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Water Current

Volume 6 Number 4

April 1974

FROM THE DESK OF THE DIRECTOR . . .

With passage of LB 149 by the state legislature, mechanics were set in motion for creation of an Institute for Agriculture and Natural Resources (IANR). Agricultural interests throughout the state were instrumental in bringing about this structural change in order to establish closer communication between University administration and agricultural and natural resources interests.

The new Institute became effective April 1, 1974 with appointment of Vice Chancellor Duane Acker, formerly Dean of the College of Agriculture and Biological Sciences at South Dakota State University, Brookings, South Dakota. The Institute's five divisions are: the College of Agriculture (including the School of Technical Agriculture at Curtis), Agricultural Experiment Station, Cooperative Extension Service, Conservation and Survey Division and the Water Resources Research Institute.

In Nebraska natural resources are closely tied to agriculture and combining these interests should provide a more unified approach and sharper focus on common problems. The new organizational structure will give greater visibility to water resources research and enhance the operation of the Nebraska Water Resources Research Institute.

ON THE HOMEFRONT

IN MEMORIUM

James L. Higgins, former Director of the Nebraska Department of Environmental Control, will be missed by his many friends and colleagues. He was appointed to his post by Governor Exon in 1971, shortly after the legislature elevated environmental control to departmental status. During the first years of the new agency, he was responsible for developing rules and regulations for pollution abatement and working with industry and agriculture in efforts to provide clean air and water.

Jim stressed a reasonable, cooperative attitude towards cleaning up wastes. He initiated many activities including a feedlot permit program to control waste runoff, statewide regulation of air pollution sources, financial aid for municipalities to assist in construction of waste treatment plants and a solid waste program. More important than all of these, however, was his ability to understand the problems of the farmer, industrialist and private citizen and to approach solutions to these in a fair and understanding manner.

1974 SUMMER INSTITUTE

The Nebraska Water Resources Research Institute will sponsor a one-week Summer Institute July 21-26, 1974. This year's theme is "Quantitative Planning Techniques in Water Resources." The objective is to provide training in the application of simulation and optimization techniques to the planning and analysis of water resources systems. Primary emphasis will be given to application. Approximately 50 percent of the program will be devoted to workshops providing participants an opportunity to manipulate operational models. A case-study approach will be used to relate lecture materials to workshop activities. Both surface water and groundwater systems will be discussed. The role of quantitative models as practical planning tools will be considered.

Speakers and topics for the Institute program are as follows:

Introduction to Water Resources Systems	Warren Viessman, Jr., Director Water Resources Research Institute
Simulation Model Structuring - Surface Water Components	Gary L. Lewis, Assistant Professor Dept. of Civil Engineering University of Nebraska-Lincoln
Simulation Model Structuring - Ground Water Components	Peter W. Huntoon, Hydrogeologist Conservation & Survey Division University of Nebraska-Lincoln
The Big Blue River Basin Model - A Case Study	Peter W. Huntoon

Screening Models for Water Resources Planning	D. Peter Loucks, Chairman Dept. of Environmental Engr. Cornell University
The Elkhorn River Basin - A case Study	Gary L. Lewis
Simulation and Optimization - Combined Tools for Flood Control Planning	Gary L. Lewis, D. Peter Loucks, Isaac Yomtovian, Research Associate Water Resources Research Institute

For further information contact: Dr. Warren Viessman, Jr., Director, Water Resources Research Institute, 212 Ag. Engineering Building, University of Nebraska, East Campus, Lincoln, Nebraska 68503. Telephone (402) 472-3307.

FEDERAL HIGHLIGHTS

NATIONAL COMMISSION ON WATER QUALITY ANNOUNCES STUDY PLANS

The National Commission on Water Quality was created by Section 315 of the Federal Water Pollution Control Act Amendments of 1972. The Commission is compelled to carry on studies and investigations, using resources of the nation's scientific and research community.

The main task of the Commission will be to evaluate costs and benefits associated with the national commitment to clean water as reflected in the 1972 Act. Focus will be on "technological aspects of achieving, and all aspects of the total economic, social and environmental effects of achieving or not achieving, the effluent limitations and goals set forth for 1983."

The 15-member Commission has adopted a plan of study to guide its investigations which includes:

(1) Definition of Terms. This section will embody a statement of the specific tasks assigned the Commission. A glossary of terms will be prepared to define words used in staff and Commission reports.

(2) Description of Present Water Quantity and Quality. Using data and reports from EPA, USGS, state, regional and local agencies, the Commission will prepare a description of the current (1973-74) quantity and quality of the nation's waters. The study will indicate those areas where data are available and adequate for defining the current quality of water. For those areas where data are inadequate, the Commission will recommend appropriate steps to remedy deficiencies in data. Attention will be given to constituents and those which reflect the biological condition of the water. This statement will establish the base line against which improvements in water quality stemming from 1977 and 1983 regulatory requirements will be assessed.

(3) Capabilities and Cost of Technology. The Commission will assess and identify the current and potential technological capabilities and fiscal and economic costs of achieving effluent reduction or elimination from municipal, industrial and other point and nonpoint sources and will quantify the economic, social and environmental costs of achieving effluent reduction or elimination for requirements and goals of the Act.

(4) Application and Reconciliation of Costs and Resultant Levels of Water Quality on a Nation-wide Basis. Data obtained from the analysis of costs of application of the requirements of the Act will be matched with available data on sources discharging into individual river basins to aggregate costs for the nation. These costs will reflect regional and national costs of achieving the applicable effluent limitations.

(5) Projection of GNP and Governmental Income and Expenditures. As a basis for examining economic and other impacts, the Commission will prepare projections of the annual Gross National Product (GNP) and governmental income and expenditures through 1985. Such projections will permit comparison of public and private revenue resources in relation to projected demands on such revenues as a result of requirements to reduce or eliminate the discharge of pollutants.

(6) Impacts--Economic, Social and Environmental. Results from the analysis of the costs, benefits and capabilities of techniques to reduce or eliminate the discharge of pollutants, together with projections of GNP and governmental income and expenditure, will be used to ascertain the economic costs and benefits of achieving or not achieving requirements of the Act. The Commission will also identify the chemical, physical and biological composition of water necessary to restore and maintain the integrity of the nation's waters and provide for the protection and propagation of fish and wildlife and recreation in and on the water. Environmental consequences of achieving or not achieving the 1983 treatment requirements will be assessed. Achieving or not achieving the Act's requirements and goals can have social costs and benefits, and these impacts will be identified and described.

(7) Institutional Capabilities. The Commission will evaluate federal-state-regional-local institutions and interinstitutional arrangements for water pollution control and analyze their administrative and financial capabilities to accomplish legislative requirements and goals. Alternative divisions of required public expenditures will be examined for relative impacts on governmental programs.

(8) Regional Assessment Studies. Eight or ten representative river basins with the best available data will be examined in depth to test and validate projections developed on a national basis. Sociological and environmental, as well as economic, impacts will be characterized and pin-pointed wherever possible.

(9) Data Accumulation and Future Use. The Commission will examine means to keep Congress informed on a continuing basis, and will suggest methods for Congress to obtain the widest possible range of reliable information with which to judge the water quality program and make adjustments.

The Chairman of the National Commission on Water Quality is Nelson A. Rockefeller of New York. Vice Chairmen are Senator Edmund S. Muskie and Congressman Robert E. Jones. Commission members from the Senate are Jennings Randolph, Lloyd M. Bentsen, Howard H. Baker, Jr., and James L. Buckley. From the House of Representatives members include John A. Blatnik, James C. Wright, Jr., William H. Harsha and James R. Grover, Jr. Commission members from the public are: Edwin A. Gee, Senior Vice President of E.I. DuPont; William R. Gianelli, engineering consultant; and Raymond Kudukis, Director of Cleveland Public Utilities. The Executive Director is Frederick J. Clarke.

Copies of the Commission's "Study Plans" can be obtained by writing to the National Commission on Water Quality, 1111 18th Street, N.W., P. O. Box 19266, Washington, D. C. 20036.

For your information, following is a list of Advisory Committee members from the National Research Council to the National Commission on Water Quality:

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MAXIMUM WATER RESOURCES DEVELOPMENT URGED

In a recent speech, William J. Hull, President of the "National Waterways Conference, Inc.," called for a program to assure the water resources utilization necessary for the achievement of the national goal of energy self-sufficiency. If America is to escape "endemic shortages and life in the world of the queue," a program of maximum water resources development must be launched.

In his speech, Mr. Hull proposed reaffirmation of the nation's toll-free waterways policy, more adequate funding for water resources development, adoption of a set of national water resources goals and evaluation of projects on the basis of long-range national interests. Hull said, Congress' leadership in formulating such a program "is more imperatively demanded by the public interest now than ever before in our history."

DEPARTMENT FOR NATURAL RESOURCES NIXED IN FAVOR OF SHORT-TERM MEASURES

In view of the current energy crisis, it appears unlikely that Congress will act this year on the Administration's proposal to create a new cabinet-level agency for energy and natural resources. Abraham Ribicoff, Chairman of a Senate subcommittee on Executive Reorganization, stated that he wanted to concentrate on pending short-term energy legislation rather than spend all the subcommittee's time and work on wholesale administrative reorganization. Senator Henry M. Jackson (Washington), a member of the subcommittee and acknowledged Senate leader on energy matters, is interested in the reorganization proposal, but sources indicate he will not make an all-out push for the new department.

CONTROVERSY REIGNS OVER PROJECT DISCOUNT RATE

The question of the discount rate for river and harbor projects remains in a state of confusion. In passing the Water Resources Development Act, Congress intended to prevent use of the higher discount rate (currently 6-7/8 percent) approved by the Water Resources Council last fall.

In signing the Act last month, President Nixon stipulated that the rate be based on the formula promulgated in December 1968. That rate is now 5-5/8 percent, but it will likely increase to 5-7/8 percent in July. The President also issued a statement that the lower rate would be used in initial evaluations but federal agencies were "free to use" higher discount rates in selecting projects for authorization and construction.

Meetings of several water agencies have failed to resolve the confusion of the discount rate. Most observers agree that one project evaluation will be made "to give Congress the information it requested" but that supplementary analyses, possibly utilizing a higher discount rate, may become the basis for decision-making in the Executive Branch.

EDF QUESTIONS FLOOD CONTROL PROJECTS

The Environmental Defense Fund (EDF) has produced a film entitled "Planning for Floods" which assails flood control projects. Last year's floods caused \$1 billion in damages in the Lower Mississippi Basin. President Nixon recently endorsed a \$100 million supplemental budget request to strengthen and raise levees in this area. EDF is not convinced that such expenditures are wise and stated, "By making flood plains seem to be safe for development, this policy creates a vicious cycle of increasing expenditures and increasing losses." EDF believes that victims are moving out of flood plains rather than rebuilding and depending upon structural protection.

EDF urges civic groups, federal and state water agencies, conservation groups and river valley associations to see the film. They contend that "millions of dollars of taxpayers' money should not be spent every year to build flood control structures that cause tremendous environmental damage and create the potential for more flood damage. . . With land uses such as farming or recreation, which are compatible with occasional flooding, a river's recurring cycle of flooding causes little or no harm."

CONFERENCES

CONFERENCE ON PLANNING FOR WATER QUALITY MANAGEMENT

Cornell University will host a National Symposium on Water Quality Planning June 26-28, 1974. The symposium is sponsored by the Technical Council on Water Resources Planning and Management of the ASCE. The conference will focus primarily on water quality planning methods, the relationship of water quality planning to resources, conservation and environmental protection, and water quality planning and social progress.

The Program Chairman is Walter Lyon, Director, Bureau of Water Quality Management, Department of Environmental Resources, P.O. Box 2063, Harrisburg, PA. 17120. Preregistration forms and additional information regarding lodging, transportation, etc. may be obtained from General Co-Chairmen Leonard B. Dworsky or Daniel P. Loucks, Water Resources and Marine Sciences Center, 468 Hollister Hall, Cornell University, Ithaca, NY 14850.

IRRIGATION COURSE IN ISRAEL

The sixth Postgraduate Course on Irrigation for Specialists will be held October 14 to November 13, 1974 in Bet Dagan, Israel. Objectives of the program are to train agronomists, hydrologists and water engineers for work on special problems and practices of irrigation. The course will be conducted by the Institute of Soils and Water of the Agricultural Research Organization and will consist of 60 hours of lectures, 40 hours of laboratory work, as well as discussion, excursions and practical field work. Main topics include: water and soil resources for irrigation; water transport in the soil-plant-atmosphere system; solute retention and transport in irrigated soils; arid zone environment and irrigation; measurement techniques for water balance control; irrigation technology; crop water requirement; and salinity and irrigation.

Candidates for this postgraduate course should have a university degree in agronomy, geoscience or engineering with general hydrological training and a knowledge of English. The tuition, including lodging, field trips and study materials, is \$650. Travel expenses to and from Israel are not included.

Applications will be taken up to June 30, 1974. For further information and application forms, contact Yoash Vaadia, Director, or Haim Zaban, Deputy Director, State of Israel, Ministry of Agriculture, Agricultural Research Organization, Volcani Center, Bet Dagan, Israel.

SYMPOSIUM ON GROUNDWATER-SURFACE WATER INTERFACE

A Symposium on the Groundwater-Surface Water Interface will be held during the week of December 12, 1974 in association with the American Geophysical Union's Western Annual Meeting in San Francisco. The symposium is sponsored by the Surface Water and the Groundwater Committees of AGU.

Two half-day sessions consisting of five or six papers each will be scheduled. One-half of the papers will be invited from chief hydrologists in ground and surface water. The remaining papers will be selected from authors submitting information on this subject. The symposium will concentrate on applications-oriented interfacing of groundwater and surface water models and the management technologies that encompass conjunctive use of groundwater and surface water, including water quality considerations at the interface.

Interested persons should prepare an abstract on a standard AGU abstract form and send it by August 15, 1974 to Dr. Peter Huntoon, Surface Water Committee, AGU, Conservation and Survey Division, Room 121 Nebraska Hall, University of Nebraska, Lincoln, Nebraska 68508; or to A. I. Johnson, Groundwater Committee, AGU, U.S. Geological Survey, National Center MS-417, Reston, Virginia 22092.

PUBLICATIONS

FACTS AND FIGURES ON THE AMAZON RIVER

One of a series of nontechnical leaflets prepared by the U.S. Geological Survey entitled "The Amazon - Measuring a Mighty River" has been reprinted to answer questions about the earth sciences. This pamphlet contains many interesting facts about the Amazon including:

- The Amazon (the world's largest river) discharges an average of about 4,000 billion gallons of water a day at its mouth-- enough to provide the fresh water needs of the City of New York for over nine years. This flow accounts for about 15 percent of all the fresh water discharged into the oceans by all the rivers of the world. By comparison, the Amazon's flow is over four times that of the Congo River, the world's second largest river on the North American Continent.
- Not only is the Amazon the largest river on earth, but its waters are among the purest. In some places, water tested by hydrologists of a joint U.S.G.S.-Brazil expedition was found to have a chemical purity nearly equivalent to that of distilled water and greater than that of tap water in the United States. One reason for the water's purity is that the heavy rainfall in the basin has almost completely washed the soil of readily soluble minerals that adversely affect the chemical purity of a river.
- Unlike most rivers, the Amazon does not build a delta. Instead, its high rate of discharge transports its small amount of sediment far out to sea, where it is intercepted by ocean currents, and deposited along the coast of northern Brazil and the Guianas.
- Although the Amazon River was discovered in 1500, it was not until the 1960's that much of the first detailed information on the river's flow and quality was gathered. The first scientific measurements began in 1963 and again in 1964 when, in cooperation with the University of Brazil and the Brazilian Navy, a team of USGS scientists conducted hydrologic investigations on the Amazon to measure its flow, physical characteristics and chemical composition. One of the latest phases in the scientific exploration of the Amazon involves scientists from the USGS and Brazil who are using imagery obtained by NASA's Earth Resources Technology Satellite (ERTS-1) to update maps of the Amazon basin and to plot recent changes in the river channel. Additional and repeated imagery taken at different wavelengths is expected to help in a better understanding of such aspects of the river as the distribution of sediment and the response of the river to snowmelt in the highlands.

Copies may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402 for 30 cents per copy.

RURAL WATER QUALITY

The Commission on Rural Water, Washington, D. C., has issued a report entitled "Rural Water Supplies in America" which highlights a problem experienced in many localities in America. The report covers the history of the original National Demonstration Water Project (NDWP) at Roanoke, Virginia, where funds from the Office of Economic Opportunity aided in the provision of good water and waste treatment for scattered rural communities.

The report makes the following observations:

- (1) Between 20 to 30 million Americans, nearly 15% of the total U.S. population, do not have a safe supply of water. Most of these people live in low density settlements in rural areas.
- (2) USDA's Economic Research Service estimates that about 50% of the water wells in the country are shallow wells which show a high degree of contamination. Once again, rural populations are most affected.
- (3) An EPA-funded study of one rural area in Georgia, judged to be typical of many locations, revealed that 40% of the water supply systems were producing unsafe water and 15% of the systems were grossly contaminated.
- (4) Between the early 1940's and 1968, the U.S. contributed nearly \$1 billion for development of water systems in foreign countries, mostly to improve the standard of living in small underdeveloped communities.

Rural communities, which are 95% dependent upon groundwater, have the largest number of bad wells. If the original source of the water is high quality, it may soon be degraded by the effect of poor well construction or absence of waste treatment designed to protect the water supply.

The report strongly endorses the NDWP and notes that the type of planning which it suggests should improve groundwater management and demonstrate the efficiency of a mix of ground and surface water as a source of supply. The cost benefits of using locally available subsurface water as opposed to importing water through expensive pipelines are well-documented. The report favors widespread scientific development of the groundwater resource to serve scattered rural residents.

RESEARCH REVIEW

PROJECT TITLE: "Practical Treatment of Feedlot Runoff"

PRINCIPAL INVESTIGATOR: Terry J. McGhee, Assoc. Professor
Department of Civil Engineering

This project was designed to study the application of aerobic biological treatment techniques to feedlot runoff water, evaluate field operational problems and establish design criteria for such units.

A field treatment system with an aeration volume of 375 gallons has been designed, fabricated, installed and operated at the University of Nebraska Feedlots at Mead, Nebraska. The sedimentation basin was designed to provide a liquid retention time of 3.5 hours and a surface overflow rate of 210 gal/ft²/day when the aeration basin was operated at a one-day retention time. The weir loading rate was 375 gal/ft/day at the same retention time.

The design of the field installation incorporated the air lift solids return system utilized in a previous laboratory study. The air required for solids return was considered to be available for meeting the oxygen demand as well since it effectively aerated the return flow. Air requirements were based upon delivery of 1,000 to 2,000 ft³ of air per lb COD. A rotary lobe compressor was selected which had a capacity of 11 cfm at 5 psi. This unit provided 1,667 ft³ of air per lb COD at a one-day liquid retention time. Air was delivered to the mixed liquor through a 12-inch diameter plastic lawn sprinkler ring. This device provided excellent mixing and a small bubble size. No plugging occurred during the period of the study.

The aeration system was installed beside the holding pond at Mead. The settled runoff was pumped from the pond to the unit by a variable speed finger pump which had a capacity of 0 to 500 gpd. The rate of pumping was checked daily and adjusted as necessary to maintain uniform flow.

The system was operated at each retention time until equilibrium was evidenced by maintenance of relatively constant levels of MLSS, COD, etc. When equilibrium had been established, complete analyses were conducted for two consecutive days in order to determine the efficiency of treatment.

Results obtained to date have largely confirmed the earlier laboratory study. Further data is being obtained at other liquid retention times, organic loading rates, etc. In addition to completing the treatability study, data will be obtained with respect to response of the system to shock loading, mechanical failures and sludge wasting. Studies of color removal by adsorption on soil columns will also be continued.

The results of this research are expected to be applicable in the design and operation of feedlot runoff treatment systems. Interest in the results of this project have been indicated by agricultural engineers throughout the Midwest and by local consulting engineering firms.

PUBLICATIONS RECEIVED BY THE INSTITUTE

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2. Coliform Bacteria Growth and Control in Aerated Stabilization Basins, S. H. Watkins, Dr. Martin D. Knittel, Pacific Northwest Environmental Research Laboratory, National Environmental Research Center, Corvallis, Oregon, December 1973.
3. Hypolimnion Aeration with Commercial Oxygen - Vol. I - Dynamics of Bubble Plume, R. E. Speece, Fawzi Rayyan, The University of Texas at Austin, Lowell E. Leach, Robert S. Kerr, Environmental Research Laboratory, Ada, Oklahoma, December 1973.
4. Hypolimnion Aeration with Commercial Oxygen - Vol. II - Bubble Plume Gas Transfer, R. E. Speece, George Murfee, University of Texas at Austin, Lowell E. Leach, Robert S. Kerr, Environmental Research Laboratory, Ada, Oklahoma, December 1973.
5. Demonstration of a Non-Aqueous Sewage Disposal System, Floyd L. Matthew, Ervin E. Nesheim, William Librizzi, Edison Water Quality Research Laboratory, Edison, New Jersey, December 1973.
6. Sea Grant Institutional Program Year 06 Vol. 2, University of Hawaii, Honolulu, Hawaii, March 1, 1973.
7. Systems Analysis of Hydrologic Problems, Proceedings of the Second International Seminar for Hydrology Professors, Utah State University, Logan Utah, August 2 - 14, 1970.
8. A Physical Model for Prediction and Control of Saltwater Intrusion in the Floridan Aquifer, Bent A. Christensen, Andrew J. Evans, Jr., Department of Civil & Coastal Engineering, University of Florida, Gainesville, Florida, January 29, 1974.
9. Coastal Zone Management Problems, Seminar Conducted by Oregon State University, Water Resources Research Institute, January 1974.
10. Axisymmetric Infiltration, Royal H. Brooks, Paul J. Leclercq, Richard R. Tebbs, Walter Rawls, Water Resources Research Institute, Oregon State University, Corvallis, Oregon, January 1974.
11. Water for Tomorrow, Recommendations of the Commission, Temporary State Commission on the Water Supply Needs of Southeastern New York, E. Virgil Conway, Chairman, Albany, New York, December 1973.
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14. Proposed Water Supply Projects for Southeastern New York, Temporary State Commission on the Water Supply Needs of Southeastern New York, Albany, New York, December 1973.
15. Recovery of Fatty Materials from Edible Oil Refinery Effluents, Wendelin C. Seng, Clifford Risley, Jr., U. S Environmental Protection Agency, Office of Research and Development, 1 North Wacker Drive, Chicago, Illinois, December 1973.
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17. Proceedings of Public Hearings, Temporary State Commission on the Water Supply of Southeastern New York, Albany, New York, December 15, 1973.
18. Studies of the Forest Energy Budget, L. W. Gay, H. R. Holbo, Water Resources Research Institute, Oregon State University, Corvallis, Oregon, March 1974.
19. Broad Spectrum Microwave Systems for Remotely Measuring Soil Moisture Content, W. P. Waite, K. R. Cook, B. B. Bryan, Water Resources Research Center in cooperation with Engineering Experiment Station, University of Arkansas, Fayetteville, November 1973.
20. Water Quality Monitoring: Bacteria as Indicators, J. H. Bowdre, N. R. Krieg, Department of Microbiology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, February 1974.
21. Survival of Intestinal Bacteria in Oligotrophic Waters, Donald L. Johnstone, A. Mark Kubinski, Water Research Center, Washington State University and University of Washington, Pullman, Washington, July 1973.
22. Studies of the Flow of a Fluid with Density Differences Caused by Turbidity, B. S. Jenkins, University of New South Wales, Manly Vale, N.S.W., Australiz, August 1973.
23. Domestic Water Use in the New Guinea Highlands: The Case of the Raiapu Enga, R. Feachem, University of New South Wales, Manly Vale, N.S.W., Australia, May 1973.
24. Steady Flow in Small Pipe Networks Using Linear Theory, T. R. Fietz, University of New South Wales, Manly Vale, N.S.W., Australia, January 1973.

25. Hydraulics of Flow Near Wells in Unconsolidated Sediments, Vol. 2, Field Studies, C. R. Dudgeon, P. S. Huyakorn, W. H. C. Swan, University of New South Wales, Manly Vale, N.S.W., Australia, March 1973.
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28. Geohydrology and Water Resources of the Tucson Basin, Arizona, Geological Survey Water-Supply Paper 1939-E, E. S. Davidson, in cooperation with the city of Tucson, U. S. Bureau of Reclamation and University of Arizona, 1973.
29. The Role of User Fees and Congestion Tolls in the Management of Inland Waterways, Steve H. Hanke, Robert K. Davis, Reprinted from the Water Resources Bulletin, American Water Resources Association, 206 East University Avenue, Urbana, Illinois, February 1974.
30. Conventional and Unconventional Alternatives for Water Supply Management, Robert K. Davis, Steve H. Hanke, Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, Maryland, August 1973.
31. Percol User's Manual, R. J. Serne, R. C. Routson, Water and Land Resources Department, Battelle, Pacific Northwest Laboratories, Richland, Washington, 1973.
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33. The Political Economy of Water Resources Development, Steve H. Hanke, The Johns Hopkins University, Baltimore, Maryland, March 18-21, 1973.
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QUESTIONS AND INQUIRIES

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