



COLORADO WATER

Colorado Water Resources Research Institute

Colorado State University

Fort Collins, Colorado 80523

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March-June, 1985

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STATE APPROPRIATION SUPPORTS FIVE RESEARCH PROJECTS

The Institute received state funding for the first time for 1984-85 when the Colorado General Assembly passed an appropriation bill providing \$67,000 for water research. Work is progressing on five research projects supported by this appropriation. Three projects were initiated at Colorado State University, one at the Colorado School of Mines, and one at the University of Colorado, Boulder.

Geochemistry of Aquifer Recharge in the Denver Basin

Principal Investigator: Dr. A. Keith Turner, Geology Department, CSM

Water demands are depleting groundwater resources in the Denver metropolitan area and regions to the south and east. Recharge of the Denver Basin aquifers by injection has been proposed, and current knowledge of groundwater flow regimes suggests that the strategy would probably be successful. However, injection recharge can cause physical changes in the aquifer materials depending on the quality of both the original and the injected water and rock minerals forming the aquifer. This project will investigate the geochemistry of injection recharge operations in the Denver Basin, including the chemical interactions of injected water with aquifer minerals and the aquifer water.

Guidelines for Developing Area-of-Origin Compensation

Co-Principal Investigators: Dr. Larry MacDonnell, Director, Natural Resources Law Center, CU; and Professor James N. Corbridge, Jr., School of Law, CU

The compensatory storage principle, established in a 1933 agreement between east and west slope interests involved in planning the Colorado-Big Thompson Project, was incorporated into the 1973 Congressional authorization for the construction of the CBT. Compensatory storage has since been advocated as appropriate for all trans-mountain diversions. A 1973 report by the National Water Commission noted this approach may cause "economic waste because the area of origin may not be prepared to use the compensatory storage for many years."

This research is directed toward producing a set of guidelines for use in negotiating area-of-origin compensation based on acceptable and effective alternatives to compensatory storage. Other approaches to be investigated include improving agricultural water-use efficiency in the basin-of-origin, the creation of some kind of development fund, and the possible purchase of instream flow rights to protect the water conditions essential for recreation and tourism in the area.

South Platte Basin Simulation Model

Principal Investigator: Dr. Hubert Morel-Seytoux, Civil Engineering Department, CSU

A comprehensive computer model capable of simulating the water system (surface and groundwater) of the entire South Platte Basin below Denver is being "constructed" under an appropriation from the General Assembly. This project contributes to the construction of the model, which will be the essential tool for evaluating basinwide impacts of proposed water management changes or project developments. With it, day-by-day responses everywhere in the basin can be found as a result of changes anywhere in the system.

Low-Flow Criteria for Discharge Permits

Principal Investigators: Dr. Thomas G. Sanders, Civil Engineering Department, CSU; and Dr. David W. Hendricks, Civil Engineering Department, CSU

Wastewater effluent discharge permits are based upon low-flow criteria which are arbitrary and which therefore may be overly restrictive. Permits are based on the lowest seven consecutive-day flow expected to occur on the average one year out of ten years combined with specified levels of toxicity of constituents of concern. Both low-flow and toxicity criteria incorporate "margins-of-safety" which, when combined, produce a compounded margin of safety. The result may be unnecessarily expensive in terms of waste treatment costs because it produces an extremely low-risk aquatic environment. This

project will examine alternatives to the low-flow criterion. A search for both modifications in the current approach and for innovative approaches will be made.

This project is being supported in part by numerous discharge permit holders, the State Water Quality Control Division, and the USEPA, Region VIII. If an acceptable alternative approach is developed by the project, state and federal regulatory agencies would expect to implement it. Cost savings to discharge permit holders stand to be very large at no sacrifice of the aquatic environments in Colorado's streams.

Voluntary, Basinwide Water Management: South Platte Basin, Phase II

Principal Investigators: Dr. Neil S. Grigg, Civil Engineering Department, CSU; Professor Henry P. Caulfield, Jr., Political Science Department, CSU; and Norman A. Evans, Director, CWRI

With completion of Phase I last year, the ten-man study team concluded that additional work was needed to develop guidelines that will be helpful to government leaders and water-user organizations in their search for comprehensive planning, evaluation of options, and coordination of leadership in water supply development as well as in basinwide management improvements. Many water problems are so urgent that local-level water managers will not wait for state-level or federal-level initiatives. Quasi-public organizations offer great potential for taking leadership to furnish technical evaluation of proposed projects or management changes. Voluntary basinwide water management suggests the need for an orderly process for evaluating alternatives that would be sufficiently comprehensive so local decisions could be made in the light of a "Master" basinwide framework. This project will address the political and legal processes that would be involved and suggest viable approaches that can be taken.

NEW REPORT PROJECTS WATER SUPPLY/DEMAND FOR YAMPA AND WHITE RIVER BASINS

A new Institute report provides information on the Yampa and White River basins and the long-term outlook for water shortages in Colorado. Investigators synthesized a 1,000-year hydrograph of virgin flow for each basin and used the record to study variability of runoff. A set of nine possible demand scenarios added to existing compact delivery requirements was used to identify when, how often, how severe, and how lengthy future water shortages are likely to be.

J.E. FLACK PRESENTS PAPER ON INSTITUTE RESEARCH AT ASCE NATIONAL CONFERENCE

"Water Management Options in Meeting Urban Water Demands" was the topic of a paper presented by Professor J. Ernest Flack at the National Conference of the American Society of Civil Engineers. The meeting was held in Denver on April 29, 1985.

Professor Flack, Civil Engineering Department, CU, was a principal investigator on the Institute's FY1983 interdisciplinary team study on Voluntary Basinwide Water Resources Management in the South Platte Basin. "The basic premise of the project," said Flack, "was that voluntary, cooperative decision-making and operations can reduce both costs and conflict in the basin and increase the water users' ability to better utilize the basin's scarce water resources. Better decision-making is based upon and reinforced through the use of high-technology models that significantly increase the ability to predict the results of various courses of action."

"It is necessary," said Flack, "to ask how emerging problems on the river will be faced. Additional problems loom ahead, such as increases in conflict and growing urban demands."

"Economic models, when coupled with hydrologic models within the institutional setting of the basin, can serve as powerful tools in helping select among the options that can lead to improved water utilization. The operation of these kinds of models can be particularly effective in assisting urban water managers in deciding when and to what degree to adopt various water conservation methods. It also permits development of drought contingency plans for coping with unforeseen but certain-to-occur deficiencies in water supply," said Flack.

Institutional constraints on increased water use are also analyzed together with potential implications for the basin and possible state actions.

The report, *Variability of Unutilized Surface Water Supplies from the Yampa and White River Basins*, is available from the CSU Bulletin Room (CR 136 — see OFF THE PRESS).

FEDERAL APPROPRIATION SUPPORTS SIX WATER RESEARCH PROJECTS

The Institute's water research and technology transfer program for FY1985 has been submitted to the U.S. Geological Survey for approval. The USGS administers the grants to State Institutes under the Water Research Act of 1984. Eleven project proposals were submitted for consideration in response to invitations to Colorado's four major research universities (CU, DU, CSM, and CSU). The water problems on which the research will be focused are those identified as highest priority by the Colorado Department of Natural Resources.

The Institute's Technical Advisory Committee, comprised of faculty scientists from the four universities, met and reviewed each of the proposals. The FY1985 program, as recommended by the TAC, includes the following projects:

Potential Groundwater Contamination from Chemigation

Principal Investigator: Dr. James W. Warner, Civil Engineering Department, CSU

Groundwater quality control is a high-priority issue for Colorado and also the nation. Chemigation, the practice of applying fertilizer and/or pesticides to crops through center-pivot irrigation systems, is becoming increasingly more common.

In Colorado's High Plains about 440 irrigation wells were attached to chemical injection systems in 1983, and the trend is toward a fivefold increase by 1985. If the well pump fails during chemigation, the potential exists for fertilizer and/or pesticide to be back-siphoned down the well, possibly contaminating the aquifer. At present little is known about chemigation's potential impact on the groundwater system. This project will study the fate of chemicals introduced in this manner into the groundwater. Computer groundwater modeling techniques will be used to simulate the behavior of the chemicals in the groundwater when an accidental event occurs.

The Impact of Water Conservation on Quality of Residential Lawns

Principal Investigator: Dr. J. Ernest Flack, Civil Engineering Department, CU

This project will compare the quality of lawns and landscaping in six Front Range cities. It will study the degree to which water demand reduction in residential

communities results in a deterioration in the visual quality of the urban environment, and whether or not various conservation practices are compatible with public preferences for visual quality.

Incentives for Improving Irrigation Efficiency in the South Platte Basin

Principal Investigators: Professor George Radosevich and Dr. Robert A. Young, ANR Economics, CSU

This project will investigate legal and financial constraints to improving on-farm irrigation efficiency. An economic model will be developed for quantifying benefits and costs to present and potential water users. This is Phase I of a three-phase plan to ultimately produce a combined hydrologic-economic model which will test possible incentives for improving irrigation efficiency against both economic and hydrologic criteria.

Geochemistry of Aquifer Recharge in the Denver Basin

Principal Investigator: Dr. A. Keith Turner, Geology Department, CSM

This project will supplement work in a project of the same title under the Institute's state-funded water research program. The geochemistry of injection recharge operations in the Denver Basin, including the chemical interactions of injected water with aquifer minerals and the aquifer water, will be investigated. The outlook is strong for future recharge by well injection into zones of high rate of withdrawal. This part of the recharge technology is completely unknown, so the project fills a gap in necessary knowledge.

Evapotranspiration of Phreatophytes in the Closed Basin, San Luis Valley

Principal Investigators: Dr. Norman A. Evans, Agricultural and Chemical Engineering, CSU; Dr. Walter Bausch, USDA/ARS; Dr. Jack Morgan, USDA/ARS.

This is a cooperative project with USDA/ARS, USBR, and the Colorado Division of Water Resources. It is the second phase of a research project that was initiated in FY1984 in response to a request from Colorado's State Engineer. Research attention is focused on the problem of estimating evapotranspiration from native vegetation in

the Closed Basin Project. The project, under construction by the U.S. Bureau of Reclamation and located in the Rio Grande River Basin, will salvage water now being consumed by evapotranspiration of non-beneficial vegetation. Salvaged water will be released into the Rio Grande River to help meet Colorado's compact obligations to New Mexico and Texas.

Project personnel will develop gas-analysis technology for making instantaneous field measurements of evapotranspiration from native vegetation in the Closed Basin. This data is needed to complement evapotranspiration measurements being made by USBR from lysimeters. The objective is to find the most accurate estimate of ET reduction due to water-table lowering by pumping in the project area. This estimate is critical to the operation of the project because it determines how much water can be salvaged legally for delivery to the Rio Grande to meet Colorado's compact requirement.

Compensation to Basin-of-Origin for Water Exports

Principal Investigator: Dr. Ed Sparling, ANR Economics, CSU

Transfer of water from western Colorado to eastern Colorado has raised numerous legal and political issues. Most recent compromises have included compensatory storage in the basin-of-origin. The economic efficiency of this approach will be analyzed and viable alternatives to equitable compensation will be examined. An analytical framework will be developed in this project to evaluate various approaches for compensation to the basin-of-origin.

The FY1985 Institute Program focuses on the current highest-priority problems identified by the Colorado Department of Natural Resources. This department includes: (1) the Colorado Water Conservation Board, the State's principal water planning and policy agency; (2) the Division of Water Resources; (3) the Division of Parks and Outdoor Recreation; (4) the Division of Wildlife; and several other agencies with water resource functions.

Student Training

Seven graduate research assistants and nine undergraduate students will participate in the projects and thereby gain experience in water resources research.

FY1985

TECHNOLOGY TRANSFER

The Technology Transfer Program will facilitate application of new technologies developed by Institute re-

search to five Colorado water problems which are particularly important at this time:

- (1) artificial groundwater recharge in alluvial aquifers of the South Platte Basin;
- (2) selection of optimum site and sizing for basin water storage;
- (3) basinwide day-by-day simulation of the conjunctive surface-groundwater systems of the South Platte;
- (4) voluntary basinwide water management including storage, hydropower and irrigation; and
- (5) on-farm water conservation in the High Plains-Ogallala region.

Other water problems to which the results of research will be applied are: the values of water for various uses (recreation, instream habitat, etc.); multiple reservoir system operation in runoff extremes; and irrigation pumping plant performance.

An innovative feature of this year's program will be the conduct of two demonstration projects applying newly developed products of research to problems (1) and (2) above.

Groundwater Recharge in the South Platte Basin

Three CSU faculty members with strong technical backgrounds will participate in a demonstration project on groundwater recharge in the South Platte Basin. Dr. James Warner, Civil Engineering, will manage the project. Dr. Daniel Sunada, Civil Engineering, and Dr. David McWhorter, Agricultural and Chemical Engineering, will also participate in the demonstration. Warner worked with USGS and recently with Daniel Sunada on the San Luis Valley Recharge Project (Institute Project A-050-COLO). Sunada has worked in California on recharge projects, and also in Colorado on projects in both the South Platte and San Luis Valley Basins. McWhorter recently assembled a comprehensive bibliography on artificial recharge and a report summarizing problems and their technical solutions.

Optimum Reservoir Site and Sizing

Hydrologic optimization technology for reservoir site and sizing, developed and tested in previous Institute research, will be applied in a demonstration project. The model, given a specific set of current or projected demands, can determine the best combination of reservoir sizes and locations for a basin. Any number of demand scenarios and any number of potential reservoirs can be investigated — the criteria is cost effectiveness and water availability to meet the demands.

The demonstration will be conducted by Dr. Darrell Fontane, Civil Engineering Department, CSU.

CWRRI ACTIVITIES REPORT FOCUSES ON WATER RESEARCH ACCOMPLISHMENTS

The Institute's focus on practical, problem-solving water research is spotlighted in its *Activities Report for FY1981-1984*, now available from the Institute office on request (491-6308). Selected examples of research activities during this period illustrate their significance and relevance to the practical concerns of water users and managers in Colorado. Advances in integrated basinwide water management, surface and groundwater management, groundwater recharge, urban drainage, computer-assisted water resources planning, urban water conservation, drought-tolerant crop development, and water quality control for metal mining operations are reviewed.

The report provides a summary of CWRRI's funding and resource allocation and professional training provided to graduate students, the water resource professionals of tomorrow. It also describes a diversity of additional services the Institute provides for executive departments of state government, the Colorado General Assembly, municipalities, industry and the general public. The processes of establishing research priorities in cooperation with water users throughout Colorado and review and selection of water research projects are explained.

COLORADO WATER ISSUES PUBLIC FORUM

The June 18 Forum is cancelled due to the move to a new location by Wyatt's Cafeteria. The Forum will resume September 17, 1985 at Wyatt's new location (still in Villa Italia Shopping Center).

CSU IS "HOME" FOR NPS WATER RESOURCES FIELD SUPPORT LAB

A number of federal and state agencies responsible for the administration and field research support of natural resource managers are based in Fort Collins. The National Park Service established its Water Resources Field Support Laboratory (WRFSL) in Fort Collins in 1980 under a cooperative agreement with CSU. The agreement provides WRFSL staff the use of University facilities and services including laboratory facilities, the CSU library, and the CYBER 170 Series computer system.

The WRFSL mission includes scientific support to the park units and regions to help ensure the preservation and protection of NPS waters, and fostering interagency cooperation in water resources research.

WRFSL activities and accomplishments for 1984 are described in its *Annual Report: 1984*, available from:

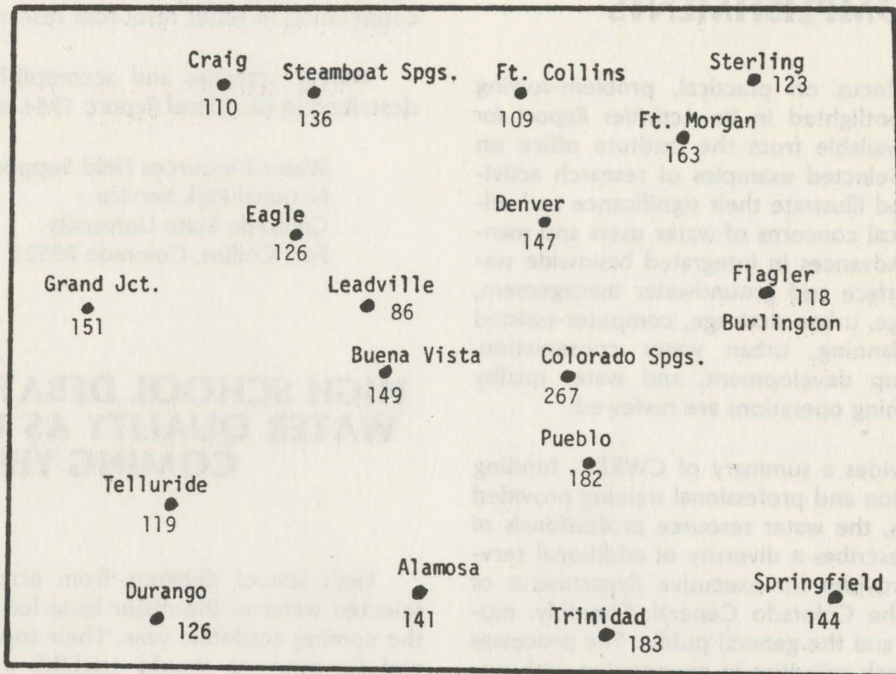
Water Resources Field Support Laboratory
National Park Service
Colorado State University
Fort Collins, Colorado 80523

HIGH SCHOOL DEBATERS SELECT WATER QUALITY AS TOPIC FOR COMING YEAR

High school debaters from across the nation have selected water as the major issue for their debates during the coming academic year. Their topic is, "That the Federal Government should establish a comprehensive national policy to protect the quality of water in the United States." This topic will provide a reason for some of our brightest young people to seriously explore the question of water quality in the United States and particularly in Colorado. It will bring public awareness of water problems to a higher level, especially for the next generation of leaders, and hopefully it will attract many to careers in water resource fields. CWRRI will be pleased to help the schools and debaters find facts and information that will be needed.

CALIFORNIA WATER NEWS

California's Metropolitan Water District is exploring ways to store surplus water now available from the Colorado River. The May issue of *U.S. Water News* reports that MWD has proposed the creation of huge underground reservoirs beneath Palm Springs, California for storing water to help meet southern California's water needs. The District's general manager said the plan will take advantage of surplus water now flowing from the upper Colorado Basin and low-cost power from Hoover Dam to pump the water. MWD plans to percolate 350,000 acre-feet of surplus water into the groundwater basin, with possible ultimate storage of as much as 600,000 acre-feet.



COLORADO PRECIPITATION

October 1984 through April 1985

(PERCENT OF NORMAL)

**STATE PRECIPITATION
INFORMATION AVAILABLE FROM
COLORADO CLIMATE CENTER**

A map and publication analyzing Colorado's average annual precipitation for the 1951-80 period is available from the Colorado Climate Center. The colored 1:500,000 map (approximately 43" x 52") and accompanying publication describing the data and analysis are available from the Center at the following cost:

Map picked up at office	no charge
Map folded, mailed parcel post	\$5.00
Map in mail tube, mailed parcel post	\$9.00
Publication	\$5.00

The Center also publishes a monthly newsletter describing each month's precipitation patterns in comparison with historic averages.

Contact: Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

CONFERENCES

- June 20-21 NATIONAL SYMPOSIUM ON INSTITUTIONAL CAPACITY FOR GROUND WATER POLLUTION CONTROL, Denver, CO. Contact: Symposium Coordinator, Environmental and Ground Water Institute, University of Oklahoma, 200 Felgar St., EL 127, Norman, OK 73019.
- July 22-25 COLD REGIONS HYDROLOGY SYMPOSIUM, Fairbanks, AK. Contact: Dr. Douglas Kane, Institute of Water Resources Engineering Experiment Station, University of Alaska, Fairbanks, AK 99701.
- July 23-25 ACID RAIN AND THE WEST: DIRECT AND INDIRECT EFFECTS, Gunnison, CO. Contact: Theo Colborn, Western State College, Gunnison, CO 81230. 943-2082 or 641-2747.
- July 28-31 ANNUAL MEETING, UNIVERSITIES COUNCIL ON WATER RESOURCES, Amherst, MS. Contact: William L. Powers, UCOWR, 310 Ag Hall, Univ. of Nebraska, Lincoln, NE 68583. (402)472-3305.
- July 29-Aug. 2 GROUNDWATER POLLUTION AND HYDROLOGY, San Francisco, CA. Contact: Mrs. Iva Barros, Director, Princeton Associates. (609)924-4163.
- July 31-Aug. 2 10TH ANNUAL COLORADO WATER WORKSHOP, Aspinal-Wilson Center, Western State College, Gunnison. Contact: Marlene Zanetell, Colorado Water Workshop, Western State College, Gunnison, CO 81230.
- Aug. 11-16 ANNUAL AMERICAN WATER RESOURCES ASSOCIATION CONFERENCE AND SYMPOSIUM, Tucson, AZ. Conference: "Water Demand: Sharing a Limited Resource." Symposium: "Groundwater Contamination and Reclamation." Contact: Dr. N. Buras, University of Arizona Department of Hydrology and Water Resources, Tucson, AZ 85721.
- Sept. 24-27 WATERPOWER '85: AN INTERNATIONAL CONFERENCE ON HYDROPOWER, Las Vegas, NV. Contact: H. Tuvel, ASCE, 345 East 47th Street, New York, NY 10017.
- Oct. 2-4 THE 3RD NATIONAL SYMPOSIUM AND EXPOSITION ON GROUNDWATER INSTRUMENTATION, San Diego, CA. Contact: Barbara J. Graves, Conference Coordinator, National Water Well Association, 500 West Wilson Bridge Rd., Worthington, OH 43085. (614)846-9355.
- Oct. 21-25 INTERNATIONAL CONFERENCE ON ARID LANDS, Tucson, AZ. Contact: G.P. Nabhan, Office of Arid Land Studies, University of Arizona, Tucson, AZ 85721.
- Oct. 29-31 SYMPOSIUM ON CAUSES AND CONSEQUENCES OF THE TRANSITION TO DRYLAND AGRICULTURE, Denver. Contact: William L. Powers, Director, Nebraska Water Resources Center, 310 Agricultural Hall, University of Nebraska, Lincoln, NE 68583-0710. (402)472-3305.
- Nov. 13-16 10TH TECHNICAL CONFERENCE ON IRRIGATION, DRAINAGE AND FLOOD CONTROL, Reno, NV. Contact: U.S. Committee on Irrigation and Drainage, P.O. Box 15326, Denver, CO 80215.
- Nov. 14-15 EDUCATION AND PROFESSIONAL DEVELOPMENT IN HYDROLOGY AND HYDROGEOLOGY: NEEDS AND OPPORTUNITIES, Las Vegas, NV. Contact: Program Coordinator, American Institute of Hydrology, P.O. Box 14251, St. Paul, MN 55114. (612)379-1030.
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OFF THE PRESS

The following publications are available upon request at prices listed plus postage of:

Up to 99¢	\$.75
\$1.00-\$4.99	\$1.00
\$5.00-\$9.00	\$1.50
\$10.00 and over	\$2.00

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- CR135 COST-EFFECTIVE DESIGN AND OPERATION OF URBAN STORMWATER CONTROL SYSTEMS, by John W. Labadie, Neil S. Grigg, Dennis M. Morrow and David K. Robinson. \$7.00

A Stormwater Control Package (SWCP) is presented with user manual to introduce automation into urban stormwater control systems. The package contains state-of-the-art technology in storm inflow forecasting, fully dynamic hydraulic routing, and dynamic programming optimization. It is designed for "simulated" real-time experimentation on application automation to combined storm and sewer control for achieving improved performance.

In addition to operational software, an optimal sewer design package called CSUDP/SEWER is presented with user manual which also employs dynamic programming. As a screening tool, CSUDP/SEWER can find least-cost vertical layouts and sizings of storm drainage systems.

- CR136 VARIABILITY OF UNUTILIZED SURFACE WATER SUPPLIES FROM THE YAMPA AND WHITE RIVER BASINS, by Hsieh Wen Shen, Raymond Anderson, Henry P. Caulfield, Jr., and Song-Kai Yan. \$7.00

Examines a wide range of flow conditions for the Yampa and White River Basins using 1,000-year synthetic hydrographs developed for the two rivers. A study was made of variability in runoff.

A set of nine possible demand scenarios added to existing compact delivery requirements was used to identify when, how often, how severe, and how lengthy future water shortages are likely to be. Institutional constraints on increased water are also analyzed together with potential implications for the basin and possible state actions.

- IS54 ARTIFICIAL AQUIFER RECHARGE IN THE COLORADO PORTION OF THE OGALLALA AQUIFER, by Robert Longenbaugh, Donald Miles, Earl Hess, and James Rubingh. \$2.00

Discusses factors to be considered before an artificial recharge project is constructed, artificial recharge methods, potential for artificial recharge in Colorado's Northern High Plains, and five aquifer recharge demonstration projects that have been constructed and monitored.

OTHER PUBLICATIONS

ANNUAL REPORT: 1984, Water Resources Field Support Laboratory, National Park Service, 107C Natural Resources, Colorado State University, Fort Collins, CO 80523.

HANDBOOK OF LAND TREATMENT SYSTEMS FOR INDUSTRIAL AND MUNICIPAL WASTES, by Sherwood C. Reed and Ronald W. Crites, Noyes Publications, Mill Road at Grand Avenue, Park Ridge, NJ 07656.

SPECIAL WATER DISTRICTS: CHALLENGE FOR THE FUTURE, James N. Corbridge, Editor. Natural Resources Law Center, University of Colorado School of Law, Boulder, CO 80309.

SAVING WATER IN A DESERT CITY, by William E. Martin, Helen M. Ingram, Nancy K. Laney, and Adrian H. Griffin. Resources for the Future, Inc., 1755 Massachusetts Ave., N.W., Washington, D.C. 20036.

SOIL, WATER, AND CROP PRODUCTION, Edited by D. Wynne Thorne and Marlowe D. Thorne. Textbook Department, AVI Publishing Co., Inc. 250 Post Road E., P.O. Box 831, Westport, CT 06881.

GROUNDWATER MONITORING (A handbook for the evaluation, design and implementation of groundwater monitoring programs), by Lorne G. Everett. General Electric Company, Business Growth Services, 120 Erie Blvd., Dept 798, Schenectady, NY 12305.

The following publications are available from:

Lewis Publishers
121 So. Main Street
P.O. Drawer 519
Chelsea, Michigan 48118

RIVER WATER QUALITY MONITORING, by Larry W. Canter

ENVIRONMENTAL IMPACT OF WATER RESOURCES PROJECTS, by Larry W. Canter

ACID RAIN AND DRY DEPOSITION, by Larry W. Canter

GROUNDWATER POLLUTION CONTROL, by Larry W. Canter

SAFE DRINKING WATER: THE IMPACT OF CHEMICALS ON A LIMITED RESOURCE, Edited by Rip G. Rice

DUST BOWL DAYS

The Winds of Change in the West Colorado State University

June 17, 7:00 P.M. Lory Student Center Theatre: "Dust Bowl Voices," an illustrated lecture by Bill Ganzel, Nebraska Public TV.

June 17, 8:15 P.M. Lory Student Center Gallery: Bill Ganzel will be on hand to open an exhibit of his stunning collection of photographs based upon his highly regarded book, *Dust Bowl Descent* (University of Nebraska Press, 1984).

June 18, 7:30 P.M. Lory Student Center: an illustrated talk, "Threats to Fragile Lands and Fifty Years of the Soil Conservation Service," Jerry D. Schwien, Don Moss and Edith Phillips.

June 25, 7:30 P.M. A "campfire" talk in Lory Center Sculpture Garden area (formerly the ice rink): "Water in the Plains: The Colorado-Big Thompson Project in a Dusty Future." Larry Simpson, Board Manager, Northern Colorado Conservation District.

July 2, 7:30 P.M. A "campfire talk in Lory Center Sculpture Garden: "Digging Holes and Planting Poles: The REA in the Dust Bowl." Richard Easton, Director of the Rural Electrification Association.

July 9, 7:30 P.M. 228 Lory Student Center: "Ghost Towns of the Plains," an illustrated talk by Perry Eberhart, author of a book by the same title.

July 16, 7:30 P.M. A "campfire" talk in Lory Center Sculpture Garden: "The Next Dust Bowl." Roger Johnson, a Colorado rancher.

July 23, 7:30 P.M. A "campfire" talk in Lory Center Sculpture Garden: "You Can't Lay Your Head on Mother Nature's Breast: Weather and Colorado People," by Neil Propst, author of "Forgotten People: A History of the South Platte Trail."

July 29, 7:30 P.M. Lory Student Center Theatre: "Bustin' the Dust," by Professor Paul Nordquist, University of Nebraska and O. Lee a Sandhill dirt farmer.

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Shirley Miller	Editorial Assistant
Cydney Conway	Secretary

Editorial comments and opinions expressed in COLORADO WATER do not necessarily reflect the views of Colorado State University, the U.S. Department of the Interior, or the Institute.

July 2, 1987 P.M. A "campfire" talk in Loy Center
 Sculpture Garden, "Digging Holes and Planting Poles: The
 524 in the Southwest," Richard Eaton, Director of the
 Rural Electrification Association

July 7, 1987 P.M. XII Loy Student Center "Chow
 Town of the Plains," an illustrated talk by Perry Ibsen,
 author of a book by the same title

July 22, 1987 P.M. A "campfire" talk in Loy Center
 Sculpture Garden "The Only Loy You Need on Home
 Nature: Great Waters and Colorado People," by Neil
 Foy, author of "Foghorn People: A History of the
 South Platte Trail"

July 25, 1987 P.M. Loy Student Center Lecture
 "From the Past to the Future: The History of
 Colorado and the West"

COLORED WATER MONITORING (A handbook for the
 evaluation, design and implementation of ground-
 water monitoring programs, by James C. Lovett, Gen-
 eral Electric Company, Business Growth Services, 120
 East Blvd., Dept 788, Schenectady, NY 12302

The following publications are available from:
 Lewis Publishers
 121 So. Main Street
 P.O. Box 718
 Chelsea, Michigan 48118

WATER QUALITY MONITORING by Jay W.
 Carter

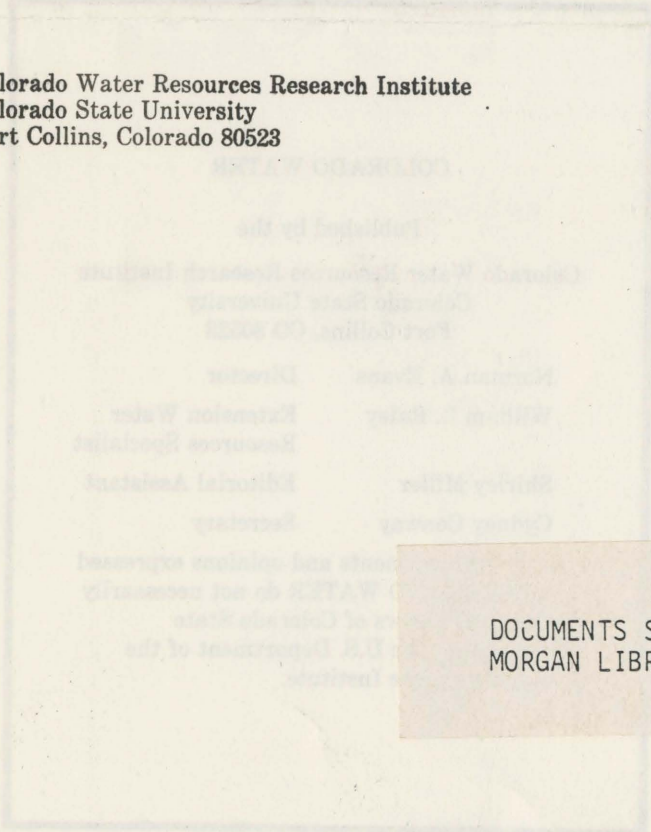
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GROUNDWATER POLLUTION CONTROL by Jay W.
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SAFETY DRINKING WATER: THE IMPACT OF CHEMICALS
 ON A LIMITED RESOURCE, edited by R. C. Rice

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 Nature: Great Waters and Colorado People" by Neil Foy, author
 of "Foghorn People: A History of the South Platte Trail"

July 25, 1987 P.M. Loy Student Center Lecture
 "From the Past to the Future: The History of Colorado and the West"