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Water Current

Millard W. Hall, Director
Volume 8 Number 2

Karen E. Stork, Editor
March/April 1976

FROM THE DESK OF THE DIRECTOR . . .

The Nebraska Water Resources Research Institute has just submitted its annual allotment proposal to the Office of Water Research and Technology for fiscal year 1977. The total federal dollars requested is again \$110,000.

Included in this proposal were three new research projects. Thirteen proposals were submitted to the Institute for consideration; however, because of the paucity of available federal funds, and commitments to continuing projects, only three new proposals could be included.

All new research proposals received were reviewed by the Director and by the Institute Executive Committee, and a rating established. The consensus of the committee was followed in selecting the three new projects for funding.

The new projects selected are as follows:

- (1) "Nitrogen Source Differentiation Through Carbon Isotopes," proposed by Roy Spalding, Conservation and Survey Division, UNL. The results of this project will facilitate identification of organic sources of nitrogen in a nitrogen contaminated aquifer.
- (2) "Corrosion in Water Distribution Systems," proposed by Donald L. Johnson, Department of Mechanical Engineering. The objective of this project is to determine the corrosion behavior of typical structural and containment materials used in water bearing or water distribution systems.
- (3) "Nitrogen Losses from Sprinkler-Applied Nitrogen Fertilizer," proposed by Gary W. Hergert, North Platte Station. This project's objectives are: (1) to quantify nitrogen losses from sprinkler-applied nitrogen; (2) to determine what factors influence the loss of sprinkler-applied nitrogen; (3) to estimate the nitrogen-enrichment of groundwater when nitrogen is sprinkler-applied; and (4) to develop practices which will result in minimum applications of water and nitrogen while maintaining optimum yields.

These investigators are to be congratulated on their successful competition for these funds. I am looking forward to working with them on these projects.

NEBRASKA WATER RESOURCES RESEARCH INSTITUTE

ON THE HOMEFRONT

NWRRI RESEARCH SEMINAR

On Thursday, April 15 the Nebraska Water Resources Research Institute will sponsor a "Research Overview" at the Nebraska Center for Continuing Education. The purpose of the seminar is to present a brief review of the current research program of the Institute. Principal investigators will make presentations on studies in progress, accomplishments to date and future research plans. Time will be allotted after each presentation for questions and discussion. The seminar is open to the general public, state and federal agency representatives, university faculty and students and other interested persons.

For further information on the seminar, contact: Nebraska Water Resources Research Institute, 310 Ag. Hall, University of Nebraska, Lincoln, Nebraska 68583. Telephone (402) 472-3305.

WATER RESOURCES ACTIVITIES - AGENCY OVERVIEW

On Thursday, April 22 the Nebraska Water Resources Research Institute will sponsor a seminar on "Nebraska Water Resources Activities - Agency Overview" at the Nebraska Center for Continuing Education. The purpose of this seminar is to review the status and future plans of water resources research and planning activities in the state in order to achieve better coordination. Representatives of state and federal agencies will review their water-related research, monitoring and enforcement activities. This seminar is also open to the general public, state and federal agency representatives, university faculty and students and other interested persons.

For further information on the seminar, contact the Nebraska Water Resources Research Institute.

AEEP DISTINGUISHED FOREIGN LECTURER

The Water Resources Research Institute and the College of Engineering and Technology are sponsoring a seminar on Friday, April 23 by Professor Poul Harremoes, Professor of Sanitary Engineering from the Technical University of Denmark. The seminar topic will be "Nitrogen Removal by Biological Denitrification" and will be held at 2:30 p.m. at the Nebraska Union.

Dr. Harremoes' lecture will review the process of denitrification and then concentrate on combined sludge systems. Three different approaches will be investigated: (1) the aerobic-anaerobic sequence; (2) the anaerobic-aerobic-anaerobic sequence; and (3) the alternating aerobic-anaerobic process. A detailed analysis of the kinetics and design of the three alternatives will be presented and compared with fixed-film denitrification systems.

Dr. Harremoes holds degrees from the Technical University of Denmark and the Massachusetts Institute of Technology. His research activities have included the use of radioactive isotopes in pollution measurements, diffusion and dispersion in outfalls, bacterial disappearance in sea water, water quality management, kinetics of denitrification and modeling of river quality.

All interested persons are invited to attend.

WATER RESEARCH IN NEBRASKA

BUREAU OF RECLAMATION

The Bureau of Reclamation acquired infrared imagery of the O'Neill Unit, Nebraska, Pick-Sloan Missouri Basin Program on July 25 and 26, 1975. The area photographed includes parts of Cherry, Keya Paha, Brown, Rock, and Holt Counties.

Infrared coverage was obtained from two altitudes, 4,800 ft. for the project service area and 2,000 ft. for the Norden Reservoir area. The high altitude imagery covers an area from Stuart, Nebraska, north 11 miles and then east to the point where Louse Creek joins the Niobrara River, then south to Page, Nebraska, then west to about nine miles south of Stuart. The scale of this area is approximately 9.2 inches equals a mile. The low altitude imagery covers an area from Valentine, Nebraska, along the Niobrara River east to the point where U.S. Highway 183 crosses the Niobrara River. This scale is approximately 4.75 inches equals a mile.

The imagery is being used in quantifying and qualifying the vegetative types in the Norden Reservoir area, to document preproject conditions, land use in the project service area, and to help identify high water table areas located in the O'Neill project area.

Anyone interested in viewing the film should contact the Nebraska Reclamation Office, P.O. Box 1607, Grand Island, Nebraska 68801.

CONSERVATION AND SURVEY DIVISION

A new mass spectrometer has recently been acquired by the Conservation and Survey Division and is now being tested and calibrated with known samples. Analyses of unknown samples from Merrick County should begin in late April. Nitrogen isotopic analyses should allow for an improved estimation of nitrate sources in the contaminated zones in Merrick County.

U.S. GEOLOGICAL SURVEY

The U.S. Geological Survey in cooperation with the five Groundwater Conservation Districts in the Upper Big Blue River basin (Clay, Fillmore, Hamilton, Seward and York counties), has been monitoring groundwater pumpage and water-level fluctuations in an effort to quantify the effects of groundwater use on the available supply.

During 1975, pumpage records from selected irrigation wells in the five-county area indicated that groundwater withdrawals totaled about 1,090,000 acre-feet from 8,037 wells for an average application of over 17 inches of water. Pumpage for the 1975 irrigation season was 172,000 acre-feet less than in 1974 and the fall 1975 water-level average was 0.72 foot higher than the average for the fall of 1974. Water levels measured in the spring of 1975 indicated that a net depletion of about 443,000 acre-feet of water from the groundwater reservoir had occurred since the spring of 1974. The number of irrigation wells in the five-county area continued to increase with 459 new wells drilled during 1975.

FEDERAL HIGHLIGHTS

AGREEMENT SIGNED BETWEEN WRC AND ERDA

Warren D. Fairchild, Director of the U.S. Water Resources Council (WRC), and James L. Liverman, Assistant Administrator for Environment and Safety of the Energy Research and Development Administration (ERDA), have jointly announced an agreement between the two agencies. The agreement provides funding for basic activities to support the Water for Energy Program and to implement the WRC's responsibilities under Section 13 of the Federal Nonnuclear Energy Development Act of 1974 (P.L. 93-577).

WRC's basic Water for Energy Program includes updating of WRC's Water for Energy report prepared in 1974 for the Federal Energy Administration, participation in the site surveys of the Nuclear Regulatory Commission, and development of the products of the 1975 National Assessment for use in the energy assessments required under Section 13.

Section 13 provides that the WRC undertake assessments of water requirements and water supply availabilities for nonnuclear technologies. Legal constraints, water and waste disposal costs, and an analysis of the environmental, social and economic impacts of the dedication of water to such uses are among the concerns which will be addressed.

The agreement signed on February 2, 1976, provides that Section 13 funds be transferred to WRC from ERDA during FY 1976 and FY 1977. The funds will be used to: (1) evaluate the adequacy of data for the water assessment program; (2) establish a water assessment data base related to energy technologies; and (3) provide specific water assessments requested by ERDA, such as those for the ERDA synthetic fuel and geothermal energy programs.

GOVERNMENT'S WATER POLLUTION PROGRAM QUESTIONED

Wendell Johnson, Chairman of the American Society of Civil Engineers' Committee on National Water Policy, during hearings of the National Commission on Water Quality, noted that the program contemplated by Congress and set forth in the Water Pollution Control Act Amendments of 1972 cannot be achieved.

He argued that the Commission's report "should consider in detail a cost-effective strategy for achieving realistic national water quality goals. It should avoid the philosophy that the best way to get things done is through massive application of federal funds applied under criteria which call for uniformity over the entire geographic area of the United States." He urged that "the Commission's recommendations be directed toward strengthening and reaffirming the policy of the Congress to recognize, preserve and protect the primary responsibilities and rights of states to prevent, reduce and eliminate pollution."

Mr. Johnson concluded that "the timing of this review by the National Commission on Water Quality has turned out to be fortuitous since it is obvious that the program contemplated by Congress in 1972 cannot be achieved. The staff review has demonstrated conclusively that the goals of the program and the schedule for this accomplishment need to be revised drastically. The staff review also makes it clear that there are many serious questions about the whole water pollution program which need answering before a final program can evolve."

The Committee on National Water Policy was created by ASCE to represent the Society, under general policies laid down by the Board, on matters pertaining to national policies for the conservation, development and utilization of the nation's water resources.

COAL AND THE POWDER RIVER BASIN: FIVE-STATE GROUNDWATER STUDY UNDERWAY

The U.S. Geological Survey has undertaken a comprehensive study to determine the availability of groundwater to meet future water needs in a 188,000 square-mile region that includes the Powder River Basin.

With a first-year appropriation of \$2 million, the USGS study will focus on the hydrology of the Madison Limestone aquifer (underground water-bearing rock unit) and its ability to supply large quantities of water in a region that includes parts of Montana, Nebraska, North Dakota, South Dakota and Wyoming.

The study was prompted in part by proposals to develop the large coal resources that underlie the same area. Development of the coal could greatly increase water use in the semi-arid region.

According to Elliott Cushing, USGS hydrologist, Denver, Colorado, and chief of the project, "At the moment, we just do not know how much water the Madison Limestone can actually supply to meet future needs. Preliminary studies indicate that the aquifer might supply a significant part of the water requirements for proposed coal development. Such large-scale withdrawals, however, could result in hydrologic and economic problems, such as decline in water levels, depletion of flow of streams and springs, or deterioration of quality of water from existing wells.

"In fact, the larger question is not just how much water can the Madison supply, but what effects would any large withdrawals have on the area's total water resources," the USGS spokesman said.

In preparation for the current intensive study, the USGS has worked with other Federal, State, and local agencies to prepare three background reports. The reports summarize the present geohydrologic knowledge of the Madison aquifer, identify the need for additional data, outline a five-year multi-million-dollar plan to study the aquifer, and describe a preliminary digital computer model that mathematically simulates the flow of groundwater in the Madison. The model is an essential planning tool for determining the particular types and areas of data deficiencies, for testing the sensitivity of hydrologic parameters such as transmissivity and storage to stresses such as pumping, and for estimating the range of effects that might result from major groundwater withdrawals.

The three reports have not been duplicated in quantity for distribution, but are available for inspection or for duplication at the requestor's expense at the outlets listed below. The reports should be requested by title and number:

- * USGS Open-File Report No. 75-631, "Plan of Study of the Hydrology of the Madison Limestone and Associated Rocks in Parts of Montana, Nebraska, North Dakota, South Dakota and Wyoming," prepared in cooperation with the Old West Regional Commission.
- * USGS Open-File Report No. 75-660, "Water in the Madison Group, Powder River Basin, Wyoming and Montana," by F.A. Swenson, W.R. Miller, W.G. Hodson, and F.N. Visser, prepared in cooperation with the Montana Bureau of Mines and Geology and the Wyoming State Engineer.
- * USGS Water-Resources Investigations Report No. 63-75, "Preliminary Digital Model of Groundwater Flow in the Madison Group, Powder River Basin and Adjacent Areas, Wyoming, Montana, South Dakota, North Dakota, and Nebraska," by L.F. Konikow, prepared in cooperation with the Old West Regional Commission.

The reports may be inspected or arrangements made for duplication at cost at: U.S. Geological Survey Library, Room 4A100, USGS National Center, 12201 Sunrise Valley Dr., Reston, Virginia 22092; USGS Library, Room 1222, Building 25, Federal Center, Denver, Colorado 80225.

The reports may also be inspected only at the following USGS Water Resources Division district offices: 421 Federal Building, Helena, Montana; Room 332, New Federal Building, Bismarck, North Dakota; Room 231, Federal Building, Huron, South Dakota; and 4015 Warren Avenue, Cheyenne, Wyoming.

CONFERENCES

SPECIAL SESSION OF THE SECOND ANNUAL MIDWESTERN AGU CONFERENCE

A special session of the Second Annual Midwestern AGU Conference will be held in Ann Arbor, Michigan on October 21-23, 1976. The Hydrology Section is sponsoring this session entitled "What is the 100-year flood?" under the chairmanship of John B. Stall who heads the Hydrology Section of the Illinois State Water Survey.

Presentations are expected to be of ten minutes duration, followed by five minutes of discussion. Abstracts are due at AGU headquarters by July 27 and there is an abstract publication charge. Papers by non-members of AGU may be sponsored by AGU members.

Anyone who wishes to have further information on AGU requirements for abstracts and names of AGU members in your vicinity, please contact: W. Hall C. Maxwell, Hydrology Section Program Chairman, 2527a Hydrosystems Lab, University of Illinois, Urbana, Illinois 61801.

SHORT COURSE ON LARGE-SCALE WATER RESOURCES SYSTEMS MANAGEMENT

A short course on application of system analysis to water resources management will be presented at the University of California, Los Angeles, California, June 28-July 2, 1976. The course will present a comprehensive survey of mathematical models for managing large-scale water resources systems with applications to reservoir operation; timing and sequencing of water resources projects; and parameter identification in groundwater hydrology. Examples of application will include the California Central Valley Project and the Tennessee Valley Authority which are presented by technical representatives from the respective agencies.

For further information, contact Professor William Yeh, Engineering Systems Department, University of California, Los Angeles, California 90024.

CONFERENCE ON WATER RESOURCES POLICY AND URBAN GROWTH

A specialty conference on water resources policy and urban growth will be held at the University of Minnesota in Minneapolis on August 18, 19, and 20, 1976. It is sponsored by the Water Resources Planning and Management Division and the Urban Planning and Development Division of ASCE with cooperation of the Minnesota Chapter of the American Water Resources Association and the Department of Civil and Mineral Engineering and Department of Conferences at the University.

Among the technical sessions dealing with such topics as land use and environmental management will be one featuring Twin Cities metropolitan problems and solutions. The nontechnical part of the program includes an introductory talk by a sub-cabinet official of the U.S. Government and a luncheon talk by a noted historian. There will also be a family night as well as activities for family attendees during the technical sessions.

For program details write to: Professor Edward Silberman, St. Anthony Falls Hydraulic Laboratory, Mississippi River at 3rd Avenue S.E., Minneapolis, Minnesota 55414.

OTTAWA TO BE SITE FOR IRRIGATION AND DRAINAGE CONFERENCE

A Specialty Conference on Environmental Aspects of Irrigation and Drainage will be held in Ottawa, Canada, July 21-23, 1976. The Conference is being co-sponsored by the American Society of Civil Engineers, Engineering Institute of Canada, International Water Resources Association, American Society of Agricultural Engineers, Canadian Society of Agricultural Engineers and the International Commission on Irrigation and Drainage.

The Conference will be held just before the 1976 Olympic Games in Montreal which is only 100 miles from Ottawa. The program for the Conference has now been finalized. Those desiring more information on this important Conference should contact Dr. Asit K. Biswas, Co-Chairman, Organizing Committee, Planning and Finance Service, Department of Environment, Ottawa, Canada, K1A 0H3, Telephone (819) 997-1745.

AFS/ASCE CONFERENCE ON INSTREAM FLOW NEEDS

The Western Division of the American Fisheries Society and the Power Division of the American Society of Civil Engineering announces a Symposium and Specialty Conference on "Instream Flow Needs" to be held May 3-6, 1976 at Boise, Idaho. The theme of the conference will be "solutions to technological, legal and social problems caused by increasing competition for limited streamflow."

The objectives of the conference are to address various major topics and subtopics through many forms of discussion and information transfer and to develop a useful proceedings for practitioners. The overall goal is to achieve a meaningful interface for dialogue between the various disciplines associated with instream and offstream uses of streamflow including fisheries experts, design engineers, hydraulic engineers, hydrologists, water resources planners and managers, lawyers, state and federal agency personnel, political and social scientists and recreationists.

For additional information, contact: John F. Orsborn, Program Chairman, AFS/ASCE Instream Flow Needs Conference, Albrook Hydraulics Laboratory, Washington State University, Pullman, Washington 99163.

PUBLICATIONS

PREVENTIVE "MEDICINE" CAN SLOW DEATH OF URBAN LAKES

Man's activities can needlessly hasten the process of extinction in urban lakes according to a new U.S. Geological Survey report that suggests preventive measures for slowing the aging process of lakes. Designed to introduce urban planners and residents to the life and care of urban lakes, the 22-page, illustrated report is the latest in the layman-oriented USGS series on water in the urban environment.

In addition to a brief introduction to the natural properties and processes of lakes and how these factors influence water quality, the report describes common lake-management problems and some solutions and suggests guides for conducting lake reconnaissance surveys.

According to Linda J. Britton, USGS biologist, Lakewood, Colorado, and senior author of the report, "More and more of the Nation's lakes and reservoirs are suffering, often needlessly, from human impact and urbanization. In addition to the many 'old' lakes that are coming under the influence of the spreading urban environment, hundreds of new urban lakes are created yearly, often in an effort to enhance real estate values. Thus many urban planners and residents are faced with the unexpected task of managing lakes for maximum public benefit."

"To head off such water and lake-quality problems, urban planners need to take preventive measures based on a knowledge of lake processes and properties," she said. "The site of new lakes should be chosen carefully, including a determination of the amount of nutrients that tributaries will carry and the removal of sources of future problems."

"Most important, however, is the wise management of the surrounding area that contributes water to the lake. An adequate plant cover with a minimum of soil disturbance must be maintained around the lake to prevent eroded soil from being deposited in the lake. Removing or preventing industrial, domestic, and agricultural wastes from being deposited in the lake is not only desirable but essential for slowing the eutrophication process," Britton said.

"Accelerated eutrophication has spurred a search for new approaches to lake and reservoir management and has fostered growing public awareness of the need for better lake management," Britton said. "Our report should provide much of the information needed for effectively managing lakes and preventing their premature aging," she concluded.

The report, "An Introduction to the Processes, Problems, and Management of Urban Lakes," by L.J. Britton, R.C. Averett, and R.F. Ferreira, and published as U.S. Geological Survey Circular 601-K, is free upon request to the Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, Virginia 22202.

PRACTICAL GUIDES TO RIVER-QUALITY MANAGEMENT

To aid the growing interest in improving the quality of the Nation's streams, a new series of reports providing practical environmental guides to planning and managing river quality is being published by the U.S. Geological Survey.

Using the current USGS intensive river quality assessment of the Willamette River Basin, Oregon, as a case history, the first reports explain in nontechnical language such topics as practical approaches to the analysis of river hydrology, computer modeling, relationship between land resources and river quality, and the development of programs for assessing specific problems.

The first two reports in the series are:

- * USGS Circular 715-A, "A Practical Framework for River-Quality Assessment," by D.A. Rickert and W.G. Hines. The report diagrams and describes a seven-step process for developing the kinds of information and insights that planners need to adequately evaluate alternatives for managing river quality. The seven steps are: (1) problem delineation, (2) analysis of hydrology, (3) selection of assessment methods, (4) identification, collection, and collation of required data, (5) development of predictive capability, (6) impact forecasting, and (7) communication of results.
- * USGS Circular 715-B, "Formulation and Use of Practical Models For River-Quality Assessments," by W.G. Hines, D.A. Rickert, S.W. McKenzie, and J.P. Bennett. This report describes in nonmathematical terms, an approach for formulating mathematical models for use in making practical assessments of river-quality problems.

Later reports in the series will describe the actual application of the suggested approaches to existing or potential river-quality problems in the Willamette River basin. Specific topics will include maintenance of high-level dissolved oxygen in the river, algal growth potential, effects of reservoir release patterns on downstream river quality, distribution of toxic metals, and the significance of erosional potential to proposed future land and water uses.

Copies of the reports are available free upon request to the Branch Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, Virginia 22202.

POSITIONS AVAILABLE

POST-DOCTORAL POSITION IN WATERSHED SCIENCE

The Department of Forestry and Outdoor Recreation of Utah State University expects to have a two-year post-doctoral position in watershed science available from July 1978. The vacancy has developed from changed administrative duty and sabbatical leave of a watershed faculty member.

The position would be approximately half-time teaching and half-time research. About three courses (wildland hydrology, water quality, instrumentation) would be taught. Research would be somewhat flexible, but the incumbent would participate in directing present research in water quality, water yield improvement, and small watershed hydrology as well as developing new research in cooperation with the Utah Water Research Lab and federal agencies.

The salary would be commensurate with other such appointments within the College of Natural Resources and would be based on the individual's background and experience. A one-year appointment for an experienced, non-doctoral, professional in watershed science on administrative leave from a public agency, or for faculty on sabbatical leave would also be considered.

Applicants should send a resume and several letters of recommendation to: L.S. Davis, Head, Department of Forestry and Outdoor Recreation, Utah State University, UMC 52, Logan, Utah 84322, by June 1, 1976.

ANNOUNCEMENT OF POSITION OPENING

The University of Wyoming has an immediate opening for a Research Hydrologist. The position involves development of research information and techniques for projects in progress; initiation of new programs of water resources research with emphasis on surface hydrology; and, development and writing of research proposals and conducting the research when funded. Eventually, the successful candidate will become involved in teaching in the graduate water resource curriculum.

A Ph.D. in Civil Engineering or a related engineering discipline, with specialization in Hydrology, and experience in applied surface water problems are required. The classification is Research Engineer III, and the salary will be commensurate with qualifications.

Interested applicants should send resume and letters of reference to: Paul A. Rechar, Director, Water Resources Research Institute, The University of Wyoming, Box 3067, University Station, Laramie, Wyoming 82071.

The University of Wyoming is an equal opportunity employer.

FACULTY POSITIONS

The Department of Systems Engineering, School of Engineering, Case Western Reserve University, seeks to fill several faculty positions by Fall 1976. The positions entail a combination of teaching and research; teaching responsibilities include undergraduate and graduate courses offered by the Department of Systems Engineering.

The Department is responsible for courses and curricular programs in the areas of control, systems theory, systems analysis, and water resources systems. We have a variety of research projects applied to water resources systems, modeling of ecological systems, world modeling, stability theory of large scale systems, biomedical modeling and control, etc.

Specific faculty requirements are as follows: (1) Department Chairman and Professor of Engineering. (2) Assistant Professor of Engineering with background and interests in water resources to participate in the teaching and research in this area. (3) Assistant Professor of Engineering with background and interests in systems or control engineering. Research experience in some applied systems area would be desirable (e.g. socio-economic systems, energy systems, world modeling, integrated industrial systems, process control, etc.) For further information contact: Professor Irving Lefkowitz, Systems Engineering Department, Case Western Reserve University, Cleveland, Ohio 44106, (216) 368-4076.

FACULTY POSITION IN CIVIL ENGINEERING

Faculty position available in the Department of Civil Engineering, South Dakota School of Mines & Technology effective August 15, 1976. Candidates with Ph.D. preferred. Should have definite interest in undergraduate and graduate teaching in the environmental engineering area. A secondary area of interest should include hydraulics or fluid mechanics. Successful candidate will be expected to pursue research in area of specialization. Permanent position. Rank and salary commensurate with qualifications. Send resume to: Professor W.V. Coyle, Chairman, Department of Civil Engineering, South Dakota School of Mines and Technology, Rapid City, South Dakota 57701. An Equal Opportunity Employer.

RESEARCH REVIEW

Project Title: Mapping Model for Determining Land Suitable for Irrigation *wrong Title*

Principal Investigator: Deane M. Manbeck, Associate Professor
Department of Agricultural Engineering
University of Nebraska-Lincoln

The objectives of this research project are to interface an improved recharge simulation model with a groundwater model and to develop selection criteria for field experimental recharge projects to obtain significant model verification data.

A recharge simulation model has been developed to estimate the amount of water which may move from the ground surface to an aquifer under various conditions as an aid in predicting the behavior of groundwater reservoirs. Several aspects of the model need to be improved for greater utility, and the recharge model must be interfaced with a groundwater simulation model. The completed model, including the improved recharge simulation model, can be used more effectively to predict groundwater changes over time under various imposed alternative uses of the water supply for more realistic planning of irrigation development.

Sensitivity of parameters of the recharge simulation model has been established. Movement of water from the ground surface through various soil layers to the water table at several depths with variable irrigation and precipitation data has been simulated. Calculated recharge values are being compared with available estimated field data. Several groundwater simulation models are currently under study to ascertain the most appropriate for interfacing with the recharge model.

Initial data from field recharge projects are being used for preliminary development of selection criteria and essential procedures to obtain significant model verification data.