



COLORADO WATER

Colorado Water Resources Research Institute

• Colorado State University

• Fort Collins, Colorado 80523

JULY, AUGUST, SEPTEMBER

SOUTH PLATTE COALITION FORMED — IMPROVED RIVER MANAGEMENT IS GOAL

The Greeley Tribune reported on July 3 that agricultural water users and major ditch companies in the South Platte River Basin have formed a coalition to improve management of the river and make more water available. The coalition established four immediate goals at its April organizational meeting:

- to maximize use of water through cooperative management;
- to obtain adequate information on present and future methodology of river operations;
- to promote cooperation among all water users; and
- to protect the environment.

Robert Walker, President of the Central South Platte Water Conservancy District, serves as coalition chairman. The coalition is motivated by a management plan created for the Potomac River Basin in Virginia and Maryland. The two states and several large cities in the basin cooperated in developing a hydrologic computer model that helped solve the basin's water supply crisis. The new management strategy increased available water by 50 percent and solved the supply problem for the next two decades. Using the basin simulation model, they discovered that only two reservoirs were needed rather than 16 as proposed in fragmented separate plans.

In Colorado, the Water Resources Research Institute's development of computer-based technology can help by testing any new management-strategy options for the South Platte Basin that may interest the coalition.

SAMSON

Dr. Hubert J. Morel-Seytoux, Civil Engineering Department, CSU, has developed computer technology over the past ten years that culminated in SAMSON (Stream-Aquifer Model for Simulation and Optimization), a technological advance that makes *daily* simulation of the basin cost effective.

Effects of management changes cannot be tested physically by trial and error, so SAMSON was created to represent, in computer language, the essence of the real water system. It calculates how the entire basin water system would be affected by changes at any point, such as transfers of water from agricultural to municipal use, groundwater pumping, shifts in demand locations, reservoir construction, interbasin transfers, and water right demands.

The basin model is complete and operational from Balzac to Julesburg, and was used to test the effects of the GASP augmentation plan. In 1983 the General Assembly appropriated funds to extend the model upstream to Denver.

MODSIM

Dr. John Labadie, Civil Engineering Department, CSU, developed MODSIM as a basinwide planning model with general application to any basin. It was tested and verified by application on two specific water management cases: high-country reservoir releases for recreational enhancement; and a set of exchanges to provide cooling water for the Rawhide Power Plant north of Fort Collins. The City now uses MODSIM to manage its raw water supply and plan for meeting future water demands (COLORADO WATER, May-June, 1984).

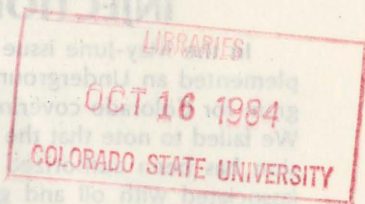
Economic Models

While hydrologic simulation models are now commonly used (and "new generations" are being developed), their combination with economic models is a developing new technology. Dr. Robert Young, Agricultural and Natural Resources Economics Department, CSU, is one of the Nation's leaders in this field. He has developed and used combined economic-hydrologic computer models in economic-impact studies of water management changes for the South Platte Basin and also the High Plains Ogallala Aquifer.

South Platte Team Study

A team of 10 researchers is developing a document that shows how computer-based technology can lead to more effective water management in the South Platte Basin. Background technical documents provided by team investigators include considerations of urban and industrial water conservation, stream-aquifer modeling, water storage optimization, Denver Basin deep-bedrock groundwater, the quality of surface and groundwaters, economics of water allocation alternatives, legal-institutional aspects of water allocation, and current management practices.

The Study Team's report on "Voluntary Basinwide Water Management for the South Platte Basin" will be available in October.



CORRECTION — UNDERGROUND INJECTION CONTROL

In the May-June issue we reported that EPA had implemented an Underground Injection Control (UIC) program for Colorado covering five classes of injection wells. We failed to note that the Colorado Oil and Gas Commission has been authorized to administer all Class II wells (associated with oil and gas production) in the State of Colorado, except those on Indian lands.

Since the passage of the "Oil and Gas Conservation Act" by the Colorado General Assembly in 1951, underground disposal of water in the oil industry has been regulated by the Oil and Gas Conservation Commission. From that time there have been no wells used for injection without review of the plan and its approval by the Commission, says Bill Smith, Commission Director.

Early in 1984 the Commission staff and the staff of EPA worked out testing procedures and other necessary improvements to the Commission rules to assure EPA that Colorado's regulations and enforcement would meet Federal standards. On April 4, 1984, the EPA granted primacy to the Commission for regulation of Class II wells.

WORK PROGRESSES ON SOUTH PLATTE MODEL

The extension of SAMSON, authorized by the General Assembly in 1983, is proceeding on schedule. Mapping preparation and grid overlay work is complete for the main stem and tributaries of the South Platte. Information gathered for the model includes locations of all diversions on tributaries and main stem, locations of surface drainage and surface return flow into the river, locations of wells, pump capacity and aquifer data.

How Does SAMSON Work?

SAMSON combines conventional computer technology with analytical methods to simulate in space and time the results of changes in river basin operation.

The model is based on a grid of cells one mile by one mile square overlaying a large map of the irrigated area. Numerous calculations must be made for each of the four corners of every grid cell (probably around 2,000).

Without the capabilities of SAMSON the computing task would be massive. However, technology developed by Dr. Morel-Seytoux reduces the number of computations needed to a small fraction of those originally required and makes this technology cost effective.

Dr. Morel-Seytoux answered questions about the model's capabilities from members of the project's advisory panel at a July 20 meeting in Greeley.

Question: Will the model account for inflow from Denver Basin bedrock aquifers or from the Ogallala Aquifer?

Answer: Inflows or outflows to the alluvial aquifer can be handled as any other "excitation" to the model.

Question: Will the model accurately simulate water right

The average man contains about 50 quarts of water, or roughly 100 pounds. The amount is important because loss of a mere 15 percent of the body's water is usually fatal. Water soaks our tissues, fills the spaces between our cells, and circulates through 60,000 miles of arteries and veins inside our bodies . . . Most of the Earth's surface is water; the oceans cover 71 percent of the globe . . . Like the air we breathe, water is so much a part of our daily lives that we usually take it for granted . . . Although America has enjoyed an abundance of high-quality water since the land's very discovery, the nation now faces a set of problems that run a disturbing gamut from toxic waste contamination of backyard wells in rural Massachusetts to the depletion of groundwater beneath Oklahoma's High Plains.

"The Magnificent Liquid of Life"

by Fred Powledge

National Wildlife, Feb.-Mar., 1984

exchanges?

Answer: Exchanges are part of the "rules of operation" which may be selected freely to be fed into the model to formulate each "scenario." There is no limitation on the type of exchanges used by water right owners which can be incorporated into the simulation runs.

Question: Can damage to intervening water rights because of exchanges be evaluated?

Answer: Yes, the model can be run with and without the exchange operating to test any damage to other water rights.

Question: Will the model be "user-friendly" with interactive capability?

Answer: As constructed it will not be "interactive" in the traditional meaning. However, the interactive capability can be added subsequently with no difficulty. That operation is simply a computer-programming task and does not affect the operation of the model itself.

Question: Are there transferability limitations?

Answer: The model will be coded in FORTRAN 77 and will be transferable to any machine capable of handling that code.

Question: Can a river commissioner isolate part of the basin model for local use?

Answer: This will not be possible, in general. However, the tributaries (Poudre, Big Thompson, St. Vrain) will be separable.

SAMSON will be completed in June, 1985, thus providing a simulation model for the entire South Platte River Basin.

GROUNDWATER COMMITTEE MAKES RECOMMENDATIONS

A Groundwater Legislation Committee under the chairmanship of David Getches, Executive Director of the Colorado Department of Natural Resources, has presented its recommendations to an Interim Committee of the Colorado General Assembly for consideration. The Committee was appointed by the Governor and charged with preparing new legislation for 1985 consideration.

In a letter to the State Senate in October, 1983, Governor Lamm said:

"We must move at once toward comprehensive legislation that will address the issue of how the State should exercise its plenary control over non-tributary groundwater. In doing so I believe we should consider all the alternatives. We should look at the experience of other states and face several important issues."

The major questions raised by the Committee at the outset were focused on non-tributary groundwater:

1. *What is the definition of non-tributary groundwater?*
2. *Can groundwater be part tributary and part non-tributary?*
3. *Should existing wells be entitled to undiminished groundwater pressure or water level?*
4. *How should aquifer supply life be established?*
5. *Should groundwater be treated as water bodies or as geologic aquifers?*
6. *Should the concept of conditional right apply to non-tributary groundwater?*
7. *What are appropriate landowner rights, if any?*
8. *Should there be priority rights in non-tributary groundwater?*
9. *Can credit be given for artificial recharge?*
10. *Should public interest be considered in issuing permits to use non-tributary groundwater?*

WATER FORUM RESUMES LUNCHEON MEETINGS

The Forum has resumed its meetings on the third Tuesday of each month, 11:45 a.m. to 1:30 p.m., at Wyatt's Cafeteria, Wadsworth and Alameda in Lakewood, west of Denver. Authoritative speakers present programs of current interest to water managers, professionals, and interested citizens. Scheduled topics and speakers are:

October 16, 1984 Gregg Hobbs; Davis, Graham & Stubbs - THE GREEN MOUNTAIN EXCHANGE — FISH OR CUT BAIT

November 20, 1984 John Wells, Regional Administrator, Environmental Protection Agency - STATUS OF EPA'S RELATIONSHIP WITH THE STATE OF COLORADO

December No Forum

General agreement was reached on the answers to these questions (not unanimous) and they formed the basis for Committee recommendations.

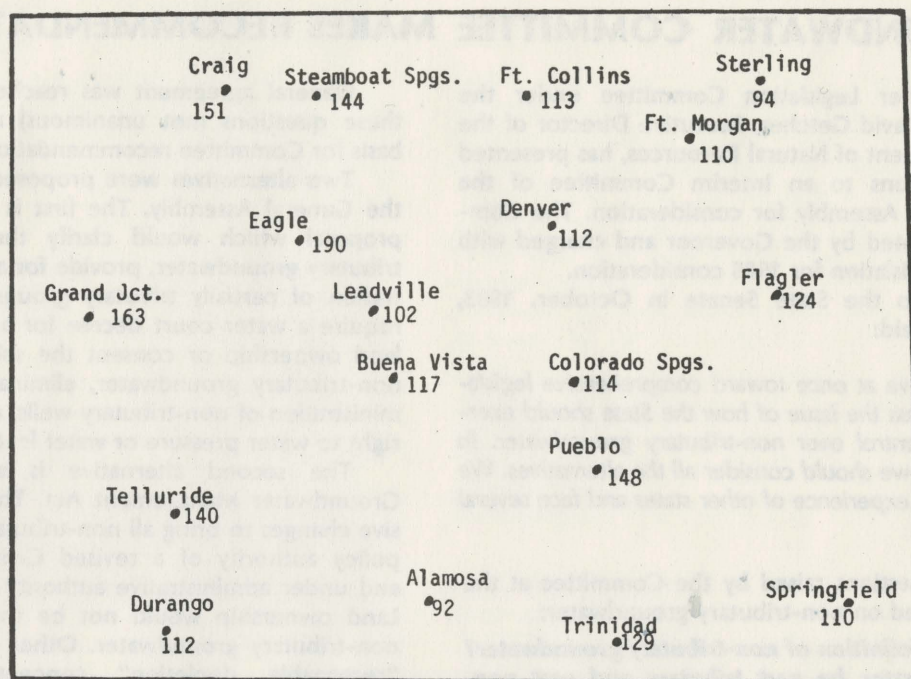
Two alternatives were proposed for consideration by the General Assembly. The first is a "minimum change" proposal which would clarify the definition of non-tributary groundwater, provide for allocation and administration of partially tributary groundwater, allow but not require a water court decree for a permitted well, make land ownership or consent the sole basis for a right to non-tributary groundwater, eliminate priority in the administration of non-tributary wells, and eliminate any legal right to water pressure or water level.

The second alternative is a completely revised Groundwater Management Act. This would make extensive changes to bring all non-tributary groundwater under policy authority of a revised Groundwater Commission and under administrative authority of the State Engineer. Land ownership would not be the basis for a right to non-tributary groundwater. Other provisions substitute a "reasonable depletion" concept for the arbitrary "100-year life" rule, alter the composition of the Groundwater Commission to make it more representative of all groundwater users, eliminate the concept of conditional permits, issue permits for renewable five-year terms, and establish a fee for well permits to support the cost of administration. The proposed code includes local management options in designated groundwater bodies and permit forfeiture after five years of non-use.

The majority of the Committee supported the first alternative (minimum change) because it meets the immediate need without entering into a number of issues which will be highly controversial, including the land ownership principle, change in the Groundwater Commission, and increased technical responsibility for the State Engineer.

The satellite monitoring program — run by the State Engineer's office — should be implemented in August and September . . . some 82 stations should be in place by September 15, and the system should be operational by October 15. Nineteen of those stations will be in the South Platte River drainage at key river points and on important ditch diversion works. The other 63 stations will be similarly situated statewide in the other river basins. Each monitoring site in Colorado will furnish flow data by way of satellite to a receiving station at the State Engineer's office in Denver. In less than an eyewink, river administrators will have the necessary information to know what Colorado's rivers are doing.

*Headgate, by Thomas J. Aron, Jr.
Colorado Rancher and Farmer
August 1984*



COLORADO PRECIPITATION

October 1983 through August 1984

(PERCENT OF NORMAL)

RESEARCH PAYS OFF

Almost ten years ago the Institute provided initial support to Professor Murray Nabors in the CSU Department of Botany for a high-tech development that has led to a new \$5 million grant from the U.S. Agency for International Development to help developing countries improve food production. Dr. Nabors pioneered the process for developing salt-tolerant and drought-resistant crop plants from mutant cells. He is the first in the world to genetically manufacture salt-tolerant crops.

The grant from USAID will include continued development of new salt- as well as acid-tolerant cereals, the organization of an international training center for crop scientists from developing countries, and the establishment of an international information network for plant biotechnology. The goal is to help developing countries modify crops for local environments. More than 50 percent of worldwide arable land suffers from excess salinity, drought, or acidity that biotechnology can help conquer.

The research results from this project, given a start by the Colorado Water Resources Research Institute, can mean substantial increases in food production and worldwide relief from hunger for untold millions of people.

Assessments of the hazards posed by toxic chemicals in drinking water have been based largely on estimates of what one might encounter through drinking. But, according to an article in the May 19 issue of *Science News*, a new study by three researchers with the Massachusetts Department of Environmental Quality Engineering in Boston suggests that the body's absorption of water pollutants through the skin — by washing, showering, bathing or swimming — has been seriously underestimated. Also, and more importantly, the report posits that skin absorption of organic chemicals may frequently constitute the primary route of human exposure to these toxic pollutants in water.

SENATE COMMITTEE RECOMMENDS \$16 MILLION INCREASE FOR WATER PROGRAMS

The Senate Committee on Appropriations has recommended an increase of approximately \$16 million for water resources investigations in the Department of the Interior's 1985 appropriation bill (August 6, 1984). This is for programs administered by the U.S. Geological Survey.

The funding package includes:

State Water Research Institutes — \$10 Million

This recommendation is the maximum authorized by the Water Resources Act of 1984 (P.L. 98-242).

The Committee report recommended that groundwater depletion and inefficient allocation of existing water supplies receive special attention in the West. Nationally, the Committee recommended that research on water quality deterioration remain a high priority (particularly nonpoint sources of pollution).

The Committee did not recommend an appropriation for matching research grants authorized by P.L. 98-242, but the Committee report stated, "... the renewed strength of the section 104 program supporting the water resources institutes will enhance the case for funding the section 105 program (Matching Grants) in fiscal year 1986 ... the Committee urges the administration to give very serious consideration to a request for funds for the section 105 program in fiscal year 1986."

Federal/State Cooperative Program — \$2 Million

For USGS water data collection and water use studies in states on 1:1 cost sharing basis.

USGS Program — \$4 Million

Includes \$2,288,000 for training, publications and supporting services activity; \$1 million for the Core Hydrological Research Program; and \$600,000 to drill additional test wells and define hydrologic properties and water quality in the San Andres-Glorieta aquifer system in New Mexico.

The full Senate will consider the appropriation bill after the August recess. A House-Senate conference on the bill will follow.

TECHNICAL ASSISTANCE FOR HIGH PLAINS

The overdraft from Colorado's Ogallala Aquifer results in the mining of approximately one million acre-feet of water annually. This depletion could cause the loss of some 240,000 acres of irrigated land by the year 2020, as the aquifer continues to draw down (see Institute Technical Report No. 34, 1982).

Water conservation is a key strategy to extend the aquifer's useful life, and advisory assistance in applying conservation technologies is available to water users through various state and federal agencies as well as private-sector organizations. While help is available, it needs to be focused on the region to be fully effective. With this in mind, the Colorado Department of Agriculture organized a voluntary technical assistance coordinating committee in 1982.

As issues, concerns, and needs in the Ogallala Aquifer region are identified, the Committee explores the availability of technical assistance. Its task is to plan and coordinate such assistance to make it most effective. The Soil Conservation Service, the Bureau of Reclamation, the U.S. Geological Survey, the Agricultural Research Service of USDA, the Cooperative Extension Service, the Agricultural Experiment Station, the Colorado Water Resources Research Institute, several divisions and agencies of the Colorado Department of Natural Resources, electricity and gas power suppliers, irrigation equipment suppliers, well drillers and others can furnish certain technical services.

Dr. David Carlson of the Colorado Department of Agriculture served as committee chairman for two years. The chairmanship has now rotated to the Colorado Water Resources Research Institute. Mr. Bill Raley, Technology Transfer Specialist for the Institute will be chairman.

The State Conservationist, U.S. Soil Conservation Service, will continue to serve as Committee secretary.

COLORADO RIVER MANAGEMENT STRATEGIES EXAMINED

Flooding of the Colorado River Basin in 1983 focused attention on operational strategies for reservoir storage and water releases. The basic strategy has been to keep reservoirs as full as possible to assure compliance with interstate compacts, court decrees, water and power contracts and international treaty requirements. But reservoirs are now full and flood operations are of concern — it is an expedient time for all interested parties to reexamine goals and objectives as well as procedures for operation of the river system.

Dr. Darrell Fontane, CSU Department of Civil Engineering, is conducting such an examination for the Bureau of Reclamation. An existing model will provide the starting point for the Institute project — when modified it can be used to identify and evaluate alternative reservoir operation strategies that meet flood control, water supply, hydropower and other objectives. The model will be used in conjunction with operational studies being conducted by Bureau of Reclamation staff.

The model was previously developed by Dr. John Labadie and Dr. Fontane to find long-range annual reservoir operational procedures that maintain specified hydropower energy reserves.

CSU PROGRAM STRENGTHENS INDIA'S IRRIGATION WATER MANAGEMENT

A pilot program at Colorado State University is providing irrigation water management training for 19 professionals from State Government Irrigation Departments and educational institutions in India. The specially designed program, part of a larger USAID technical assistance project, will prepare Indian professionals (Trainers) to train irrigation water management field staff.

The urgent need for irrigation improvements in India is reflected in this statement by B.B. Vohra, former chairman of the Indian National Committee on Environmental Planning:

"Conservation and optimum utilization of (India's) vast land and water resources should be achieved as early as possible if any headway is to be made in the fight against poverty . . . We are poised to reach the 1000 million (population) mark in another 15 to 20 years and the only hope of sustaining such a large population . . . lies in making the best possible use of . . . its land and water resources."

The CSU program's goal is to assist India in strengthening its ability to plan, design, construct, operate, manage and maintain efficient and productive irrigation systems. Five Water and Land Management Train-

ing Institutes (WALMIs) will be established in India to which the Trainers will be assigned as instructors. The WALMIs offer specialized training in irrigation systems operation and maintenance for government-service professionals.

The trainers are from backgrounds in civil and agricultural engineering, agronomy, economics and agricultural extension. The CSU program is designed to refresh their training skills, demonstrate interdisciplinary approaches to irrigation water management, help them develop course materials, and apply effective training methods (including audio-visual aids).

The first group of Trainers will complete their seven-month program in January, and second and third groups will arrive in 1985.

Dr. Max Lowdermilk, Project Officer for USAID's Irrigation Management and Training Project in India, says:

"There is no more exciting irrigation drama in the world than that currently being played in India . . . the main actors are the farmers, for whom the outcome spells the difference between success and failure and even life and death."

TRANSFERS OF WATER INTERBASIN, INTERSTATE, INTERNATIONAL

When in the foreseeable future groundwater supplies from the Ogallala Aquifer run out or are too costly to pump, some believe it would be appropriate to bring water many hundreds of miles across the plains from the Mississippi, Missouri and/or lower Arkansas Rivers.

There is nothing irrational about the concept of major interstate, interbasin water transfers from a construction-engineering point of view. Engineers know how to build such projects, and no technological advances are necessary to make them feasible. It is just cost relative to benefit — to the farmer or the Nation — that is at issue. The cost of importing water from the Missouri River to eastern Colorado, for example, is \$360 per acre-foot per year in 1981 dollars, excluding distribution costs to deliver water from storage reservoirs to farm headgates. This cost is clearly outside farmers' present ability to pay, since it is more than double their gross revenue per acre-foot. Thus, water conservation, change to crops requiring less water and other less costly measures are under consideration. These measures will ease the transition to the eventual return of "dryland" farming.

Similarly, bringing water from the Columbia River to the Colorado River, or from the Nelson River in Canada

to the Missouri River would be very costly.

Generally, in the arid and semi-arid west 80 to 90 percent of developed water supplies are presently withdrawn for irrigated agriculture. Urban and industrial water is only around 10 percent of total water withdrawals and an even smaller proportion of water consumption. And with a generally overabundant food and fiber supply now and in the foreseeable future, *reallocation* of water supplies in the arid and semi-arid West — not increase of water supply via very expensive interbasin, interstate or international water transfer — should be a basic national water policy.

(Henry P. Caulfield, Jr. is Professor of Political Science at Colorado State University and former Executive Director, U.S. Water Resources Council, Washington, D.C. The above remarks are extracted from a paper presented at the Symposium on Rivers and River Management, sponsored by the National Waterways Foundation, at the Louisiana World Exposition, New Orleans, July 10, 1984.)

PUBLICATIONS

TO QUENCH OUR THIRST: THE PRESENT AND FUTURE STATUS OF FRESHWATER RESOURCES OF THE UNITED STATES, Univ. of Michigan Press.

FUTURE WATER, William Morrow, 105 Madison Ave., New York, NY 10016. Price: \$14.94.

CHANGES IN FLOOD RESPONSE OF THE RED RIVER OF THE NORTH BASIN, NORTH DAKOTA-MINNESOTA, USGS, 582 National Center, Reston, VA 22092. W 2243. Price: \$4.00.

FLUVIAL-SEDIMENT DISCHARGE TO THE OCEANS FROM THE CONTERMINOUS UNITED STATES, USGS, 582 National Center, Reston, VA 22092. C 0670.

APPLICATIONS OF SURFACE GEOPHYSICS TO GROUND-WATER INVESTIGATIONS, USGS, 582 National Center, Reston, VA 22092. TWI 02-D1. Price: \$5.00.

MEASUREMENT OF PEAK DISCHARGE BY THE SLOPE-AREA METHOD, USGS, 582 National Center, Reston, VA 22092. TWI 03-A2. Price: \$1.75.

METHODS OF ANALYSIS OF ORGANIC SUBSTANCES IN WATER, USGS, 582 National Center, Reston, VA 22092. TWI 05-A3. Price: \$2.50.

TIME OF TRAVEL AND DISPERSION OF SOLUTES IN A 36.4-MILE REACH OF THE NORTH PLATTE RIVER DOWNSTREAM FROM CASPER, WYOMING, Open-File Services Section, Western Distribution Branch, USGS, Box 25425, Federal Center, Denver, CO 80225. WRI 82-4103. Price: \$2.75.

A MODIFICATION OF THE FINITE-DIFFERENCE MODEL FOR SIMULATION OF TWO-DIMENSIONAL GROUND-WATER FLOW TO INCLUDE SURFACE-GROUND WATER RELATIONSHIPS, Open-File Services Section, Western Center, USGS, Box 25426, Federal Center, Denver, CO 80225. WRI 83-4251. Price: \$13.50.

A DATA-MANAGEMENT SYSTEM FOR USE IN GROUNDWATER MODELING AND RESOURCE EVALUATION, Open-File Services Section, Western Distribution Branch, USGS, Box 25425, Federal Center, Denver, CO 80225. WRI 84-4014. Price: \$37.25.

U.S.-CHINA BILATERAL SYMPOSIUM TO ANALYZE EXTRAORDINARY FLOOD EVENTS

A bilateral symposium organized by the U.S. Geological Survey and the Bureau of Hydrology of the Ministry of Water Resources and Electric Power of the People's Republic of China (PRC) will be held in Nanjing, China, October 17-18, 1985. The symposium's theme is the analysis of extraordinary floods (floods with a recurrence interval in excess of 50 years), and the following topics will be addressed:

1. The detention of historical floods and the uncer-

tainties of their peak discharges and times of occurrence.

2. Frequency analysis of annual flood peaks when extraordinary floods are present in systematically gaged flood records and when historic floods are detected.
3. The use of storm data in determining design storms and design floods.
4. Multivariate analysis of flood peaks and flood volumes in the presence of historic floods and historic storms.
5. Detection of trends in flood occurrences in the presence of extraordinary floods.
6. Critique of U.S. and PRC guidelines for flood analysis that treat extraordinary floods.
7. Comparative case studies of U.S. and PRC flood analysis.

There will be particular emphasis on the effects of errors in the determination of flood magnitudes for each of the above topics.

Attendance will be limited to 50 persons, approximately equally divided between citizens of the sponsoring countries. Each attendee will contribute a paper on one of the above topics, and selection will be based on one-page abstracts which must be submitted by October 1, 1984 to:

Dr. Marshall E. Moss
Chief, Surface Water Branch
U.S. Geological Survey
415 National Center
Reston, Virginia 22092

Selection will be completed by early December, 1984. Deadline for complete manuscript is July 1, 1985.

The symposium will include a six-day study tour of sites in China where historical floods have been documented.

The cost is \$500 which includes all meals, lodging, travel expenses in China, registration and symposium documents. Transportation to and from China and study tour costs not included. Some stipends will be available to assist U.S. attendees.

COURT DEFINES WETLANDS

A U.S. Court of Appeals recently ruled that the Corps of Engineers' wetlands jurisdiction under section 404 of the Clean Water Act applies only to swamps, marshes, and bogs frequently flooded from adjacent streams. The presence of aquatic vegetation is a necessary condition but frequent inundation is also necessary. Neither aquatic vegetation nor inundation alone is sufficient to bring a piece of land under the definition of wetlands. Both must be present and the vegetation must be caused by frequent inundation.

CONFERENCES

- November 5-7 **PETROLEUM HYDROCARBONS AND ORGANIC CHEMICALS IN GROUND WATER — PREVENTION, DETECTION AND RESTORATION**, Houston, Texas. Contact: K. Butcher, National Water Well Assoc., 500 W. Wilson Bridge Rd., Worthington, OH 43085. Telephone: (614) 846-9355.
- November 7-9 **5TH NATIONAL CONFERENCE AND EXHIBITION ON MANAGEMENT OF UNCONTROLLED HAZARDOUS WASTE SITES**, Washington, DC. Contact: HMCRI, Superfund Convention, 9300 Columbia Blvd., Silver Spring, MD 20910.
- November 8-9 **ILLINOIS LAKE AND WATERSHED MANAGEMENT CONFERENCE**, Springfield, Illinois. Contact: Water Resources Center, Univ. of Illinois, 208 N. Romine, Urbana, IL 61801. Telephone: (217) 333-0536.
- November 11-14 **NATIONAL WATER RESOURCES ASSOCIATION ANNUAL CONVENTION**, Phoenix, Arizona. Contact: Agribusiness Council, Convention Coordination Committee, 333 W. Indian School Rd., Suite 209, Phoenix, AR 85013. Telephone: (602) 274-3422.
- November 11-16 **CONFERENCE ON GROUNDWATER CONTAMINATION**, Santa Barbara, California. Contact: Dr. Sanford S. Cole, Director, Engineering Foundation Conference, 345 E. 47th St., New York, NY 10017. Telephone: (212) 705-7835.
- December 2-7 **NATIONAL SYMPOSIUM ON SURFACE MINING, HYDROLOGY, SEDIMENTOLOGY AND RECLAMATION**, Lexington, Kentucky. Contact: J. Snedegar, Continuing Education, 223 Transportation Research, Univ. of Kentucky, Lexington, KY 40506. Telephone: (606) 257-3973.
- December 10-11 **NATIONAL SYMPOSIUM ON EROSION AND SOIL PRODUCTIVITY**, New Orleans, Louisiana. Contact: Erosion Symposium, American Society of Agricultural Engineers, 2950 Niles Rd., St. Joseph, MI 49085-9659. Telephone: (616) 429-0300.
- December 31 **CALL FOR PAPERS, HYDROLOGY DAYS**, April 16-18, 1985, Fort Collins, Colorado. Abstracts due Dec. 31, 1984. Contact: Prof. Morel-Seytoux, Civil Engineering, Colorado State Univ., Fort Collins, CO 80523. Telephone: (303) 491-5448.

January 7-12

17TH CONGRESS OF IAH: "Hydrogeology of Rocks of Low Permeability," Tucson, Arizona. Contact: Prof. E.S. Simpson, Chairman, Arrangements Committee, 17th Congress of IAH, Dept. of Hydrology and Water Resources, College of Earth Sciences, The University of Arizona, Tucson, AR 85721.

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- CR130 CONJUNCTIVE OPERATION OF A SURFACE RESERVOIR AND THE GROUNDWATER STORAGE THROUGH A HYDRAULICALLY CONNECTED STREAM**, by Hubert J. Morel-Seytoux. \$3.00
- Describes analytical solutions that represent the impact of net withdrawal from an aquifer on water table elevations and on induced seepage from a river in hydraulic connection with the aquifer.
- CR131 THE EFFECT OF LITHOLOGY AND CLIMATE ON THE MORPHOLOGY OF DRAINAGE BASINS IN NORTHWESTERN COLORADO**, by Sandra L. Ecker. \$7.00
- Studies the impact of mining and reclamation on drainage-basin morphology so as to better design a stable post-mining watershed.
- IS51 ENVIRONMENTAL REGULATION: APPLICANT BEHAVIOR AS A FACTOR IN OBTAINING PERMITS**, by Barney M. Opton. \$8.00
- Explores the degree of success or failure of various approaches and tech-

niques in obtaining permits. Included are techniques used by a wide variety of businesses, individuals, agencies and others who successfully received permits from the U.S. Army Corps of Engineers.

TR36	THE ECONOMY OF THE POWDER RIVER BASIN REGION OF EASTERN WYOMING: DESCRIPTION AND ANALYSIS, by J.R. McKean, J.C. Weber and R.K. Ericson.	\$4.00
TR37	AN INTERINDUSTRY ANALYSIS OF THREE FRONT RANGE FOOTHILLS COMMUNITIES: ESTES PARK, GILPIN COUNTY, AND WOODLAND PARK, COLORADO, by J.R. McKean, W. Trock, D.R. Senf.	\$6.00
TR38	GROUNDWATER QUALITY REGULATION IN COLORADO, by T.J. Looft. A discussion of the current regulatory framework for groundwater quality control in Colorado. Included are the role of the federal government and the impact of Colorado laws concerning groundwater quality.	\$6.00
TR39	SPORTSMEN EXPENDITURES FOR HUNTING AND FISHING IN COLORADO - 1981, by J.R. McKean and K.C. Nobe.	\$5.00
TR40	THE ECONOMY OF LINCOLN, SUBLETTE, SWEETWATER AND UINTA COUNTIES, WYOMING - ROCK SPRINGS BLM DISTRICT, by J.R. McKean and J.C. Weber.	\$5.00
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