

# Colorado Water

Newsletter of the Colorado Water Resources Research Institute, Fort Collins, Colorado 80523

## WATER ITEMS AND ISSUES . . .

June 1993

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## CALLS FOR PAPERS

### SEEKING AN INTEGRATED APPROACH TO WATERSHED MANAGEMENT IN THE SOUTH PLATTE BASIN

University Park Holiday Inn, Fort Collins, Colorado -- Oct. 27-28, 1993

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### WATER POLICY & MANAGEMENT: SOLVING THE PROBLEMS

Denver Tech Center Sheraton -- May 23-26, 1994

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### COLORADO WATER WORKSHOP

*The Big Squeeze*

July 28-30, 1993

see page 29

**Colorado  
State  
University**





## OOPS!

Editorial by  
Robert C. Ward

Several months ago a graduate student came to me complaining about his inability to find CWRRRI reports in the Colorado State University (CSU) library. I thought to myself, "Go learn how to use the library!" This student

was persistent in articulating his problem in locating CWRRRI reports. Finally, I agreed to check into the situation. I will admit that I was very surprised at what I found!

CWRRRI has been producing research reports, conference proceedings, and general information documents for 28 years. We have regularly sent three copies of every document we produce to the CSU library and to many other libraries around the state. I assumed that the reports were then processed into the library in such a way that they were readily available to users of the library.

I guess there has been a major "slip between the cup and the lip" because CWRRRI reports are not readily available in the CSU library. Here is what I believe is the problem. CWRRRI reports are defined as a "series." Because of this, they are not generally cataloged individually. That is, the series title is catalogued, with the individual reports listed under the series title. There is generally no separate entry for the title of each report. One must know the series title in order to find the catalog entry for the individual report. The effect of this is to make the individual reports difficult to find without the assistance of a librarian.

For example, a farmer interested in improving the application of chemicals via an irrigation system might approach the CSU catalog and look under a keyword like "chemigation." Many references would appear, but none from CWRRRI, even though CWRRRI has published three completion reports on the topic. To me, this is a major failure of CWRRRI to get its research results to Colorado citizens.

There are two articles in this newsletter that address this situation. First, Lindsay Sweetser describes her efforts to document how users can discover if CWRRRI publications exist on topics of interest to them. The CARL system (described in Lindsay's article) should be the most general, but this system, currently, has the limitations noted above. Lindsay has been working with the staff at the CSU library and we are hoping to have CWRRRI's reports listed individually in the near future. In this way, anyone with access to CARL has access to CWRRRI reports under keyword searches.

Lindsay also has set up a GOPHER directory at CSU to provide a quick overview of a number of CWRRRI information pieces. Lists of reports, lists of faculty and courses (at Colorado State

University, University of Colorado at Boulder and the Colorado School of Mines), lists of Extension specialists working in water, lists of centers/institutes, and lists of current CWRRRI research projects. This information will be updated regularly.

Mary DeMartini has described the many databases containing information about water-related topics that are available at the CSU library. This gives you an overview of the large number of ways one can go about searching for information about water.

Thus, while I am embarrassed about discovering how invisible CWRRRI reports have been to the citizens of Colorado, I hope that our realization of the problem will permit us to remove some of the veil that has shrouded CWRRRI publications. I want to personally thank Lindsay, Mary and Mike Culbertson (Science/Technology Librarian at CSU) for helping me discover the problem and for developing a cooperative means for solving it. Hopefully, the articles Lindsay and Mary have written will help *Colorado Water* readers gain better access to CWRRRI reports and water literature, in general. Let me know if you have problems getting to our literature.

### COLORADO WATER

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Robert C. Ward, Director



## **WATER RESEARCH**

### **RESEARCH PROJECTS SELECTED FOR 1993-94 CWRRI PROGRAM**

CWRRI received 35 proposals this year in response to its RFP for the 1993-94 water research program. Faculty from Colorado State University, the University of Colorado and the Colorado School of Mines submitted proposals. CWRRI's Research Planning Advisory Committee (water professionals) reviewed and rated the proposals for relevance to Colorado water problems, and the Technical Advisory Committee (faculty members from CSU, CU and CSM) ranked them on technical merit. The following 11 projects were selected for the 1993-94 program.

#### **Demonstration and Publication of Best Management Practices for Irrigated Agriculture in Colorado**

This CWRRI project will complement work already underway to develop Best Management Practices guidance materials for the use of agricultural chemicals. Currently field plots have been established at the new CSU Agricultural Research, Development and Education Center in cooperation with the USDA-ARS. Field plots are also in place on farmer fields in Larimer, Weld, Morgan and Boulder counties, in cooperation with Cooperative Extension and the Northern Colorado Water Conservancy District. The CWRRI funding will provide automated furrow flumes, soil moisture monitoring devices and data recording units needed to collect data and demonstrate the need for better management of irrigation water. An Irrigation Best Management Practices Guidebook for Colorado will be developed for use by farmers, consultants and water agency personnel in the South Platte Basin. *Principal Investigator: Grant Cardon, Department of Agronomy, Colorado State University.*

#### **Design and Operation of Small Lysimeters for Estimating Return Flows from Urban Lawn Water Use**

Urban lawn watering accounts for 75 percent of summer water usage along Colorado's Front Range. This ongoing project is a cooperative effort to develop a methodology for determining return flow from urban lawn watering using small lysimeters. Following CWRRI's initial commitment of funds, support has been provided by the State Engineer's Office and the City of Colorado Springs. The research site, located at CSU's Engineering Research Center, employs a large weighing lysimeter refurbished to serve as a reference measurement and 24 small lysimeters that provide continuous readings of water use by grass as well as a climatic data set. The City of Colorado Springs continues to collect data for their lysimeter study, and these are being analyzed with data collected by the project investigators. *Principal Investigator: Terry Podmore, Department of Agricultural and Chemical Engineering, Colorado State University.*

#### **Initiating a Water Management Decision Support System for the Platte River Basin**

Recent years of drought and the relicensing process of the Nebraska McConaughy projects have increased stress on the Platte River, which provides water for irrigation, industry, municipalities, hydropower and habitat. In addition, the river's resources are affected by individual state problems such as water rights reallocation in Colorado and instream flow issues in Wyoming. This project, which covers the Platte River basin including Colorado, Wyoming and Nebraska, will seek a unified water management approach among the states. The focus will be on a cooperative, three-state effort to integrate and improve existing computer technology that each state has developed individually. Project results will show potential users and their information needs, necessary model attributes, and the capabilities of existing models. This will help determine whether a new basin model must be developed or if existing models can be adapted or revised to provide the needed data. Participating coinvestigators will be Rollin Hotchkiss, Nebraska Water Institute and Victor Hasfurther, Wyoming Water Institute. The three-state summary of information needs and model requirements will be a major product of this research. *Principal Investigator: Darrell G. Fontane, Department of Civil Engineering, Colorado State University.*

#### **Use of GIS Modeling Techniques as a Planning Tool for Establishment of Wetlands as Nitrate and Pesticide Removal Facilities**

The Colorado Front Range area is confronted with nitrate buildup -- both from irrigated agricultural lands and point-source nitrates in surface waters that originate with municipal waste treatment facilities. In addition to nitrate buildup, agricultural lands in eastern Colorado have potential salinity problems that require additional irrigation for leaching control. This project will generate a spatially-based, planning-level model that can estimate the ability of wetlands to uptake agricultural nitrogen and pesticides. The project will utilize remote sensing data, satellite imagery and automated computer classification techniques to identify off-stream and riverine wetlands in the Poudre River Basin. This modeling will then be used to initiate the development of a management plan using wetlands to control or reduce both nitrates and pesticides. The user will be able to simulate the impact wetlands have in changing water quality for an area and compute improvements to wildlife habitat (as measured by an index for at least four species). *Principal Investigator: Luis Garcia, Department of Agricultural and Chemical Engineering, Colorado State University.*



### **Changes in Morphology and Endangered Fish Habitat of the Colorado River**

Four species of Colorado River fish currently are listed as "endangered" (bonytail chub, humpback chub, Colorado squawfish and razorback sucker). This endangered status is attributed to various causes, including a reduction in the abundance of habitat caused by water withdrawals and channel modifications. Recent recommendations of the U.S. Fish and Wildlife Service call for the release of more water from upstream reservoirs to improve in-channel habitat. This change will surely affect downstream users -- irrigation districts, hydropower authorities, the Colorado River Water Conservation District and the Bureau of Reclamation. The objectives of this project are to (1) quantify historic changes in the morphology of the upper Colorado River near Grand Junction, Colorado; (2) evaluate the changes in light of what is known about the water development history of the basin; and (3) examine the processes of in-channel habitat formation and evolution. *Principal Investigator: John Pitlick, Department of Geography, University of Colorado at Boulder.*

### **Field Assessment of Stream- Aquifer Interaction and Development of a Computer Teaching Tool**

This project has two objectives: the first is to improve technical understanding of stream-aquifer interaction by collecting data needed for the stream-aquifer interaction model MODFLOW; the second and primary objective is to improve public understanding of stream-aquifer interaction through development of a simple, user-friendly, interactive computer program that illustrates groundwater mechanics. Public domain software will be used to simulate groundwater mechanics and to provide graphical representation of the system. Users will be able to input "what if" scenarios of, for example, a well pumping at a given rate and see the effect on streamflow and groundwater levels. Other fundamental concepts will be included, such as the difference between confined/unconfined aquifers, the concept of storage in these two types of aquifers, the nature of leakage between aquifers, and other concepts that will be determined as the project progresses. The program will target the teenage level, but similar software packages have demonstrated that even mature adults can learn from "hands-on graphical examples" designed for young people. *Principal Investigator: Eileen Poeter, Department of Geology and Geological Engineering, Colorado School of Mines.*

### **Economic, Political and Legal Aspects of Colorado Water Law Changes from 1973 to 1993 and Needs for the Future**

*Water resources management looms as one of the most important political, social and economic issues of the coming century in the Western United States. Western Regional Coordinating Committee, 1993.*

Since 1973, many changes have occurred in Colorado's water laws in response to federal, state and public pressures and perceived needs. The extent to which policy changes, legislative enactments and judicial decisions have been implemented during this time period has not been systematically documented. Nor has there been a more general but comprehensive examination done of the more recent national and global focus on sustainable development of natural resources, particularly water, and the convergence of resource development and environmental management. This project will update a 1973 report by the principal investigator on Colorado water law to show the changes that have taken place over the past two decades. It will include: (1) an analysis of the policies, laws, regulations, judicial interpretations and implementing frameworks of Colorado water law; (2) an analysis of the basis for those changes (judicial, legislative, administrative); and the identification of key areas for further changes in the institutional framework of Colorado's water law to meet the requirements and needs of the future -- for sustainable resources utilization and environmental management of the state's water resources. *Principal Investigator: George Radosevich, Department of Agricultural and Resource Economics, Colorado State University.*

### **South Platte Management Support System, Phase V**

Colorado water commissioners determine which water rights are entitled to divert water from the South Platte based on the existing supply. Their goal is to allocate the maximum amount of water without injuring senior water rights, thereby maximizing beneficial use of the state's water. This continuing project is developing a pilot management support system to help water commissioners make near real-time water allocation decisions and assist water users in managing their water supplies. Phase V objectives will focus on technology transfer, installing the system in the State Engineer's Office, and testing new features of the application. The project is a cooperative effort by the Center for Advanced Decision Support for Water and Environmental Systems (CADSWES), University of Colorado, the State Engineer's Office, and South Platte Basin water users. *Principal Investigator: Jacquelyn Sullivan, Director, CADSWES, University of Colorado at Boulder.*

### **Water Transfer Effects on Vegetation and Riparian Systems in a High Altitude Mountain Meadow**

This project will examine changes in vegetation composition of formerly irrigated mountain meadows that occur as a result of water transfers. Such transfers have occurred for many years in Colorado, but their impact on the surrounding vegetation and riparian system is unknown. These transfers have been particularly significant in the South Park region of Colorado, where approximately 50,000 acres were irrigated prior to the beginning of large-scale transfers in the late '60s. Only a small fraction of this acreage is currently irrigated, and as a result much of the riparian land formerly devoted to hay production is now used for livestock grazing. Investigators will indicate the nature of changes in vegetation composition of formerly



irrigated mountain meadows and provide estimates of the impact of summer livestock grazing on riparian zones and downstream water quality from these areas. *Principal Investigator: Dan Smith, Department of Agronomy, Colorado State University.*

#### **Developing a Biotic Index for Colorado Stream Water Quality**

The objective of this project is to begin to develop an index of stream water quality for Colorado based on aquatic insects. The project will use a long-term data set from a study conducted at ten sampling stations encompassing a 50-kilometer reach of the Cache la Poudre River. The study, a cooperative venture between Eastman Kodak and the City of Fort Collins, began in 1970 and continues today. The concept of using aquatic organisms as water quality indicators is based on the premise that the biota reflect not only present, but also past and extreme environmental conditions. A biotic index of water quality based on aquatic insects is not now available for Colorado. Such an index would be a valuable tool for industry and government agencies concerned with evaluating the effectiveness of water treatment facilities and for analyzing long-term trends in stream water quality. Federal agencies currently are developing national programs using benthic macroinvertebrates as biomonitors of water quality. However, the benthic fauna of Colorado streams are quite different from those of the eastern and midwestern streams where most biotic indices have been developed. Kodak has endorsed the project and agreed to supply all of the data collected. *Principal Investigator: James V. Ward, Department of Biology, Colorado State University.*

#### **Ecological Integrity and Western Water Management: A 1994 Synthesis and Perspective**

This project will involve an eight-member task force of scientists, representing six different disciplines, which will integrate developments of the respective fields and link them together to provide a more holistic and inclusive view of the concept of "ecological integrity."

Water resource managers are under increasing pressure to address ecological integrity of aquatic ecosystems when making decisions about water management in the Rocky Mountain west. The Clean Water Act of 1972 and its amendments, as well as recent mandates to states by the U.S. Environmental Protection Agency to develop biocriteria for protecting biological integrity, have the potential to affect how water is used in Colorado. Litigation concerning water rights on U.S. Forest lands, interpretation of Colorado's instream flow law and concern over the potential effects of endangered aquatic organisms also have the potential to affect how water is managed.

Biomonitoring approaches have been applied in various regions since the early 1980s, but these ideas have not been widely presented to water resource managers in an accessible form. Consequently, the acceptance of these ecologically-based tools has not been widespread. A focus on the social dynamics of accepting applications of "ecological integrity" in water resource management will require an interdisciplinary approach.

The USEPA has described a new program that will have significant implications for water users and dischargers in Colorado. It will require that assessment of water quality be based on the "ecological integrity" of surface waters (*Biological Criteria: National Program Guidance for Surface Waters*). Because there is little agreement among ecologists concerning the exact definition of ecological integrity, achieving the regulatory goal of maintaining a "healthy, balanced ecological community" will be problematic.

Project investigators, as a first step, will assemble the most important literature in their discipline that addresses the concept of ecological integrity and its role in water resource management.

A field trip to a specific watershed that incorporates complex water management issues will allow them to view ideas from other perspectives -- the biological and physical aspects of ecological integrity and the engineering and social aspects of water management.

Investigators will canvass the Colorado and national water community about how the issue of ecological integrity and its effect on management decisions or political actions is perceived. They will convene small group meetings to solicit input in person, drawing participants from a wide range of water users.

The result will be a document that includes:

- the history and background of the concept of biological integrity, as defined in the Clean Water Act of 1972 and amendments

- a definition of the task force's expanded concept of ecological integrity, especially as it relates to water management in the Rocky Mountain west

- ways in which the concept and its implications have the potential to affect water resource management decisions in the region through legal and regulatory processes

- options for incorporating concepts and measures of ecological integrity in future water resource management, with the goal of forestalling or resolving conflicts

- pinpoint areas where research is needed

*Project Investigators, Colorado State University: Alan Covich (Principal Investigator), Kurt Fausch and William Clements, Department of Fishery and Wildlife Biology; John Stednick, Department of Earth Resources; Steve Abt, Department of Civil Engineering; John Wilkins-Wells, Department of Sociology; James Ward, Department of Biology; and*

*John Pitlick, Department of Geography, University of Colorado at Boulder.*



**USDA NATURAL RESOURCES RESEARCH CENTER**  
**1992 Water Related Research**

While *Colorado Water* has reported on the many water education, research and outreach efforts of higher education in Colorado, there is another source of excellent water research -- the many federal research programs that operate in Colorado. This article describes the water-related research of one of these federal research programs -- the Natural Resources Research Center that is operated in Fort Collins by the U.S. Department of Agriculture. The Center, headed by James R. Welsh, operates as part of USDA's Agricultural Research Service. Its administrative offices are located at the Crops Research Laboratory, 1701 Center Avenue, just west of the University Park Holiday Inn in Fort Collins. Dr. Welsh's office phone number is (303) 498-4227, for those who might want more information about the Center's water research efforts.

The following list of research project titles and principal investigator(s) is divided into the seven units of NRRC.

Central Plains Resources Management Research Unit - Ardell D. Halvorson is the research leader and is located in Akron, Colorado (phone 303/345-2259). Research emphasis is on efficient use of plant nutrients, pesticides, and water and soil conservation/preservation. The following projects are listed as being of interest to the water community; however, there are a total of 33 projects currently being conducted by this unit.

- o Management of phosphorus fertilizer for dryland winter wheat in reduced tillage systems -- A.D. Halvorson, J.L. Havlin, and R.A. Bowman
- o Effect of nitrogen fertilization on water-use efficiency by crops grown in an annual cropping system -- A.D. Halvorson
- o Crop rotation and nitrogen fertilization for efficient water use -- A.D. Halvorson
- o Irrigated soybean yield and water gradient -- Steven E. Hinkle
- o Irrigated corn population-yield study -- S.E. Hinkle and D.C. Nielsen
- o Crop rotation and tillage effects on water use, water stress, and yield of alternative crop rotations for the Central Great Plains -- D.C. Nielsen, A.D. Halvorson, R.L. Anderson, and S.E. Hinkle
- o An evaluation of nitrification inhibitors and precision placement of large urea pellets for irrigated corn -- M.F. Vigil, J.F. Power, J.S. Schepers, D.D. Francis and A. Mosier

Great Plains Systems Research Unit - Lajput R. Ahuja is the research leader and is located in the Federal Building in Fort Collins (phone 303/490-8300). This unit is focusing on the

synthesis, quantification, evaluation, and enhancement of knowledge to support the development of sustainable and adaptive agricultural production systems. Of their 16 research projects, the following appear to have the most interest to water users.

- o The root zone water quality model (RZWQM) validation and enhancements -- K.W. Rojas, M.J. Shaffer, F.D. Hanson, C.V. Alonso, R.M. Aiken, G. McMaster, L.R. Ahuja, Q. Ma, and V.A. Ferreira
- o Application of the NLEAP model to regional nitrate leaching along the South Platte River in Eastern Colorado -- M.J. Shaffer and B.K. Wylie
- o Root zone water and chemical transport as altered by macropores -- L.R. Ahuja and K.E. Johnsen
- o Root zone water and chemical transport as affected by management and root water uptake in row crops -- J.G. Benjamin and L.R. Ahuja
- o Two-dimensional characterization of transport in variably-saturated soils -- C.V. Alonso, J.G. Benjamin, F.C. Lar and H.D. Rector
- o Sediment intrusion and dissolved oxygen transport in the SFSR spawning areas -- C.V. Alonso and R.N. Havis
- o Characterizing management -- temporal and spatial variability in soil hydrologic properties of field soils - B. Dunn, L.R. Ahuja, R.D. Williams, and D.F. Timlin

Soil-Plant-Nutrient Research Unit -- Ronald F. Follet, Research Leader, is located in the Federal Building in Fort Collins (Phone 303/490-8200). This unit emphasizes the role of nitrogen in achieving optimum crop yields, maximizing farm profitability, maintaining environmental quality, and sustaining long-term productivity. Of this unit's 16 projects, the following five appear to be of most interest to water users.

- o Groundwater nitrate -- Ronald F. Follett
- o Maintain quality of water and the environment through improved nitrogen use efficiency -- Gordon L. Hutchinson, Arvin R. Mosier, Kevin F. Bronson, Jorge A. Delgado and David W. Valentine
- o Bioremediation of high nitrate well water by vegetable oil injection -- William J. Hunter and Ronald F. Follett
- o Main quality of water and the environment through improved N-use efficiency -- Lynn K. Porter



- o Efficient use of fertilizer and soil nitrogen -- Lynn K. Porter

Sugarbeet Research Unit -- Earl G. Ruppel is Research Leader and is located at the Crops Research Laboratory at 1701 Center Avenue in Fort Collins (phone 303/498-4204). This unit currently conducts seven research projects on the biotechnology of sugarbeets. None of the projects appears to be related directly to water.

Terrestrial Ecosystems Research and Analysis (TERRA) Laboratory -- Donn G. DeCoursey is Project Leader and is located in the Rocky Mountain Building in Fort Collins (phone 303/490-8390). This is a new unit that is addressing the need to develop and deliver tools and methodologies for the analysis of interactions among people, land, and natural resources. This unit, thus far, has one project with the above title.

Water Management Research Unit - Dale F. Heermann is the Research Leader and is located at the Agricultural Engineering Research Center at the west end of Vine Drive in Fort Collins (phone 303/491-8511). This unit focuses on the need to integrate applied and basic principles to develop improved water, chemical and alternative weed management systems and irrigation system designs. Of the 21 active projects of this unit, the following 13 relate directly to water.

- o Improving weed control and water quality with tillage and less herbicide -- M. VanGessel, P. Westra, and E. Schweizer
- o Protecting water quality by scouting weed populations -- L.J. Wiles and E.E. Schweizer
- o Protecting water quality by scouting weed populations in soybean fields -- D.A. Mortenson, L.J. Wiles and E.E. Schweizer

- o Safety and water supply protection when applying agricultural chemicals in irrigation water -- E.G. Kruse, H.R. Duke and G.W. Buchleiter

- o Water use and labor requirements for irrigated crops -- E.G. Kruse

- o Design criteria and integrated management technology for surface and center pivot irrigation systems -- D.F. Heermann and C. Fraisse

- o Irrigation technologies for sustainable farming which conserve water and protect water quality -- D.F. Heermann and R.E. Smith

- o Study the physics and develop theory of infiltration for improved irrigation -- D.F. Heermann

- o Uniformity and efficiency of chemical application through irrigation systems -- H.R. Duke, W.C. Bausch, G.W. Buchleiter, D.F. Heermann and R.E. Smith

- o Integrated management systems for self-propelled sprinkler irrigation systems -- G.W. Buchleiter, D.F. Heermann, H.R. Duke, R.E. Smith and E.E. Schweizer

- o Irrigation scheduling for water and chemical management -- G.W. Buchleiter, H.R. Duke, W.C. Bausch, R.E. Smith and D.F. Heermann

- o Application rates, infiltration, runoff and erosion in irrigation -- R.E. Smith, H.R. Duke, G.W. Buchleiter and D.F. Heermann

- o Management decisions aided by remotely sensed inputs -- W.C. Bausch, H.R. Duke, E.E. Schweizer and L.J. Wiles

## WATER RESEARCH AWARDS

A summary of water research awards and projects is given below for those who would like to contact investigators. Direct inquiries to investigator c/o indicated department and university.

Colorado State University, Fort Collins, CO 80523

DEVELOPMENT OF THE NATURAL RESOURCES WORKSTATION, Luis Garcia, Agricultural & Chemical Engineering  
ANALYSIS OF EFFECTIVE WIDTH & EQUIVALENT ROUGHNESS OF CHANNEL HYDRAULICS, Chester C. Watson, Civil Engineering

2-D HYDROLOGY MODEL, Pierre Y. Julien, Civil Engineering

BIOLOGICAL HYSTERESIS IN CLIMATE CHANGE MODELS FOR THE GREAT PLAINS, Dennis Ojima, Natural Resources Ecology Lab

APPLICATION OF SEWAGE SLUDGE TO DRYLAND WHEAT, Kenneth A. Barbarick, Agronomy

SATELLITE ANALYSIS OF COVER TYPES ON A POUVRE RIVER WATERSHED, Roger M. Hoffer, Forest Sciences

STATISTICAL FRAMEWORK FOR THE UTILIZATION OF RADAR DATA IN TROPICAL RAINFALL MEASURING MISSION, V. Chandrasekar, Electrical Engineering

IDENTIFICATION & ENUMERATION OF BENTHIC MACROINVERTEBRATES FOR THE COLORADO DEPARTMENT OF HEALTH, Boris C. Kondratieff, Entomology



FLAMING GORGE STUDIES: ANALYSIS OF PAST COLLECTIONS FOR YOUNG RAZORBACK SUCKER & HUMPBACK CHUB...

Robert T. Muth, Fishery & Wildlife Biology

FLAMING GORGE STUDIES: EARLY BIOLOGY & DEVELOPMENT OF SELECTED FISHES IN THE GREEN RIVER, Robert Muth,

Fishery & Wildlife Biology

FLAMING GORGE STUDIES: ANNUAL ASSESSMENT OF MAINSTEM RAZORBACK SUCKER PRODUCTION, Robert T. Muth,

Fishery & Wildlife Biology

DECISION SUPPORT SYSTEM FOR MULTI-PURPOSE RESERVOIRS, John W. Labadie, Civil Engineering

NATIVE AND INTRODUCED FISH IN COLORADO, Eric Bergersen, Cooperative Fish & Wildlife Research

EFFECTS OF ELECTROFISHING ON ENDANGERED FISHES: ANALYSIS OF EXISTING DATA, Robert T. Muth, Fishery & Wildlife Biology

DYNAMICAL STUDIES IN HURRICANE INTENSITY CHANGE, Michael T. Montgomery, Atmospheric Science

DEVELOPMENT OF ECOLOGICAL RISK ASSESSMENT METHODOLOGIES, Edward F. Redente, Range Science

GROUND WATER MONITORING OF BMP'S IN THE SAN LUIS VALLEY, Deanna S. Durnford, Agricultural & Chemical Engineering

COMMUNICATIONS IN WILDLIFE MANAGEMENT, Alan P. Covich, Fishery & Wildlife Biology

TROPHIC INTERACTIONS IN COLORADO RESERVOIRS, Brett M. Johnson, Fishery & Wildlife Biology

RUSSELL LAKES SWA WETLANDS STUDY, David J. Cooper, Cooperative Fishery & Wildlife Research

HYDRAULIC MODEL STUDY OF ROCK CREEK & CRESTE DAM SEDIMENT MANAGEMENT, Albert Molinas, Civil Engineering

SEDIMENT TRANSPORT MATHEMATICAL MODEL FOR THE LOWER YELLOW RIVER, CHINA, Neil S. Grigg, Civil Engineering

GENETIC IDENTIFICATION OF SUCKER LARVAE FROM THE UPPER COLORADO RIVER BASIN, Robert T. Muth, Fishery & Wildlife Biology

EVALUATION & PREDICTION OF THE CUMULATIVE HYDROLOGIC EFFECTS OF FOREST MANAGEMENT, Lee H. MacDonald, Earth Resources

University of Colorado, Boulder, CO 80309

OPPORTUNITIES FOR INCREASED ENVIRONMENTAL BENEFITS, Lawrence MacDonnell, Natural Resources Law Center

THE SOLID FORMS OF LEAD IN MINING, MILLING AND SMELTING WASTES, LEADVILLE, COLORADO WITH

APPLICATIONS TO AQUEOUS LEACHABILITY..., Donald Runnells, Geological Sciences

SENSITIVITY OF TROPICAL OCEANS TO FRESHWATER FLUX AND THE USE OF TRMM PRECIPITATION DATA IN

OCEAN MODELING, Richard Gosnell, Astrophysical, Planetary and Atmospheric Sciences

EFFECTS OF CLIMATE CHANGE IN THE COLORADO ALPINE: ECOSYSTEM RESPONSE TO ALTERED SNOWPACK

AND RAINFALL REGIMES, Carol Wessman, Institute of Arctic and Alpine Research (IAAR)

BIOLOGICAL HYSTERESIS IN CLIMATE CHANGE MODELS FOR GRASSLANDS: IMPLICATIONS OF PLANT

COMMUNITY DYNAMICS ON BIOGEOCHEMICAL FEEDBACKS, Timothy Seastedt, Institute of Arctic and Alpine Research (IAAR)

COMPARATIVE LITHOLOGICAL MAPPING USING MULTIPOLARIZATION, MULTIFREQUENCY IMAGING RADAR AND MULTISPECTRAL OFFICIAL REMOTE SENSING, Alexander Goetz, Cooperative Institute for Research in Environmental Sciences (CIRES)

INVESTIGATIONS OF NATURAL GROUNDWATER HAZARDS AT THE PROPOSED YUCCA MOUNTAIN HIGH LEVEL NUCLEAR WASTE REPOSITORY, Charles Archambeau, Physics

APPLICATION OF THE INFLUENCE DIAGRAMMING TECHNIQUE TO DOE ENVIRONMENTAL RESTORATION PROJECTS, James Diekmann, Civil, Environmental and Architectural Engineering

PALEOECOLOGICAL TESTS OF CLIMATE MODEL SIMULATIONS FOR THE PAST 18,000 YEARS IN EASTERN NORTH AMERICA, Jonathan Overpeck, Institute of Arctic and Alpine Research (IAAR)

GROUNDWATER TRANSPORT OF VIRUSES, Gary Amy, Civil, Environmental and Architectural Engineering

NATIONAL WATER POLICY PRIORITIES, Lawrence MacDonnell, Natural Resources Law Center

MODELING FOR DESIGN AND TESTING OF TREATMENT AND REMEDIATION TECHNOLOGIES FOR AQUIFERS

CONTAMINATED WITH ORGANIC WASTES, Tissa Illangasekare, Civil, Environmental and Architectural Engineering

OPTIMIZED COAGULATION FOR NATURAL ORGANIC MATTER (NOM) REMOVAL FROM MWD SOURCE WATERS:

DEMONSTRATION AND BENCH-SCALE STUDIES, Gary Amy, Civil, Environmental and Architectural Engineering

INTERACTION OF TERRESTRIAL AND ATMOSPHERIC HYDROLOGICAL CYCLES IN THE CONTEXT OF THE NORTH

AMERICAN SOUTHWEST SUMMER MONSOON, William Emery, Aerospace Engineering

LATE QUATERNARY PALEOCLIMATES IN THE AMERICAS: DYNAMICS OF PAST CLIMATE CHANGE AND ITS

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## **FEATURES**

### **ACHIEVING ECOLOGICAL INTEGRITY THROUGH THE FEDERAL CLEAN WATER ACT**

**Max H. Dodson**

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*Editor's Note: This paper was first presented at the 1992 South Platte Conference, "Defining Ecological and Sociological Integrity for the South Platte River Basin," October 27-28, 1992 in Fort Collins. The original paper was edited and condensed for publication in Colorado Water.*

Over the last few years, the EPA has stressed the importance of examining entire systems, such as the South Platte Basin. The emphasis is on a watershed approach, rather than by point sources. For that reason, I think this is an innovative and outstanding conference.

I was asked to discuss the relationship between ecological integrity and the Federal Clean Water Act, as it applies to the South Platte Basin. I have a managerial background, and dealing with such a technical topic is a little scary.

I would have to admit, looking back on my 21-year career with EPA, that not too long ago if someone from EPA was asked to give a speech on ecology or biology as it relates to the Federal Clean Water Act, there might not have been many candidates.

However, I think things are changing, and the agency is placing additional emphasis on biological and ecological integrity. This change can be largely attributed to EPA's Science Advisory Board report, initiated by Lee Thomas, the administrator of EPA's Unfinished Business Report, who emphasized the need for EPA to make overall assessments of its position. EPA considered the environmental risks they presently addressed and saw others that should be addressed. It was determined that EPA had been preoccupied with managing resources and the environment in order to reduce cancer risks. The Science Advisory Board, convened by Bill Reilly, recommended a balance within EPA, between the emphasis on human health and on ecological health.

In a sense, the Science Advisory Board and the Unfinished Business Report reiterated the basic goal of the Federal Clean Water Act, which is to maintain and restore the physical, biological and chemical integrity of the nation's waters.

Let me illustrate the relationship between the Science Advisory Board's definition of ecological integrity and the goals of the Federal Clean Water Act. From the EPA's perspective, ecological integrity is defined as consisting of chemical, physical and biological integrity. In the past, we have placed considerable emphasis on chemical integrity and monitoring of chemical parameters. I do not mean to suggest that the approach, taken by EPA and the states in the past, is the wrong way to go. In fact, the successes across the country, based

solely on chemical integrity, are very profound. For example, Lake Erie and the Jordan River have seen measurable improvements in water quality as a result of permitting chemical discharges. In regards to the Clean Water Act, the EPA feels that because it consists of chemical, physical and biological integrity, ecological integrity is being addressed. The idea is that by combining the three, hopefully ecological integrity can be attained.

The question then becomes, "How is ecological integrity achieved?" Historically, our foundation and our fundamental regulatory tool has been water quality standards. Water quality standards have many perspectives. The first is designated uses. The criteria vary based on whether you are assessing a fishery, water supply, body-contact water body, or an agricultural water supply.

In many instances, people assume criteria to be entirely quantitative, e.g. dissolved oxygen, BOD, or suspended solids. However, let me explain the term "narrative standard" in the context of toxic substances. The foundation for regulating toxics is found in the Federal Clean Water Act. It is stated, "Thou shalt not discharge toxics in toxic amounts." A program called Whole Effluent Toxicity was created to test and develop protocol using bioassay techniques to control discharge of toxics. In the state of Colorado, *Cerra daphnia* (Water Fleas) and Flathead Minnows are frequently used to determine the effluent's potential impact on the biota. This technique is an example of how to implement a narrative standard, and is an extremely important tool in terms of addressing toxic discharge problems.

Secondly, anti-degradation policy must be addressed. The Anti-Degradation policy states that the existing usage creates a "floor" for the water quality. This base level must be maintained except in cases where important social or economic development conflicts. In any case, any activity that lowers the water quality must not lower it below existing uses.

An additional area that EPA is beginning to embrace, as an agency, is the development of biological criteria. One of the primary issues, in terms of developing biological criteria, is the need for well-established protocols. While EPA has delegated



states to implement the Federal Clean Water Act policy, it has an interest in maintaining national consistency. The formulation of an established protocol for developing biological criteria will hopefully standardize the process between the states.

To develop biological criteria, identifying and conducting biosurveys at unimpaired reference sites is extremely important. The majority of our major water systems have been exposed to the human experience at some time. This makes the process of establishing reference sites for determining biological criteria more difficult. The goal is to compare unimpaired reference sites with an impaired site and determine whether or not there are significant deviations.

The most difficult aspect of establishing biocriteria is determining why an impaired site is impaired. If you cannot do the detective work of identifying why a particular condition exists, then it is difficult to determine a remediation that will return the site to a condition similar to that of the reference site.

In developing these standard protocols, EPA has been working with the states to develop rapid bioassessment protocols. These protocols define the methods and process of data collection and analysis. It is a necessary tool for assessing biological integrity. It has been developed for streams and small rivers. However, it has not been developed for lakes. It involves five levels of investigation, from sampling fish, which comprises three levels, to macroinvertebrates, which comprise the remaining two levels. When using this particular technique, the biology of the system is studied and the appropriate protocol must be determined. This rapid bioassessment protocol is used to qualitatively and quantitatively describe the site and create a basis for comparison against impacted systems.

This particular process is the subject of an upcoming workshop conducted by EPA Regions VII and VIII. The focus will be on the area's common water body, the Platte River System. The workshop will center on developing consistent biocriteria between the two regions. The goal is to use the Platte as a demonstration system for developing protocol. Protocol development does not sound as though it is an important process, but in terms of the levels of investigation you hope to conduct and the standard methods you are going to use, the process of developing protocol becomes extremely important.

I have given you a sense of how the EPA defines ecological integrity in the context of the Federal Clean Water Act. However, there is a plethora of different perspectives, organizations and goals that can be attached to a particular system. Therefore, there are questions to be confronted:

- What does ecological integrity mean to a system -- in this case to the South Platte? The examples of physical, chemical and biological integrity have been considered. Are there additional considerations?
- What are the overall implications of ecological integrity, not only for the Platte River, but for the West?

- How will basic management activities need to be changed in order to emphasize the importance of ecological integrity?
- Is the goal a return to pre-European ecology? There is a realization in the lower Platte system that we are unable to return to a pre-European system.
- How do we define a direction for changes in our way of life under the policy of ecological integrity? Will there need to be specific changes in our lifestyles? Changes could very well be anticipated if we are to reach our biological goals.
- How do we maintain social integrity while seeking ecological integrity? The development of the Platte River system has continued over an entire century. Therefore, in terms of the social fabric of the local population, there may be conflicts between maintaining ecological integrity and sociological integrity.

These are some basic questions that lie beyond developing the protocol.

The EPA has been involved in funding a study of the South Platte and its tributaries that aims to find suitable reference sites. The contractors, Science Applications International Corp. (SAIC), divided the Platte Basin into eight ecologically similar subregions, examined data (predominantly fish data), and ranked the potential sites. They ultimately determined eight that would be good reference sites.

I am going to walk you, using slides [not available for this publication. -- Editor], through the Upper South Platte system. One objective is to give you some sense of the diversity within just a small part of the entire Platte Basin. Ask yourself questions concerning not only ecological integrity but also the lifestyles and practices requiring modification in order to protect ecological integrity.

This is the southern portion of the basin, which some people refer to as a world-class fishery. As we proceed to an area above Cheesman, which I believe is Wild Cat Canyon, we enter a much different environment with a relatively undisturbed riparian habitat. Moving into an area near Deckers, below Cheesman, the surroundings are again much different. This area is also described as a world-class fishery.

Nearing Fairplay, there are some fairly profound human disturbances. The condition of the riparian system needs to be addressed. In the system above Kassler there are drop structures that have a tendency to create problems for fish migration, as well as some basic chemical problems. Proceeding toward the Denver metro area, there are again some profound changes occurring within the system. This is an area above Littleton-Englewood. Looking at a single shovelful of the deposits found on the bottom of this system, the question arises, "How will we ever be able to establish ecological integrity in this portion of the system?" Despite the appearances, this is a desirable niche



for salmonids. In this area below Chatfield all the way to the Littleton-Englewood area, one might come to the conclusion that it is not a particularly viable fishery. However, it is quite viable. In fact, there are reports of large trout, up to 10 lbs. being caught. It is also reported that there are between 30-34 different species in that particular segment. This area of the South Platte is very diverse and healthy with regards to biological resources.

Further down we come to the Metro discharge. During some parts of the year, the effluent comprises nearly 90 percent of the flow. After examining the biological integrity upstream of Littleton-Englewood, the question arises, "Can the same conditions exist in this particular segment?" There are dissolved oxygen problems associated with the drop structures. This is an interesting picture. From the standpoint of appearance, it looks healthy. However, a problem exists with the sediment's influence on the dissolved oxygen concentration. Preliminary studies suggest that approximately 50 percent of the dissolved oxygen problem can be attributed to uptake by sediment.

Recently, EPA sponsored a workshop in Fargo, North Dakota, focusing on biocriteria, bioassessment technology, and developing rapid bioassessment protocol. When establishing reference streams an eco-region approach is important. The concept of the eco-region approach is that when developing reference sites, it is important to remain within an ecosystem similar to that of the impaired site. For example, comparing a stream in Maine with a stream in Washington may be very difficult as their climate, geology, land use, soils, and other factors may vary greatly. Therefore, a comparison cannot be made.

Wetlands are an important area in terms of referencing biological criteria. As an example, consider the wetland resources of Lake Winnipeg -- the only place where the Walleye reproduces effectively. Without those wetland resources we are without a fishery in Lake Winnipeg. Wetlands often provide a very important biological function.

This is the Elm River in North Dakota. It appears to meet the criteria of a relatively undisturbed system that can be used for reference purposes. A biological investigation was conducted, and many benthic organisms were identified.

Many of the tributaries to the Red River are relatively undisturbed, and it is quite easy to develop a reference site. Therefore, a biological resource "score" for the reference site can be determined and used for comparison on impacted areas. The main stem of the Red River has been greatly disturbed for the last one hundred years. With the tributary established as the reference site, can you be assured that it has the same characteristics -- flow, chemistry, land-use, soils, geology, climate, etc. -- as the impacted site? That is a real dilemma.

I have given a cursory view of how EPA defines and deals with ecological integrity. On a national level, we are determining how ecological integrity fits into the mission of EPA and the states. Change is occurring, as we are in the midst of an

election, and the Federal Clean Water Act is up for reauthorization. Hopefully, the reauthorization will stress the ecological integrity aspects of the Act. Perhaps the goals will be articulated in greater detail and the importance of viewing the Act in the context of watersheds will be addressed. Most of the states are currently emphasizing the importance of targeting resources and watersheds. The EPA, in the past, has had a tendency to stress the importance of the point source program and routinely writing and enforcing permits. While there are successes within that approach, we are broadening our mission to target entire watersheds from the standpoint of chemical, biological, physical and ecological integrity.

In closing, I would like to leave you with a Platte River success story. As you all know, the Metro Reclamation Facility, previously called the Denver Metro Sewage Disposal District No. 1, was not particularly effective in protecting the South Platte River. In the late 1970's and early 1980's the river below Denver was nearing the conditions of a biological desert, as a result of the discharges from Metro.

Over the last four years, Metro has increased their treatment, and solved their chlorination problems. In October of 1985, the percent mortality of *Cerra Daphnia* was approximately 50 percent. As a result of improved treatment, equipment changes and improved operations, this mortality rate was near zero in October of 1990. The biologists are seeing much more biodiversity, and biomass than in the past. I think this improvement has genuinely excited the Metro staff to the extent that they are actively working with the State of Colorado and the EPA on a very innovative project.

I indicated earlier that the drop structures and the quiescence creates dissolved oxygen concentrations that are not able to meet the standards. The dissolved oxygen (DO) concentration has been measured at 2 ppm, which is below the standard of 4 ppm. That sends a strong biological message. The old agencies, the old EPA and the old State of Colorado might have told Metro staff that some nitrification and denitrification practices, on both sides of the plant, would be necessary to meet the DO standard. However, with regards to achieving the goals of biological integrity and ecological integrity, it has been mutually agreed that it makes sense to examine what options exist in altering the fluvial geomorphology, the hydrology, the riparian system, and the drop structures to solve the DO problem, hopefully saving millions of dollars.

There are still many options to investigate and everyone agrees that this area has a high potential for returning as a viable fishery as well as one that can achieve biological integrity.

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**MEETINGS OF WATERS:  
THE CONCEPTUAL CONFLUENCE OF WATER LAW  
IN THE EASTERN AND WESTERN STATES**

George William Sherk

*Editor's Note: George ("Jerry") is currently conducting "A Study to Determine the Alternative Means by Which Science/Technology and Law/Policy May be Integrated Vertically on a Regional Basis." This study is being funded by the Powell Consortium, and focuses on the Colorado River Basin. The work below was done a few years ago, and reflects a unique perspective on the evolution of water law in the United States. It was taken from the journal *Natural Resources & Environment*, Vol. 5, No. 4, Spring 1991, and has been edited and condensed for publication in *Colorado Water*.*

A traveler flying west from Washington, D.C., on Trans World Airlines will most likely have the privilege of changing planes in St. Louis. If the flights arrive from or depart to the northeast, the traveler will fly over the confluence of the Missouri and the Mississippi Rivers.

It is a fascinating sight. The rivers join and share a common riverbed, yet they remain distinct. An aerial view shows the silt-laden Missouri flowing along the western bank with the clearer waters of the Mississippi following the opposite shore. The two rivers do not fully become one until they are well downstream. As it flows south of St. Louis, the Mississippi is joined by other rivers such as the Meramec, the Ohio, and the Arkansas. By the time the "Great River" flows into the Gulf of Mexico, it is composed of waters that began their journey to the sea in different parts of America and that have taken various routes on that journey.

The image is appropriate in considering the conceptual confluence of water law in the eastern and western states. The prior appropriation doctrine, the basic concept adopted in the western states for the allocation and management of water resources, reflects the realities of the region. In the words of Professor Dan Tarlock, Chicago Kent College of Law, those realities produced a "drought-driven culture" in the western states. The "first-in-time is first-in-right" concept of the prior appropriation doctrine provides certainty in times of shortage.

The riparian doctrine of traditional eastern water law reflects the realities of a region historically blessed with abundant water resources. It does not provide a basis for the allocation and management of state water resources. In general, it requires water to be used "reasonably," limits water use to lands adjoining or overlying the water resource, and provides for a pro rata sharing of available water supplies. Specifically, there are more exceptions than generalities.

Both doctrines have been subject to substantial criticism. Strictly construed, the prior appropriation doctrine can be exceedingly rigid, especially with regard to new water uses having junior priorities. The doctrine is not well-suited to protect water uses that do not have easily quantifiable economic benefits such as instream flows.

The riparian doctrine can be exceedingly vague. It does not provide a means by which certain water uses may be either

protected or regulated. It neither allows water to be moved to higher valued uses nor protects environmental amenities. In addition, the riparian doctrine is predicated on the assumption that there is an abundant supply of water. Professor Robbie Abrams of Wayne State University School of Law questions this assumption. Given instream flow requirements, gradual climate changes and the contamination of existing supplies, the eastern states may not have the abundant water resources that were assumed to be available. In fact, argues Professor Abrams, the eastern states have remained riparian precisely because they have never faced a severe water shortage. Given the continuously increasing stress upon eastern water resources, the riparian doctrine may have outlived its usefulness.

Most of the eastern states have enacted new laws that either amend or supersede the riparian doctrine. Contrary to the expectations of numerous water law commentators, however, the eastern states have not adopted the prior appropriation doctrine of the western states. While the eastern states are moving away from the riparian doctrine, the western states have been moving away from a strict doctrine of prior appropriation. The resulting conceptual confluence finds the eastern states adopting some aspects of the prior appropriation doctrine while the western states temper that doctrine by adopting certain concepts that are historically riparian in origin.

Looking upstream from New Orleans, it is impossible to tell where the waters of the Mississippi River originated. Did they fall as snow in Colorado or as rain in West Virginia? We know only that the circumstances of their passage have consistently, continuously, and irresistibly brought these waters ever closer together.

Like the Mississippi, the conceptual confluence of eastern and western water law, driven by consistent environmental and economic circumstances, is gradually producing a system of water laws on which the harsh rigidity of the prior appropriation doctrine is made more flexible, and the useless vagaries of the riparian doctrine are given new definition. The emerging legal construct is focused on a balance among all natural and man-made uses of a water resource or on what Professor Luna Leopold, University of California at Berkeley, would call the "preservation of the hydrologic continuum." It is hoped that the emerging system of water laws will be both principled and coherent and will work as well in times of shortage as they do in times of abundance.



## UNIVERSITY WATER NEWS

### CWRRRI REPORTS: ACCESS AND AVAILABILITY

by Lindsay Sweetser

**OVERVIEW** -- For over a quarter century, the Colorado Water Resources Research Institute (CWRRRI) has been providing information to assist Colorado's water managers in solving water problems. Much of this information is developed through research funded from both federal and non-federal sources.

CWRRRI now has an extensive and wide-ranging bank of knowledge from its twenty-seven years in research. This knowledge is available to the public in the form of Completion Reports, Technical Reports and the Information Series, which together number over 300. Since 1980, more than 30,000 copies have been dispersed. These reports are designed for use by both professionals and non-professionals. They are available at libraries around the state, and for sale at Colorado State University. Several data bases on water research also contain information about the reports.

**HOW TO ACCESS INSTITUTE REPORTS** -- How does the typical water manager, interested citizen, or graduate student find out about CWRRRI generated reports and obtain copies? The purpose of this article is to summarize the current status of CWRRRI report access and availability.

CWRRRI research can be accessed in a variety of ways. The resources available to the reader will determine the easiest method of access. There are two direct routes to finding CWRRRI material.

The first is through the CARL system, which is available at many libraries on terminals throughout Colorado. Created by the Colorado Alliance of Research Libraries, CARL is an on-line, menu driven catalog system through which the user can browse titles, authors, and subjects at colleges, universities, and public libraries throughout Colorado. CARL also offers access to several information data bases. For more information on CARL, the Colorado Alliance for Research Libraries can be reached at (303) 758-3030.

There are two methods of searching CARL for Institute reports. First, the reader can inquire under the corporate author name of Colorado Water Resources Research Institute. This method might be used instead of a subject word search because, as of this writing, the Completion Reports have not been catalogued by subject, and only some of the Technical Reports and Information Series have been catalogued by author or title. This means that use of key words in a generic subject search may not locate any CWRRRI reports.

The second method for searching in CARL is by title or author as a key word. If a key word search includes a word that appears in a catalogued report title, that report will appear in a

list with other applicable materials. The Colorado State University library staff plans to have the Completion Report Series catalogued before the beginning of fall semester, and to finish the Information and Technical Reports some time after that. The goal is to organize the reports in CARL so that a key word search will cause all appropriate Institute reports to appear, not just those reports with catalogued titles. Until the cataloguing project is completed, using CARL may not be the most effective research method for finding CWRRRI reports. Instructions for searching in CARL and the related problems are given below.

To search by corporate author from a library terminal, begin by typing: **n** then **Colorado Water Resources Research Institute**. Because the reports are catalogued by series, searching under the corporate author name will provide call numbers for the three series (Completion Report Series, Information Report Series, etc.). The call numbers will lead to the location of the series in the library. For instance, in Morgan Library at CSU, the call number for the Completion Report Series is GB653/C6; for the Information Series, it is QH541/C7; and for the Technical Report Series, it is HC55/C6. This information may not be immediately visible when the search is complete because the screen will display a list of 85 items. In addition to the three series, these 85 items show the list of partially catalogued reports. Once the cataloguing process is completed, a search by corporate author will display the entire list of CWRRRI reports.

In addition to the library terminals, CARL can be accessed by user with a terminal and modem. The following steps will connect the user to CARL:

1. Set terminal communications settings to 8 data bits and no parity.
2. Dial 491-2121. (This is a Fort Collins number, but most local numbers for participating libraries are available from those individual libraries. For instance, Denver Public Library is (303) 758-1551 and Colorado Springs Public Library is (719) 531-5531.)
3. Some libraries do not have local CARL numbers, but a user with access to Internet can telnet to CARL by typing: **telnet csn.carl.org**, which leads directly into CARL. The user may be prompted to type **PAC** before being connected to CARL.
4. Long distance users with a modem, but without access to the Internet, may have to dial to the closest available CARL library or the Colorado State University library at (303) 491-2121. This may be a long distance phone call.



Once connected via modem, the reader should follow these steps to search CARL for the reports:

1. Press the <Return> key one or more times until the screen displays: "Welcome to the CSUNet Terminal Server." At the prompt, `csu-ts>`, type: **carl**.
2. Next, the screen will ask for identification of the terminal in use. (If there is question about the terminal type, select "8" for "hardcopy.")
3. At this point, the program is menu driven. Begin the corporate author search in CARL by typing: **n** then **Colorado Water Resources Research Institute**. The display will show the list of 85 items along with the call numbers for the report series.
4. To search by title or subject, instead of typing **n**, type **t** or **w** for Title or Word. The menus will then prompt the user to enter the desired title or word.

Once the report cataloging is completed, using CARL will be the best way to reach CWRRI reports. The user will not need to know that CWRRI exists to access the research reports, because key word searches will bring the user straight to the reports without doing the now-necessary corporate author search or a search for title words. However, until the cataloging has been completed, readers may wish to use a second method of researching the reports, CSUgopher, as an interim measure to access CWRRI research. At present, this method of finding Institute reports is more helpful than the CARL system because it can be searched by subject, although it is not geared to finding the reports in the library. CSUgopher is set up to assist a reader in ordering a report in addition to providing an on-line display of abstracts.

CSUgopher is an on-line system, which disseminates information through Internet. For those users not linked to Internet, it can be accessed by any computer with a modem. Users can hook into CSUgopher in the following ways:

1. Users with access to Internet can telnet to Gopher by typing: **telnet gopher.colostate.edu**. and login as **gopher**. There is no charge if the Internet is used, regardless of user location.
2. Users with access to a Gopher server can access CSUgopher through their server. (Access in most cases can be made by typing: **gopher** at the prompt, but this may not be true for all cases. If not, the individual's local computer services department should be contacted for the correct login.)
3. Users with a terminal and modem can dial into the system at 491-2121 (8 bits, no parity) and typing: **csugopher** at the `csu-ts>` prompt.
4. Users at CSU with a Lamar account can type **gopher** at the Lamar prompt to get into CSUGopher.

Once the user has accessed CSUgopher successfully, the following steps should be taken to find CWRRI's reports and other information:

1. In the menu which appears, the user should select choice **(1): On-campus Information**.
2. From the next menu, the user should select **(5): CSU Affiliates**. On the menu following, select **(2): CWRRI**.
3. The next menu displayed shows a list of information available on CSUgopher from CWRRI. It includes a short history of CWRRI, a Contact File which contains ordering information, a Publications Directory, and an Education Inventory Directory.

The Publications Directory includes subdirectories of Completion Reports, Information Reports, Technical Reports, and Special Reports. Within these subdirectories are files containing lists of all publications, which can be browsed by screen or searched by key words in the titles or author names. Also in the subdirectories are Abstracts Files for each report series which can be browsed by screen or searched by key words in the title, subject matter, or by author names.

In addition to research reports, CWRRI also offers an inventory of water expertise in Colorado's higher education. It can be found under the Directory of Water Expertise. It is designed to briefly summarize the available expertise without great detail. Listed are faculty, courses, and water-related institutes, centers, seminars, et cetera connected with Colorado State University, University of Colorado, and Colorado School of Mines. Other schools will be added as the inventory is completed. The list is also available in hardcopy from the CWRRI office.

WHERE TO ACCESS INSTITUTE REPORTS -- In the Institute's library, there is a complete set of CWRRI publications as well as a hardcopy bibliography of all reports. The library is located at the Institute offices, 601 South Howes Street, fourth floor, in Fort Collins. A complete set of research reports is also housed at Morgan Library on the CSU campus. Some can be found at various repositories such as Denver Public Library and Norlin Library on the CU Boulder campus. Local libraries may not have complete sets of the research reports, but Inter-Library Loan offices can assist in obtaining copies. Also, copies of any report can be purchased by contacting the Bulletin Room on the CSU campus at (303) 491-6198.

NATIONAL WATER INSTITUTE REPORT AVAILABILITY  
How do water professionals find out about reports from other state water institutes? The Water Research Act established CWRRI and created 53 other water institutes in the U.S., Guam, the Virgin Islands, and Puerto Rico. The National Institutes for Water Research (NIWR) has compiled a database of all research from the Water Institutes, which can be accessed at the CWRRI office. The publications, which number 6,521, cover the period 1984 to 1990 and can be cross-referenced by subject, author, state, and type of publication. Although CWRRI does not have the NIWR reports, contact information for ordering is available.



**CONCLUSION** -- The Institute has been a major contributor to the field of water resources research for Colorado, and will continue to aid Colorado citizens by finding answers to challenges in water supply and management. CWRRI is constantly adding new topics to its research base, and interested

readers are encouraged to take advantage of the extensive report collection. The Institute mailing address is: Colorado Water Resources Research Institute, 410 North University Services Center, Colorado State University, Fort Collins, CO 80523, and can be reached at (303) 491-6308.

### WATER-RELATED INFORMATION ABUNDANT AT CSU'S MORGAN LIBRARY

by Mary DeMartini

The Morgan Library at Colorado State University has a collection of over 1.2 million books, 20,600 serial subscriptions, 1,953,000 microforms, and 494,000 U.S. Government and Colorado documents. In addition to the main library are three branch libraries: one at the Engineering Research Center, one at the Atmospheric Sciences Building at the Foothills Campus, and the third in the Veterinary Teaching Hospital.

The CD-ROM and the CARL on-line catalog assist in assessing and obtaining the literature available on a given subject.

**CD-ROM:** In addition to books and other documents one can access the following water-related databases through CD-ROM at the Morgan Library. (Compact Disks can store over 275,000 typed pages on a single disk.)

- **Selected Water Resources Abstracts:** covers water resources quality, conservation, and management issues. '67-'89.
- **Hydrodata - Colorado Water Rights Tabulations:** contains all of the conditional and absolute water rights granted under Colorado's prior appropriation system.
- **Hydrodata - Daily and Peak values:** covers stream flow and other related daily data and annual and partial flood peaks of stations from the USGS Watstore database.
- **Hydrodata - Quality of Water:** 100 years of USGS data on surface and ground water quality management issues. '67-'89.

**AGRICOLA:** indexes materials from the U.S. National Agriculture Library related to agriculture, engineering, chemistry, life sciences, natural resources, and more. '79-present

- **Food, Agriculture, and Science:** contains full text of 20 publications in food and agriculture areas (1 from each of the 20 international agricultural research centers)
- **Aquatic Sciences and Fisheries abstracts:** covers biological, and ecological aspects of marine, freshwater, and brackish environments, aquaculture, oil, minerals, pollution, oceanography, meteorology, marine technology, and engineering. '87 - present.

- **Compendex plus:** indexes and abstracts engineering and science material. '85-present.
- **Toxic Chemical Release Inventory:** EPA compiled data on toxic chemicals for current year.
- **Climedata:** includes selected data of hourly and daily observations of temperature, precipitation, snowfall, and evaporation from all states during the past 100 years.
- **Weatherdisc:** meteorological data collected by the National Climate Data Center and the National Center for Atmospheric Research.
- **Electromap World Atlas:** detailed information on geography (200 maps), people, government, economy and communications.
- **Tiger/line precensus files for Colorado:** extract of selected geographic and cartographic information from the US Bureau of the Census TIGER database.
- **Dissertation Abstracts:** bibliographic citations and abstracts for doctoral dissertations and some masters theses completed at accredited North American colleges and universities.
- **Acid Rain:** index of 113 Canadian Government documents containing acid rain information.
- **National Hazards Research:** NSF database with bibliographic citations of publications on national hazards research.
- **Natural Resource Database:** bibliographic access to worldwide information on natural resources, fish, and wildlife and implications for human society.
- **Tomes Plus:** annually updated database of toxicology and environmental health data on chemicals.
- **Deep Sea Drilling Project:** marine, geological, and geophysical data resulting from an international study of the global oceans which spanned three decades and 96 cruises of the D/V Glomar Challenger.
- **Earth Sciences:** information on geologic maps, USGS books, and earth science databases.



- **Georef:** references and abstracts to the world's literature in geology. coverage 1784- present.
- **Wildlife and fish worldwide:** a bibliographic database covering publications on fish, wildlife, and natural resources. '71-present.

**NTIS:** abstracts of publicly available research reports and analyses prepared by government agencies and their contractors or grantees. 1980-present.

CSU houses the **Karen W. Jacob map collection** which consists of over 50,000 maps: USGS and other government agency maps; atlases; maps of most countries in the world; vegetation, soils, minerals, and other special maps; as well as satellite images and relief maps. Most maps can circulate for a 2-week period.

**CARL: The Colorado State University On-line Catalog:** CARL (Colorado Alliance of Research Libraries) is the on-line catalog and information system shared by many college, university, and public libraries throughout Colorado. The CARL catalog lists all CSU books acquired since 1977 and all U.S. government publications since 1976. It includes archival material such as all CSU dissertations and theses. In some subject areas, particularly in science and technology, CARL extends back further in time.

The following twenty-one other library catalogs from the state and surrounding area are represented on CARL:

|  |                                 |
|--|---------------------------------|
| Auraria Library                          | Colo. Health Sciences Libraries |
| Colorado School of Mines                 | Regis University                |
| Univ. of Colorado at Boulder             | Luther College Network          |
| Univ. of Colorado Health Sciences Center | Northwest College               |
| Univ. of Colorado Law Library            | State Dept. of Education        |
| Univ. of Colorado Law Library            | Bernis Public Library           |
| Univ. of Colorado Law Library            | Denver Public Library           |
| U.S. Government Publications             | Denver University               |
| Univ. of Colorado Film/Video             | Denver Univ. Law Library        |
| High Plains Regional Library             | University of Wyoming           |
| Univ. of Northern Colorado               | Teikyo Loretto Heights          |
| CCLINK-Community Colleges                |                                 |

These six major library systems across the nation are represented on CARL:

Public library systems on the front range and western slope (CO)  
 MELVYL, the catalog of the University of California  
 Arizona State University and Northern Arizona University  
 The University of Hawaii system  
 Northeastern University (Boston)  
 The University of Maryland system

Also offered on CARL are several information databases including:

**Environmental Education:** a directory of Colorado agencies, organizations, individuals, and resources.

**Uncover 2:** a word index and a table of contents listing for articles appearing in 12,000 journals received by CARL libraries. Word searching scans for keywords in titles and in any accompanying contents notes. A document delivery component allows ordering articles on a credit card.

**CARL: Dial-up Access:** If you have a computer or terminal with a modem and a phone line, you can connect to the CARL on-line catalog (491-2121 [Fort Collins] or 758-1551 [Denver]). If you would like to access Uncover 2 or other special aspects of CARL and are not a member of the CSU faculty or staff, or a CSU student, you will need to register as a borrower at the Libraries Loan Desk and have your borrower identification number entered onto the CARL system. Please contact the Morgan Library (491-1887) if you have questions or need further details about this opportunity.

The Library also offers, for a fee, an on-line literature search service called Fee-based On-line Searching. You can ask a librarian to access any of over 300 databases covering a wide variety of subjects and types of materials. To arrange for a search, contact a librarian specializing in the subject area (491-1887 for Science Reference Desk).

**Interlibrary Loan Service:** Materials that are not available in the CSU libraries can be requested through interlibrary loan (ILL). Both loans and photocopies are obtained from libraries worldwide. Request forms and information on electronic ILL access are available at all reference desks and in the ILL Office (Morgan Library, room 210). An average of 2 weeks is needed to search, process, and receive each request. There is no charge on most ILL requests; special orders for material exceeding \$15 will be paid in full by the patron. (To inquire about interlibrary loan services, call 491-1868.)

**Colorado Water Resources Research Institute Library:** The CWRRRI has a small collection of water-related books (3000 volumes); a news clippings file of water issues in Colorado, and a file of newsletters covering water-related topics from a diversity of perspectives. This small library represents a valuable resource for students and researchers, and is also browsed by other interested individuals. Also housed in the CWRRRI library is the series of technical, completion and information reports published by Institute.

#### CWRRRI'S VIDEOTAPE INVENTORY

In addition to the books, newsletters, reports and other materials within the Colorado Water Resources Research Library, there is have a small collection of video materials available for loan. The library is located in Room 410N of the University Services Center, just north of the CSU campus at 610 S. Howes Street.

#### VIDEOS

##### Colorado Water Issues:

*A Systems Approach to Managing Colorado's Water Resources* -- Colorado Outdoor Recreation Resources Project (CORRP) -- Colorado Bureau of Land Management -- July, 1991



*Poudre River Basin* -- City of Fort Collins -- September, 1991

*The Wealth of Water in Northern Colorado* -- The American Lyceum, Inc. -- 29:20 min. -- 1989

#### National Water Issues:

*Water Quality Standards on Indian Lands* -- U.S. Environmental Protection Agency -- approx. 19 min. -- 1992

*Economic Considerations in Water Quality Standards* -- U.S. Environmental Protection Agency -- approx. 15 min. -- 1992

*The Sand Wash Watershed: Restoring the Balance* -- The Soil Conservation Service, Salt Lake City, UT -- 9 min. -- July 1991

*Visions of America* -- The American Lyceum, Inc. -- 15:30 min.

*Water - The Life Giving Resource* -- Texas Water Resources Institute, Texas A&M University -- 12 min.

A collection of tapes on the *Red River Helicopter Trip* -- October 1989

A collection of tapes on the *Red River May 1990 Flood*

#### SLIDES and AUDIO

*Land Treatment and Disposal of Municipal Waste Water* -- Office of Instruction Services at Colorado State University for U.S. Environmental Protection Agency -- 1984

*Understanding Ground Water: The Hidden Resource* -- The National Association of Conservation Districts -- 140 slides, 24:30 min.

### UNIVERSITY OF COLORADO AT BOULDER WATER COURSES AT THE SENIOR/GRADUATE LEVEL -- 1992/93

The following courses offered through the University of Colorado at Boulder (at the senior level and above) have been identified as being particularly relevant to water (eg., water quantity, water quality, and the causes and management of both). Course letters refer to the department or college in which the course is taught:

|      |   |
|------|---|
| ECON | Economics   |
| EPOB | Environmental, Population, and Organismic Biology   |
| GEOG | Geography   |
| GEOL | Geological Sciences                                 |
| ASEN | Aerospace Engineering Sciences                      |
| CVEN | Civil, Environmental, and Architectural Engineering |
| LAWS | School of Law                                       |

| Course No.<br>(Credits) | Title |
|-------------------------|-------|
|-------------------------|-------|

#### Climatological Processes

|           |                                   |           |                         |
|-----------|-----------------------------------|-----------|-------------------------|
| GEOG 4211 | Physical Climatology - Principles | GEOG 5951 | Climatic Change Seminar |
| GEOG 4221 | Physical Climatology - Applied    |           |                         |

#### Economics

|           |                               |           |  |
|-----------|-------------------------------|-----------|--|
| ECON 6070 | Applied Micro-Economic Theory | ECON 8535 | Natural Resources Seminar                          |
| ECON 8535 | Natural Resources Seminar     | ECON 8555 | Water Resources Development and Management Seminar |

#### Glaciers

|                |            |
|----------------|------------|
| GEOL 4640/5640 | Glaciology |
|----------------|------------|

#### Groundwater

|                |                              |           |                                    |
|----------------|------------------------------|-----------|------------------------------------|
| GEOL 4040/5040 | Geohydrology                 | GEOL 5280 | Principles of Aqueous Geochemistry |
| GEOL 5300      | Low-Temperature Geochemistry | CVEN 5353 | Groundwater Hydrology              |
| CVEN 5383      | Groundwater Modeling         | CVEN 6333 | Flow Through Porous Media          |



Hydraulics

ASEN 4317 Computational Fluid Mechanics  
 ASEN 5021 Viscous Flow  
 ASEN 5051 Macroscopic Physics of Fluids  
 ASEN 5091 Quantum Fluid Dynamics  
 ASEN 5327 Advanced Computational Fluid Mechanics  
 CVEN 5748 Design of Earth Structures

ASEN 5011 Ideal Fluids  
 ASEN 5037 Turbulent Flow  
 ASEN 5061 Microscopic Physics of Fluids  
 ASEN 5317 Computational Fluid Mechanics  
 CVEN 4343/5343 Open Channel Hydraulics  
 CVEN 7353 Hydraulic Design

Hydrology

GEOG 4321/5321 Snow Hydrology  
 CVEN 4333/5333 Applied Hydrology

GEOG 4980/5980 Hydrology

Institutions and Policy

GEOG 6402 Comparative Environmental Studies Seminar

Irrigation and Drainage

GEOG 5440 Morphology and Genesis of Soils

Law

CVEN 5373 Water Law, Policy, and Institutions  
 LAWS 6102-3 Natural Resources Law  
 LAWS 6510-3 International Environmental Law  
 LAWS 7202-3 Environmental Law  
 LAWS 7307-3 Taxation of Natural Resources  
 LAWS 7702-2 Conservation Philosophy and the Law  
 LAWS 8112-2 Advanced Natural Resources Seminar  
 LAWS 8302-2 Advanced Problems in Water Resource Management

LAWS 6002-3 Public Land Law  
 LAWS 6302-3 Water Resources  
 LAWS 7154-3 Land Use Planning  
 LAWS 7209-3 Natural Resources Litigation Clinic  
 LAWS 7402-2 Toxic and Hazardous Wastes  
 LAWS 8012-2 Public Land Law and Policy Seminar  
 LAWS 8202-2 Environmental Policy Seminar  
 LAWS 8420-2 International Economic Development Policy and Law Seminar

Management and Planning

GEOG 4501/5501 Water Resources and Water Management of Western U.S.  
 CVEN 5393 Seminar in Water Resources Development and Management

CVEN 5323 Water and Environmental Systems Analysis

Models/Computer Data Management and Presentation

CVEN 5363 Modeling of Hydrologic Systems  
 CVEN 5537 Numerical Methods

CVEN 5454 Simulation Models in Environmental Engineering

Oceans

ASEN 4215 Oceanography

Sediment Transport

GEOG 4241 Principles of Geomorphology

Stream, Lake, and Riparian Zone Biology

EPOB 4020/5020 Stream Biology  
 EPOB 4180 Ecological Perspectives on Global Change  
 EPOB 4630/5630 Field Techniques in Environmental Science

EPOB 4030/5030 Limnology  
 EPOB 4380/5380 Respiratory Adaptations to the Environment

Water Quality Management

CVEN 5404 Advanced Aquatic Chemistry

CVEN 5494 Fate and Effects of Pollutants in the Environment



### Water and Wastewater Treatment/Environmental Engineering

EPOB 4360/5360 Microbial Ecology  
 CVEN 4424/5424 Municipal and Sanitary Design  
 CVEN 5414 Pilot Plant Laboratory  
 CVEN 5484 Processing and Disposal of Wastewater Concentrates

CVEN 4404 Environmental Engineering Applications of Chemistry  
 CVEN 4444 Environmental Engineering Chemistry  
 CVEN 5474 Hazardous and Industrial Waste Management  
 CVEN 5524 Advanced Wastewater Treatment

### NEW HYDROLOGY HANDBOOK PUBLISHED

A new Handbook of Hydrology has just been published by McGraw Hill Book Co., New York. Dr. Jose D. Salas, a Colorado State University Civil Engineering Professor, wrote Chapter 19, "Analysis and Modelling of Hydrologic Time Series." It was part of the hydrologic statistics section.

The Handbook serves a need for hydrologists, water resource specialists and related professionals by pulling together the vast amount of knowledge spread across journals, textbooks and reports in 29 chapters of this handbook. It compiles information on the hydrologic cycle, hydrologic transport, hydrologic statistics and hydrologic technology. Although the Handbook is a compendium of hydrologic practice rather than a description of hydrologic science, sufficient information is provided to enable hydrologists to understand the underlying hydrologic processes.

The Handbook of Hydrology was written by several authors from five countries, a Practitioner Advisory Board, and an International Advisory Board. D.R. Maidment, Engineering Professor at the University of Texas at Austin, edited the Handbook.

### WATER EDUCATION

#### THE DENVER EARTH SCIENCE PROJECT

**The Project** -- The Denver Earth Science Project (DESP) is a K-12 curriculum development effort coordinated by the Colorado School of Mines. In partnership with corporations, federal agencies, school districts, and professional organizations, a series

of educational "modules" addressing a range of earth science topics is being developed. The modules deal with critical issues facing society and are prepared by trained curriculum development teams composed of experienced earth science teachers and practicing scientists. The key to the success of the project is the involvement of teachers in the design and writing of the materials. Each module is designed to incorporate input from teachers and industrial and governmental partners to assure technical accuracy and relevance to current situations.

**The Ground Water Studies Module** -- The "Ground Water Studies" module teaches students basic earth science concepts through the study of ground water -- the largest accessible and most valuable source of fresh water on earth. The hands-on student activities use real data from industry and government agencies, and follow a problem-solving approach. In addition, the module integrates science, mathematics, geography, and economics, as well as social and environmental issues into a topic that is rarely addressed in most K-12 curricula. The teacher resource kit includes plastic ground water models, aquifer maps, water use posters, and visual aids.

Teachers in grades 7-9 may obtain the teacher resource kit and notebook for the "Ground Water Studies" module by attending a teacher training workshop. The two-day workshop provides teachers an opportunity to actively participate in the module activities while attending special lectures by hydrologists from water resource industries and government agencies. In addition, a local field trip gives the teachers a real-life experience to relate to their students.

For further information please contact: Director, Denver Earth Science Project, Office of Special Programs and Continuing Education, Colorado School of Mines, Golden, Colorado 80401 Tel. 303/273-3494; FAX 303/273-3314.

### EDITOR'S IN-BASKET

#### INJECTION RECHARGE STILL GOING STRONG

Willows Water District is continuing to inject millions of gallons of water into the Arapahoe Aquifer, using the natural reservoir as an underground storage tank, 800 to 1500 feet below the surface. Injection would continue through April, however, the Denver Water Board has granted Willows an extension to inject until June 15. "The aquifer project has been going really well, but with all the snowfall we've had this winter we are pleased that Denver has given us an extension to continue injecting," said district field engineer David Irish. "We hope to inject 500

acre feet before the high-use season," said Irish. Willows is a pioneer in the technology of using potable water for injection into underground reservoirs for storage and later retrieval.

Source: *Willows Water Words*, April 1993

#### NATIONAL BIOLOGICAL SURVEY PROPOSED

When Bruce Babbitt took office in January as the new Secretary of the Interior, he proposed creation of a new agency to consolidate scientific research that is now spread among several



different bureaus. Creation of the National Biological Survey (NBS) as a free-standing bureau within the Department of the Interior is aimed at filling the vacuum that currently exists for broad-scale biological information and assessments of the nation's natural resources. The Department of the Interior proposes to establish the NBS by combining substantial portions of the biological research and survey activities of three departmental bureaus -- the U.S. Fish and Wildlife Service (FWS), the National Park Service (NPS), the Bureau of Land Management (BLM), and smaller research activities from five other departmental bureaus. Organizationally, the NBS will report to the Assistant Secretary for Fish, Wildlife, and Parks.

The mission of the NBS will be to gather, analyze, and disseminate the information necessary for the wise stewardship of our nation's natural resources, and to foster an understanding of our biological systems and the benefits they provide to society -- to build a map of the whole country's ecosystems in order to head off emerging endangered species controversies. The NBS will act as an independent science bureau, without advocating positions on resource management

#### USGS BUDGET REQUEST UP FOR 1994

The president's U.S. Geological Survey budget request for fiscal year 1994 totals \$598 million -- up \$20 million from the current budget. This would restore about half of the \$42.46 million cut from its budget in fiscal 1993.

Bruce Babbitt, Secretary of the Department of the Interior, said, "The USGS budget reflects about \$35.5 million in increases for several high-priority programs balanced against an \$11.4 million reduction in administrative costs and lowered employment levels as part of the president's deficit reduction efforts."

The largest increase will be for the **National Water Quality Assessment Program**, which is to receive a \$14.5 million increase to begin assessment activities at a second set of twenty study units.

**Information and Data Systems and National Data Base Management** is to receive an additional \$12.6 million to be used for constructing a new building addition at the EROS Data Center for the National Land Remote Sensing Data Archive and to house necessary ground systems to process, archive, and distribute land and land-related data in support of NASA's EOS program. The EROS Data Center is expected to see a tenfold increase in the reception, manipulation, and distribution of remote-sensing data from NASA satellites.

**National Mapping, Geography and Surveys** would receive a \$5 million increase to accelerate production of high-priority, multi-purpose digital cartographic data for the DOI and other federal agencies to support analysis of resource management, hazardous waste, endangered species, and water-quality issues. Increased production of data would rely predominantly on support from the private sector.

issues and without regulatory or land and water development authorities.

But as the Department of the Interior moves ahead with this proposal, a few well-respected people in the fields of wildlife biology and land management are voicing concern. The criticism involves the sketchy details of the proposal, that creation of the survey will sever links between research scientists and resource managers, and would disrupt existing federal relationships with state fish and game agencies and universities.

Approximately 1,600 employees are slated for the new agency, 950 of them biologists who would come directly from FWS. The potential problem, critics say, is that once removed from the FWS, those scientists will be less available to the agency for the routine decisions and consultations that occur every day.

Source: Department of the Interior Budget Justifications, F.Y. 1994, *Washington Post* 5/13/93

**Advanced Cartographic Systems** would lose \$4 million. Funds are to be shifted to production of high-priority data. The procurement of modernized production equipment and implementation of its full operational capability are to be delayed by 1 year.

**Water Resource Investigations** are to be discontinued at about 130 continuous record streamflow stations, and the National Stream Quality Account Network is to be reduced by 10%. Data analysis, methods development, and program support are to be reduced, for a savings of \$1.9 million.

**Nuclear Waste Hydrology** will be cut by \$1.3 million. All nuclear waste studies conducted by USGS with appropriated funds would be eliminated. All USGS involvement in nuclear waste disposal issues would be conducted at the direction of the Department of Energy, mostly related to the potential repository site at Yucca Mountain, Nev., and funded through reimbursements.

Plans for a **National Water Information Clearinghouse** have been canceled, for a savings of \$1.7 million. New indexing of data and information systems and abstracting of water resources literature are to be discontinued. The Sacramento, California clearinghouse pilot center is to be terminated, and the clearinghouse pilot center at Reston, Virginia, will operate at a reduced level.

Source: *EOS*, Transactions, Amer. Geophysical Union 4/20/93



## EMAP -- EPA DESIGNS AN ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM

The Environmental Monitoring and Assessment Program (EMAP) is a research, monitoring, and assessment effort designed to report on the condition of our nation's ecosystems. Managed by the U.S. Environmental Protection Agency's Office of Research and Development (ORD), EMAP is a response to the EPA Science Advisory Board's recommendation to monitor ecological status and trends and to characterize environmental problems.

The program is assessing the condition of ecological resources - wetlands, surface waters, the Great Lakes, agroecosystems, arid ecosystems, forests, and estuaries. The program is currently in the pilot and demonstration phase for these resource areas. EMAP strives to support environmental decisionmaking and to complement existing monitoring efforts that are conducted by EPA and other agencies to meet statutory requirements. The program will generate new ecological monitoring and assessment information, which will be combined with data from other monitoring programs to provide a comprehensive view of the effectiveness of environmental policies. In addition, as it accumulates data from all sources over time, EMAP will provide support for regional comparative risk assessments and strategic planning.

The first pilot study of the EMAP sampling and plot design for forests was conducted in 1990. The study resulted in recommendations for improving sampling and logistics procedures. Several 1991 pilot studies, conducted in Georgia,

California, and Colorado, focused on indicator development and the applicability of indicators and measurement procedures to different geographical regions.

Two demonstration projects and one pilot study are being conducted in 1992 to further develop and evaluate forest indicators. The demonstration projects will test the regional assessment potential of a broad suite of indicators in the loblolly/shortleaf pine forest ecosystem of Virginia, North Carolina, South Carolina, and Georgia, and provide an opportunity to evaluate indicators in an oak-hickory ecosystem in the southern Appalachian Mountains. The pilot study in Colorado and California is testing a similar suite of indicators in western forests.

The California Department of Forestry and Fire Protection and the Colorado Department of Forestry have been instrumental in the EMAP Western Forests Pilot Project. California has provided advice, site access, and logistical support. Both Colorado and California are involved in joint field monitoring activities with EMAP, the U.S. Forest Service, the Soil Conservation Service, and the Bureau of Land Management.

For more information, contact Mike Shoemaker, Colorado Forest Health Monitoring Coordinator, at (303) 491-6303.

Source: *EPA EMAP Monitor*, 2/1993

## JONES HOLE DEDICATED

At noon on March 21, 1993 the friends, family, and colleagues of D. Earl Jones, Jr. gathered near the first footbridge over Boulder Creek in Boulder Canyon to dedicate **JONES HOLE**, an idyllic glen along Boulder Creek in the shadow of high cliffs.

Mr. D. Earl Jones, Jr. died on July 24, 1991. Earl published well over 100 professional papers during his long and distinguished career. His professional accomplishments were many: originator of the "major system/minor system" design basis for storm drainage systems; one of the earliest advocates

of major drainageway preservation in urban areas and multi-purpose stormwater detention to facilities; co-founder of the National Flood Insurance Program and recognized authority on flood hazard assessment and management; and expert on natural hazards assessment and mitigation. Earl was best known as Chief Engineer for the U.S. Department of Housing and Urban Development/Federal Administration, although he held a variety of public and private assignments during his career. He was unusually active professionally, was committed to excellence, and tackled all facets of life with great energy and honesty.

## WATER NEWS DIGEST

### WATER PROJECTS

#### AB Lateral Water Project Killed

Federal officials have effectively killed a \$63 million water project slated for construction on the Uncompahgre River near Montrose. "There was not sufficient information" to grant a necessary permit to dam the river for the AB Lateral project, said U.S. Army Corp of Engineers biologist Ken Jacobson. According to Jacobson, the partnership seeking to construct

the hydroelectric power project near Montrose must readdress a host of scientific questions if it hopes to reapply for the permit. The Uncompahgre Valley Water Users Association is in partnership with Montrose Partners, a Massachusetts-based firm, to construct the hydroelectric project. Signs of failure of the project began to surface when the company seeking to purchase the power asked to move the power sales contract to Greeley.

Grand Junction *Daily Sentinel* 4/16/93



### Hughes Reservoir Spillway Repaired

Recent repairs on the eroding spillway of Hughes Reservoir were risky but a complete success, according to Orlyn Bell, water resources engineer for the Colorado River basin. The creek could still rise and flood low-lying areas during spring runoff, but Bell is confident the dam will hold. The repairs were made after reservoir owner David D. Price discovered that the dam's spillway was eroding from the rush of water pouring out of the reservoir. The dam was fully breached years ago because of the flood danger it posed to residents along Three Mile Creek, but Price rebuilt a lower dam, about 8 feet high last year. Runoff has already filled the reservoir, and from two to four feet of snow remains in the basin above the reservoir.

Grand Junction *Daily Sentinel* 5/15/93

### Ground Movement at Dam is Detected

Delta County and state officials are keeping a close eye on an earthen dam, after movement of sub-surface ground was detected by instrumentation. No warnings or evacuation orders have been made to those living below the Minnesota (Monument) Reservoir, but the town of Paonia and residents below the dam have been advised of the situation. The dam, which holds about 470 acre-feet of water in the reservoir, is located on the Dry Fork of Minnesota Creek, about six miles east of Paonia. The Minnesota Canal and Reservoir Co., owners of the dam, placed instrumentation on the dam last fall to detect ground movement. The state Division of Water Resources office has sent its division engineer and dam safety engineer to look over the dam and make an evaluation. Monitoring personnel have two-way radios, so that emergency notices can be made quickly if there is a sudden failure of the dam.

Montrose *Daily Press* 5/12/93

## WATER ALLOCATION

### Claim on Rio Grande Water to be Decided

Water Judge Robert Ogburn has granted hydrographer Bruce Whitehead's request for irrigation water from the Rio Grande. The water right will be applicable during years in which there is "excess" water in the river -- after all senior rights and interstate obligations are met. Whitehead has made application for water rights on the Rio Grande to irrigate native grass for pasture for cattle and horses, and for a wildlife habitat for recreational purposes.

Whitehead's attorney said it is recognized that the Rio Grande has been overappropriated since the late 1800's, but that the system is overappropriated only at times. The Rio Grande Water Users' Association, objector to the application, agreed a right could be given as long as Whitehead takes water during years of a spill at Elephant Butte Reservoir in south central New Mexico. Whitehead's attorney pointed out that would have been the case in 11 of the last 46 years.

Pueblo *Chieftain* 4/4/93, 5/27/93

### C-BT Water Quota set at 50 Percent

With one of Colorado's wettest winters behind and hopes of rebuilding the water supply at Lake Granby, directors of the Northern Colorado Water Conservancy District (NCWCD) have set the 1993 Colorado-Big Thompson water quota at 50 percent. Quotas are set depending upon the amount of water that is expected to be needed by users, which include cities and towns, ditch and irrigation companies, farmers and rural domestic suppliers. The average quota is 74 percent, but has been set lower because of the amount of precipitation this winter. During dry years, the quota is higher. NCWCD board president Bill Bohlender said the board felt it prudent to declare a low initial quota to save as much water as possible for future dry years. District officials will monitor the water season closely, and if conditions warrant can increase the quota later in the season. End-of-year storage levels in NCWCD reservoirs have been a major concern in recent years. Lake Granby, Colorado's second-largest reservoir and the major storage reservoir for the C-BT system, has not filled since 1986. But with forecasted inflows, Lake Granby should rise to almost 85 percent of capacity -- the highest level in seven years.

Greeley *Tribune* 4/10/93

## WATER QUALITY

### Many Cities' Water At Risk

Most state inspection programs to ensure the safety of public water systems are in a shambles, a recently released government study found. The study by the General Accounting Office does little to allay concerns about the purity of the nation's water supply. Such concerns have recently been heightened by Milwaukee's problems with its drinking water. While Wisconsin officials said the Milwaukee water system had been checked in 1991, the new study found that 45 states do not evaluate all components of their public water systems recommended by the EPA. The EPA calls these sanitary inspections the "backbone of state drinking water programs," but it has done nothing to improve state compliance or obtain increased funding for cash-strapped states, the study reports. The report puts most of the blame for the poor sanitary inspections on the EPA, which has for many years failed to request enough money to conduct the surveys and meet an ever-increasing number of federal water quality standards. Federal environmental officials did not take issue with the study.

Denver *Post* 4/15/93

### 819 Cities Told 'Get Lead Out'

The federal government warned 819 communities that their tap water contains too much lead and ordered them to correct the health hazard. EPA sampling in the second half of 1992 revealed unsafe levels of lead -- more than 15 parts per billion -- in public water systems serving a combined population of 30 million people. The worst problem was found at Camp Lejeune in North Carolina, a Marine base, which had lead levels of 484 parts per billion in some tap water. Excessive exposure to lead can impair a child's mental and physical development. EPA advised residents in the affected areas to have their tap water tested. If it exceeds



safe levels, they should have their children's blood tested for lead. Other recommendations include drinking bottled water, running the tap for up to 30 seconds before drinking, using cold water for cooking, and avoiding the use of hot tap water when preparing baby formulas.

*Pueblo Chieftain 5/12/93*

#### **Grand Junction Lifts Water-Boiling Advisory**

Grand Junction officials lifted a water-boiling order three days after it had been expanded citywide because of concern that bacteria had contaminated the water supply. Initially, only residents in north Grand Junction were ordered to boil their water after coliform bacteria were found in tap water March 29. This particular bacteria is not known to cause illness, and there has been no increase in illness in Grand Junction linked to the water. Unlike parasitic contamination of the water supply in Milwaukee, caused by improper chemical treatment of water taken from Lake Michigan, the problem in Grand Junction was caused by bacteria growing within distribution lines serving the city. Increased chlorination and aggressive flushing of the system apparently have been effective in fighting the problem. Public Works Director Jim Shanks said all tests have been negative, so the city was comfortable in lifting the advisory.

*Rocky Mountain News 4/17/93*

#### **Residents Target Lake's High Salt Level**

Evaporation, electricity, and salt-eating bacteria are among ideas for reducing the amount of salt in Cheraw Lake, which is twice as salty as any ocean. The 800-acre lake, eight miles north of La Junta, also is saltier than the Dead Sea or the Great Salt Lake. For nearly a century, salt-laden water has run off irrigated fields and seeped through groundwater in the Holbrook Valley. In 1987 the water in the lake contained 6 percent salt, compared to about 3 percent in oceans. Last year Congress approved cleanup of the lake, but didn't provide any funding. A group of local residents has formed the Cheraw Lake Resource Development Committee, which has presented five possible solutions to federal reclamation officials. Those possibilities include using an evaporation pond, chemicals, or electricity to remove the salt. The committee also wants to investigate using salt-eating plants or bacteria to get rid of the salt, or diluting the lake with irrigation water and discharging it into the drainage basin that runs into the Arkansas River.

*Pueblo Chieftain 4/15/93*

#### **Rio Grande a "Cesspool," Says Environmental Group**

The Rio Grande is a "virtual cesspool" along some stretches of the Texas-Mexico border, according to a river conservation group that listed the river as North America's most endangered. The Pacific Northwest's Columbia and Snake River system, Florida's Everglades, and the Platte River in Nebraska are among the others cited by American Rivers in Washington, D.C. The group's sixth-annual list includes 10 endangered and 15 threatened rivers as those facing the most imminent damage from dams, mining, logging, pollution, and other forms of development. The Rio

Grande -- stretching 2,000 miles through Colorado, New Mexico, and Texas -- and the accompanying Rio Conchos River system in Mexico won the lead spot on the list because of a host of problems ranging from cyanide-leach mining to livestock grazing. Agricultural water diversions and urbanization in the middle Rio Grande have contributed to the degradation. Traces of nuclear waste from Los Alamos National Laboratory have also been found in the river. Second on the list is the Columbia and Snake River system, which was first a year ago. It once sustained about 16 million wild Pacific salmon. Since the turn of the century, almost 70,000 large-sized dams have been constructed on U.S. rivers.

*Grand Junction Daily Sentinel 4/20/93*

### **WATER TRANSFER**

#### **Chevron to Pursue Roan Creek Project Despite State Protest**

Despite Governor Roy Romer's announcement that Colorado will oppose the Roan Creek project, a project spokesman said Romer's stand will not stop the effort to lease Colorado water to Las Vegas, Nevada. Chevron and Getty Oil Exploration Co. proposed building a reservoir on Roan Creek near De Beque to store their unused Colorado River water to lease to Las Vegas. Among Romer's objections is the argument that water court battles over the project will cost water users and taxpayers millions of dollars and ultimately end up before the U.S. Supreme Court.

The Colorado Water Conservation Board and the Colorado River Water Conservation District boards already have voted to oppose the project. Romer is also worried that the Roan Creek project would open up an interstate water market and turn Colorado into a "water farm." Under an interstate market, water from Colorado would flow to higher prices for water than the value of the water from farms and other consumptive uses in Colorado, which could raise the price of water in Colorado to all users as out-of-state users would look for the oldest, most valuable rights available.

Romer said the private lease between the oil companies and Las Vegas would disrupt water talks between the seven Colorado River basin states and 10 Indian tribes. The so-called "7-10" talks are aimed at helping the Lower Basin states of California, Arizona, and Nevada solve their water supply problems.

*Grand Junction Daily Sentinel 5/15/93*

### **ENVIRONMENT**

#### **Sacred-site Pact the "Start of Some Trust," Utes Say**

Ute Indian leaders hope their historic signing of a sacred-site protection agreement with three Colorado forest managers will lead to similar pacts between tribes and public land managers nationwide. The Southern Utes, the Ute Mountain Utes, and the Uintah-Ouray Utes signed a good-faith memorandum with the White River, Routt, Grand Mesa, Gunnison, and Uncompahgre National Forest supervisors that formalizes ongoing cooperative efforts. The agreement promises tribes more protection over the thousands of sacred sites on public lands and holds out more



safekeeping for artifacts. The agreement highlighted a week-long gathering of the three Ute tribes in what used to be their homeland. It is the first time they have met together in this area in more than a century.

*Grand Junction Daily Sentinel 4/25/93*

### **Grand Junction Considers Watershed Plan**

Grand Junction officials are contemplating a plan to control activities well outside of city boundaries that could affect the city's watersheds. City staffers have drafted a proposed watershed ordinance that would require city permits for activities ranging from building sewage disposal systems to timber harvesting within the city's watersheds in the Kannah Creek area. A state law allows such ordinances, even though it means city control outside city boundaries. As proposed, the ordinance would cover watersheds in the Kannah Creek and Whitewater Creek basins, but only about a half-dozen private property owners would be affected. The rest of the property upstream from the facilities is city or federal property. Mesa County Attorney Lyle Dechant said he was reviewing the ordinance, but that he is concerned the city is trying "to expand the envelope" of its powers even more than state law allows.

*Grand Junction Daily Sentinel 4/15/93*

### **Residents Seek Alternatives to Ponds at Rocky Flats**

The normally quiet neighborhood of Westbrook in Westminster rose up in late April as residents protested a proposed retention pond designed to capture and hold runoff water from the Rocky Flats plant. The pond is part of an \$80 million plan to prevent runoff from the former nuclear weapons plant from seeping into Standley Lake, the main drinking water supply for Northglenn, Thornton, Federal Heights, and Westminster. Hundreds of people attended a meeting where they questioned city officials about the safety of potentially contaminated ponds so close to their homes. One of the ponds planned is about 200 yards from the elementary school where the meeting was held. Construction is slated to begin this summer.

*Rocky Mountain News 5/2/93*

### **Muddied Grape Creek Shows Promising Signs of Life**

Division of Wildlife officials have found some signs of life in mud-mired Grape Creek, which stretches between Westcliffe and Canon City. The creek was polluted with hundreds of tons of black silt and mud last fall when DeWeese Reservoir was emptied for drain outlet repairs. Division of Wildlife fishery biologist Doug Krieger said it was the worst water pollution situation he had ever seen, and he feared nearly all the fish would die. The deluge of mud did take a toll on fish and bugs, but it was not as bad as officials expected. The stretch of creek right below the dam was the hardest hit. The situation there is still not ideal, but even at that location there are some fish. Officials believe a summer of high water runoff will flush out most of the remaining mud. Biologists have found that as they sample further down the creek, conditions improve as they get closer to Canon City. If the water bugs can rebound from the deluge, the fish will have

enough to eat this summer. Biologists have also discovered quite a few small fish in the creek, which don't need quite as much food and have a better chance of surviving. Wildlife officials will stock some catchable fish at all three major access points along the creek -- just below the dam, at Bear Gulch, and Temple Canyon.

*Pueblo Chieftain 5/11/93*

### **Tailings Cleanup to be Costly**

A project to clean up mine tailings pollution in Kerber Creek near the historical mining town of Bonanza would cost an estimated \$20 million. The U.S. Forest Service is leading the effort to obtain money to clean up the creek, which is a dead stream from below the Rawley Mill site to Villa Grove. About 20 property owners might help pay for the cleanup, or money might come from the EPA. The pollution in Kerber Creek was caused by tailings ponds that were blown up in the 1920's when the Rawley Mill was abandoned. The site, located below the Continental Divide high in the Rio Grande National Forest, is about 25 miles north of Saguache.

*Denver Post 4/15/93*

### **River's Future Designation Clouded**

A preliminary proposal by the U.S. Forest Service to establish wild and scenic designation for the North Fork of the Poudre River is hitting rough waters. The agency announced last fall that it would commence a study of the river, to determine if it should receive the special federal designation. Located in northern Larimer County, a 29-mile stretch of the river was identified as a unique waterway in a nationwide inventory in 1982. While the proposal is in its early stages, the idea already is receiving opposition. The river flows through about 14 miles of private property, and some of the owners don't want their land included in the designation. They worry that such a designation will bring more people who would trespass on private land. Karen Roth, a Forest Service staffer who is leading the suitability study, hopes to convince property owners otherwise. Studies show a wild and scenic designation doesn't pull more people to the river, and does not force owners to relinquish any property rights. What it does, according to Roth, is preserve the waterway in its current state for future generations. However, it will be years before the question is settled. A portion of the mainstem of the Poudre River received a wild and scenic designation in 1988 after 12 years of study and negotiations, and remains the only river in the state that has received the designation.

*Fort Collins Coloradoan 4/19/93*

### **EPA Suggests Globeville as Superfund Cleanup Site**

The EPA has announced plans to add ASARCO's Globe Plant cadmium smelter to its Superfund cleanup list. The state and ASARCO published a cleanup plan last October, and recently forwarded a consent decree to a federal judge for approval. The decree will govern the cleanup of Denver's Globeville neighborhood and portions of southern Adams County near the 107-year-old smelter with the cost to be shouldered by ASARCO.



The state health department filed a natural resources damage suit against ASARCO in 1983, alleging contamination of soil, air, and groundwater.

In 1987 the two sides agreed to study cleanup options. 1989 study results showed area residents faced a slightly elevated cancer risk as a result of plant pollution. In 1990 a feasibility study was released, listing cleanup options. In March of 1993, a Denver District Court jury ordered ASARCO to pay \$28 million to Globeville residents who filed a lawsuit against the company. The jury found ASARCO had negligently permitted heavy metals to spread from its smelter into the surrounding environment, harming area families. Colorado Health Department officials said the Superfund designation would likely have little effect on a cleanup plan. But the designation does mean neighbors can get technical assistance grants to hire consultants and scientists to keep tabs on the cleanup.

*Pueblo Chieftain 5/9/93*

## WETLANDS

### Wells Would Ruin Wetlands, Rancher Argues

In 1992 Larry Birdwell bought a 400-acre ranch along West Plum Creek in Douglas County. Four months later, Birdwell was informed by the town of Castle Rock that it also had plans for the ranch. Castle Rock, which owns water rights upstream, plans to take its water out of the creek at Birdwell's property by drilling six shallow wells and building a pumping station. Birdwell said he has been told an 11-acre easement on his land will be condemned by the city, and that he will receive \$7,500 as reimbursement. He contends that if the wells go in, they will destroy the wetlands and subirrigation, and ruin the ecosystem for the valley. Birdwell regards the 55 acres of wetlands on his property as one of the last natural preserves in the metro area.

Castle Rock has plans to pump at least 390 acre-feet of water annually out of West Plum Creek. According to Bob Flentz, Castle Rock attorney, "This project won't have any effect on the water level or on wildlife or vegetation. We will address any wetlands issues or department of wildlife issues that come up."

*Denver Post 4/19/93*

## WILDERNESS

### Developer Gives Up on Wilderness Development Plan

A real estate developer says he won't build a posh log-cabin subdivision in the West Elk Wilderness and has agreed to a land swap for property near Telluride. Under a compromise plan with the Forest Service, West Elk Development Corp. agreed in principle to exchange 240 acres of private land it owns in the West Elk Wilderness for 105 acres of national forest land near the Telluride ski area. Both parcels of land were appraised at \$640,000 by an independent contractor. Land regulations will allow the corporation to subdivide the land near Telluride and develop it for resort homes. The agreement culminates six months

of delicate negotiations and gives the two parties until November 1993 to reach a final agreement. Forest Service officials warn, however, that the plan now must go through an environmental analysis, and will be open to public comment and input, and be subject to the General Exchange Act as well as other applicable laws.

*Pueblo Chieftain 5/12/93*

### Huge Wilderness Bill Reintroduction Slated

A five-state, 13 million-acre wilderness bill, known as the Northern Rockies Ecosystem Protection Act, may be reintroduced in Congress by Rep. Joe Kennedy, D-Mass. The measure would designate 13 million acres of federal wilderness in Montana, Idaho, Wyoming, eastern Oregon, and eastern Washington. The bill also would establish wilderness-type protection for 1.5 million to 1.8 million acres of "corridors" between wilderness areas. Matching legislation was introduced last year, but died when the House adjourned for elections. The current legislation is essentially unchanged from last year. Wilderness areas in the forthcoming bill would be selected from about 22 million acres of roadless land in the five states.

*Montrose Daily Press 5/11/93*

### Colorado Wilderness Bill Going Nowhere Fast

When the Colorado wilderness bill perished last year in the U.S. Congress, the state's lawmakers promised quick action this year. But seven months after last year's session, the bill has gone nowhere fast. In the Senate it's stuck in committee, and in the House it hasn't seen its first subcommittee hearing, let alone a vote. The bill is being blocked in the Senate by Republican Senator Hank Brown because he wants the House version to be voted on first to make sure it is the compromise version agreed upon previously. If the Senate and the House passed different versions of the bill, the disputes would have to be settled in a House-Senate conference committee. The bill has been stalled in the House because of other priorities early in the new session.

*Denver Post 5/20/93*

## WILDLIFE

### Bald Eagles at Standley Lake Could Delay Project

Bald Eagles have been seen again at Standley Lake, although wildlife experts say it is too late in the season for them to nest. Jerry Craig, raptor biologist for the Colorado Division of Wildlife, said several eagles were seen in early April after a pair that seemed to be on the verge of starting a family there left late in March. If the eagles stay, there could be a delay in a \$30 million water diversion project to keep runoff from the Rocky Flats nuclear-arms plant from draining into Standley Lake, the source of drinking water for several cities in the northern Denver area. Activity around the nesting area would cause the birds to abandon that site for future use. The eagles are protected under the



Endangered Species Act and the Bald Eagle Act. The Front Range is home to only two pairs of bald eagles, one at Barr Lake State Park, and another near Fort Morgan along the South Platte River.

*Rocky Mountain News* 4/11/93

### Endangered Fish Found

Biologists for the Colorado Division of Wildlife have found 67 endangered razorback suckers in a private pond east of Grand Junction. Wildlife regional manager Bob Caskey said two other razorback suckers were caught from the Colorado River. The find in the private pond was a major breakthrough in the \$2 million a year effort to save the razorback sucker and three other endangered species, the bonytail chub, humpback chub, and Colorado squawfish. The 67 rare fish were found in a 25-acre pond near De Beque after biologists searched unsuccessfully for the species in 25 other lakes and ponds in western Colorado.

*Montrose Daily Press* 5/3/93

### River Protection Plan Denounced

A federal plan to protect 2,094 miles of Colorado River basin streams for four endangered fish species was denounced by four Western states but welcomed by environmental groups. Opponents say the designation would curtail dam-building and hydroelectric generation. Supporters said it would safeguard the fish species from extinction and strike a fairer balance between water development and environmental protection.

At issue is a U.S. Fish and Wildlife proposal to designate long expanses of the Colorado River system as critical habitat for the Colorado squawfish, humpback chub, bonytail chub, and razorback sucker. Federal biologists are preparing to make a final decision in November on which fish habitat to protect. In river areas designated as critical habitat for the fish, it would become tougher legally to construct new water developments and alter natural stream courses.

*Denver Post* 4/1/93

### USBR Installs Fish Net

The U.S. Bureau of Reclamation has installed a huge fish net near McPhee Dam's spillway to keep sport fish in the lake during water releases so they don't damage endangered fish populations downstream. Fish biologists said they do not know how many sport fish escaped between the end of March, when releases began, and mid-April, when the net was installed at the reservoir 10 miles north of Cortez. Some species of sport fish are predators that could swim down the Dolores River into habitats occupied by endangered fish species. Under the Endangered Species Act, the bureau is participating in programs to recover endangered fish in the Upper Colorado River and San Juan River basins.

*Montrose Daily Press* 5/14/93

### Group Pushes to Deconstruct Dams

Environmentalists have teamed up with a clothing manufacturer to save some of Oregon's wild salmon runs. In March, Patagonia Inc. and the Oregon Natural Resources Council launched an advertising campaign advocating the removal of abandoned and obsolete dams that block salmon runs on the Rogue River in southern Oregon. The ads in *The New York Times* and *The New Yorker* magazine speak to national lawmakers. Ads in *Fly Fishing* and other leisure magazines target recreational anglers, while a third ad runs in local newspapers.

Three Rogue River dams are targeted for removal. One, the Elk Creek Dam, blocks 25 miles of salmon habitat even though it was never finished. Completing it would cost an estimated \$70 million, while its removal would cost \$2.5 million. The second is Gold Tey Dam, an abandoned hydropower facility in Jackson County, where squawfish prey on salmon smolts. The third dam, Savage Rapids, blocks nearly 25,000 fish from the upper river, and could be replaced by irrigation pumps.

*High Country News* 5/17/93

### Bull Trout Endangered, FWS Says

The U.S. Fish and Wildlife Service says there is enough evidence of declining bull trout populations to formally consider declaring the fish an endangered species in six western states. Three conservation groups in Montana petitioned the FWS last October for protection of bull trout under the Endangered Species Act. Citing development threats to its habitat, they asked that the fish be listed as endangered. The fish are thought to have disappeared from California and a number of drainages in the western states. Information indicates bull trout have been in serious decline throughout their historical range due to habitat degradation and loss, genetic isolation, overharvest, and competition and hybridization with introduced species. After a formal status review of the species, it could be added to the list of threatened or endangered species as early as October.

*Montrose Daily Press* 5/26/93

## PEOPLE

### River District Lawyer Quits After 12 Years

Don Hamburg, staff attorney for the Colorado River Water Conservation District, has announced his resignation. Hamburg is well-regarded for his work on Western Slope water issues and has been a key player in the defense of Gunnison Basin water against proposed transmountain diversions. He said he will work until Oct. 1 to give the district time to find a new attorney, and to spend the summer filing briefs before the state Supreme Court on the Gunnison River case. Arapahoe County has appealed the favorable decision Hamburg and other Western Slope attorneys won in 1991. He has worked as the district's attorney for 12 years, after 20 years as a water lawyer for the state attorney general's office. The district hopes to have a new attorney on board by Aug. 1.

*Grand Junction Daily Sentinel* 4/22/93



## CONSERVATION

### Denver May Abandon Lawn-Watering Advisories

The Denver Water Board may abandon the circle-square-diamond system of advising homeowners when to water their lawns. The system was developed when people watered their blue grass every day. "A lot of people now know better. And a lot still think they have to water every square inch every day," said Liz Inman, conservation officer for Denver Water. Denver's circle-square-diamond system advises watering every three days. The system began in 1977 as a mandatory program. It has been voluntary since 1983, when the Foothills water treatment plant began operating. Ed Markham of Green Hills turf farm in Mead feels the wrong information is being presented. Markham says he waters his Kentucky Blue Grass every seven to nine days. Kentucky Blue Grass needs a lot of water to get established. But after that, the resident should water every fourth day, then every fifth day, until the grass "learns" to get by on less water.

*Rocky Mountain News 4/25/93*

## PUBLIC LANDS

### Water's Quantity, Quality Declining in National Parks

Decades on mismanagement and neglect are threatening the quantity and quality of the water in the national parks, according to a three-year study released by the National Parks and Conservation Association (NPCA). The non-profit association studied 12 national parks around the country and found all with individual water crises. Problems ranged from leaching toxins from mining wastes to dams to geothermal development to water grabs by urban areas. In many cases, the declining amounts of water that are making it to the parks are laced with toxins and heavy minerals that are taking a toll on plants and animals. The NPCA is calling for changes in the nation's 121-year old mining law to hold mining companies more accountable for environmental problems, particularly those caused after mining stops. It is also calling for changes to the federal Clean Water Act, which Congress will reauthorize this year, to strengthen water quality standards and reduce non-point pollution such as agricultural and other runoff.

*Fort Collins Coloradoan 3/31/93*

## LITIGATION

### Grand Junction Barred from Moving into Ute Zone

Developers building on land that is within Grand Junction city limits but also within Ute Water Conservancy District boundaries must use Ute water, a District Court judge ruled in granting Ute an injunction against the city. The city sought to provide water service to a new senior complex on Patterson Road. The development, Heritage Homes, is within both city limits and Ute territory. The city charges \$3,200 for the same size tap. The outgoing Grand Junction city council gave Wilson authority to appeal to the Colorado Court of Appeals.

*Grand Junction Daily Sentinel 4/26/93*

### Nebraska Water Request is Denied

Wyoming officials claimed a victory in the continuing legal battle over the North Platte River as the U.S. Supreme Court denied Nebraska's requests for more water from the river system to protect Lake McConaughy and wildlife habitat in central Nebraska. This marks the second time the court denied a Nebraska attempt to amend the case and modify the court's 1945 decree. Nebraska claims that Wyoming is using more water from the system than it is entitled to under a 1945 agreement between the two states.

The court earlier ruled that the U.S. Bureau of Reclamation can continue to divert water from the river for use by Nebraska irrigators. But it also ruled that Nebraska cannot prevent Wyoming from putting dams on tributaries of the river system unless Nebraska can prove such developments would cause substantial injury to the state's water users.

*Montrose Daily Press 4/27/93*

### State Wins Equal Say in Arsenal Cleanup

A federal appeals court gave Colorado more power to toughen rules for environmental cleanup at the Rocky Mountain Arsenal. State officials applauded the decision. Patricia Nolan, executive director of the Colorado Department of Health, said the ruling gives the state an equal say with the EPA in tough environmental decisions. The three-judge panel said U.S. District Judge James Carrigan erred in 1991 when he ruled that the state doesn't have power to enforce hazardous waste laws at federal facilities. Colorado standards for soil and groundwater contamination are tougher than federal laws. The Army, which made weapons for chemical warfare at the arsenal starting in 1942, shares cleanup liability with Shell Oil Co., which made pesticides at the arsenal beginning in 1952. Spokesmen for the Army, EPA, and Shell said they would comment after they review the decision.

*Rocky Mountain News 4/8/93*

## RECREATION

### Great Plains Park Funded by House Vote

The Colorado House has passed a bill authorizing the State Division of Wildlife to spend \$5 million to acquire water rights for Great Plains State Park between Eads and Lamar. The funds will act as seed money for federal grants and other contributions to develop the first state park in southeastern Colorado. The \$5 million will be added to \$1 million allocated to the State Division of Wildlife to start planning the project last year. Another \$7 million will be committed by the State Board of Parks and Outdoor Recreation to plan and build the park over a six to 12-year period. The bill will be carried in the Senate by Sen. Jim Rizzuto, D-Swink.

Gov. Roy Romer has committed \$12 million of park and wildlife funds to build the park at the Great Plains reservoirs. The Colorado Wildlife Commission has unanimously endorsed the



plan, which gives the go-ahead to the Colorado Division of Wildlife to begin negotiations for the water rights.

*Pueblo Chieftain* 5/8/93, 5/18/93

#### **Snowmass Expects Approval of Expansion after 25-year Court Battle**

After a 25-year environmental battle, the U.S. Forest Service is expected to give preliminary approval to a \$45 million expansion of the Snowmass ski area. After a preliminary decision, public comment will be allowed for 45 days before the Forest Service makes a final decision in late summer. When Snowmass opened in 1967, the Forest Service permit included Burnt Mountain, an 11,385-foot peak between Baldy Mountain, where the current ski area is, and Tiehack-Buttermilk ski area to the east.

The Aspen Ski Co., which owns Tiehack-Buttermilk and Aspen Mountain ski areas, is confident the proposal will be approved. But environmental groups say the inclusion of Burnt Mountain would harm elk migration and calving areas, decrease water quality, threaten fisheries, and increase air pollution. The Forest Service has been studying seven alternatives to the plan, including one which calls for no development.

*Grand Junction Daily Sentinel* 4/26/93

#### **When Ski Areas Fail, Taxpayers Clean Up**

The U.S. Forest Service is beginning to come to grips with a little-known impact of skiing on public lands: the reclamation work that must be done when ski areas go belly-up. As old resorts have shut down, they have left behind such headaches as open dumps and decrepit buildings and sewage treatment plants. In Colorado, reclamation work for the Pikes Peak and Berthoud ski areas alone is expected to cost at least \$400,000. The cost of reclaiming an area called Geneva Basin, closed since 1986, is unknown.

On Pikes Peak near Colorado Springs, where a ski area went bankrupt in 1985, the Forest Service has already spent \$250,000 on a reclamation job that is far from complete, including extensive drainage work on the old ski runs. The former operator mistakenly and illegally diverted a stream, and now a gully has been cut to a depth of five feet in some spots. At Berthoud, managers of the Arapaho-Roosevelt National Forest are left with the job of dismantling drinking water and wastewater treatment plants, all at taxpayer expense.

*High Country News* 5/17/93

### **GROUNDWATER**

#### **Conoco to Pay for Permit Violations**

Conoco has agreed to pay the state \$200,000 for permit violations and groundwater violations at Sand Creek, the health department announced. A Conoco refinery adjacent to Sand Creek in Commerce City was cited in November for violating discharge limits and for seepage from spills and underground leaks. The Sand Creek site has been at the center of environmental concerns

for years -- contaminated by chemicals and toxins from nearby plants, landfills, and Stapleton International Airport. The EPA has been overseeing a \$9.9 million Superfund cleanup of the 400-acre site since 1991. As part of the agreement, Conoco will continue cleanup of soil, groundwater, and surface-water contamination in the area. The agreement follows Conoco's \$1 million settlement of a Sierra Club lawsuit earlier in March.

*Denver Post* 3/25/93

#### **New Regulations Coming for Water Well Permits**

Water well permits issued by the Colorado Division of Water Resources (DWR) for household-use-only cannot be used to water domestic animals effective July 1. The new restriction will apply both to new permits and to applications to amend existing household-use-only permits. The change is a result of the expiration of a 1988 law that allowed owners of certain new or existing household-use-only permits to request to be allowed to water their domestic animals. DWR will consider allowing the watering of domestic animals under new permits and amendments of existing permits only if applications are date-stamped in a DWR office on or before June 30. Beginning July 1, people who hold valid permits that specifically state that they can use the well to water domestic animals can continue to do so, but any other household-use-only permit will automatically exclude watering of domestic animals. The ban will include applications that are submitted to replace permits that expire because construction was not completed within the two-year life of the original permit. People with questions about the procedures for submitting new permit applications or amending existing permits before the June 30 deadline should contact the nearest DWR office, or call (303) 866-3587.

*Greeley Tribune* 5/16/93

### **LAST MINUTE NEWS**

#### **Negotiations Yield Deal in Water Lawsuit**

A deal has been struck over use of the controversial Wolford Mountain Reservoir on Muddy Creek. The reservoir will be used in a water exchange capacity, enabling Denver to divert more water from Dillon Reservoir in dry years and replace it with releases from Wolford Mountain. The deal calls for spreading out the more saline releases from Wolford Mountain from July through November rather than concentrating them during August, the heaviest portion of the irrigating season. In addition, twice as much of the exchange releases will come from Denver's Williams Fork Reservoir near Parshall, which holds cleaner water than Wolford Mountain. Finally, Denver and the Colorado River Water Conservation District agreed to let the four objectors (Clifton, Orchard Mesa, and Palisade irrigation districts, and the City of Grand Junction) help them develop the actual exchange plan that must win the approval of the U.S. Bureau of Reclamation. The deal must also be formally ratified by the boards of the Denver Water Department, the Colorado Water Conservation District, and the Grand Junction city council, but support appears to be solid.

*Grand Junction Daily Sentinel* 5/27/93



## **CALLS FOR PAPERS AND MEETINGS**

### **SEEKING AN INTEGRATED APPROACH TO WATERSHED MANAGEMENT IN THE SOUTH PLATTE BASIN**

October 27-28, 1993

University Park Holiday Inn, Fort Collins, Colorado

The way in which we manage our natural resources is undergoing a fundamental change in philosophy and direction. Concepts such as riparian habitat restoration and management, maintaining ecological integrity and integrated watershed management are being discussed in many different forums. How will pending changes in resource management affect the way in which we manage the South Platte Basin? What is meant by these phrases? How can integrated management of South Platte Basin resources be implemented?

The 1993 South Platte Forum will provide a setting for discussing these questions and developing a strategy for

- Managing resources as an integrated system
- Competing uses and conflict resolution
- Regional scale assessment and modeling
- Habitat assessment, protection, and restoration
- Water conservation and use efficiency
- Social and cultural issues
- Legislative and political issues
- Farming partnerships
- Information management and geographic information systems

Abstracts will be reviewed and authors whose papers are selected for presentation will be notified by August 1, 1993. The abstracts should be one page or shorter in length and be submitted both in hard copy and Wordperfect or ASCII format on disk if possible. The actual presentation should be approximately 15 minutes in length and allow for an additional five minutes of discussion. Submitted abstracts will be published in the proceedings.

#### **Submit materials to:**

Colorado Water Resources Research Institute  
410 University Services Building, CSU  
Fort Collins, CO 80523  
Attention: Kathleen C. Klein, Coordinator  
Phone: (303) 491-6308 FAX: (303) 491-2293

#### **Sponsored By:**

Colorado Division of Wildlife, US Fish and Wildlife Service, Colorado Water Resources Research Institute, Denver Water Department, US Environmental Protection Agency, US Geological Survey, and Northern Colorado Water Conservancy District

### **COLORADO WATER WORKSHOP: THE BIG SQUEEZE 18th Annual Colorado Water Workshop**

July 28-30, 1993, Western State College, Gunnison, Colorado

-- Participants will examine how limited resources, both financial and natural, are encouraging communities, agencies, and businesses to seek cooperative solutions to water quality challenges. What integrated approaches are achieving results and saving money? Panelists will also discuss watershed-based approaches that may be incorporated into the Clean Water Act. Speakers from other western states, Colorado, and Washington

an integrated approach to resource management in the basin. The format will include invited presentations that seek to define the concept of integrated management and provide case studies of integrated approaches. In addition, technical presentations and discussion sessions will be held to facilitate a better understanding to the "integrated" approach.

You are invited to submit a one-page abstract for a planned short presentation to the organizing committee by July 1, 1993. Topics on interest include the following:

D.C. will share their perspectives and experiences. Western State College will offer one undergraduate or graduate credit for the three-day conference. The registration fee, which includes meals, is \$200. A limited number of scholarships are available. Inexpensive dorm rooms also will be available. The conference schedule and registration information will be mailed in early June. For more information, please call (303) 943-7156 or -2090.



Management Division,  
21st Annual Conference  
Denver Tech Center Sheraton

May 23 - 26, 1994

**WATER POLICY & MANAGEMENT:  
SOLVING THE PROBLEMS**

**CONFERENCE THEME:** The ASCE Water Resources Planning and Management Division will hold its 21st Annual Conference May 23-26, 1994, in Denver, Colorado. The theme of the conference will be "Water Policy and Management: Solving the Problems." As the WRPMD enters its third decade, this conference will refocus on national water issues and will also serve as a forum for western water issues.

**CALL FOR PAPERS:** The Technical Program Committee solicits paper proposals from individual authors, poster presentations, tutorials, and proposals for complete sessions on topics related to the following:

- Water Marketing
- Conservation and Water Use Efficiency
- Water Reclamation and Reuse
- Interbasin Transfers and Basin of Origin
- Conjunctive Use
- Groundwater Development, Management and Reclamation
- Water Pricing
- GIS in Water Resources
- International Issues
- Western Water Issues
- Water Salvage
- Water Law
- Interstate Issues
- Hydrodiplomacy
- Endangered Species
- Energy Development
- City-Farm Cooperation
- Environmental/Recreational Issues

Send three copies of the abstract to Technical Program Chair. Abstracts should be limited to 500 words and must include the affiliation and position of the author(s), and daytime telephone and FAX numbers. The conference proceedings will consist of extended papers limited to four pages each. Posters summarized as a paper also will be accepted for the proceedings, which will be distributed with registration materials at the conference. Speakers are expected to register for the conference.

Abstracts must be received by **July 16, 1993**. Authors will be notified of acceptance in September, 1993. Camera-ready final papers must be received by December 3, 1993, to assure inclusion in the conference proceedings. Address correspondence to the Technical Program Chair: Harry N. Tuvel, Boswell Engineering, 330 Phillips Avenue, South Hackensack, NJ 07606, Tel.: (201) 641-0770, FAX: (201) 641-1831.

**SECOND INTERNATIONAL SYMPOSIUM ON  
ARTIFICIAL RECHARGE OF GROUND WATER**

**July 17-22, 1994, Walt Disney World Swan Hotel, Orlando, Florida** -- Issues will include technical as well as legal, regulatory, environmental, economic, institutional, and other considerations that comprise successful recharge projects. Papers invited and will be published in an ASCE Proceedings to be distributed at the Symposium. A poster session will also be held. Posters summarized as a paper will also be accepted for the Proceedings. Abstracts (3 copies, up to 300 words) will be accepted until **November 15, 1993**. Attendees presenting papers or posters will be expected to pay the registration fees and travel expenses. Abstracts and requests for registration forms should be sent to: Ivan Johnson, Co-Chairman, SISAR Organizing Committee, A. Ivan Johnson Inc., 7474 Upham Court, Arvada, Colorado 80003, Tel/FAX: (303) 425-5610.

**SECOND INTERNATIONAL CONFERENCE ON  
GROUNDWATER ECOLOGY**

**March 27-30, 1994, Atlanta Hilton & Towers, Atlanta, Georgia** -- The conference will focus on the need to increase knowledge of groundwater ecology and to explore ways for applying this knowledge to groundwater protection efforts. Abstracts should be submitted by **November 16, 1993** to: John Simons, General Chairperson, U.S. EPA, Ground Water Protection Division, Mail Code WH550G, 401 M Street, SW, Washington D.C., 20460, Tel.: (202) 260-7091.

**CONFERENCE ON TAILINGS & MINE WASTE 1994**

**January 19-21, 1994, Fort Collins, Colorado** -- This conference will cover the latest information on mine and mill tailings and waste, as well as provide a forum for discussion of current and future mining and environmental issues. The program will include issues related to: tailings and mine waste management, reclamation and remediation, regulatory framework and public awareness. Authors are requested to submit a short abstract (250 words) by June 30, 1993. To submit an abstract or for information, contact: Janet Lee Montera, Department of Civil Engineering, Colorado State University, Fort Collins, CO 80523. Tel. 303/491-7425; FAX 303/491-7727.

**ASSESSMENT OF MODELS FOR GROUNDWATER  
RESOURCES ANALYSIS AND MANAGEMENT**

**March 21-23, 1994, Honolulu, Hawaii** -- This conference is jointly sponsored by the Water Resources Research Centers of Alaska, Guam/Micronesia, Hawaii, Idaho, Oregon and Washington. The conference will focus on the state-of-the-art of groundwater models in both theory and application. Papers will address the role of models in decision making and the problems facing decision makers regarding potential conflict with nontechnical, e.g., social or political factors. Submit an abstract of 300 words or less, including title, authors names and affiliation, and specific session of interest to: Dr. Aly I. El-Kadi, Dept. of Geology and Geophysics & Water Resources Research Center, University of Hawaii at Manoa, 2525 Correa Rd., HIG



441, Honolulu, Hawaii 96822. Tel. 808/956-6331; FAX 808/956-2538. Email: aly@water.soest.hawaii.edu. Fax or electronic mail submissions will be accepted. **The abstract deadline is June 30, 1993.**

**RESPONSES TO CHANGING MULTIPLE-  
USE DEMANDS: NEW DIRECTIONS FOR  
WATER RESOURCES PLANNING  
AND MANAGEMENT**

**April 17-20, 1994, Nashville, Tennessee** -- The American Water Resources Association's (AWRA) Annual Spring Symposium. **The abstract deadline is August 16, 1993.** Submit three (3) copies, 200 words, and include title, all author's names, and affiliations. Include, on a separate page, the full mailing addresses and a telephone number for each author. Acceptance notification will be made by September 15, 1993. All attendees, including authors, will be expected to pay the registration fees for the symposium. Submit abstract to the Symposium Technical Program Chairperson: Jack Gordon, Tennessee Technological University, Civil Engineering Department, P.O. Box 5015, Cookeville, TN 38505. Tel. 615/372-3454.

**EFFECTS OF HUMAN-INDUCED CHANGES  
ON HYDROLOGIC SYSTEMS**

**June 26-29, 1994, Jackson Hole, Wyoming** -- The American Water Resources Association's (AWRA) Annual Summer Symposium. **The abstract deadline is August 16, 1993.** Submit three (3) copies, 250 words, and include title, all authors' names and affiliations. Include, on a separate page, full mailing addresses and a telephone number and FAX number (if appropriate) for each author. Indicate if you have a preference for either poster or oral session consideration. Acceptance notification will be made by October 15, 1993. All attendees, including authors, will be expected to pay the registration fees for this symposium. Abstract should be submitted to the

Symposium Technical Program Chairperson: Victor Hasfurther, Dept. of Civil & Architectural Engineering, P.O. Box 3295, University of Wyoming, Laramie, WY 82071-3295. Tel. 307/766-2963.

**FUNDAMENTALS OF BIOREMEDIATION OF  
HAZARDOUS WASTE CONTAMINATED SOILS**

**August 30-September 3, 1993, Logan, Utah** -- The Utah Water Research Laboratory will offer this five-day workshop. It will provide a summary and applications of soil fundamentals critical to the understanding and management of the fate and transport of hazardous materials in soil systems. The course will emphasize the application of chemical physical, biological and soil sciences to the development and implementation of bioremediation strategies for CERCLA and RCRA regulated hazardous waste sites. It will be held at the Eccles Conference Center on the Utah State University in Logan, Utah. Cost will be \$435 through August 1, or \$485 thereafter. Direct registration inquiries to: Ivonne Harris, Registration Services, Utah Water Research Laboratory, Utah State University, Logan, Utah 84322-8200, Tel. 801/750-3693; FAX 801/750-3663. For technical information on the workshop, contact Dr. R. Ryan Dupont, Course Co-Director, Tel. 801/750-3227.

**Four States Irrigation Council  
"NEW PARTNERS IN WATER RESOURCES"  
August 18-19, 1993**

The Four States Irrigation Council will hold its Summer Tour in Hays, Kansas this year. While many of the details are yet to be finalized, please get the dates and locations on your calendars as early as possible. We encourage you to make reservations early if you plan to attend. The number for the Holiday Inn is (913) 625-7371. The rate is \$52 for single or double. Additional information and registration forms will be mailed as soon as tour plans are finalized or contact Four States Irrigation Council, P.O. Box 163, Loveland, CO 80539.

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**FUNDAMENTALS OF STOCHASTIC MODELING OF FLOW AND TRANSPORT IN POROUS FORMATIONS**

**June 28-July 2, 1993.** The course acquaints participants with the foundation of stochastic theory and stochastic modeling so that they will be able to apply this knowledge to solving field problems. To support this objective, the course will include exercise-solving, use of a few codes, analysis of field applications, and discussion of the most recent and future developments. Fee \$1395 before May 28, 1993; \$1595 after that date.

*For course information contact:*  
*Short Course Coordinator*  
*International Ground Water Modeling Center*  
*Colorado School of Mines*  
*Golden, Colorado 80401-1887*  
*Phone: (303)273-3103; FAX (303)273-3278*

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## CALENDAR

- June 20-23 **JOINT INTERNATIONAL SUMMER MEETING OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS AND THE CANADIAN SOCIETY OF AGRICULTURAL ENGINEERING**, Spokane, WA. Contact: American Society of Agricultural Engineers, 2950 Niles Rd., St. Joseph, MI 49085-9659; Phone 616/429-0300.
- June 27-30 **COLLECTION SYSTEMS OPERATION & MAINTENANCE**, Tucson, AZ. For information call: 1-703-684-2464.
- June 27-30 **AWRA ANNUAL SUMMER SYMPOSIA -- Water Resources Education: A Lifetime of Learning & Changing Roles in Water Resources Management and Policy**, Bellevue, WA. Contact: American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814-2192. Phone (301)493-8600.
- Aug. 2-13 **ENVIRONMENTAL MANAGEMENT OF WATER RESOURCES PROJECTS**, Denver, CO. Contact: David Schaack, American Water Foundation (303)628-5516.
- Aug. 3-6 **UNIVERSITIES COUNCIL ON WATER RESOURCES ANNUAL MEETING**, San Francisco, CA. Contact: Dr. Howard S. Peavy, Dept. of Civil Engr., Montana State University, Bozeman, Mt 59717; 406/994-6690.
- Aug. 12-13 **TEXAS SYNERGISTIC CONFERENCE ON CONSTRUCTED WETLANDS**, Nacogdoches, TX. Contact: David Schaack, American Water Foundation (303)628-5516.
- Aug. 29-31 **ASSOCIATION OF STATE DAM SAFETY OFFICIALS 1993 ANNUAL CONFERENCE**, Kansas City, MO. Contact: Susan Sorrell, P.O. Box 55270, Lexington, KY 40555. Phone (606)257-5146 or 5140.
- Aug. 29-Sept. 2 **AWRA 29TH ANNUAL CONFERENCE & SYMPOSIUM, "EFFLUENT USE MANAGEMENT"**, Tucson, AZ. Contact: AWRA, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814-2192. Phone (301)493-8600.
- Sept. 6-17 **DESIGN AND CONSTRUCTION OF ROLLER COMPACTED CONCRETE DAMS**, Denver, CO. Contact: David Schaack, American Water Foundation (303)628-5516.
- Oct. 11-22 **OPERATION, MAINTENANCE AND MANAGEMENT OF IRRIGATION AND DRAINAGE PROJECTS**, Loveland, CO. Contact: David Schaack, American Water Foundation (303)628-5516.
- Oct. 14-15 **COLORADO HAZARDOUS WASTE MANAGEMENT SOCIETY 7TH ANNUAL REGIONAL CONFERENCE**, Denver, CO. Contact: Rick Giardina, Ernst & Young, 4300 Republic Plaza, Denver, CO 80202. Phone: (303)628-4389; FAX (303)628-4550.
- Oct. 31-Nov. 5 **RISK BASED DECISION MAKING IN WATER RESOURCES VI**, Santa Barbara, CA. Contact: Donna McArdle, Engineering Foundation, 345 E. 47th St., New York, NY 10017. Phone (212)705-7836; FAX (212)705-7441.
- Oct. 31-Nov. 3 **1993 INTERNATIONAL IRRIGATION EXPOSITION AND TECHNICAL CONFERENCE**. Contact: The Irrigation Association, 1911 North Fort Myer Drive, Suite 1009, Arlington, VA 22209-1630.

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