boundary between Mexico and the United States cuts across the hydrologic system. Recognizing that the entire basin must be included to develop a valid management tool, a working data-transfer mechanism must be established.

The nature of the regional aquifer system suggests the pattern of approaching its study. It is proposed therefore to study the intermontane basins as individual units, and then to link these units to develop the regional characterization of the system.

Data distribution on the system in turn creates limitations on studying basins as individual units. It is anticipated that the study will focus on the highly developed basins, and that the hydrologic parameters defined in these basins will be extrapolated to basins where data are sparse.

The study plan may be described best in phases.

1. Phase I constitutes preliminary work and is expected to last 12 months.

At the end of Phase I an open-file report will be prepared to document:

   a. The plan or strategy of the study;
   b. Basin characterization criteria;
   c. Distribution of all categories of basins and identification of the representative basins to be studied intensively in each category;
   d. Plans for further data acquisition; and
   e. Summarization of the data sources and the available literature relating to groundwater in the study area.

2. Phase II will involve data acquisition and modeling, and will span approximately 30 months. Phase II will overlap Phase I by as much as six months, thus Phase II should be completed by the end of the third project year.

Phase II report products are expected to include:

   a. One or possibly several data summary reports on individual or groups of basins;
   b. A report or series of reports documenting representative models for individual basins or groups of basins; and
   c. A report documenting the preliminary routing model.

These report products will be produced as various data collections or modeling efforts are completed. Report release should coincide with needs, which can be determined only at the time that the report contents are known.

3. Phase III will focus on production and completion, and probably will take 18 months to complete. Allowing for a six-month overlap with Phase II, Phase III should be completed by the end of project year four.

Report products documenting Phase III findings are expected to include:

1. A report documenting information transfer from representative basins to those represented; and
2. A report documenting the regional aquifer-system model.

In addition, a final comprehensive report is planned. It will be part of the USGS Nationwide Regional Aquifer-System Analysis program final report series. The product will document the results of model analyses and will demonstrate use of the models in evaluating stress changes on the regional aquifer system.

CONDENSATION

WRC PREDICTS SERIOUS WATER SUPPLY PROBLEMS BY 2000

Critical water-resources management problems facing the nation through the year 2000 have been outlined in the Water Resources Council (WRC) Second National Water Assessment.

The Southwest and the Midwest were identified as regions that "have or will have a serious problem of inadequate surface-water supply by the year 2000," according to the WRC assessment.

"The most dramatic instances of ground water overdraft are found in the High Plains area that extends from Texas to Nebraska. Central Arizona and parts of California also depend heavily on ground water. In some of those areas ground water levels are declining from seven to ten feet per year," WRC stated.

With respect to surface water pollution, WRC found that "Dispersed agricultural sources, municipal and industrial wastes, acid mine drainage, and accelerated urban runoff are the significant sources.

"Ground water pollution, whether existing or potential, natural or manmade, poses a significant health threat inasmuch as 40% of the population derives drinking water from ground water sources," WRC noted.

"In 1975," the WRC report continued, "107 people were killed by flood waters, and . . . property damage was estimated to be $3.4 billion. By the year 2000, potential flood damage is expected to increase to $4.3 billion annually unless there is expansion of flood-plain management efforts and the regulation of flood plains."

And the 1975 average cropland soil loss to erosion was nearly 9 tons per acre, but in some areas the soil loss exceeded 25 tons per acre. Forest and pasture lands sustained soil losses of about 1 ton per acre, the WRC report noted.

WRC calculated groundwater overdraft percentages across the nation. The three highest overdraft percentages calculated were for the Texas-Gulf Region, 77 percent; the Arkansas-White-Red Region (Oklahoma and parts of Arkansas, Kansas, northern Texas, New Mexico and Colorado), 61.7 percent; and the Lower Colorado Region, 48.2 percent.

The 86-page summary report (Stock No. 052-045-00051-7) is available for $3.25 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. WRC plans to publish other volumes of the study in June 1979. These volumes include reports on water quantity, quality and related land considerations; analytical data; and water resources regional information.

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SOLAR-HYDROELECTRIC POWER TIE TO BE STUDIED

The U.S. Departments of the Interior and of Energy will conduct a joint study of the technical and economic feasibility of combining large, central-receiver solar electric generating plants with a major hydroelectric power grid.

The study will assess the feasibility of constructing a 100- to 300-megawatt solar-thermal power tower in the Lower Colorado River Basin where the U.S. Bureau of Reclamation will be required to build a desalting plant near the Mexican border to reduce salinity of Colorado River waters flowing into Mexico. Such a solar-hydro facility could produce the large amounts of energy required by a desalting plant.

A solar-hydro tie could provide a supplemental, renewable source of electric power by saving water that would be used to generate power only during nighttime or cloudy periods. The solar generator would employ many movable mirrors to focus the sun's rays onto a central receiver.

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PUBLICATIONS

Statistical summaries of Arizona streamflow data has been published as U.S. Geological Survey (USGS) Water-Resources Investigations 79-5. The report, written by T.W. Anderson and Natalie D. White, was prepared in cooperation with the Arizona Water Commission (AWC).

The report is a compilation of statistical summaries of streamflow data that most frequently are used by water managers and planners.

Included in the summaries are flood frequency data for selected streamflow-gauging stations; annual peak discharges, heights and volumes; daily discharge duration tables; lowest mean discharges; highest mean discharges; normal monthly mean discharge statistics; and normal annual mean discharge statistics.

Report USGS Water-Resources Investigations 79-5 is available to the public for a nominal fee from the National Technical Information Service, U.S. Department of Commerce, Springfield, Va. 22161.

Perusal copies are available at the AWC office, 222 N. Central Ave., Suite 800, Phoenix, Ariz. USGS offices also have copies for perusal at Room 5-A, Federal Building, 301 W. Congress St., Tucson; Suite 1880, Valley Center, Phoenix; 2255 N. Gemini Drive, Building 3, Flagstaff; 1940 S. 3rd Ave., Yuma; and Room 5312 National Center, 12201 Sunrise Valley Drive, Reston, Va.

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Groundwater is a book that brings the disciplines of chemistry, physics, geology, hydrology and engineering to bear on the study of groundwater. Authors R. Allan Freeze and John A. Cherry discuss the role of groundwater as a resource, as a contribution to geotechnical problems, as a liability to

environmental contamination, as a factor in the hydrologic cycle, and as a factor in a variety of geological processes.

Detailed coverage of the chemical aspects of groundwater hydrology is included as well as hydraulics and aquifer yields. In addition, the most current calculation techniques applicable to groundwater hydrology and chemistry are introduced.

Copies of the 624-page book cost $28 and are available from Robert Jordan, Department J-419, Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632.

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Salt-Water Purification; Second Edition, by K.S. Spiegler, is an introductory text to basic desalination science and technology. Included in the 200-page publication are sections on reverse osmosis (hyperfiltration), economic factors related to equipment and materials, and alternatives for securing adequate water supplies. A guide to current, relevant literature is included.

Copies of the illustrated book are available for $19.50 from Plenum Publishing Corp., 227 W. 17th St., New York, N.Y. 10011.

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Water Resources and the National Welfare is a publication designed to help prepare courses for persons responsible for managing water and related natural resources.

Written by Walter U. Garstka, the 654-page textbook has 25 sections that include 95 topics of interest based on teaching both undergraduate- and graduate-level students.

No extensive prerequisites are necessary to understand the hydrology discussed in the publication. Mathematical analyses and problems are simplified and require only arithmetical proficiency.

Copies of the publication are available for $24 from Water Resources Publications, P.O. Box 2841, Littleton, Colo.

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Please address your news items or comments on the News Bulletin to any of the three editors:

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