

COLORADO WATER

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

October 1991

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CALL FOR PAPERS
COLORADO WATER ENGINEERING AND MANAGEMENT CONFERENCE
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SCHEDULED MEETINGS

AWRA-COLORADO SECTION PRESENTS:

FLOW AUGMENTATION FOR RECREATIONAL PURPOSES ON THE ARKANSAS RIVER

Sheraton Inn, Colorado Springs - Oct. 9, Dinner 6:45 p.m.; Program 7:30 p.m.

Contact: Gary Bostrum, Colorado Springs 719/636-5685; Doug Cain, Pueblo 719/544-7155; Dave Mueller, Denver 303/236-4882

FORT COLLINS CHAMBER OF COMMERCE PRESENTS:

WATER DETERMINES FUTURE ECONOMIC TRENDS

University Park Holiday Inn, Fort Collins - October 21

Contact: Lindsay Sweetser at The Chamber, 482-3746



WATER RESEARCH AND EDUCATION:

A GOOD INVESTMENT

*Editorial
by Neil S. Grigg*

Back in 1964 before Vietnam and the turmoil of the late 1960's, Congress was beginning the "Great Society" with high expectations of social engineering - the intervention of government into society's problems. Although most of the Great Society experiments failed, the Water Resources Research Act has endured and achieved much. I would like to provide a brief personal testimony of part of the Act's achievements.

Basically the Act provides for state water resources research institutes, a central coordinating office in Washington and a nationally competitive grants program. From the beginning each state institute received a basic support grant of about

\$100,000 from the Federal Government. States had to make up the rest of the support needed, but in 1964 \$100,000 went about as far as \$400,000 would go today. It was enough to get an institute going and to finance some faculty research and graduate student education.

In 1964 I left the Army and went to Auburn University for a Master's degree in hydraulic engineering. The Water Resources Research program paid \$2000 to build a laboratory flume for a study of roughness in open channels. Later I used that knowledge to design flood control structures, city storm drains and water supply facilities for a Denver firm and to help in graduate work at CSU. Then I found jobs teaching and doing research in water resources, and served as director of the North Carolina and Colorado water research institutes. During these years I have seen many students get excited about water resources careers and witnessed firsthand the complexity and conflict involved in water problems. Today I feel strongly about the importance of effective water resources management and investments in water education and research.

We have a greater appreciation now than in 1964 for the political and environmental complexities of water resources. Providing support for students to study the disciplines involved - engineering, science and policy - is even more important than 25 years ago. It is my personal hope that the leaders who have the authority to recognize and support the Water Resources Research Act will do so in the future.

CENTENNIAL CELEBRATION HONORS COLORADO'S 229 VOLUNTEER WEATHER OBSERVERS

by Joyce Hersh, National Weather Service

From Gunnison on the Western Slope to Cheyenne Wells in the East, from the mountains, valleys and plains of Colorado, they came to celebrate two birthdays: a century of cooperative weather observing and the 100th anniversary of the National Weather Service.

To recognize over 100 years of continuous cooperative weather observing and the dedicated service of Colorado's volunteers, the National Weather Service and Colorado State University threw a first-in-a-century party on June 8 at the CSU Lory Student Center. There were flashy meteorological displays to take in, like the billboard-sized map of Colorado with Christmas tree lights pinpointing each of the state's 240 weather stations; old weather maps; and copies of 100-year old weather observation records. Grant Goodge, climatologist from the National Climatic Data Center in Asheville, NC, gave a talk on weather and climate enhanced by footage of tornadoes and other severe storms in action.

Larry Mooney, Colorado Area Manager for the Weather Service, served as master of ceremonies for Saturday's program. He opened the program by introducing Helen McHugh, Director of the Colorado Agricultural Experiment

Station. McHugh delivered the welcome on behalf of the University, acknowledging the volunteers' contributions to a more complete weather picture and the importance of their climate data to agricultural research. A number of climate and weather experts spoke on a range of related topics, such as the Colorado climate and its relationship to water supply and agriculture.

Awards, Prizes and Surprises

For the awards luncheon, the West Ballroom tables were festooned with red, white and blue balloons and laden with food and drink; there were more displays, handouts, gifts, door prizes, awards--and more speeches. Representative Wayne Allard presented awards to honorees in his district. E.W. (Joe) Friday, National Weather Service director, flew in on the red-eye from Washington to add his thanks and praise and help hand out the awards. Throughout the day, Assistant State Climatologist Nolan Doesken was ever present. Doesken, who has worked with the cooperative program daily during the eight years of his tenure, almost single-handedly raised the private-sector funds for financing the celebration.

(continued on page 5)

Colorado Water Engineering and Management Conference

Including AWRA, Colorado Section Symposium

March 2-3, 1992
Holiday Inn Denver Southeast
3200 South Parker Road
Aurora, Colorado

Organized and sponsored by

Colorado State University
Civil Engineering Department
Colorado Water Resources Research
Institute

Colorado Office of the State Engineer

AWRA, Colorado Section



Conference/Symposium Objective

The Civil Engineering Department and the Colorado Water Resources Research Institute at Colorado State University, the Colorado Office of the State Engineer and the American Water Resources Association (AWRA) Colorado Section, seek papers for the **1992 Colorado Water Engineering and Management Conference including the AWRA Symposium and Annual Meeting**. The Conference/Symposium will focus on two main problems of water management: complexity and conflict. Complexity is addressed by the presentation of technical papers to encourage coordination and communication and build the competence of water professionals. The exchange of technical information also promotes cooperation, the most important measure to reduce conflict in water management.

Who Should Attend

The Conference/Symposium will be of interest to water resources engineers, water district managers, utility and municipal officials, agricultural and industrial water managers, scientists, water attorneys, public officials, and other citizens interested in the engineering and managerial aspects of water management.

General Information

For all information concerning this Conference and Symposium, please contact Janet Lee Montero, Civil Engineering Department, Colorado State University, Fort Collins, CO 80523, Telephone: 303-491-7425 and Fax: 303-491-7727.

CALL FOR PAPERS

To Submit a Paper for Consideration

Submit by: November 8, 1991
Submit to: Janet Lee Montera
 Civil Engineering Department
 Colorado State University
 Fort Collins, CO 80523
 Telephone: 303-491-7425
 Fax: 303-491-7727

Abstracts must be one page, single spaced with full names and mailing addresses of all authors following the title of the paper. Notification of acceptance of abstracts will be made by **December 6, 1991**. Five-page papers for preprinting in the Conference/Symposium Proceedings will be due **January 10, 1992**. [Papers received after this date will not appear in the Proceedings.] The Proceedings will be available at the time of the Conference. Authors are expected to pay the registration fee.

Conference/Symposium Topics

- Water Resources Management
- Water Management by Exchanges, Banking, Conjunctive Use
- Computing and Telecommunications in Water Management
- Flood and Storm Water Management
- Urban Water Supply and Treatment
- Drought Planning
- Waste Water Processes
- Groundwater Management
- Climatic Issues
- Agricultural Water Management
- Interstate Delivery Issues
- Water Conservation
- Water Quality Planning
- Water Quality Policy (including Colorado Case Studies)
 - Standards and Classifications
 - Enforcement and Management Practices
 - Quality of Substitute Supply
- Water Quality Investigations (including Colorado Case Studies)
 - Data Collection Methodology
 - Data Interpretation Methodology



Civil Engineering Department
 Colorado State University
 Fort Collins, CO 80523

Organized and Sponsored by:



The Civil Engineering Department at Colorado State consistently ranks among the top five nationally in research and publications with a faculty which is both internationally known and dedicated to a quality graduate and undergraduate program. In 1990, the Colorado Commission on Higher Education designated Colorado State's water programs as a statewide "Program of Excellence".

The Colorado Water Resources Research Institute works with water agencies and water-user associations to identify and prioritize water research problems; plans and manages research projects; disseminates information to water managers; advocates Colorado water research needs, and facilitates research that deals with policy issues facing the General Assembly.

COLORADO OFFICE OF THE STATE ENGINEER



The Colorado Office of the State Engineer has traditionally distributed water according to the state's water rights system and interstate compacts, administered the water well permitting process, and conducted a dam safety program. Its modern mission also includes the maximization of beneficial use of the state's water supplies, planning for the future through engineering and geological studies, and consideration for water quality and environmental factors in water resources development.

AMERICAN WATER RESOURCES ASSOCIATION



The AWRA, Colorado Section, is an interdisciplinary organization dedicated to the advancement of water resources research, planning, development, management and education. The Colorado Section, encourages communication between the various segments of the water community in Colorado by sponsoring an active schedule of programs, seminars, tours and symposia. The Section sponsors an annual scholarship to a Colorado college or university for research concerning Colorado's water resources.

Cosponsorship Sought

The 1991 Conference was cosponsored by several state water associations. They are being invited to cosponsor again. If your organization with an educational or research mission desires to cosponsor, please notify Janet Lee Montera [address under "General Information"] by **December 2, 1991** in order to meet the deadline for publication of the Registration/Program brochure.

Educational Displays Sought (Limited Space)

The Organizing Committee invites your participation in presenting an "Educational Display". This meets one of the Conference/Symposium goals which is to exchange ideas about technological and management solutions for current state water problems and policies. The displays will provide technology transfer and, therefore, no exhibit fee is associated with the display space. However, the Organizing Committee requires that the registration fee applies to anyone who staffs the display area if they attend the Conference. Please contact Janet Lee Montera [address under "General Information"] if interested in this opportunity. **Space is limited to the first 10 confirmations received.**

1992 Hydrology Days Announcement

The 12th Annual Hydrology Days will be held at Colorado State University, Fort Collins, Colorado, during the week of March 31 - April 3, 1992. This annual event is sponsored by the Hydrology Section of the American Geophysical Union, the Front Range Branch, the Hydraulics and Irrigation and Drainage Divisions of ASCE, the Colorado Section of ASCE, the American Water Resources Association and the Colorado Groundwater Association. The objective of this Conference is to provide a forum for hydrologists and hydrology students to get acquainted and to share problems, analyses and solutions. For information regarding Hydrology Days contact: Professor H. J. Morel-Seytoux, Civil Engineering Department, Colorado State University, Fort Collins, CO 80523, Telephone: 303-491-6762 or Fax 303-491-7727.

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Colorado Governor Roy Romer signs state proclamation for Cooperative Weather Observer Appreciation Week. Looking on are members of the Colorado Weather Centennial Committee: Thomas McKee and Nolan Doesken, Colorado Climate Center; Michael Elias and Larry Mooney, National Weather Service; Helen McHugh, Colorado Agricultural Experiment Station; and Jerry Sherlin, National Weather Service.

The Centennial Stations--Eleven stations in Colorado were cited for 100 years or more of continuous operation: Canon City, Cheyenne Wells, Delta, Durango, Fort Collins, Greeley, Gunnison, Lamar, Las Animas, Montrose and Rocky Ford. Several mayors of these cities, along with their weather observers, were on hand to pick up the laser-etched plaques awarded by the Weather Service.

Distinguished Service Awards--Seven volunteers received special awards for long and distinguished service:

Marvin Rankin, the undisputed dean of the Colorado observers, for 52 years' service. A retired postal worker, Rankin began delivering the mail in 1930 to the mountain valleys surrounding Westcliffe and became a cooperative weather observer in 1939.

"Weatherbird" Woods, for 49 years of dedicated weather reporting, despite failing eyesight. It was also announced that later this year Woods will receive the coveted Thomas Jefferson Award, named for the President who was one of the nation's earliest systematic weather observers. To a standing ovation, Woods was proclaimed "Commander of the National Weather Service" and presented a specially-made cap with military insignia.

Rancher Harold Kreuger, for 44 years' service. Kreuger has lived since early childhood in the lonesome Cochetopa Creek valley near Gunnison.

Layton Munson, Sedgwick farmer, ham radio operator and former pilot, also for 44 years.

Two winners of the distinguished service award were missing:

92-year old rancher Mabel Wright of Creede, who has given 47 years to the program, and Orville Altenbern, 87, of DeBeque, who is in his 49th year. On June 5 weatherman Willard Scott saluted Wright on the NBC Today show, and in May she was featured in a *Rocky Mountain News* Sunday magazine cover story. Altenbern, who suffered a broken leg a few months ago in an accident on his ranch, also sent regrets in a brief letter.

Neil Lindstrom accepted a special citation for the Leroy 5WSW station, which has a history like no other in the state: continuous operation for 102 years--by members of the same family. The station was begun in 1889 by his great-great-uncle, Charles Green, who operated it for 50 years.

Surprise Awards--Ray Weaver, an observer representing the Denver Water Department, accepted an institutional citation for the department for its more than 92-year participation in the cooperative program. The department now maintains 13 weather stations, more than any other organization in the state.

The public service Company of Colorado presented an organizational award to the National Weather Service for "training the cooperative weather observers and collecting valuable weather and climate information." Jerry Sherlin, cooperative program manager for Colorado, accepted the award on behalf of the Weather Service.

There was also time for levity. State climatologist Tom McKee presented a special award to former cooperative program manager Bill Tate, who held the position from 1978 to 1986, longer than any other Colorado CPM. McKee provided an account of a 1985 incident when he, Tate, and Nolan Doesken made a trip to Maybell, Colorado to confirm

the lowest temperature ever recorded in the state--minus 61 degrees. The trio had taken a special thermometer for a second reading and planned to return with it for calibration in a CSU cold room. However, back inside the car, Tate inadvertently sat on the thermometer and broke it. The wood plaque with bronze plate that McKee handed him not only bore an inscription commemorating the occasion, but the broken thermometer as well.

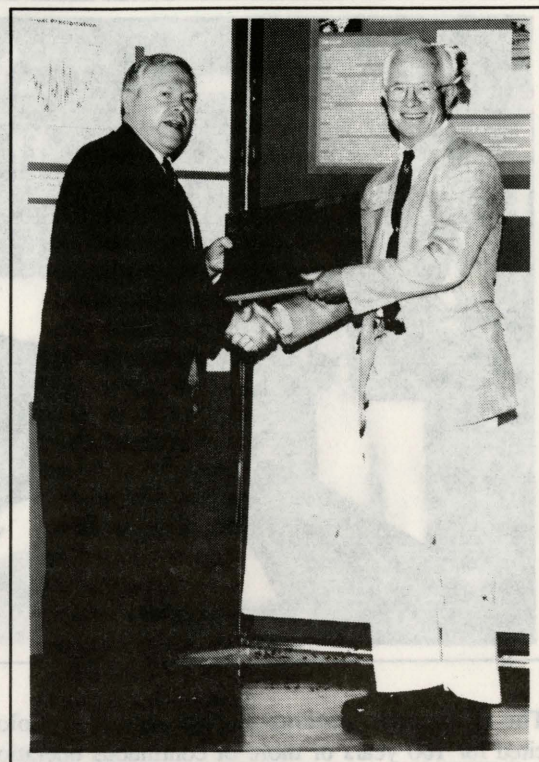
The grand finale was a surprise birthday cake ablaze with 100 candles, which CSU attendants wheeled into the ballroom to mark the National Weather Service's first century as a civilian agency.

MEETING HIGHLIGHTS FRONT RANGE WATER AND ENVIRONMENTAL ISSUES

Emerging Issues in Water and Environmental Sciences was the theme of the 46th annual meeting of the Rocky Mountain Hydrologic Research Center (RMHRC), formerly named the Rocky Mountain Hydraulics Laboratory. Fifty people participated in the August 17, 1991 meeting, held at the Wild Basin Lodge in Allens Park, Colorado and organized by Robert Jarrett of the U.S. Geological Survey (USGS). The purposes of the meeting were to: (1) provide a forum for the exchange of ideas among researchers, faculty and students, and practicing scientists and engineers, with an emphasis toward field-oriented research in the Front Range of Colorado; (2) provide university faculty and students with an opportunity to interact with researchers on a broad spectrum of water and environmental-science issues; and (3) make researchers aware of the research center, enhance cooperative research, and encourage faculty, students, and others to conduct research at the center.

The Research Center is near Allens Park, Colorado, on U.S. Highway 7 and is located on 8.1 ha that straddles the upper North St. Vrain Creek immediately downstream from Wild Basin of Rocky Mountain National Park. It is a nonprofit research corporation devoted to interdisciplinary research and is operated by the USGS. The purpose of the RMHRC is to conduct interdisciplinary research on the hydrology of headwater basins in the Rocky Mountains. The Center includes a workshop/classroom and an outdoor flume. The USGS installed a streamflow-gaging station, which provides baseline hydrologic data on the North St. Vrain Creek at the RMHRC.

Fourteen papers were presented at the meeting. Speakers and topics were: Ray Herrmann, National Park Service (NPS), Protecting Global Natural Resources; Mark Meier, University of Colorado (CU), Global Change and the Mountain Watershed; Roger Barry, CU, Changes of Mountain Climates; Donald Sullivan, University of Denver, Tree-Ring Evidence of Precipitation Variability; Connie Woodhouse, CU, Use of Dendrochronology to Reconstruct Hydrologic Variables; Randy Parker, USGS, Assessing Effects of Potential Climate Change on Hydrology; William Rense, Shippensburg University, Water Budget Analysis of the Front Range of Colorado; Cynthia Paulson, Brown and Caldwell Consultants, Stormwater-Quality Monitoring; Carol Angel, Colorado Department of Law, Federal Reserve Water Rights; Katherine Chase, Colorado State University (CSU), Threshold for Gravel and Cobble



Harold Shipps, Mayor of Durango, Colorado, accepts centennial plaque for his city from E.W. "Joe" Friday, Director of the National Weather Service.

Motion; Rebecca Summer, Private Consultant, Estimating Short-Term Sediment Transfer in the Colorado Front Range; Dorothea Panayotou, CSU, Nutrient Movement and Accumulation of Sheep Creek, Colorado; Terence Boyle, NPS, Retention Ability of Eddies in Lotic Systems; and Robert Edwards, NPS, Ecosystem Dynamics in the Southern Rocky Mountains.

Several issues were addressed during an open discussion. These included: (1) the representativeness and transferability of site-specific studies in mountain watersheds; (2) scaling problems between local, regional and global processes; (3) recognition of interactions between components of the environmental system working in mountain areas; and (4) the need for additional climatic, hydrologic, and other environmental data in mountainous areas that takes account of the problems of representativeness and scaling. Meeting attendees agreed there is a need for additional research to understand the complexity, variability, and sensitivity of mountain hydrology. Additional information on this meeting or the 47th annual meeting of the RMHRC to be held on August 15, 1992, can be obtained from Robert Jarrett at (303) 236-6447.

New Groundwater Guide Available--The recently issued Groundwater Reference Guide from the University of Michigan Biological Station Groundwater Center includes references to materials used and recommended most frequently by the

Center. The guide to recently published material is not meant to be comprehensive but is a starting point for individuals looking for information on different aspects of groundwater. The reference guide can be obtained by contacting either the

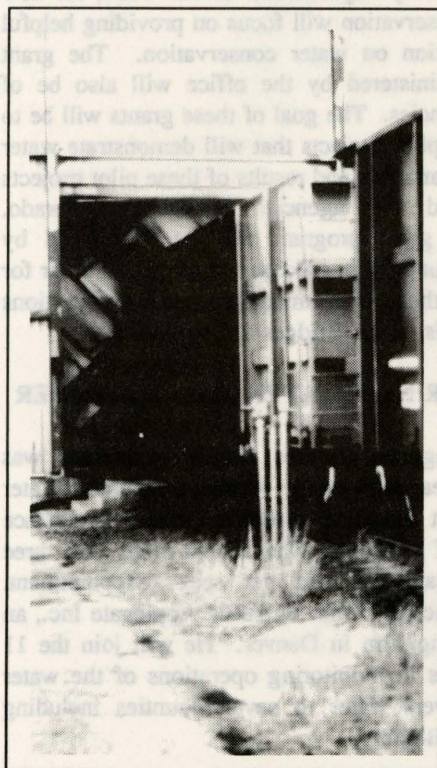
Regional Groundwater Center, UMBS, Pellston, MI 49769, (616)539-8789; or the Institute of Water Research, 334 Natural Resources Building, Michigan State University, East Lansing, MI 48824-1222, (517)353-3742.

CCWCD AND GASP HOST 8TH ANNUAL RIVER TOUR

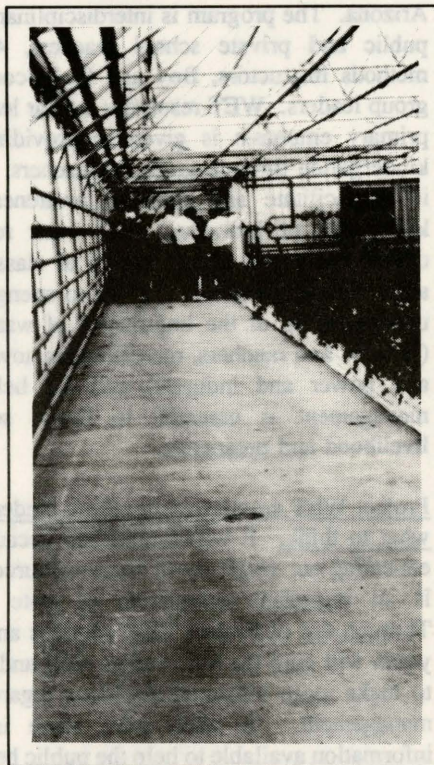
The Boards of Directors of the Central Colorado Water Conservancy District in Greeley and the Groundwater Appropriators of the South Platte, Inc. (GASP) of Fort Morgan hosted their 8th Annual River Tour on Sept. 12, 1991. Approximately 130 participants including state, local, and federal officials were on hand to tour a variety of water features in eastern Weld and western Morgan Counties.



Brush Prairie Ponds Recharge and State Wildlife Area



Pawnee Power Plant



Brush Cogeneration Tomato Facility

The group started at the Weld County Courthouse with a tour of the Division Water Court and a brief historical overview by Judge Robert Behrman.

A video was then shown by Bill O'Hare, in the Centennial Center, on the National Hog Farm operation located near Kersey. The tour group drove through the National Hog Farm facility, then had lunch at Riverside Park in Fort Morgan, hosted by the City of Fort Morgan.

The group then toured Vancil Reservoir, a 6,000 acre-foot reservoir that was completed in 1991 by the Riverside Irrigation Company. Next stop was the Brush Cogeneration/Tomato Facility, where 18 acres of tomatoes are grown in a computerized, climate-controlled greenhouse environment. Heat is provided by a peaking power cogeneration plant located on-site.

Final stops were the Brush Prairie Ponds Recharge and State Wildlife Area and the Pawnee Power Plant. Don Halffield and Randy Rhoades of the Public Service Company led the group through the plant. Participants also viewed a coal train unloading by means of a completely automated process.

WATER EDUCATION - Project WET

by Carolyn Early

Project WET is a water education program for K-12 teachers. There is a counterpart program for adults, Watercourse. Project WET was started in North Dakota in 1984 by the North Dakota State Water Commission and now, through the efforts of the Western Watercourse, exists in Montana and Arizona. The program is interdisciplinary and can be used by public and private school teachers, 4-H leaders, science methods instructors, Boy and Girl Scout leaders, and other group leaders. WET resources are for learners of all ages, but primary emphasis is given to providing teaching aids for kindergarten through grade 12 teachers. Project WET's goal is to facilitate and promote awareness, appreciation and knowledge of individual state water resources through the development and dissemination of classroom-ready teaching aids. Special emphasis is given to strengthening the students' understanding of the importance of water to all water users (farmers and ranchers, recreationists, towns, fish and wildlife, and power and industry) and the belief that wise water management is essential to future social and economic livelihood and prosperity.

Project WET emphasizes teaching students how to think, not what to think. It was established because of the belief that educating our youth about water resource issues and concerns is an important component of state water management. Through use of Project WET services and resource materials, youth will gain the knowledge, skill and commitment needed to make more informed decisions regarding water resources management. In each state, there is a vast wealth of information available to help the public better understand water resources and issues. Project WET can unlock that vast wealth for dissemination to our youth. Western Watercourse (which facilitates the development of state Project WET programs) is teaming up with the Western Regional Environmental Education Council, the organization that developed the highly successful Project Learning Tree and Project WILD, to develop Project WET into a national-level water education program.

For information on the Western Watercourse's youth education Project WET or for its counterpart for adults, contact Director, Western Watercourse, 335 Culbertson Hall, Montana State University, Bozeman, Montana, 59717 - (406)994-5392.

DNR LAUNCHES NEW PROGRAM: YOUTH IN NATURAL RESOURCES

Colorado's Department of Natural Resources has begun a pilot project, Youth in Natural Resources, that employs about 160 young people in the department's 10 divisions during the summer. Most of the area high school students employed are from low-income homes. Ken Salazar, DNR Director, says the program's goals are educational. One student who was considering dropping out of school now plans to major in wildlife biology at Colorado State University. The pilot

program is funded by federal money and private grants. Students spend two days each at the University of Colorado at Boulder and CSU in Fort Collins for exposure to higher education.

Source: DNR News, Aug. 1991 and Rocky Mountain News 7/15/91

COLORADO LEGISLATURE ESTABLISHES OFFICE OF WATER CONSERVATION

Colorado's Water Conservation Act of 1991 (HB 1154), signed into law this Spring by Governor Romer, authorizes the establishment of the State Office of Water Conservation within the Colorado Water Conservation Board. The new Office officially opened for business on July 1. This effort, says the CWCB, places Colorado in the forefront of national water conservation efforts. Key elements of the bill include:

The establishment of the Office of Water Conservation;

Authorization for \$500,000 from the CWCB construction fund for grants toward water efficiency demonstration projects;

Requirement for state agencies to develop water conservation plans by 1993; and

Requirement for water providers with annual water delivery in excess of 2,000 acre/feet to develop water conservation plans by 1996.

Along with the statutory requirements of HB 1154, the new Office of Water Conservation will focus on providing helpful and timely information on water conservation. The grant program to be administered by the office will also be of interest to many agencies. The goal of these grants will be to provide funding for pilot projects that will demonstrate water use efficiency. The analysis and results of these pilot projects will then be shared with agencies throughout Colorado. Guidelines for the grant program will be announced by October 1. Kim Hout is Water Conservation Coordinator for the new office, and those with immediate needs or questions can contact her or Ms. Chris Bridges at 866-3311.

CIVIL ENGINEER NEW WATER BOARD MEMBER

Ft. Collins civil engineer Charles "Mike" Applegate was selected for a four-year term on the Northern Colorado Water Conservancy District board of directors. He will replace Gordon Dyekman of Loveland, who served more than three decades on the board and did not seek reappointment. Applegate is the principal owner of Tuttle Applegate Inc., an engineering consulting firm in Denver. He will join the 11 other board members in monitoring operations of the water district, which delivers water to seven counties including Larimer, Weld, and Boulder.

Ft. Collins Coloradan 9/24/91

UNIVERSITY WATER NEWS

Colorado State University Students Receive CCHE Scholarships

Thirteen Colorado State University students have received Colorado Commission on Higher Education (CCHE) scholarships for the 1991-92 academic year. Last year, CCHE designated Colorado State University's water resources program as a "program of excellence," one of only five such designations throughout the state. This designation enabled the university to offer the CCHE scholarships as part of CSU's Water Resources Program of Excellence to recognize the students' outstanding achievements and to give them an opportunity to take advantage of the excellent program at CSU in the area of water resources.

The recipients include two Engineering Science majors, junior Scott Andre of Bellvue and sophomore Jennifer Roberts of Fort Collins. Both students have chosen an environmental emphasis. Future plans for Roberts include international work and graduate study in environmental administration, while Andre will attend graduate school.

Agricultural Engineering award winners include sophomore Kirsten Close and senior Samara Iodice. Close, a native of Arvada, hopes to enter the Peace Corps upon graduation. From Fort Myers, Florida, Iodice is also majoring in Environmental Engineering, and plans to work in the soil and water area.

The nine remaining scholarship recipients are Civil Engineering majors, including seniors Trudy Olin of Cortez, Lisa Poppenga of Lakewood, Heath Stein of Otis, and Heather Trantham of Pueblo. All plan to attend graduate school. Senior Richard Pringle of Greeley will be an officer in the U.S. Navy Civil Engineering Corps upon graduation. Junior recipients include Mary DeMartini of Fort Collins, Brian Foy of Grand Junction, and Todd Lewis of Rye. Foy intends to work in water management consulting upon graduation, while Lewis may attend graduate school or enter a career in water resources management. DeMartini hopes to enter the Peace Corps upon graduation, and then attend graduate school. Future plans for sophomore Carlos Sanchez of Brownsville, Texas include working for an engineering firm in the Rio Grande Valley.

Computerized Flash-Flood Warnings on the Horizon

On the 15th anniversary of the Big Thompson Flood that took at least 139 lives, scientists are much closer to preventing flood-related deaths with advance computer warnings. CSU engineers have designed a computer program that simulates the rainfall spawned by a localized rainstorm and predicts the runoff that may swell watersheds and threaten populations.

Civil Engineering Professor Pierre Julien and graduate student Fred Ogden have coupled two-dimensional simulations of watersheds in Colorado and Idaho with newly obtained weather data from Colorado State's CHILL radar facility. Located near Greeley, CSU-CHILL is a state-of-the-art Doppler radar facility. Doppler radar can scan an entire storm and spew out a five-minute report of the amount and size of the raindrops, ice or hail falling on the ground. "We can link the radar data from the CHILL facility with the 2-D surface-runoff model to simulate flash floods such as the Big Thompson flood," Julien said. In predicting the march of a storm over an entire watershed, the model also can estimate where flooding may cause the most damage.

Given a watershed's terrain, soil type, permeability, vegetation and other physical characteristics, Julien and Ogden can simulate the motion of summer storms, especially summer convective storms of high-intensity and short duration. "One potential benefit of this model could be to issue advance warnings that could be given to anyone responsible for evacuating critical areas. If released one to two hours ahead of time, mass media could warn people," Julien said.

Guidelines Developed for Water Quality Monitoring In Forested Areas

Lee H. MacDonald's publication, Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska, is now available from the Environmental Protection Agency. The document provides guidance for designing water quality monitoring projects and selecting monitoring parameters. The parameter selection process is incorporated into an interactive PC-based expert system called PASSSFA. Although the focus is on forest management and streams in the Pacific Northwest and Alaska, much of the information is more widely applicable. MacDonald is Associate Professor of Earth Resources at CSU. He developed the guidelines for Region 10, USEPA, in cooperation with Alan W. Smart and Robert C. Wissmar of the Center for Streamside Studies in Forestry, Fisheries & Wildlife, College of Forest Resources/College of Ocean and Fishery Sciences, University of Washington, Seattle. The publication and expert system are available from the USEPA, Region 10, NPS Section, WD-139, 1200 Sixth Ave., Seattle, WA 98101 (EPA 910/9-91-001).

CWRRI Intern Working for Italian Environmental Firm

Palermo, Sicily currently is the home base for former CWRRI Student Intern Joe Pollara. Joe is participating in a two-year experiment to determine if wastewater reuse can provide a safe source of irrigation water for the island's crops. Sicily

averages 25 to 30 inches of precipitation a year, 80 percent of which occurs during three winter months. Therefore, the region is confronted with water resource shortages similar to those in many arid and semi-arid countries throughout the world. Intercepted surface runoff and pumping of aquifers have been tapped close to their limit, so the island has turned to technology to meet its growing agricultural, industrial and domestic demands. The town of Carini, 20 miles west of Palermo, has constructed a pilot treatment plant that uses treated wastewater from the town's sewer to irrigate nearby plots planted with a crop typical of the area. For comparison purposes, identical agricultural practices are carried out on similar plots irrigated with groundwater. Biochemical and microbial analyses are being performed on all waters used in the experiment and on all soils and crops. Preliminary study results indicate that safe irrigation water can be produced if careful operational techniques are adopted.

The study is managed by StudioAmbiente, Hydraulic and Sanitary Engineering, Palermo, with analyses being performed by the Department of Hygiene and Microbiology, Università di Palermo.

Joe, who received a Masters in Agricultural and Chemical Engineering from CSU in May 1991, writes:

This is the most amazing experience of my life (so far). I have been immersed into a vastly different culture and swallowed up into the teeming masses of this vibrant city...Work here is busy. I frequently put in 12-13 hour days, but I'm learning so much here I can't believe that three months have already passed...The food? Well, you can imagine.

CSU Grad Receives Scholarship From AWRA Colorado Section

Cynthia Paulson has been selected as the first recipient of the American Water Resources Association, Colorado Section, Scholarship. Cynthia, who received a Masters degree in Civil Engineering at CSU in 1985, is pursuing her Ph.D at the Department of Civil Engineering, University of Colorado, Boulder, researching the speciation of metals in urban runoff. In addition to her graduate studies, Cynthia is employed as an environmental engineer at Brown and Caldwell Consultants, Denver. Cynthia was chosen from nine applicants for the scholarship.

Biotechnology Research Provides University/Industry Link

The Colorado Institute for Research and Technology (CIRB) was formed to stimulate and coordinate biotechnology research and development activities within Colorado. It is a consortium of Colorado-based biotechnology companies, universities and federal laboratories. As part of CIRB's program the Colorado Bioprocessing Center, located at CSU, provides training for graduate students, courses for industry scientists, and access to

state-of-the-art equipment and ideas for companies developing new production bioprocesses. The Center's Unit Operations Laboratory of bioprocessing equipment can model each of the important states in a real biotechnological manufacturing facility. The Center, housed in CSU's Department of Agricultural and Chemical Engineering, is directed by Professor Eric Dunlop.

CIRB's state funding is provided by the Colorado Advanced Technology Institute (CATI) and matched by in-kind cash support for specific projects or activities. Its program includes:

Fellowship awards for outstanding graduate students whose thesis work is important to industry. The fellowships are matched by university, industry or federal sources.

Matching funds for student interns hired by Colorado biotechnology companies.

Small grants to university investigators for research on projects of industrial relevance. Research must include collaboration by a biotechnology company, another department, or another campus and a minimum of 1:1 matching funds.

Sponsorship of the *Annual Colorado Biotechnology Symposium* and the *CIRB Newsletter*, issued quarterly.

Matching funds for acquisition of specialized research equipment at Colorado universities.

CIRB is directed by Virginia Orndorff of CATI; two co-directors - Vincent Murphy, Department of Agricultural and Chemical Engineering, CSU and Robert Davis, Department of Chemical Engineering, CU; and a Board of Directors consisting of university, industry and federal laboratory representatives.

IGWMC Relocates to Colorado School of Mines

The International Ground Water Modeling Center (IGWMC), formerly at Butler University's Holcomb Research Institute at Indianapolis, Indiana, has relocated to the Colorado School of Mines at Golden. The IGWMC will be part of the Institute for Ground-Water Research and Education (IGWRE). IGWRE's mission is to facilitate ground-water education through interdisciplinary research and course offerings; to promote ground-water information transfer; and to encourage cooperation between CSM and ground-water communities in government, industry, academia, and professional societies. Paul K.M. van der Heijde, IGWMC Director, said CSM will provide a dynamic and responsive environment for IGWMC.

WATER RESEARCH AWARDS

A summary of water research awards and projects is given below, with sponsor noted, 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

Vegetation Restoration Research, Rocky Mountain National Park, Edward F. Redente and Terry McLendon, Range Science
Water & Climate, David A. Randall, Atmospheric Sciences
Modeling Ecological & Distribution Responses of an Aquatic Macrohyte, Michael B. Coughenour, Natural Resource Ecology Lab
Improved Rural Bridge Technologies, Richard M. Gutkowski, Civil Engineering
The Effects of Information Level on the Stability of Willingness to Pay Estimates, Michael J. Manfredo, Recreation Resources
The Creation of Wetlands at the Rocky Mountain Arsenal: Monitoring the Patterns & Process, David J. Copper, Coop. Fish & Wildlife Unit
Successional Changes in Benthic Communities in Wetlands at the Rocky Mountain Arsenal, William H. Clements, Fishery & Wildlife Biology
Structural & Functional Responses of Benthic Communities to Heavy Metals, William H. Clements, Fishery & Wildlife Biology
Characterization of the Land Cover of the Great Sand Dunes National Monument & Wind, Roger M. Hoffer, Forest & Wood Science
Spatial Trends in Surface Water Quality, Noatak National Preserve, Daniel E. Binkley, Forest & Wood Science
Regional Analysis of Ecosystem Structure & Function in the Central Grasslands Region, Ingrid C. Burke, Forest & Wood Science
The Role of Clouds in CO₂-Induced Climate Change, David A. Randall, Atmospheric Science
Range-Watershed Training for Native Americans, Ellsworth T. Bartlett, Range Science
Expeditious Design & Review of Drop-Pipe Drainage, Chester C. Watson and Steven R. Abt, Civil Engineering
Evaluation of NEXRAD Doppler Weather Radar Algorithms & Mesoscale Analysis..., Thomas H. Vonderhaar, CIRA
Mesoscale Analysis & Forecast Product Development for Severe Storm Now-casting, Thomas H. Vonderhaar, CIRA
Research & Product Development to Support NOAA's Mesoscale Weather Prediction Program, Thomas H. Vonderhaar, CIRA
Development of an Advanced Decision Support System (ADSS), Luis Garcia, Agri. & Chem. Engr.
Development of an Advanced Finite-Difference Atmospheric General Circulation Model, David A. Randall, Atmospheric Science
Application of Ft. Collins Waste to Rangeland, Kenneth A. Barbarick and Edward F. Redente, Agronomy Collins
Observational & Modeling Studies in Support of the Atlantic Stratocumulus Transition..., Stephen K. Cox, Atmospheric Science
A Study of Water Vapor Over the Global Oceans in Comparison with Climate Model Simulation, Graeme L. Stephens, Atmospheric Science
Adapt Rhea-CSU Orographic Model to Provide Precipitation Input to Hydrologic Model..., Lewis O. Grant, Atmospheric Science
Climate Change Effects on Soil Carbon Balance, Edward T. Elliott, Natural Resource Ecology Lab
Computer Modeling, Software Development & Documentation for Watershed Hydrology, Jose D. Salas, Civil Engineering
Regional Flood Hazard Analysis, Jose D. Salas, Civil Engineering
Characterization of Soil Hydraulic Properties for Pesticide Study, Greg Butters, Agronomy
Design Criteria & Integrated Management Technology for Surface & Center Pivot Irrigation, Israel Boner, Ag. & Chem. Engr.
Integration of Tillage & Reduced Herbicide Rates for Improved Weed Control & Water Quality, Philip Westra, Plant Pathology & Weed Sciences
Irrigation Technologies for Sustainable Farming Which Conserve Water & Protect Water Quality, Paul Ayers, Agric. & Chem. Engineering

University of Colorado, Boulder, CO 80309

Improved Climate Data Sets for Global Change Research, Roger Barry, Cooperative Institute for Research in Environmental Sciences (CIRES)
Sea Ice - Atmosphere Interaction: Application of Multispectral Satellite Data in Polar Surface Energy Flux Estimates, Konrad Steffen, CIRES
Repair & Retrofit of Unreinforced Masonry Structures, P.S. Benson Shing, Civil Engineering
Relative Effects of Long-term Climatic Variation on Alpine Tundra Vegetation in Colorado, T. Nelson Caine, Institute of Arctic and Alpine Research (IAAR)
D and Deuterium Measurements on the GISP II Deep Ice Core, National Ice Core Curatorial Facility, Mark Meier, IAAR
Development of an Optimal Predictive Supervisory Control Scheme for a Canal System with Multiple Local Automatic Controllers, David Clough, Civil Engineering
Optimal Reactor Design and Analysis for Water Treatment Using Photodecomposition of Environmentally-Hazardous Organic Compounds, Richard Noble, Chemical Engineering

- Chemical Characterization and Simulation of Biodegradative Processes of Benthic Layer of Kraft and Flint Mill Waste Water,**
Daniel Errampalli, Civil Engineering
- Polar Exchange at the Sea Surface,** Roger Barry, CIRES
- Han River Control System, Phase II. Addition of Dam Break, Hydrologic Forecasting, and Estuary Crossing Modules to the**
Han River Control System, Pedro Restrepo, Civil Engineering
- Thermohaline Circulations and Global Climate Change,** Howard Hanson, CIRES
- Water Resources Global Climate Change ADSS-River Systems Simulation,** Pedro Restrepo, Civil Engineering
- Potential Effects of Global Climate Change on the Maintenance of Biodiversity in Florida,** David W. Crumpacker, Environmental,
Population and Organismic Biology
- Complex River Basin Management in a Changing Climate,** William Riebsame, Institute of Behavioral Science
- Investigations of Data from High Resolution Imaging Spectrometer (HIRIS) Facility Instrument on Earth Observing System,**
Carol Wessman, CIRES
- Modeled and Observed Sea Ice Variability in the Arctic: Sensitivity to Atmospheric Conditions and the Surface Energy Budget**
James Maslanik, CIRES
- Arctic Ocean Atmosphere-Ice System Studies Program,** Roger Barry, CIRES
- Distribution and Recovery of Refinery Waste Products in Groundwater Aquifers: Experimental Study and Model Evaluation,**
Tissa Illangasekare, Civil Engineering
- Field Laboratory and Modeling Studies of Water Infiltration and Runoff in Subfreezing Snow on Regional Scales to Estimate**
Future Greenhouse-Induced Changes in Sea Level, Tissa Illangasekare, Civil Engineering
- International River Basin Management in a Changing Climate: A Sensitivity Analysis of Selected Rivers,** William Riebsame,
Civil Engineering
- Determination of Precipitation via Remote Sensing,** Susan Avery, Aerospace Engineering
- Global Surface-Based Cloud Observations for ISCCP,** Julius London, CIRES
- Studies of Global Sea Level and Ice Sheet Volume Changes,** John Wahr, CIRES
- Parameterization and Scaling of Arctic Ice Conditions in the Context of Ice-Atmosphere Processes,** Roger Barry, CIRES
- Flow Channeling in Soft Clays,** Dobrosław Znidarcic, Civil Engineering
- AMS 14C Dating of Arctic Lake Sediments,** Geological Sciences
- Planning Bridge Deck Repair Based on Chloride Content,** Bruce Suprenant, Civil Engineering
- Data Management for the 1990-94 Greenland Ice Sheet Project,** Richard Armstrong, CIRES

COLORADO WATER SUPPLY CONDITIONS UPDATE

From the Office of the State Engineer--Statewide, water supplies diminished slightly in August as municipal and irrigation demands increased. However, except for isolated areas of the state conditions are near normal. Water supplies have generally been adequate. Periodic precipitation events have occurred at opportune times lessening irrigation demands. Conditions are much improved over one year ago in the Gunnison and Yampa/White basins when these basins were classified as being in a moderate drought. Reservoir storage remains above average. Soil moisture conditions are generally much improved over last year's conditions.

Statewide precipitation for the month of August was 121 percent of average, ranging from a low of 83 percent of average in the Gunnison basin to 163 percent of average in the Arkansas basin. Water year totals are slightly above normal across the state with the Rio Grande basin the highest at 122 percent of average and the South Platte basin the lowest at 99 percent of average. Statewide reservoir storage was 107 percent of average on September 1, which is 105 percent of last year's September 1 amount. The Gunnison basin continues to have the highest storage rate at 115 percent of average, while the Rio Grande basin has the lowest storage

rate at 93 percent of average. Statewide storage is currently 49 percent of capacity (approximately 9 million acre-feet).

The National Weather Service 30-day forecast (starting September 1) for Colorado is for above average precipitation and above average temperatures. The 90-day forecast (starting September 1) is for above average precipitation and below average temperatures. The Office of the State Climatologist at CSU advises that there is no correlation between summer weather patterns and winter weather patterns. As such, the wet summer of 1991 does not suggest that the winter of 1991-92 will be anything but normal. Climatologists across the world are closely monitoring two phenomena: El Nino, the South Pacific ocean current, and the active Philippines volcano, Mount Pinatubo. To date, temperature anomalies of the El Nino current are relatively insignificant. However, if these anomalies strengthen as expected, the results in the Western U.S. are likely to be a significant departure from normal. This could be either exceptionally wet or exceptionally dry. The last time El Nino effects were felt, in 1988, conditions in the western U.S. were dry. Climatologists are also concerned that the extraordinary amounts of volcanic ash spewed into the atmosphere by Mount Pinatubo could alter weather patterns.

The Surface Water Supply Index (SWSI) developed by this office is used as an indicator of water supply conditions in the state. It is based on reservoir storage, stream flow, and precipitation for the summer period (May 1-Nov. 30). Weight factors are applied to each of the measured hydrologic factors in computing the SWSI values for each basin. During the

summer period, streamflow is the primary component in each basin except the South Platte, where reservoir storage is the primary component. The following SWSI values were computed for each of the seven basins on September 1, 1991 and 1990:

Basin	Sept. 1, 1991 SWSI Value	Change From Aug. 1, 1991	Sept. 1, 1990 SWSI Value
South Platte	+3.0	+1.6	+2.1
Arkansas	-0.2	-0.3	+0.5
Rio Grande	-0.1	0.0	-0.4
Gunnison	+0.1	-0.7	-2.6
Colorado	-0.3	-0.7	-1.9
Yampa/White	+0.1	+0.1	-3.5
San Juan/Dolores	-0.6	+0.3	-1.7

SCALE							
-4	-3	-2	-1	0	+1	+2	+3
Severe Drought		Moderate Drought		Near Normal Supply		Above Normal Supply	Abundant Supply

WATER NEWS DIGEST

WATER DEVELOPMENT

Board votes to scale down Animas-La Plata project

Members of the Colorado Water Conservation Board have voted to approve a memorandum of understanding to scale down the Animas-La Plata project. The board unanimously agreed to the concessions as an alternative to scrapping the project. This means building the reservoir, Durango pumping station and pipeline, while researching the status of the Colorado squawfish.

Denver Post 9/7/91

Water Bill Sent to President

Congress sent President Bush an energy and water appropriations bill for signature. The bill includes \$54 million to continue construction of a water delivery system for the Dolores water project and complete construction of the McPhee Dam hydropower plant, and \$3 million to continue design work and begin construction at the Animas-La Plata project.

Denver Post 8/8/91

Court to Examine Thornton Water Plan

Thornton's plan to divert agricultural water from 70 northern Colorado farms through a 56-mile pipeline is being tested in Colorado Water Court. The Northern Colorado Water

Conservancy District opposed the plan, maintaining that the transfer would harm the Cache la Poudre River and irrigation systems using the river.

Denver Post 8/9/91

CBT Rates to Increase 20 Percent

The Northern Colorado Water Conservancy District will raise rates 20 percent for Colorado-Big Thompson water to rebuild financial reserves. The increase will occur in 1992 and will affect only CBT users with open-rate contracts.

Coloradoan 8/14/91

Fort Lupton Considers Different Water Source

The Fort Lupton City Council is studying whether to withdraw from the Platte Valley Water Authority and seek a less expensive arrangement with the Northern Colorado Water Conservancy District. Preliminary figures from NCWCD estimate the District can deliver water for \$1.25 per 1,000 gallons, compared to the Authority's estimated cost of \$1.45 to \$1.50 per 1,000 gallons.

Greeley Tribune 8/15/91

Lamm Urges San Luis Valley Truce

Former Governor Richard Lamm contends that money used to pay lawyers in the fight over the proposed transfer of San Luis Valley groundwater could make all the poor people in the

valley middle class. Lamm is on the board of American Water Development Inc., which seeks to pump up to 200,000 acre feet a year from an aquifer under the valley, pipe some to Denver and use the rest in the valley. The proposal goes before the water court in Alamosa October 15. The battle could last months or years and the millions of dollars in legal costs could be better used if the factions came to a settlement, according to Lamm.

Rocky Mountain News 8/19/91

Water Witch's Record Impresses Skeptics

Stan Renaud, a 79-year-old Lakewood man, has been witching water for 50 years and says he has hit dry wells about 40 times and found water 3,960 times. He says there is nothing magical about what he achieves with a copper tube and a wire. He can find water, anticipate the depth of the well and how much water it yields. His skill has turned Ron Barta, an Evergreen civil engineer and homebuilder, into a true believer. Barta employs Renaud to help determine where to drill and where to place the septic system to avoid pollution problems.

Denver Post 8/13/91

China to Build Yantze Dam

China will move forward with a controversial plan to build a giant dam on the Yangtze, flooding the Three Gorges. This landmark--a stretch of racing water, sharp cliffs and soaring peaks--is revered by Chinese as Americans revere the Grand Canyon. The 350-mile lake created by the project would submerge the homes, factories and farmland of 725,000 people and the project is estimated to cost at least \$10 billion. On the other hand, it would be the world's biggest hydroelectric producer and could save tens of thousands of lives by controlling the devastating floods that roar down the Yangtze.

Denver Post 8/29/91

WATER CONSERVATION

Low-volume Toilets Tested at Denver Airport

In a cooperative study by the Denver Water Board (DWB) and U.S. Environmental Protection Agency (EPA), low-volume toilets are being tested at Denver's Stapleton Airport in anticipation of use in the new airport under construction. Tests on 3.5 gallon units are being conducted through the holiday season to obtain results that can be applied nationally. EPA became involved when it was discovered that no test of this size had ever been conducted. Specifications for the new airport call for use of the 3.5 gallon units, but Denver Airport Authority officials will await test results before making a final decision. The authority has donated plumbing labor costs to install the test toilets; Stevens Institute of Technology, a New

Jersey engineering school, is conducting the test; DWB is supervising the project; and Sloan Valve Co. has donated the toilet fixtures and special valves.

U.S. Water News 9/91

Southern California to Study Water Reuse

The Bureau of Reclamation (Bu/Rec) is joining with Southern California water agencies in a shared cost comprehensive water reuse program for Southern California, with emphasis on San Diego. The Dept. of Interior (DOI) backgrounder on the initiative reports that as much as 2 million acre-feet per year of reclaimed water could be used to save fresh water. Currently only about 140,000 acre-feet per year is being reclaimed in the area.

The initial six-year effort to study and plan for reuse of Southern California water will focus on San Diego because that city is 90 percent dependent on imported water, including almost 70 percent of Colorado River water, and there are only limited groundwater supplies in the vicinity. The six-year study will include development of a distribution model and analysis of political, institutional and technical problems relative to water reuse. At the end of the six years, Bu/Rec plans to prepare a report recommending a plan on how to best use reclaimed wastewater. The report will cover designs of methods for reclaiming and transporting the water; costs of reuse; an implementation strategy; and environmental and health studies.

DOI designated Bu/Rec as the lead federal agency in the water reuse initiative because it has operated for years in the area. Some of the local water agencies are currently prohibited from being involved in water reclamation and distribution. Local agencies will, however, share in the cost of the report. They are also likely to do much of the construction work that results from the initiative, but expect federal assistance, mainly through federal loans from Bu/Rec and DOI.

Western Resources Wrap-Up 8/29/91

Expanded Water Reclamation Planned

The Eastern Municipal Water District (EMWD) of San Jacinto, California has applied for \$32.4 million in federal aid for a new reclamation project, designed to include a seven million gallon-a-day advanced water treatment facility at the Hemet/San Jacinto regional water reclamation facility, 45 miles of new cement mortar-lined and coated steel pipeline, two pumping plants, and creation and construction of 600 acres of wetland enhancement areas. Dept. of Interior Secretary Manuel Lujan, Jr. approved the aid, subject to a Congressional review period ending Oct. 10. EMWD plans to put up the remaining third of the estimated \$46 million project cost.

Western Resources Wrap-Up 8/29/91, 9/12/91

Water Agencies Plan Statewide Conservation

California urban water agencies are considering a comprehensive water conservation program statewide to make lasting changes in how Californians use water. After four years of study and negotiation, the State Water Conservation Coalition of water agencies, environmentalists and elected officials has agreed on a 16-point conservation program. If adopted, the agreement would obligate environmentalists to accept the agreed-upon level of conservation and would bar them from pressuring water agencies to do more. If most California water agencies sign the agreement, a state board will be set up to monitor compliance. The plan is expected to save 500,000 acre-feet a year. Agencies hope that a good faith effort to put water conservation first will help generate support for future supply and distribution projects that many agency officials feel will be needed in spite of the water savings.

Denver Post 8/27/91

Report Calls for Integrated Water Plan

The Association of California Water Agencies (ACWA) has issued a report, California's Water Future: An Overview and Call to Action, urging California Governor Pete Wilson to adopt a balanced and integrated plan covering all aspects of the state's water supply system. ACWA's recommendations address water conservation and management, drinking water quality, environmental protection, endangered species, wetlands, water reclamation and other technologies, voluntary water transfers and conjunctive use, state-federal cooperation, and additional water projects.

Western States Water 8/30/91

Study of S.E. Water Resources Planned

The states of Alabama, Florida, Georgia, and the U.S. Army Corps of Engineers have formed a partnership to conduct a comprehensive water resources study within the Alabama-Coosa-Tallapoosa and Apalachicola-Chattahoochee-Flint river basins. The purpose is to determine capabilities of the water resources, to describe water resource demands of the basins, and to evaluate alternatives that utilize the water resources to benefit all user groups within the basins. The study will examine all potential actions that may affect water resources within the basins through the year 2050. Estimated to take 3-5 years, it is contingent on availability of federal and state funds. The states and the COE will act as equal partners in the study.

Drought Drives Drip Solution

While the five-year California drought has hit some farmers hard, Lee Simpson is growing twice the raisin grapes on half the water and has decreased his use of fertilizer, herbicide, labor, power and heavy equipment. Seven years ago, the yacht-salesman-turned-grape-farmer installed drip irrigation tubes aboveground, later sinking them near the plants' roots for

greater efficiency. The drip system is run by an interactive computer system that lets him irrigate and fertilize his land from his office and to monitor his acreage 24 hours a day. Simpson is one of 50 farmers in the country with a sub-surface drip system run by interactive computers, one of 15 in California.

Los Angeles Times, 6/2/91

Arizona Creates Groundwater Replenishment District

Recently passed legislation in Arizona creates a groundwater replenishment district inside the Phoenix Active Management Area. The new replenishment district will be phased in over 15 years. The district will allow groundwater users to continue to pump and use groundwater indefinitely because the pumped water will be replaced in the aquifer through the actions of the district. Members of the district will pay a fee representing the amount of water they pump. The district will use the fees to acquire other water and recharge it to the aquifer. Other water sources may include CAP water or water leased from recently-settled Indian water rights. The whole system applies only to non-agricultural water.

U.S. Water News 9/91

Desalination Research Funds Sought

Desalination could provide up to ten percent of water needs in U.S. coastal areas if research is successful in improving technology and reducing costs, according to recent congressional testimony. Hearings were held by the Senate Committee on Environment and Public Works and the House Science, Space and Technology Subcommittee in anticipation of legislation to provide research money. The administration has requested \$1 million for the next fiscal year to reinstate a research program within the Bureau of Reclamation. In spite of the need for better technology, desalination increasingly is being used in the U.S. because of the scarcity of water in coastal areas. There are over 125 low pressure reverse osmosis plants in the U.S.

U.S. Water News 9/91

ENVIRONMENT

Conflict Brewing Over Corporate Contributions to Green Groups

Corporate contributions to some environmental groups is causing tension in the environmental movement. Some green groups see the contributions as a business effort to infiltrate and disarm the environmental movement. They cite such examples as the head of Waste Management Inc., which has paid more than \$20 million in environmental fines, sitting on the board of directors of the National Wildlife Federation, while the president of World Wildlife Fund serves on Waste Management's board. Other green groups, however, have

initiated the contact with businesses, some seeking funding during recessionary times. Some have found many of their goals similar to those of businesses interested in proving their commitment in a decade of rising environmental awareness. These environmentalists argue that avoiding corporate ties is an anti-business stance that may inhibit companies from becoming more environmentally sensitive.

Fort Collins Coloradoan 9/1/91

Well Users Advised to Test for Radon

Two geochemists advise that if the air in your house has high levels of radon, you should test your well water also. George Mushrush and Douglas Mose, at George Mason University in Fairfax, Virginia, found unhealthy levels of cancer-causing radon in two-thirds of the home wells they tested in the Appalachian foothills of Virginia and Maryland. Unlike airborne radon which has been linked primarily with lung cancer, waterborne radon can pass into the blood and cause cancer throughout the body. The two geochemists point out that they are not crying doom and gloom but are advising people to test for the problem and to get it fixed if necessary.

Fort Collins Coloradoan 8/27/91

Some Water Filters Reduce Fluoride

Some home water filters may remove fluoride as well as impurities, according to a recent study by British dental experts. They found that three of four popular types of water filters sold in the United Kingdom remove a significant portion of the fluoride that is added to water to reduce tooth decay. Darrell Sanders, fluoridation engineer with the Centers for Disease Control, stated that about 63 percent of Americans are served by fluoridated public water supplies, but he knew of no studies in the U.S. comparing various types of filters.

Denver Post 8/13/91

Oil Drilling Off Washington Coast to be Banned

The Bush Administration plans to ban oil and gas drilling off about half of the Washington Coast, among the last U.S. wilderness coastlines. Under its new proposal, the administration could consider lifting the drilling prohibition in the year 2000.

Denver Post 8/23/91

Group Threatens to Sue

Unless the razorback sucker is listed as an endangered species within 60 days, a wilderness group, through the Sierra Club Legal Defense Funds, plans to sue the U.S. Department of Interior. Listing the fish could delay or halt development of water projects on the Colorado River.

Denver Post 8/8/91

WETLANDS

Federal Definition Change Sought

The Bush Administration issued a proposed change to the definition of wetlands, stating a wish to better balance economic and environmental concerns. The proposal opens previously protected land for development, prohibits development on other unprotected lands and simplifies the process for getting government approval to build on such land. Leading environmental groups accused the President of reneging on his campaign promise of no net loss of wetlands. The current standard defines a wetland as any area where the soil is saturated within 18 inches of the surface for at least seven days each year during the rainiest season. The proposed rule would define a wetland as an area with standing water for 15 days or saturated to the surface for 21 days. The proposal does not take effect until after the 60 day period allowing the public to make comments on it to the EPA.

Denver Post 8/10/91, Ft. Collins Coloradoan 8/10/91

1989 Wetlands Definition Put on Hold

The FY 1992 Energy and Water Development Appropriations legislation, signed by President Bush on August 17, provides that, "None of the funds in this act shall be used to identify or delineate any land as 'water of the United States' under the federal manual for identifying and delineating jurisdictional wetlands that was adopted in January 1989 or any subsequent manual not adopted in accordance with the requirements for notice and public comment of the rule-making process of the Administrative Procedure Act." The proposed revisions to the 1989 manual were published in the August 14 Federal Register, with public comment sought by October 15.

Western Resources Wrap-Up 9/12/91

Columnist Lists Economic Worth of Wetlands

Nationally syndicated columnist John Javna, writing in response to the proposed change of definition of wetlands, delineated the economic costs of the proposal. Although a dollar value is hard to estimate for land if no one makes a direct profit from it, Javna listed costs to be expected under the proposal. They include loss of fishing jobs and damage to the sports fishing industry, since 70 to 80 percent of all commercially important fish are dependent on wetlands for spawning or eating; more expensive seafood as seafood harvesting declines with the decline in wetland spawning grounds; increased cost of sewage control and water treatment to replace the water quality control provided by wetlands; and increased flood control costs, since wetlands also provide soil and vegetation that absorb water.

Ft. Collins Coloradoan 9/1/91, 8/18/91

Constructed Wetlands Increasing in Use

The creation of artificial wetlands for secondary treatment of wastewater is being promoted by a number of engineering firms, cities, and industrial concerns. CH2M Hill of Denver, Colorado engineered the Carolina Bay Natural Effluent Disposal System, which discharges treated wastewater from the new George R. Vereen Wastewater Treatment Plant to a series of four bays, where biological processes provide natural filtration and tertiary treatment. The wastewater is distributed to over 800 acres of bays through a series of gated aluminum pipes, supported on wooden boardwalks. Dense vegetation absorbs nutrients and filters the effluent, and no chemical or energy sources other than the sun are used.

At Sierra Vista, Ariz., southeast of Tucson, plans are proceeding to transform a seven-acre sewage pond into a sewage treatment marsh, which will treat Tucson's effluent before it is discharged into the San Pedro River. In Missouri, the state Dept. of Conservation is working with the capital city Columbia to create one of the nation's largest wastewater treatment wetlands. The department plans to use Columbia's 13 million gallons per day of treated effluent as a water source for developing and managing wetland habitat on the Eagle Bluffs Wildlife Area adjacent to the Missouri River.

There has been mixed response to the artificial wetlands. Some engineering firms acknowledge that wetlands can remove pollutants such as heavy metals and organics over the short term but worry that over the long term, wetlands will serve to concentrate these pollutants, evolving into toxic waste dumps.

U.S. Water News 9/91

Greenhouses May Take Wetlands Indoors

Solar powered greenhouses could hold the answer for septage treatment, sewage that is 30 to 100 times as concentrated as regular waste. The town of Harwich, on Cape Cod, Massachusetts, is experimenting with greenhouse wastewater treatment facilities, the brainchild of Dr. John Todd and marketed by Ecological Engineering Associates of Marion,

ISSUES OF OUT-OF-BASIN WATER TRANSFERS IN COLORADO

by Maureen Maxwell

Aurora and Arapahoe counties want to divert 60,000 to 100,000 acre-feet of water from Blue Mesa Reservoir. A Gunnison-based group called People Opposing Water Export Raids (POWER) has been conducting a letter writing campaign against the trans-divide water transfer. Last March, Aurora announced it was abandoning its Collegiate Range Project Plans (AP, *Ft. Collins Coloradoan*, 30 Nov. 1990; Bowers, *Rocky Mountain News*, 1 Nov. 1990; McBean, *Denver Post*, 2 April 1990).

American Water Development Inc. (AWDI), a private for-profit venture, is seeking to send 30,000 to 200,000 acre-feet of water from the San Luis Valley to Denver's suburbs. In October, 1991, AWDI will go to water court and face three conservancy districts, four cities

Mass. The technology uses the natural organisms associated with wetlands to purify water, bringing indoors the outdoor purification systems used increasingly in the south. To date, the project has tripled its processing of septage from 1200 gallons per day to 3600 gallons per day. The only problem has been that nitrates are not yet being held below 10 parts-per-million, but the designers expect to be able to correct that problem. The final plan for a greenhouse "living machine" treatment facility will be submitted to the Mass. Dept. of Environmental Protection in December.

U.S. Water News 9/91

COLORADO INTEREST

Greeley Water Board Rejects National Heritage Area

The Greeley Water and Sewer Board unanimously rejected endorsement of the designation of the Poudre River as a National Heritage Area. Board members said the project should not be funded with federal tax dollars, particularly considering the national budget deficit. The designation was proposed by U.S. Senator Hank Brown to preserve floodplains along the Poudre River for green space and recreation.

Ft. Collins Coloradoan 9/7/91

CSU Prof Chronicles 'Last Waterhole'

Colorado State University history professor Dan Tyler is writing a book on the history of the Northern Colorado Water Conservancy District, to be titled The Last Waterhole in the West. The "waterhole" refers to the Colorado River, tapped by the district's Colorado-Big Thompson project to bring water to the Front Range. That project was the first big water diversion plan that the district completed in its 54-year history. Tyler predicted he will complete the book by the end of the year. The University Press of Colorado plans to publish it by next summer.

Ft. Collins Coloradoan 8/12/91

and towns, two counties, a well owners' organization, and the State of Colorado and the U.S. Government (Smith, *Pueblo Chieftain*, 6 July 1990; Schuff, *Colorado Rancher & Farmer*, 1 Oct. 1990).

Three cities, two of them out-of-basin, own much of the water of the Arkansas river. Crowley County residents are concerned about the lack of revegetation of land taken out of production as a result of the Colorado Springs water rights acquisition (Woodka, *Pueblo Chieftain*, 27 May 1990; Stangl, *Pueblo Chieftain*, 3 Feb. 1991).

The battle of the basins is nothing new. The organized effort and widespread active support for keeping water in its basin of origin is stronger than it has been before. The battle line is preserving the

economy, environment, life styles, and future of the basins of origin—or shipping the water to areas of high demand and higher per-acre-foot return. The history of U.S. water projects is littered with stories of projects based on shaky economics, bald lies, and mean politics. (Reisner, 1986) Now opponents of interbasin water transfers are using economics and politics to fight the further rearrangement of Mother Nature's aquatic plan.

Several categories of issues affect the question of out-of-basin transfers of water:

1. New urban water is getting more expensive: cities must go further away to obtain water, and good dam and reservoir sites are becoming increasingly scarce and costly to develop. Potential exporting communities are fighting the transfer of water rights to out-of-basin entities for fear of losing the economic future of their communities.
2. The increased activism of exporting communities to protect their lifestyles and future has altered the social and political considerations that must be taken into account by planners, both those interested in transferring the water and those within the exporting areas.
3. Colorado has a complex and entrenched water law system that sometimes facilitates transfers and sometimes provides tools for protection for the basins of origin. The system receives mixed reviews, depending on which side of which transfer battle is interviewed.
4. Environmentalists and recreationists are becoming increasingly effective participants in the business of allocating water, demanding that aesthetic and monetary value of in-stream uses and preservation of natural settings be weighed.
5. Before the above issues are even examined in a proposed water transfer, certain "gut" issues arise and control the ensuing debate: farmers' distrust of the big cities, the historic antagonism of West Slope against East Slope water transfers, the belief that water should stay within its historic basin, and the political games of distrust that prevent inner cities, suburbs, and rural communities from working together for maximum efficient use of water with minimum possible damage to rural communities and to the environment.

The Economics

One out of every four people living in the western United States gets his or her water from a supply system that imports from a source 100 miles or more away (Quinn 1971). Today only three out of one hundred American workers are engaged in farming, compared to four out of ten in 1900 (Schaffer & Schaffer 1984).

If water were to be allocated strictly by economic criteria, it would be allocated to the use bringing the greatest return per unit of water at the least cost. There is not a water market in the West in the sense that there are markets for other natural resources, so there is not a well-established structure to determine prices. There are sales of water rights and rentals of water use within some conservancy districts, for rural-to-urban transfers. Most changes of water use in Colorado historically have been the result of urban encroachment

into agricultural areas. Recently, cities have had to look for water further away.

When there is competition between uses, economic analysis calls for the establishment and comparison of per unit (per acre foot) values. This becomes more complex as indirect costs and benefits are taken into consideration. Comparable prices require comparability in place, time, and form (Gray and Young 1983). Howe's primer on assessing impact due to delay or cancellation of water storage projects describes this complexity (1979). An example he uses is the building of a new elevator and feed mill near a new irrigation project. If the private investments are from within the state, the net income generated in the elevator-mill operation is legitimate secondary benefit. If the investment is from outside the state, however, the income should not be counted as a benefit. Secondary activities are rarely estimated because of the difficulty in identifying them. Because these secondary activities are not considered, Howe pointed out, secondary benefits tend to be overstated and secondary costs understated. Furthermore, it is difficult to measure the value of aesthetic quality, such as urban parks, open spaces, green lawns, trees and shrubs. The loss of aesthetic value for the exporting community and the gain in aesthetic value for the importing community are real losses and gains but are extremely difficult to measure in the dollar units of other project costs and benefits.

The above elevator-mill operation is just a single illustration: multiply the examples of new businesses and employment as benefits, and transportation, public services, health services and other needs generated by growth in a water importing area as costs; then compare the same kinds of tallies for the water exporting and transit areas, and the cost-benefit analysis become infinitely more complex. The interrelatedness of water uses and associated business and environmental aspects means that a large city can no longer claim that what is good for the city will be good for the state or region.

This is not to say that there is not convincing economic evidence that some water transfers to cities will provide far greater returns per acre-foot than if left in rural areas. Young (1984) surveyed several analyses of the value of water measured in terms of foregone irrigation, and compared it to the value of water in industry, households, hydroelectric power generation, and water-based recreation. He found that the direct net economic value foregone from partially reduced irrigation water supplies would most likely fall in the range \$5-\$30 per acre-foot, depending on location and type of use. The net value of that water transferred to industrial and household use is five to ten times or more as high as the losses in the agricultural sector. Looking further at the indirect impacts, Young concluded that indirect losses to a region exporting irrigation water are not insignificant in terms of monetary flows or employment but they will be dwarfed by gains in the nonagricultural area.

Young pointed out that specific communities may feel large proportional impacts of increased urban demands for water, impacts that may be masked by the use of state data. Rural communities losing water to urban areas may suffer significant loss of incomes and employment. However, he believes that a reasonable scenario for urban water demand growth will result in only a 10 to 20 percent reduction of water supply to agriculture. He reasoned that the last 10 to 20 percent of water used in irrigation is a tiny portion of the economy of any of the western states and will not produce the severe effects on western economies that some predict.

Social and Political Issues

It is the closing of local businesses and decrease in local services and credit that represents a reallocation of not only water but also wealth from the rural to urban communities. The migration of farmers, business, and professional people weakens leadership and undermines a rural community's capacity to adjust to the economic changes that a transfer of water can induce (Schaffer & Schaffer 1984). To a person residing in a small town along the Arkansas River or in an agricultural community in the San Luis Valley, the loss of 150 jobs and half a dozen businesses resulting from the transfer of a few thousand acre feet of water is a big impact to that community. On the other hand, the opportunity to sell some or all of one's water rights has been a boon to some farmers. In the late 1960s, the Crowley Land and Development Co. offered \$380 per acre for land and Colorado Canal water. More than half of the farmers took the offer. Other ditch users kept the water in the area by requiring a two-thirds vote of water users to move water elsewhere. In the 1980s, a farm depression led many farmers to sell their shares in Twin Lakes (AP, *Ft. Collins Coloradoan*, 12 July 1990). In some cases, farmers used the money from sale of their water rights to pay off their debts, then leased the water back and continued farming (Woodka, *Pueblo Chieftain*, 3 June 1990). Young points out that land and water values have risen greatly in anticipation of urban, industrial, and energy demands. "The fact is that large acreages with associated water rights in regions of urban growth are held speculatively (by farmers and others) in anticipation of further asset appreciation" (Young 1984).

Sometimes a pending transfer can draw together unusual allies. Unlike other agricultural areas where some farmers have sold and some have not, thereby splitting the community, ditch companies and pump irrigators formerly in competition have joined forces to fight the AWDI project in the San Luis Valley. Furthermore, the increased activism of water exporting communities has influenced the political arena as well. Those opposing the AWDI proposed transfer have allies among Colorado's Congressional delegation (Obmascik, *Denver Post*, 2 Nov. 1990).

Institutional Allocation of Water

In Colorado, ownership of water rights can be transferred without legal review. The purchaser of the water right may use that right in the same manner with the same priority as the seller. However, if the purchaser wishes to change the point of diversion, place of use, time of use, or type of use, he must go through a formal change of water right proceeding through the Colorado water courts (MacDonnell 1990) and must show absence of injury to other water rights holders. If he does so to the court's satisfaction, the court must approve the change. Other parties may file statements of opposition to the application. The issue of injury is the most frequently disputed aspect in changing a water right.

Property rights is the only issue considered by the court in a transfer case. Only the effects on other water rights holders are considered, not the analysis of the costs and benefits of the transfer (Hartman and Seastone, 1970). The "no injury" rule protects water right holders in the continuation of condition of flow relied upon to make their initial appropriations. Since 1954, the courts have taken an approach that prohibits the depletion of the stream by the new use from exceeding the depletion of the stream caused by the original use. Terms and conditions may be imposed on the transfer in the

decree to insure no injury. (MacDonnell)

A recent law passed by the Colorado legislature may offer additional protection for water users in basins facing potential exports. Under this 1989 law, the applicant is required to provide a proposed decree to the water courts in any case in which a statement of opposition has been filed. This proposed decree is to prevent injury to other water rights (MacDonnell 1990).

Colorado water law is complex and adversarial. While holding water rights for speculative purposes is not permitted in Colorado--the water must be put to beneficial use--municipalities are permitted to appropriate more water than is needed currently because of their need to plan for future growth and development. (MacDonnell 1990) MacDonnell's study of water transfers in six western states showed, however, that although Colorado was the only state in which the approval period for an application for change in purpose or place of use averaged more than a year, 80 percent of the applications made within the study period (1975-1984) were approved. Shifting water rights from agricultural to non-agricultural uses is the dominant pattern in Colorado.

Environmental and Recreational Considerations

Historically, water rights have been based on the diversion and use of water. Colorado now has a program to establish certain instream water rights. These rights are limited because they seek to protect only cold-water fisheries. Other values based on instream flow, such as recreation, water quality, and wetlands, are not considered in the application process (MacDonnell 1990). While the influence of environmentalists and recreational interests are limited in the Colorado water courts, they are not without clout. For all the expertise and arguments lined up in favor of the Two Forks Dam, its application for an essential federal permit was denied on environmental grounds.

Environmental and recreational interests can make themselves heard in transfer proposals smaller in scale than the Two Forks Dam. Although a particular environmental organization or recreational business may not have the legal standing to file a statement of opposition to a change application, they can participate in the activities of coalitions fighting out-of-basin transfers. Many such organizations have become adept at public education campaigns and at raising money. Some even become players in negotiated settlements of water disputes--there was a time they could no even get in the door.

Gut Issues

Rural distrust of the big city, West Slope-East Slope antagonism, political rivalry--these often form the debate over transfer projects before specific proposals have even been aired. Some of these issues are as old as man and will always be there; for example, the distrust rural communities have for big cities. Others, such as the West Slope suspicion of the Front Range, are based on history.

Those who seek to transfer water out of the basin of origin can no longer expect silent acquiescence from the basin residents. After the initial public reaction, AWDI amended its application to address San Luis Valley concerns about the export of the water and resulting reduction in available irrigation water. (Schuff) Addressing the gut issues up front and honestly may not stop the opposition, but it is

more likely to lead to discussion and compromise, instead of guaranteeing all-out war.

Conclusion

Out-of-basin transfers clearly produce much antagonism and there is evidence that some of the current proposals are not the best options to resolve water needs. Out-of-basin transfers are expensive undertakings for both the water importers and the water exporters, even if the transfer does not happen in the end.

One of the proposals offered by the MacDonnell study group (1990) would probably go the furthest toward reducing the costs of the Colorado water law system and make it a less exclusive to those who have neither the money, time nor connections to participate in the legal process. The group suggests that the process for reviewing proposed changes of water rights should provide that all findings of fact be made by the division engineer. According to MacDonnell, most issues under consideration in the change application case are factual: historic diversions, transport losses, consumptive use, return flows, other hydrologic and engineering issues. Relying on the staff expertise of the division engineer's office, rather than each side providing reports from their own engineers, would lower the costs of the case, and would provide an objective reporting of the facts. This approach is used in New Mexico and Utah and seems to be working effectively.

MacDonnell also recommends broadening Colorado law to allow the consideration of affected interests other than water right holders. Tourism is a prime industry and big employer in Colorado, much of it based on Colorado's scenery and availability of outdoor rural activities. It is only logical that the economic contributions of such businesses as rafting, fishing, hiking and camping should be weighed when the transfer of the water supporting such businesses is determined. "Every western state except Colorado provides for some kind of public interest review of proposed new appropriations of water and at least eight states subject water transfers to this kind of review....there is no constitutional barrier to establishing a requirement that changes of water rights be in conformance with protection of interests beyond the property interests of other water right holders." (MacDonnell, Vol. II, Ch. 3, p. 37)

Scientist Dan Luecke's suggestion that cities buy drought insurance from the farmers would have a number of beneficial effects (Scanlon, *Rocky Mountain News*, 20 March 1991). First, it would reduce the need for new water storage and might therefore reduce municipalities' water purchasing and transporting expenses. Second, it would also reduce the environmental changes that new and expanded storage facilities produce. Third, it would provide rural water right holders with an alternative to selling out in bad times, while still permitting those who wish to sell to do so.

These are the sort of suggestions that take time to be implemented thoughtfully and effectively. They are also the sort of suggestions that can address the concerns of a broad range of water interests and, therefore, offer room for negotiation and compromise. The more parties that can see they have a vested interest in the solution, the more likely it is that Colorado's water conflicts will be settled with intelligence and not acrimony.

References

- Associated Press. "Gunnison-area residents oppose water diversion plan." *Ft. Collins Coloradoan*, 30 November 1990.
- _____. "County fears future without water rights." *Ft. Collins Coloradoan*, 12 July 1990.
- Bowers, Karen. "Aurora ends bid to divert water from the West Slope." *Rocky Mountain News*, 8 March 1991.
- Gray, S.L. and Young, R.A. *Economic Issues in Resolving Conflicts in Water Use*, Completion Report 119. Ft. Collins: Colorado Water Resources Research Institute, 1983.
- Hartman, J.M. and Seastone, Don. *Water Transfers: Economic Efficiency and Alternative Institutions*. Baltimore: The Johns Hopkins Press, 1970.
- Howe, C.W. *Federal Water Storage Projects: Pluses and Minuses*, Information Series #35. Ft. Collins: Colorado Water Resources Research Institute, 1979.
- MacDonnell, Dr. Lawrence J., Principal Investigator. *The Water Transfer Process as a Management Option for Meeting Changing Water Demands*. Submitted to U.S. Geological Survey, April 1990.
- McBean, Bill. "Opposition to water sale rises as Gunnison basin dries up." *Denver Post*, 2 April 1990.
- Obmascik, Mark. "Brown bashes water proposal." *Denver Post*, 2 November 1990.
- Quinn, Frank J. "New Rivers and Old Realities: Why Westerners Disagree About Sharing Their Water Wealth." *Arizona Review*, 20 (April 1971): 1-9.
- Reisner, Marc. *Cadillac Desert*. New York: Viking Penguin Inc., 1986.
- Scanlon, Bill. "Attorney is dams' nemesis." *Rocky Mountain News*, 20 March 1991.
- Schaffer, Albert and Schaffer, Ruth C. "Social Impacts on Rural Communities." In *Water Scarcity: Impacts on Western Agriculture*, ed. Englebert, Ernest A. and Scheuring, Ann Foley. Berkeley: University of California Press, 1984.
- Schuff, Sally. "High Stakes." *Colorado Rancher & Farmer* (1 October 1990): 8-20.
- Smith, Erin. "AWDI loses historic claim to water; trial date set." *Pueblo Chieftain*, 6 July 1990.
- Stangl, Marilyn. "Crowley trying to keep dry land from becoming dust" and "Crowley real estate moving better than expected after water sales." *Pueblo Chieftain*, 3 February 1991.
- Woodka, Chris. "Three cities reshape the Arkansas River." *Pueblo Chieftain*, 27 May 1990.
- _____. "Farmers resist pressure to sell water to cities," "Water sales, farm condition both cut into valley irrigation." *Pueblo Chieftain*, 3 June 1990.
- Young, Robert A. "Local and Regional Economic Impacts." In *Water Scarcity: Impacts on Western Agriculture*, ed. Englebert, Ernest A. and Scheuring, Ann Foley. Berkeley: University of California Press, 1984.

The South Platte River Basin: Uses, Values, Research, and Management --Current and Future

**November 19-20, 1991
University Park Holiday Inn Fort Collins, Colorado**



The settlers crossing the South Platte River, from 'California Crossing' by William Henry Jackson

Rivers especially those near populated areas are increasing in value and demand. Their basin resources provide a great variety of uses: both existing and potential. Managing and planning these uses requires good information on hydrology, water quality, fisheries, and many other aspects of the river system. The South Platte is an excellent example.

Please join us for the 1991 South Platte Research Conference to be held November 19-20 at the University Park Holiday Inn in Fort Collins. The 1991 focus is as follows:

- *What is the nature and extent of present and future uses of the river and its tributaries, and*
- *What research or management information is currently available and what research should be emphasized in the future.*

Sessions at the conference will include water management, water quality, water education, the South Platte as an agricultural, environmental, and recreation resource. Target attendees include water management organizations, concerned citizens, farmers, recreationists, conservationists, resource consultants, local and state government officials, university students and researchers, and federal agency staff.

- Registration is \$35.00 if received by November 8, 1991 (late registration is \$45) cost covers workshop materials, proceedings, lunch and coffee breaks. Make checks payable to South Platte River Conference
- Room reservations direct thru University Park Holiday Inn (303) 482-2626 \$48/night, single or double
- For further information, call Chuck Grand Pre, Colorado Division of Wildlife, (303) 291-7202

Detach here and return, with payment, by November 8, 1991 to:

**Gene Schleiger, Northern Colorado Water Conservancy District
1250 N. Wilson Avenue, P.O. Box 679, Loveland, CO 80539**

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Complete Address _____

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Please check here if vegetarian lunch is preferred _____

CALLS FOR PAPERS

Colorado GEM Network 1992 Environmental Seminar, March 17-18, 1992, Colorado Convention Center, Denver. Abstracts due to GEM office by November 15, 1991. Send to: The Colorado GEM Network, c/o the Colorado School of Mines, Golden, CO 80401.

Interdisciplinary Approaches in Hydrology and Hydrogeology, Oct. 17-22, 1992, Portland, OR. Submit 250-word, one page double-spaced abstract and diskette with abstract in ACS11, WordPerfect, or Wordstar to: Antonius Laenen, USGS, WRD, 10615 E. Cherry Blossom Lane Portland, OR 97216. Tel. (503)231-2025. For general information contact: Helen Klose, American Institute of Hydrology, 3426 University Ave. SE, Minneapolis, MN 55424-3328. Tel. (612)379-1030. **Deadline:** Oct. 15, 1991.

International Symposium on Engineering Hydrology, July 25-30, 1993, San Francisco, CA. To be held in conjunction with 1993 National Conference on Hydraulic Engr., Hydraulics Div., ASCE. Abstracts should be no more than two pages long. Submittals and requests for further information should be addressed to: Dr. Chin Y. Kuo, Professor and Head, Dept.

of Civil Engr., 212 Sackett Bldg., Pennsylvania State University, University Park, PA 16802. Tel. (814)863-3084. FAX: (814)863-7304. **Deadline:** Nov. 1, 1992.

AWRA 28th Annual Conference and Symposia, Managing Water Resources During Global Change, Nov. 1-5, 1992, Reno, NV. Abstract cannot exceed 250 words and must include title of paper, all authors' names and their affiliations. On a separate page include full mailing addresses and telephone number for each author. Submit 3 copies to: Raymond Herrmann, NPS, WR-CPSU, WRD, Colorado State University, Fort Collins, CO 80523. Tel. (303)491-7825.

16th Annual Conference of the Association of State Floodplain Managers (ASFPM), May 18-22, 1992, Grand Rapids, MI. The theme is "Multi-Objective Approaches to Floodplain Management." Papers are invited for, but not limited to, the following topics: flood warning systems, floodplain regulations, social research, floodproofing and mitigation, mapping and engineering, hydrology, dam safety, stormwater management, river management, coastal hazards, and wetlands. **Deadline:** Oct. 15, 1991.

OCTOBER SYMPOSIUM TO ADDRESS REGIONAL WATER ISSUES

WATER DETERMINES FUTURE ECONOMIC TRENDS

The Water Resources Committee of the Fort Collins Chamber of Commerce invites you to participate in a symposium with leading experts to discuss regional economic development trends influenced by the most controversial and sought-after resource in Northern Colorado - water.

"It's important for all area businesses to know what's happening on the state water scene," said Neil Grigg, Chamber Water Resources Committee chairman and Head of the Colorado State Civil Engineering Department. How water resources are used and

distributed today will affect how businesses grow tomorrow. Decisions concerning water will seriously impact land use development and environmental quality, which in turn will determine the types of businesses that will prosper or fail in the future, according to Grigg.

"Northern Colorado got started as an agricultural region and big changes are now underway," said Grigg. "The informed business owner has to know what those changes will be," he continued. Topics to be addressed at the symposium include the status of

Thornton's water project, an increase in regional water demand, potential supplies for the future, growth of Denver's northern tier, and preservation of environmental quality. Participants will have the opportunity to ask questions of presenters.

The symposium will be held Monday, October 21, at the University Park Holiday Inn in Fort Collins. The cost will be \$20 prepaid by Friday, October 18 (\$25 at the door). Lunch will be provided.

Call Lindsay Sweetser at The Chamber, 482-3746, for more information.

POSITIONS AVAILABLE

Director, Cooperative Extension, Colorado State University.—The Office of the Director of Cooperative Extension is located on the campus of Colorado State University in Fort Collins. The Director reports to the newly-created position, Associate Academic Vice President for Agriculture/Dean, College of Agricultural Sciences. The Director is the chief administrative officer of Cooperative Extension and, as delegated by the Associate Academic Vice President for Agriculture/Dean, is responsible for providing leadership and overall management of all programming, budgeting, and related activities of Colorado Cooperative Extension. The Director is responsible for the development and support of state programs responsive to the needs of the people of Colorado in manufacturing, agriculture and natural resources, home economics, youth and community development. The Director has responsibility for all personnel within Cooperative Extension, maintains relations with relevant State and County agencies and the United States Department of Agriculture, and assures appropriate interaction with academic colleges and departments on campus, with the Agricultural Experiment Station, and with other university outreach functions, like continuing education.

Recruiting, selecting, orienting, and evaluating new staff are responsibilities of the Director. Other responsibilities include submission of approved annual work plans and reports in compliance with rules and regulations of the United States Department of Agriculture.

Candidates must have an earned doctoral degree and the ability to be tenured in an academic department at Colorado State at the appropriate professorial rank. The successful candidate must have demonstrated excellence in Cooperative Extension programs or in other relevant areas of work, recognized leadership, public relations, and interpersonal skills. Significant previous administrative experience is required. The successful candidate must demonstrate familiarity with, and understanding of, the role and mission of a land-grant university. Colorado State University is strongly committed to increasing gender and ethnic diversity and to providing equal opportunity to the handicapped. A successful candidate must be equally committed.

Salary will be competitive and commensurate to the experience of the candidate. Send nominations and applications to Dr. Marcia W. Bankirer, Division of Continuing Education, Chair, Search Committee, Colorado State University, Fort Collins, Colorado 80523. **Deadline:** Oct. 30, 1991. Applications

consist of a statement of intent and interest indicating the candidate's understanding of the responsibilities and role of the position, current vitae, and the names, addresses, and telephone numbers of five references, and a one-page statement of the applicant's vision and philosophy of Cooperative Extension in a modern land-grant institution.

Director, School of Renewable Natural Resources, College of Agriculture, University of Arizona.—Has administrative responsibility for all activities of the School and reports to the Dean of the College of Agriculture. The School maintains strong instruction, research and cooperative extension programs and consists of four divisions: Landscape Resources, Range Resources, Watershed Sciences and Wildlife and Fisheries Science. Undergraduate and graduate majors are offered in all of these fields plus a graduate major in Renewable Natural Resources Studies which stresses multidisciplinary studies. The School is also home to the Advanced Resource Technology (ART) Program and the Arizona Water Resources Research Center.

Applicants should have a Ph.D with credentials for appointment as a full professor, a distinguished scholarly career in natural resources, and proven leadership ability. Send letter of application including curriculum vita and addresses and phone numbers of at three least references to: Dr. Malcolm J. Zwolinski, Co-Chairperson, Director's Search Committee, School of Renewable Natural Resources, 325 Biological Science East, University of Arizona, Tucson, AZ 85721. Tel. (602)621-7257. **Deadline:** Dec. 20, 1991.

Department of Natural Resources and Conservation, Lewistown, MT. Hydrologist—The Lewistown Regional Office is an extension work unit of the Water Resources Division, and is responsible for providing field support in a variety of water resource programs for a multi-county area. The incumbent performs a variety of hydrological studies and planning functions for river basins in the state, including evaluation of surface water problems and development of basin management plans; coordination of efforts of state federal, and local government in dealing with water issues; design and conduct of field studies and research projects, and application of hydrological and water planning expertise to development of the State Water Plan. For additional information contact: Dept. of Natural Resources and Conservation, Personnel Office, 1520 East Sixth Ave., Helena, MT 59620-2301. Tel: (406)444-6873. **Deadline:** Oct. 25, 1991.

MEETINGS

Oct. 7-Denver

Nov. 4-San Francisco

Understanding Wetlands and 404 Permitting: Getting Through the Process. Contact: Continuing Education Services, ASCE, 345 E. 47th St., New York, NY 10017. Tel: (212)705-7668.

Oct. 10-11

Agricultural Water Management Research Workshop, Austin TX. Contact: Wayne N. Marchant, USBR, P.O. Box 25007, D-3750, Denver, CO.

Oct. 11

Water Marketing in Colorado's Future: Debate and Analysis, Denver, CO. Contact: University of Denver, College of Law, Institute for Advanced Legal Studies, 7039 East 18th Ave., Suite 140, Denver, CO 80220.

Oct. 11

The Fourth Water Policy Retreat, Preparing for water law reform in the second session of the 58th General Assembly, January 1992 and Beyond, University of Colorado, Boulder. Contact: The National

Wildlife Federation, Box 401 Fleming Law Bldg., Boulder, CO 80309 (303)492-6552; or Colorado Environmental Caucus, 1405 Arapahoe Ave., Boulder, CO 80302 (303)440-4901.

Oct. 16 **11th Annual Workshop on Federal and State Water Quality Developments**, Northglenn, CO. Contact: Colorado Water Congress, 1390 Logan St., Suite 312, Denver, CO 80203. Tel: (303)837-0812.

Oct. 17 **Wetlands Protection and Water Development**, Northglenn, CO. Contact: Colorado Water Congress at above address or telephone.

Oct. 18 **The Law of International Watercourses: The UN International Law Commission's Draft Rules on the Non-Navigational Uses of International Watercourses**, Boulder, CO. Contact: Natural Resources Law Center, University of Colorado School of Law, Campus Box 401, Boulder, CO 80309-0401. Tel. (303)492-1288; FAX (303)492-1297.

Nov. 5-7 **1st National Conference on Climate Change and Water Resources Management**, Albuquerque, NM. Contact: Climate Change and Water Resources Management Conference, 4350 East-West Highway, Suite 600, Bethesda, MD 20814; Lucia Buie at (301)652-8444.

Nov. 6-8 **Riparian. What Does It Mean To Me?** Pueblo, CO. An informational conference sponsored by the Colorado Riparian Association. Contact: Colorado Riparian Assoc., c/o The Nature Conservancy, 2060 Broadway, Suite 230, Boulder, CO 80302.

Nov. 14-15 **Annual Meetings, Colorado/Utah Sections of the Society for Range Management**, Grand Junction, CO. Contact: Harold Goetz at (303)491-1907 or Douglas Johnson at (801)750-3067.

Nov. 20-22 **Wyoming Water Development Association and the Upper Missouri Water Users Association Joint Annual Meeting**, Cody, WY. Contact WWDA, P.O. Box 2719, Cheyenne, WY, 82003; (307)635-1936.

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