



COLORADO WATER

Newsletter of the Water Center at Colorado State University

AUGUST 2001

*CWRRI requests proposals for FY2002
see page 4.*

*Is Colorado prepared to adapt to
extreme, long-term dry conditions?
see page 7.*

*Researchers from Agricultural Research
Stations and the U.S. Department of
Agriculture's Agricultural Research
Service and Economic Research Service
are examining and evaluating the rapidly
changing configuration of water use in
the American West... see page 11.*

*Watershed organizations encompass a
variety of water interests --
see page 14.*



*Colorado-Big Thompson near Milliken,
Colorado. (Photo by Charles W. Miller)*

Co Sponsored by:
Colorado Water Resources Research Institute
Colorado State University Agricultural Experiment Station
Colorado State University Cooperative Extension
Colorado State Forest Service

**Colorado
State
University**

Knowledge to Go Places

💧 WATER ITEMS AND ISSUES ...

WATER RESEARCH AGENDA FOR THE 21ST CENTURY
 -- Editorial by Robert C. Ward, Director..... 3

CWRRI Request for Proposals..... 4
 NIWR/USGS Announce FY 2001 National Competitive
 Grants Program Awards 5

RESEARCH
 Drought Threat to Colorado Water 7

CSU AGRICULTURAL EXPERIMENT STATION
 Agricultural Water Management Technologies, Institutions and
 Policies Affecting Economic Viability and Environmental Quality 11

CSU COOPERATIVE EXTENSION
 Design of a Cooperative Monitoring System
 For the Big Thompson Watershed..... 14

WATER SUPPLY 15

COLORADO STATE FOREST SERVICE 16

MEETING BRIEFS
 CB-T Tour and Technical Symposium a Big Success..... 18

NEW FACULTY PROFILES..... 19

CWRRI Water News 21
Research Awards..... 24
Water News Digest..... 29
Publications..... 36
Web Paths 37
Call for Papers..... 37
Meetings 38
Calendar..... 40



COLORADO WATER

Vol. 18, No. 4

August 2001

Editor: Shirley Miller

Writers: Marian Flanagan and Michael Blackledge

COLORADO WATER is a publication of the Colorado Water Resources Research Institute. The scope of the newsletter is devoted to enhancing communication between Colorado water users and managers and faculty at the research universities in the state. This newsletter is financed in part by the U.S. Department of the Interior, Geological Survey, through the Colorado Water Resources Research Institute. The contents of this publication do not necessarily reflect the views and policies of the U.S. Department of the Interior, nor does mention of trade names or commercial products constitute their endorsement by the United States Government.

Published by the

Colorado Water Resources Research Institute
Colorado State University, Fort Collins, CO 80523
Phone: 970/491-6308 FAX: 970/491-1636
E-mail: CWRRI@ColoState.EDU

INTERNET SITES

- Colorado Water Resources Research Institute <http://cwrri.colostate.edu>
- CSU Water Center <http://watercenter.colostate.edu>
- South Platte Forum <http://southplatteforum.colostate.edu>
- Colorado Water Knowledge <http://Waterknowledge.colostate.edu>
- Hydrology Days <http://hydrologydays.colostate.edu/>
- Student Water Symposium <http://watersym.colostate.edu/>
- Water REU <http://waterreu.colostate.edu/>



WATER RESEARCH AGENDA FOR THE 21ST CENTURY

by Robert C. Ward, Director

The structure of the water 'industry' does not lend itself to the development of a systematic, integrated, and strategic water research agenda because it comprises many different types of organizations and institutions and consequently is not cohesive.

The above quote from the National Research Council's recently published report, **Envisioning the Agenda for Water Resources Research in the Twenty-First Century**, indicates the external challenge facing university-based water research planning and operations in the 21st century. The report was authored by the National Research Council's (NRC) Water Science and Technology Board (WSTB). The NRC report goes on to note that:

It is not at all clear whether the fundamental research that is undertaken, largely at the nation's universities, is balanced in terms of its support of the various disciplines that are needed for water research, or how the research is used. Future research of this sort will almost certainly need to be interdisciplinary in nature, and there is scant evidence of any current effort to support effective interdisciplinary research aimed at the nation's water problems.

Thus, the complex array of needs/complexities of the water 'industry,' when combined with the disciplinary fragmentation within the university water research community, presents water research managers with the proverbial 'Mission Impossible'. The NRC report, however, by describing the issues surrounding current efforts to establish water research agendas, helps define the difficult task facing the water 'industry' and researchers.

The task of creating a water research agenda that meets the needs of the United States in the 21st century requires a level of coordination, among many players, that has not been practiced in the past. On this point the NRC report notes:

... a coordinated research program in which researchers and agenda setters can be accountable to the public will require an alignment of state and federal governments, research universities, users and purveyors of all kinds, non-profit organizations, and public interest groups. These groups will need to ally to identify and support the research agenda.

To develop a widely-supported water research agenda, the NRC report calls for creation of a National Water Research Board with broad membership, including academic representatives. The new Board would be charged with "...the ongoing task of developing (and keeping up-to-date) a strategic and anticipatory national water research agenda."

The NRC report does not define an institutional mechanism to implement and administer a water research agenda. It does suggest alternatives that may be considered:

...an ad hoc interagency organization, a body within an existing agency, or an independent agency, each of which has its advantages and disadvantages. The WSTB believes that the appropriate mechanism for implementation should be identified through customary policy-making processes after careful consideration of available alternatives.

Within Colorado, the Colorado Water Resources Research Institute's legislatively mandated Advisory Committee on Water Research Policy identifies and supports a water research agenda. The Advisory Committee has established the top research priorities for CWRRI's FY 2002 water research program, and the Request for Proposals can be found on page 4. Unfortunately, the list of research priorities must reflect the limited budget available; thus, many other potential research topics are not included in the CWRRI RFP.

Thus, Colorado, as do many states participating in the national water institutes program, has a mechanism to identify and support a state-based water research agenda. It remains to be seen if a similar mechanism can be established at the national level. The experiences of the water resources research institutes in working closely with state and local water managers and users to establish water research agendas should prove helpful at the national level.



Colorado Water Resources Research Institute
FY 2002 Request for Proposals¹
CLOSING DATE: SEPTEMBER 28, 2001

Proposals are invited for the Colorado Water Resources Research Institute FY 2002 water research program.

The Colorado Water Resources Research Institute (CWRRRI) is one of 54 water institutes administered by the U.S. Geological Survey in the Department of Interior. Under Section 104(b) of the Water Resources Research Act, CWRRRI is to '...plan, conduct, or otherwise arrange for competent research...' that fosters the entry of new scientists into water resources fields, the preliminary exploration of new ideas that address water problems or expand understanding of water and water-related phenomena, and disseminates research results to water managers and the public. The research program is open to faculty in any institution of higher education in Colorado that has 'demonstrated capabilities for research, information dissemination, and graduate training ... to resolve State and regional water and related land problems.'

Funds Available: The CWRRRI Request for Proposals is partially supported by the U.S. Geological Survey. It is anticipated that approximately \$50,000 in federal funds will be available for this competition. The federal funds must be matched 2:1 by non-federal funds (resulting in a total of approximately \$150,000 for this competition). Matching funds come from the university submitting the proposal and/or from local and/or state agencies via agreements arranged during preparation of the proposal. CWRRRI research funds are awarded through a competitive process guided by the CWRRRI Advisory Committee on Water Research Policy. Proposals that contain matching funds from Colorado water and water-related organizations are strongly encouraged. *Final CWRRRI awards are contingent upon Congressional approval of FY 2002 funding for the national water institute program.*

Solicited Research Topics: For the FY 2002 competition, CWRRRI is employing a 'Solicited Research' approach, i.e., proposals are solicited that address specific research objectives. The FY 2002 solicitation contains four priorities representing the most pressing Colorado water research needs as identified by CWRRRI's Advisory Committee on Water Research Policy. The FY 2002 priorities are:

- Water Quality Implications of Ground/Surface Water Conjunctive Use in the Denver Basin
- Identifying/Evaluating Best Management Practices to Control Non-point Source Pollution within Colorado Forests
- Identifying and Evaluating Best Management Practices to Control Non-point Source Pollution from Septic Tank Systems in Colorado
- Salinity Mitigation Options for the Lower Arkansas Valley

Deadline: All proposals are due in the CWRRRI offices by September 28, 2001.

Proposal Review Process: Proposals will be peer reviewed before final review and ranking by the CWRRRI Advisory Committee for Water Research Policy. The general criteria used for proposal evaluation include: (1) scientific merit; (2) responsiveness to RFP; (3) qualifications of investigators; (4) originality of approach; (5) budget; and (6) extent to which Colorado water managers and users are collaborating. Proposal reviews should be completed by December 2001 with March 1, 2002, start dates. [Once projects are selected for funding by the Advisory Committee, CWRRRI submits a formal funding request to the U.S. Geological Survey, including each accepted proposal.]

Eligibility: The competition is open to regular, full-time faculty at Colorado's research universities.

Project Duration: Awards will be made for one year beginning March 1, 2002. Multiple year projects will be considered; however, funding for additional years must be obtained through the annual CWRRRI research competition.

Proposal Submission: Proposals, in both hard and electronic copy, are to be submitted by 5:00pm, September 28, 2001, to:

¹ Solicitation is dependent upon Congressional approval of FY 2002 funding for Section 104(b) of the Water Resources Research Act.



Director
Colorado Water Resources Research Institute
E-102 Engineering Building
Colorado State University
Fort Collins, Colorado 80523

Send electronic copy via e-mail, if you wish, to: Shirley.Miller@Colostate.edu.

Proposal Preparation Guidelines:

For proposal guidelines see the CWRI web site at: <http://cwrri.colostate.edu>.



NIWR/USGS Announce FY 2001 National Competitive Grants Program Awards

The nine proposals listed below have been selected for funding under the fiscal year 2001 National Institutes for Water Resources and U.S. Geological Survey National Competitive Grants Program. Colorado received one award (described on the following page). Abstracts of the proposals are available at <http://water.usgs.gov/wrri/2001.html>. Bob Volk, Coordinator NIWR/USGS National Competitive Grants Program, and John Scheffer, Chief, Office of External Research, U.S. Geological Survey, said the selection panel had a difficult task in selecting these nine proposals out of 75 proposals received. Only \$1 million in federal funds was available this year. When contrasted with the total of \$9,056,385 million requested by the 75 proposals, it is evident that the competition for the available funds was very intense. Many excellent proposals could not be funded.

Use of Low-Cost Data to Simulate Fractured-Aquifer Watersheds for Management of Water Quality and Quantity, Eileen Poeter, John E. McCray, and Geoffrey Dickerson Thyne, Colorado School of Mines; Collaborators: Janet Bell, Jefferson County (Colorado) Planning and Zoning; Kip Bossong and Janet Heiny, U.S. Geological Survey; Michael Wireman, United States Environmental Protection Agency; Institute: Colorado Water Resources Research Institute; Fed. Funds: \$120,000 (2 years).

Complementary Investigations for Implementation of Remote, Non-Contact Measurements of Streamflow in Riverine Environment, Marian Muste, Iowa Institute of Hydrologic Research; Allen Bradley, University of Iowa; Anton Kruger, University of Iowa; Collaborator: Ralph Cheng, U.S. Geological Survey; Institute: Iowa State Water Resources Research Institute; Fed. Funds: \$85,070 (3 years).

Does Aluminum Geochemistry Control the Trophic Status of Oligotrophic Lakes?, Stephen A. Norton, Aria Amirbahman, and Jeffrey S Kahl, University of Maine; Roy James Bouchard, Maine Dept. of Environmental Protection; Collaborator: Robert Lent, U.S. Geological Survey; Institute: Senator George J. Mitchell Center for Environmental and Watershed Research, University of Maine; Fed. Funds: \$99,894 (2 years).

Antibiotic Losses in Runoff and Drainage from Manure-Applied Fields By: Satish Chander Gupta, University of Minnesota; Ashok Kumar Singh, University of Minnesota; Kuldeep Kumar, University of Minnesota; Collaborator: Michael Meyer, U.S. Geological Survey; Institute: Water Resources Center, University of Minnesota; Fed. Funds \$105,804 (2 years).

Photochemical Fate of Pharmaceutical Compounds Discharged and Detected in Natural Waters, William Alan Arnold and Kristopher McNeill, University of Minnesota; Collaborator: Kathy Lee, U.S. Geological Survey; Institute: Water Resources Center, University of Minnesota; Fed. Funds \$102,656 (2 years).

Modeling Phosphorus Control Best Management Practices on a Watershed Scale to Improve Surface Drinking Water Quality, Tammo Steenhuis, Cornell University; Collaborator: Edward F. Bugliosi and Michael R. McHale, U.S.



Geological Survey; William J. Gburek and Andrew Sharpley, U.S. Department of Agriculture, Agricultural Research Service; Institute: New York State Water Resources Institute; Fed. Funds: \$84,294 (3 years).

Enrichment, Biochemical, and Molecular Techniques for Assessing Microbial Arsenic Reduction, John F. Stolz, Duquesne University; Partha Basu, Duquesne University; Collaborators: Ronald S. Oremland and Robert Anderson, U.S. Geological Survey; Institute: Environmental Resources Research Institute, The Pennsylvania State University; Fed. Funds: \$109,048 (2 years).

Assessing Water Quality Impacts of Nutrient Imports into an Urban Gradient, Clyde L. Munster, Donald M. Vietor, Richard H. White, J. Bruce Moring; and Tony Lee Provin, The Texas AM University; Collaborators: Jeff Arnold, U.S. Department of Agriculture, Agricultural Research Service, and J. Bruce Moring, U.S. Geological Survey; Institute: Texas Water Resources Institute, The Texas AM University; Fed. Funds \$140,000 (3 years).

Microfabricated, Low Power, Inorganic Water Quality Sensor based on Direct Current Argon Plasma Emission Spectroscopy, Marc A. Anderson and Yogesh B. Gianchandani, The University of Wisconsin-Madison; Collaborator: David Krabbenhoft, U.S. Geological Survey; Institute: Water Resources Institute, The University of Wisconsin-Madison; Fed. Funds \$150,000 (2 years).



USE OF LOW-COST DATA TO SIMULATE FRACTURED-AQUIFER WATERSHEDS FOR MANAGEMENT OF WATER QUALITY AND QUANTITY

*Principal Investigators:
Eileen Poeter, John McCray, and Geoffrey Thyne
Colorado School of Mines*

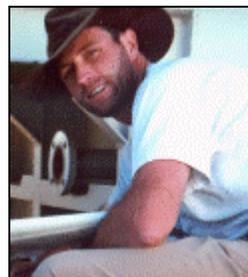
The rapid population growth and development in mountain watersheds caused Jefferson County, Colorado, to begin collecting data in a pilot study of ground-water resources in the Turkey Creek Watershed. The watershed's fractured-crystalline rock aquifer is typical of those that support individual domestic wells and sewage disposal systems for residents of the county and similar areas throughout the Rocky Mountains, the United States, and the world. A number of agencies funded data collection in the watershed, but the data are in different forms at many locations and have not been integrated into a model for a management tool. Although a ground-water model of the watershed is not expected to predict conditions in a particular well, it can provide information about future conditions in specific areas of the watershed. This research will utilize a rare database from the watershed to complement and extend the work of the U.S. Geological Survey by integrating data from many sources and developing models to:

- Better understand the flow system;
- Determine which low-cost data are instrumental in describing the system and which data reduce uncertainty; and
- Simulate the impacts of alternative development scenarios on ground-water levels, quality, and total maximum daily load in streams.

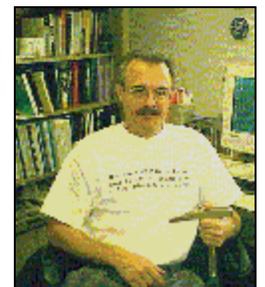
Professors and students will work with USGS and EPA scientists, Jefferson County staff, and any other interested parties.



Eileen Poeter



John McCray



Geoffrey Thyne



RESEARCH



DROUGHT THREAT TO COLORADO WATER

by

Roger A. Pielke, Sr.¹, Nolan J. Doesken¹ and Jose D. Salas²

¹Colorado Climate Center, Atmospheric Science Department

²Hydrologic Science & Engineering Program, Civil Engineering Department
Colorado State University

McKee et al. (1999) developed the standardized precipitation index (SPI) in order to monitor total rainfall over time periods from 1 month to 4 years and more with respect to average rainfall conditions. SPI can be interpreted as normalized standard deviations with respect to the average conditions. For time periods longer than 1 year, the rainfall distributions can be interpreted as represented by a normal probability distribution.

Figure 1 illustrates their analysis of four year SPI values when averaged across the state of Colorado. As clearly evident from the figure, the 1930s and 1950s included time periods of long term drought. One question that arises is the consequences to Colorado's water resources if similar droughts occurred today.

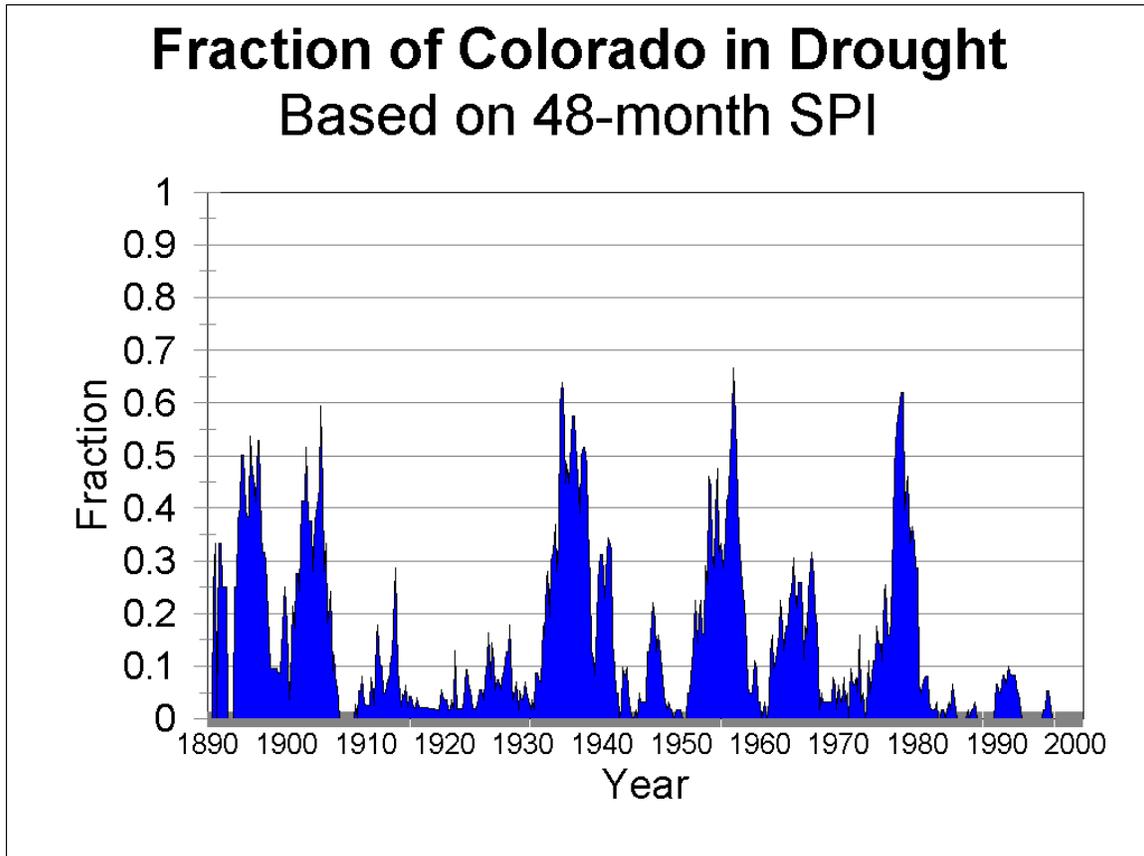


Figure 1. Fraction of Colorado in drought, based on 48-month Standardized Precipitation Index (SPI) from McKee et al (1999).

Historic climate data were surveyed to identify Colorado's five driest years during the past century. For the state as a whole (not necessarily at each and every weather station) the driest years were found to be 1934, 1939, 1950, 1954 and 1956.

Precipitation totals for these five years were accumulated and expressed as a percent of the 1931-1990 average (Figure 2). For most of the state this would amount to just 70% of the long-term average. While this may not sound that extreme, under this scenario, the vast majority of Colorado would be facing extreme water shortages. Often, the analysis of droughts at a point gives a good idea of the drought severity around a particular location. For example, Figure 2(a) shows the annual precipitation record for Boulder, Colorado and Figure 2(b) shows the corresponding sequence of drought durations (relative

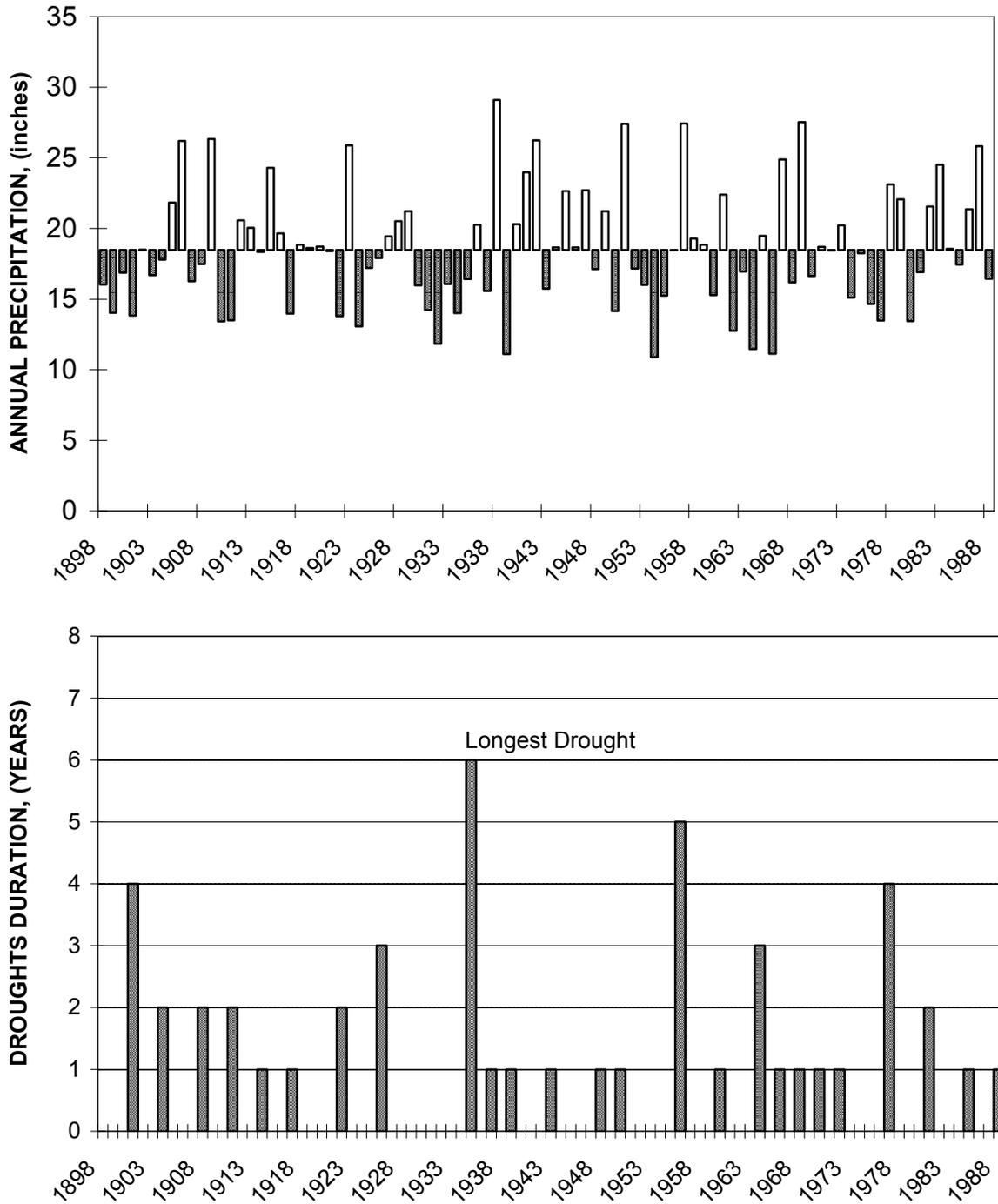


Figure 2. (a) Deficit and excess (relative to the median Y_0) of annual precipitation at Boulder; (b) corresponding drought durations (from Fernandez and Salas, 1999).



to the sample median). The return period of droughts of 6-years duration (the longest drought in the record of 91 years) is 126 years (Fernandez and Salas, 1999). Also Frick et al. (1990) analyzing annual streamflows shows that Fort Collins could have a deficit of water over 350,000 acres feet as a result of a serious 5 year drought with even more serious consequences for longer duration events. Furthermore, the analysis of the annual streamflows of the South Platte River measured at Denver station indicates that the return periods of droughts (relative to the long term sample mean) of 5 and 10 years durations are of the order of 15 and 115 years, respectively (Chung and Salas, 2000; Salas et al, 2001). Figure 3 shows the relation of estimated return periods for various drought lengths.

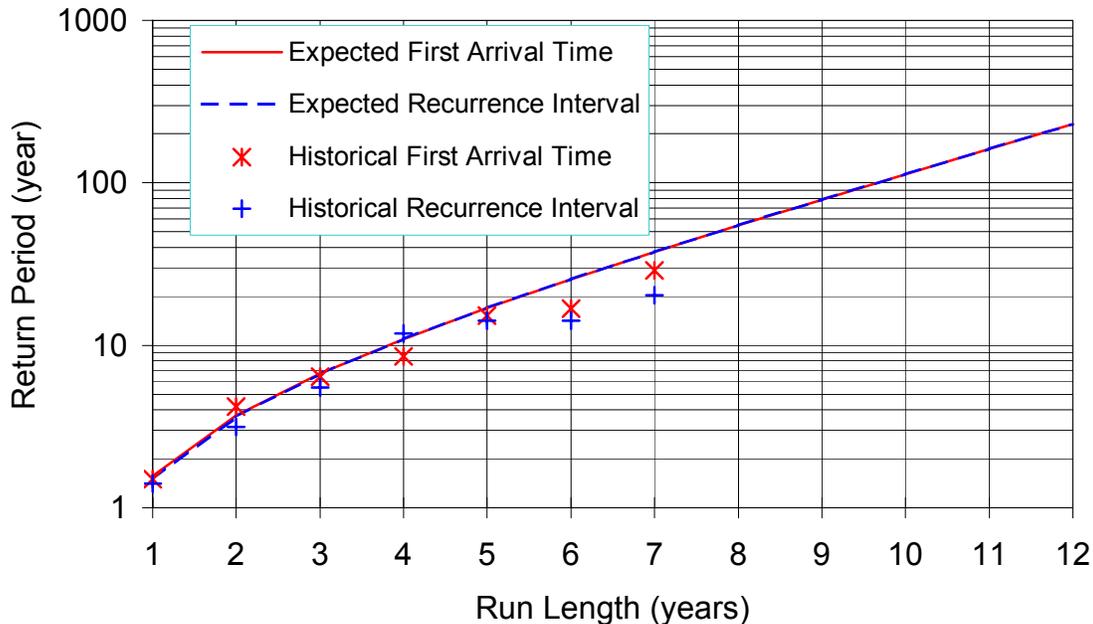


Figure 3. Return period of drought lengths (relative to the long term mean) for the South Platte River annual flows at Denver (from Chung and Salas, 2000).

These are quite sobering results. The consequences of such a prolonged drought would not only impact agriculture, but other water resource issues such as municipal water supplies. These risks need to be assessed so as a society we can prepare for such extreme events. We do not need to make predictions of the future climate, with all the uncertainties that they have (Pielke, 2001) in order to be concerned. The years that were used to create Figure 4 (next page) -actually occurred!

Prior to the historical record, even more serious drought conditions occurred. As seen in Figure 1, the 1930s were the time period of most serious long-term drought in Colorado since weather records were collected beginning in the later 1800s. However, as we discussed in the Fall 2000 issue of the Colorado Climate, is this as bad as it can get? The 16th Century megadrought that occurred over large parts of North America including Colorado lasted for decades, and far exceeded any drought over North America for at least the last 500 years! This drought was part of the Earth's natural climate system and cannot be explained by any human causes.

Natural drought by itself is frightening. If it happened today, are we prepared to adapt to such extreme, long-term dry conditions? The answer is no. We are only resistant in our municipal water supplies, for example, for about a couple of years. Plans should be made today for such an occurrence. The challenge is to develop an environmentally sensitive, yet effective long-term water use efficiency and storage capability. Is it absurd to consider pipelines to transport water from elsewhere in North America to Colorado? Perhaps, but water is an even more fundamental requirement for society than oil, so we should consider similar technologies to assure we don't run out!

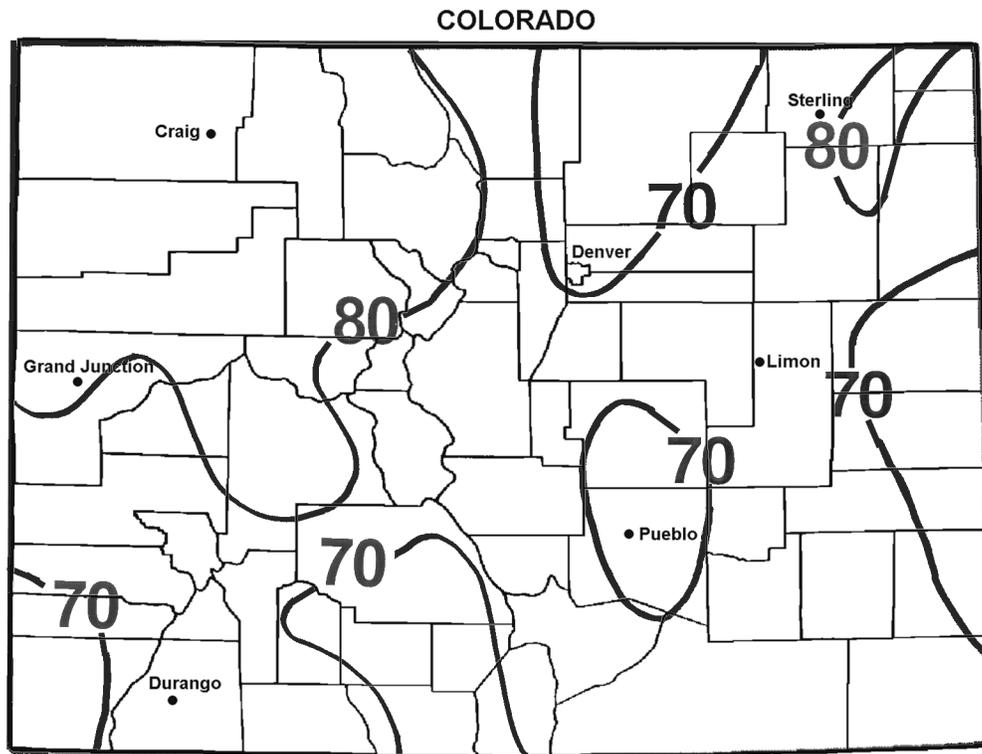


Figure 4. Colorado's five driest years of precipitation (1934, 1939, 1950, 1954 and 1956) as a percent of the 1931-1990 average.

References:

- Fernandez, B. and J.D. Salas, 1999: Return period and risk of hydrologic events. II: applications. *J. Hydrologic Engr.*, 4(4), October, pp. 308-316.
- Chung, C.H. and Salas, J.D., 2000: Drought Occurrence Probabilities and Risks of Dependent Hydrologic Processes. *J. Hydrologic Engr.*, 5(3), July, pp. 259-268.
- Frick, D.M., D. Bode, and J.D. Salas, 1990: Effect of drought on urban water supplies. I: Drought analysis. *J. Hydraulic Engr.*, 116(6), June, pp. 733-753.
- Pielke, R.A. Sr., 2001: Overlooked issues in the U.S. National Climate and IPCC assessments. *Climatic Change*, in press.
- McKee, T.B., N.J. Doesken, J. Kleist, and C.J. Shrier, 1999: A History of Drought in Colorado – Lessons learned and what lies ahead. *Water in the Balance*, Colorado Water Resources Research Inst., Colorado State University, No. 9, 20 pp.
- Salas, J.D., C.H. Chung, and B. Fernandez, 2001. Relating autocorrelations and crossing rates of continuous- and discrete-valued hydrologic processes. *J. Hydrologic Engr.*, 6(2), Mar/Apr., pp. 109-118.



AGRICULTURAL WATER MANAGEMENT TECHNOLOGIES, INSTITUTIONS AND POLICIES AFFECTING ECONOMIC VIABILITY AND ENVIRONMENTAL QUALITY

An Introduction to Western Regional Research Project, W-190

by

*Grant E. Cardon, Associate Professor, Irrigation Water Management
Department of Soil and Crop Sciences
Colorado State University*

Background

This is a joint research project involving researchers from Agricultural Experiment Stations at western Land Grant Universities, along with researchers from the United States Department of Agriculture, Agricultural Research Service and Economic Research Service. The rapidly changing configuration of water use in the American West in recent years has resulted in a number of economic, environmental, and institutional problems with profound impacts on irrigated agriculture. The purpose of the W-190 regional project is to identify, examine, and evaluate the multiple impacts of these challenges on western irrigated agriculture, help develop viable mechanisms to effectively address them, and thus contribute toward informed water policy formulation.

Justification

As new problems associated with water management emerge, the need to devise dynamic new approaches for solving them takes on added importance and urgency. Examples of such emerging areas of concern include climate change and its impact on irrigated agriculture, increasing demand for water transfer from agriculture to environmental and urban uses, impacts of animal waste management from concentrated animal feeding operations (CAFOs) on water quality, precision agriculture and the effects of site-specific management on water conservation and quality, contingent water marketing, and new approaches (e.g., game theory) to conflict resolution among competing water uses and users. This regional project is a concerted effort to address these emerging concerns in innovative ways.

The consequences of water management and policy decisions are frequently difficult or impossible to predict because of the many complex interactions between technological, institutional, and economic factors. Extensive research has been done on the individual

factors and their effect on economic and environmental outcomes. In addition, many models have been constructed which attempt to account for the myriad interactions that may occur which affect such outcomes. Little work has been done, however, on the application of such models to evaluate and quantify the interactions, or to direct the development of sound integrated research to verify and corroborate model predictions. In addition, the difficulty in applying existing models is the lack of complete on-farm or regional data appropriate for input to them.

Objectives

The project is pursuing the stated problem through the following three objectives:

1. Evaluate the farm-level economic and environmental implications of alternative resource-conserving irrigation technology and water management systems.
2. Apply alternative methodologies to evaluate economic, environmental and social impacts of potential technology, policy, and institutional changes affecting water resources for irrigated agriculture.
3. Evaluate alternative institutions and policies for resolving competing agricultural and environmental water demands.

Each of these objectives is further detailed below.

Objective 1: Evaluate the farm-level economic and environmental implications of alternative resource-conserving irrigation technology and water management systems.



This objective focuses on the assessment of farm-level economic and environmental outcomes under integrated systems of alternative irrigation technologies and resource management strategies. The research involves experimentation and demonstration of alternative irrigation production systems combined with farm-level economic analysis. Research within this objective addresses the farm-level profitability and environmental benefits of precision-farming techniques in irrigated agriculture, the on-farm economics of using best-management practices (BMPs) for water quality goals, and the impact of alternative irrigation production systems on farm economic risks.

Results from the research within objective 1 will help explain the implications of irrigation technology and water management change regarding agricultural water use, its potential impacts on water quality, its potential contribution to water-resource reallocation, and the profitability of alternative irrigation systems at the farm level. Further, research for this objective will also investigate the factors that limit or facilitate farmer adoption of irrigation technology, as well as assess the likely effectiveness of alternative technology/water management transfer mechanisms.

Objective 2: Apply alternative methodologies to evaluate economic, environmental, and social impacts of potential technology, policy, and institutional changes affecting water resources for irrigated agriculture.

Competition for scarce water resources in the west continues to increase. Meeting new water demands for urban and recreational growth, the Endangered Species Act, and for water quality goals for human and ecological health, as well as demands for Native American and rural economy development, will require assessments of economic tradeoffs of reallocating scarce supplies among competing water users. Agriculture, the largest consumptive user of western water supplies, is a principal stakeholder in policy, regulatory, and institutional changes needed to address water conservation and reallocation issues. Research and extension within this objective is addressing these issues to evaluate the economic and resource use impacts on agriculture, benefits to water quality, and benefits of enhanced water supplies for ecological habitat as well as for rural economy development.

Water policy and institutional change may encourage water resource conservation, regulate its use, and/or promote its exchange. All three broad policy



Figure 1. Irrigated agriculture, the highest consumptive user of water in the West, is under constant pressure from ever-increasing competing water demands.

perspectives, particularly when change involves an integrated policy focus, generate resource availability for competing demands. In addition, policy change that encourages farm-level conservation may not only enhance farm profitability, but increased farm-level input-use efficiency (for both water and chemical inputs) generally also will enhance surface and groundwater quality. These impacts also are likely to contribute to other human health, ecological, and environmental goals. Changes in resource and environmental policies and institutions, then, may not only impact agriculture, but also likely will occur to promote both resource-use efficiency and to enhance or create public-sector goods.

To address these issues, specific research within this objective has been undertaken by project cooperators to integrate and validate models of agricultural production, hydrology, and regional economy impacts. This work makes use of both static and dynamic modeling frameworks to assess economic, conservation, hydrologic, and water quality tradeoffs of conservation-incentive, regulatory, and institutional water policy changes. Modeling approaches emphasize measuring producer and regional resource, output, and water management and technology adjustments in response to policy and institutional changes, as well as the impact these changes have on resource opportunity values to agriculture and agricultural economic conditions. Both the private and social (public) costs and benefits of alternative policy and institutional changes are being investigated.

Objective 3: Evaluate alternative institutions and policies for resolving competing agricultural and environmental water demands.

Irrigated agriculture accounts for about 90 percent of the water consumed in the West. Agricultural water rights are based on the prior appropriation doctrine underpinning western water law. The doctrine grants a user's right to a person diverting previously unappropriated public water to a beneficial private use. The priority of the right is based on the date of first diversion and use. Consequently, water is allocated during shortages to completely satisfy the most senior rights first, and to partially satisfy more junior rights as the water supply permits. Agriculture perfected the most senior rights over the last century, and the security of these rights has been strengthened by protectionist legislation in a number of states.

Most would agree that the prior appropriation doctrine was highly successful in promoting the rapid development of the West over the previous century. However, the doctrine's strength in securing water rights to traditionally productive uses can render it inflexible in allocating water to competing environmental uses

which have been largely unprotected under the doctrine's traditional application.

Specifically, the doctrine generally prohibits an appropriator from engaging in any use that infringes on the rights of another. Since a water transfer from one user to another can impair the appropriative rights of a user not involved in the transfer, many state water codes require the proponent of a water transfer to demonstrate that no such impairment will occur as a condition of approval. The burden of such a showing has been identified as a major reason that water markets have not developed more extensively.

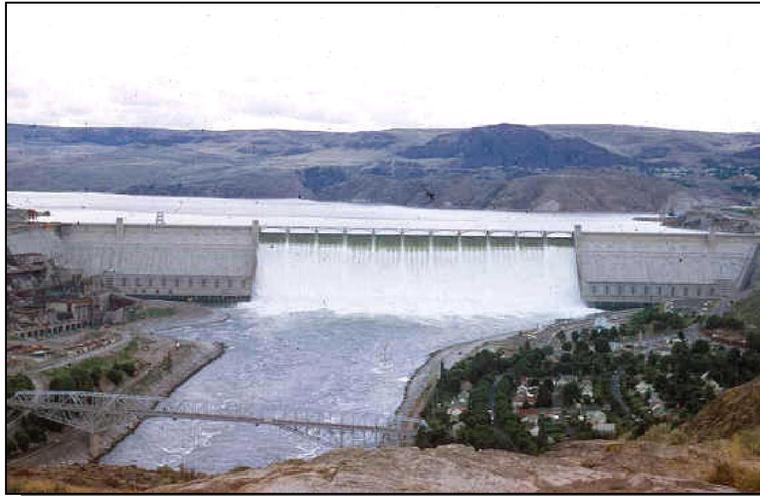


Figure 2. Removal of dams and changes in their operation to provide for in-stream uses (i.e., wildlife and recreation) may require extensive changes in irrigation water management and water allocation institutions.

Despite the doctrine's inflexibility in providing for water transfers in general, the economic and legal pressures to transfer water to environmental uses are increasing. The economic pressure mounts as economists demonstrate that the marginal value of water in many environmental uses exceeds that in agricultural use. The legal pressure mounts, as environmental uses increasingly are protected by the public trust doctrine (a common-law doctrine that protects public resources from private harm and predating the prior appropriation doctrine) and federal environmental statutes.

Objective 3 is concerned with crafting water institutions that facilitate water transfers while protecting the historic appropriative water rights of current users, and developing institutions to resolve conflicts among user groups that arise as water is transferred from one use to another. Results from research within objective 2 are

being used to identify opportunities for improved resource allocation and to provide justification for institutional change. A regional approach will require communication among researchers in different states, since legal and institutional arrangements are quite variable throughout the western region.

More Information

A web site has been created which documents the cooperating agencies, institutions, and scientists within each that conduct research

under the auspices of this regional project. In addition, regular updates of the projects being conducted, proposals being written, and papers produced by the numerous sub-projects within the umbrella project are detailed. An extensive bibliography of past work by members of the regional project is also available. Anyone interested in becoming part of the W-190 regional project can have their institution apply through the USDA-CSREES application procedures.



DESIGN OF A COOPERATIVE MONITORING SYSTEM FOR THE BIG THOMPSON WATERSHED

by

Jim Loftis, Cooperative Extension Agricultural Engineer

The Big Thompson Watershed Forum, formed in 1996, is open to all who are interested in protecting the quality of water in the Big Thompson watershed.

The Forum fosters stakeholder teamwork in conducting watershed assessment, identifying priority protection measures, educating affected interests, and promoting voluntary practices that protect the Big Thompson watershed and the quality of its waters.

Major water quality issues within the watershed include the impacts of increasing population, land development and recreation; protection of drinking water quality and recreational uses; eutrophication of reservoirs; impacts of agriculture; and maintaining the ecological integrity of streams and reservoirs.

Since 1998, faculty and students from Colorado State University and the Big Thompson Watershed Forum have worked to develop a cooperative water quality monitoring system for the Forum's constituents. U.S. Environmental Protection Agency, Region VIII, the City of Fort Collins, Tri-Districts Water Treatment Plant, the City of

Loveland, the City of Greeley and the Northern Colorado Water Conservancy District are funding the work. Participating faculty include Jim Loftis and Luis Garcia, Civil Engineering Department and Cooperative Extension Agricultural Engineers, and Melinda Laituri, Earth Resources Department. Graduate students included Adrienne Greve, Troy Monroe, and Teresa Parker from Bioresource and Agricultural Engineering and Juliane Brown from Earth Resources.

The goal of the project was to design and implement a monitoring system that produces the information all of the major user groups need at the least possible cost. At the beginning of the project, many organizations were collecting water quality samples in the watershed with no effort to standardize methods, reduce overlap or share data. There was considerable redundancy of effort, and the data from different organizations were not comparable.



Figure 1. The familiar inverted siphon at the exit to the narrows of the Big Thompson Canyon.

The project began with common monitoring goals. These included:

- Assessing compliance with stream standards,
- Determining the trophic state of major reservoirs
- Assessing the impact of feeder streams on reservoirs, especially nutrient loads, and
- Assessing the magnitude and statistical significance of apparent trends in quality.

The project design was accomplished in three major stages. The first stage was to develop a list of the water quality variables that are required to accomplish the stated monitoring goals. The second stage was to calculate sampling frequencies that are required to estimate seasonal averages, loads and trends of key variables with desired statistical precision. The variable list was finalized with the participating organizations.

Since adequate background data for the statistical calculations existed for only a few variables at a few locations, those few cases served as the basis for selecting network monitoring frequencies. As expected, the calculated sampling frequencies turned out to be too expensive, and had to be scaled back to achieve a

realistic budget. The final recommended design consisted of 24 stream and canal stations, eight reservoir stations and 38 water quality variables. The final design stage was to develop a recommended sampling protocol, data analysis protocol including statistical methods and reporting format.

Implementing the project has required many meetings of the participating organizations. All participants are strongly committed to the success of the project and are willing to compromise individual monitoring needs and to devote resources to the joint effort.

Currently, implementation is scheduled in phases. Sampling has begun at a limited number of stations. In order to achieve high quality and comparable data, the U.S. Geological Survey is taking all of the stream samples. To reduce laboratory analysis costs, though,

several different laboratories are being used, but each water quality variable is analyzed at a single laboratory to achieve comparable results. Reservoir sampling will involve more than one organization and will include considerable biological monitoring of algae and zooplankton.

During this initial stage of implementation, Ben Alexander from the City of Fort Collins has been coordinating the sampling along with Greg O'Neil of the USGS. Though ultimate success of this effort is not yet guaranteed, it is off to a great start, demonstrating the potential for big rewards from cooperative efforts to protect water quality.

For more information on the Big Thompson Watershed Forum, see the web page at www.btwatershed.org. Private individuals are welcome to join the Forum at no cost.



WATER SUPPLY



The majority of this year's runoff occurred in May, with June streamflows then being below average. This resulted in higher May SWSI values and lower June SWSI values. By the latter part of June, post-runoff stream administration was typically in effect over most of the state with the more junior water rights being curtailed. Reports from the Rio Grande, San Juan/Dolores, and Yampa/White basins all contain reference to dry conditions and a desire for summer rains, with the Yampa/White basin being especially dry. Early reservoir use was reported in the Rio Grande and Gunnison River basins.

The Surface Water Supply Index (SWSI) developed by the State Engineer's Office and the USDA Natural Resources Conservation Service is used as an indicator of mountain-based water supply conditions in the major river basins of the state. It is based on streamflow, reservoir storage, and precipitation for the summer period (May through October). During the summer period, streamflow is the primary component in all basins except the South Platte basin, where reservoir storage is given the most weight. The following SWSI values were computed for each of the seven major basins for July 1, 2001, and reflect the conditions during the month of June.

Basin	71/01 SWSI Value	Change from the Previous Month	Change from the Previous Year
South Platte	0.6	-1.7	-0.9
Arkansas	0.1	-2.6	-0.8
Rio Grande	-1.6	-4.6	-1.5
Gunnison	-1.4	-2.3	0.0
Colorado	-3.0	-2.1	-2.1
Yampa/White	-3.3	-2.4	-0.7
San Juan/Dolores	-1.0	-3.8	+0.7

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



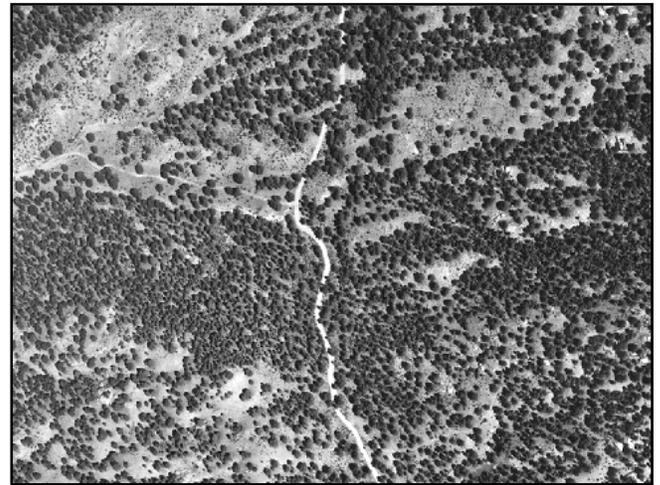
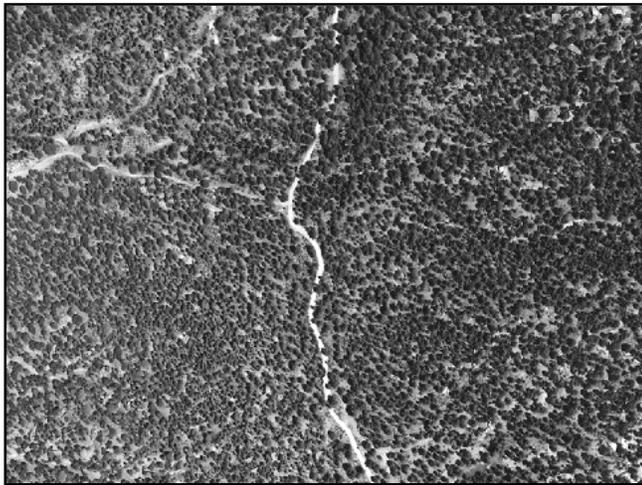


PARTNERSHIPS KEY TO SUCCESS OF UPPER SOUTH PLATTE WATERSHED PROTECTION AND RESTORATION PROJECT

The Buffalo Creek and Hi Meadow fires are reminders of the devastating effects of wildfire in Colorado's watersheds and wildland-urban interface. Such fires threaten property, human life, wildlife, vegetation and the aesthetics local residents value, and pose a serious threat to water quality. In an effort to reduce the catastrophic effects of wildfire in the South Platte Watershed, several agencies have partnered to implement the Upper South Platte Watershed Protection and Restoration Project. The project was later selected as one of 15 national watershed restoration projects being funded by the U.S Forest Service.

100,000 acres of state and private lands within the watershed; the CSFS has responsibility for managing state land in the project area and has a contract to manage Denver Water's 15,725 acres.

The project is based on more than six years of research conducted by Merrill Kaufmann, research forest ecologist at the USFS-Rocky Mountain Research Station, on Denver Water's lands at Cheesman Reservoir. Significant information is now available on the natural disturbance processes and historic and current landscape components of the South Platte Watershed. Kaufmann's



*Denver Water's Trumbull Forest Restoration Demonstration Area
Left: Before Thinning – Right: After Thinning*

"The environmental analysis decision by Abigail Kimbell, forest supervisor of the Pike & San Isabel National Forests, is key to implementing the first phase of the watershed restoration work on national forest lands," said Jim Hubbard, state forester and director of the Colorado State Forest Service (CSFS). "We have worked closely with the U.S. Forest Service, Denver Water and other agencies, and involved the public in the planning of this project." The evolution of the Upper South Platte Watershed Protection Project began in 1998 when several federal, state and local organizations collaborated to identify an area where fire risks were high and where research could guide the selection of appropriate treatments to reduce fire risks. In 1999, the USFS, CSFS and Denver Water formed a partnership to support watershed restoration actions in the 645,000-acre Upper South Platte Watershed, which involves federal, state and private land ownership. There are more than

work indicates that, historically, the ponderosa pine/Douglas-fir forests in the watershed were patchy with an open forest canopy, and not likely to support large and intense wildfires. Forest conditions in the watershed today are relatively homogeneous and dense with few openings. Current forests are conducive to catastrophic crown fires and are not considered to be ecologically sustainable.

Over the past two years, the CSFS has worked closely with Kaufmann to implement forest restoration projects on Denver Water and other non-federal lands in the South Platte Watershed. For example, on Denver Water's Trumbull Demonstration Area, treatments based on research were used to restore the forest to earlier conditions. This area provides a visual reference that helps the public understand appropriate management of forested lands within the watershed. The CSFS also



works closely with private landowners to manage their forested lands and to reduce the risk of wildfire in the wildland urban interface. Jen Chase, project forester, Elk Creek Management Unit, CSFS, is stationed in Aspen Park to work specifically with residents and fire departments in the lower Elk Creek sub-watershed, a high fire risk area in the wildland urban interface.

“Projects such as the Upper South Platte Watershed Protection and Restoration Project are essential for land-management agencies and private landowners to work successfully on a landscape scale across jurisdictions, which is the most effective strategy to reduce the threat of wildfire in Colorado’s critical watersheds and the

populated wildland urban interface,” said Hubbard. “This project can serve as an example of what can be accomplished when federal, state and local agencies work together to reduce the risk of catastrophic fire and improve forest health conditions on all ownerships.”

Project partners include the USFS (Rocky Mountain Region, Pike & San Isabel National Forests, Rocky Mountain Research Station); CSFS; Denver Water; U.S. Geologic Survey; U.S. Natural Resource Conservation Service; U.S. Environmental Protection Agency; the Elk Creek, North Fork, Mountain Communities and Trumbull Fire Protection Districts; and the Upper South Platte Watershed Protection Association.

For more information about the Upper South Platte Watershed Protection and Restoration Project, contact Jim Hubbard, director, Colorado State Forest Service, 970.491.6303; Dave Hessel, community development coordinator, Colorado State Forest Service, 303/635-1597; or Chips Barry, manager, Denver Water, 303/628-6500.



CRITICAL WATERSHEDS FOR DENVER TO RECEIVE RESTORATION WORK

August 1 marks the beginning of healthier forests for critical watersheds in 17,000 acres of the Pike and San Isabel National Forests along Colorado’s Front Range southwest of Denver. Forest Supervisor Abigail R. Kimbell signed two Decision Notices for the Upper South Platte Watershed Restoration and Protection Project (Project) that allows improvement work to begin later this winter or early Spring 2002 and continue for the next five to eight years.

While the project contains activities such as thinning overstocked timber stands and prescribed burning, it is foremost a watershed restoration effort. According to Kimbell, “The focus of this work is to restore watersheds that supply vital water to the Denver area. Our work with the Colorado State Forest Service and Denver Water is a showcase endeavor based on years of research, planning and talking with local people who care as much about the outcome as we do.” The Project encompasses 640,000 acres on the Pike & San Isabel National Forests as well as additional lands managed by the State and Denver Water. The restoration work is based on years of ecological research by Merrill Kaufmann, research forest ecologist at the USFS-Rocky Mountain Research Station, and others, near Cheeseman Reservoir in Jefferson

County. A landscape assessment, begun in 1999, identified which sub-watersheds have the greatest need for improvement. There are 13 sub-watersheds in the Project with Waterton/Deckers and Horse Creek as the priority due to a combination of high fire risk, erodible soils, and the potential to impact water quality.

Kimbell said, “The opportunity to start returning this landscape to a healthier, sustainable condition is really exciting. Our efforts will revegetate burned areas, invigorate the trees and reduce the threat of insects, disease and catastrophic fire. Perhaps, best of all, it will help to create a forest condition that can, with treatment, be sustained over time and will protect water quality, wildlife habitat and tree vigor.”

Project partners include Denver Water; Colorado State Forest Service; U.S. Geological Survey; U.S. Natural Resource Conservation Service; U.S. Environmental Protection Agency; Elk Creek, North Fork, Mountain Communities and Trumbull Fire Protection Districts; Upper South Platte Watershed Protection Association and the U.S. Forest Service (Rocky Mountain Region, Pike & San Isabel National Forests and the Rocky Mountain Research Station).

NOTE: The Decision Notices may be viewed at the following web address: <http://www.fs.fed.us/r2/psicc/spl/planning.htm> Contact: Barb Timock, Public Affairs Officer, 719-585-3738. Pike & San Isabel National Forests, Cimarron & Comanche National Grasslands, Forest Supervisor’s Office, 1920 Valley Dr., Pueblo, CO 81008. <http://www.fs.fed.us/r2/psicc/>.



MEETING BRIEFS



C-BT TOUR AND TECHNICAL SYMPOSIUM A GREAT SUCCESS

by Brett Johnson

Department of Fishery & Wildlife Biology, CSU



Collaborative planning by the Northern Colorado Water Conservancy District (NCWCD), CSU faculty, the City of Fort Collins, and the Colorado Division of Wildlife created a forum to foster coordination and cooperation among the various entities with an interest in water resources of the C-BT. The "Colorado-Big Thompson Tour and Technical Symposium, hosted by the NCWCD on June 6, brought together personnel involved in water quality and quantity issues in the Three Lakes and Big Thompson watersheds.



The tour began at NCWCD headquarters in Loveland, traveled up the Big Thompson Canyon, over Trail Ridge Road, and proceeded west to Windy Gap Reservoir before returning to Loveland via Horsetooth Reservoir. Numerous stops along the route highlighted engineering features of the C-BT system and ongoing studies. Participants enjoyed informative and entertaining accounts of the history, structure and operations of the C-BT system provided by Brian Werner, Eric Wilkinson, and Don Carlson of the NCWCD. There were 18 presentations by tour participants on topics ranging from water management and water quality monitoring, fishery management issues, and importance of food webs to reservoir water quality dynamics.



Discussion topics included the Big Thompson Watershed Forum Water Quality Monitoring Program, by Jim Loftis (CSU) and Rob Buirgy (BTWF); Long-Term Ecological Research and Monitoring, Jill Baron (CSU); Three Lakes Clean Lakes Study, Jean Marie Boyer (Hydrosphere); Watershed Approach to the Upper Colorado River Basin, Taylor Hawes (NW Colorado Council of Governments); NWCCOG 208 Planning, Robert Ray (NWCOG); Grand Lake/Shadow Mountain Reservoir Monitoring Projects, Sarah Clements (Three Lakes Watershed Association), Modeling Reservoir Ecosystem Dynamics, Laurel Saito (CSU); Windy Gap Coordinated Facilities Operations Studies, Leo Eisel (Brown and Caldwell); Windy Gap Firming Project, Blaine Dwyer (Boyle Engineering); Whirling Disease Investigations, Barry Nehring (Colorado Division of Wildlife); Water Quality Trend Analysis of C-BT Reservoir and Related Conveyances, Mike Stevens (US Geological Survey); BT and Windy Gap Baseline Water Quality Monitoring, Richard Harlan (Harlan and Associates); Modification of Dams at Horsetooth Reservoir, Beth Boaz (US Bureau of Reclamation); Top-down Influences on Water Quality, Brett Johnson (CSU); Platte River Species of Concern, Randy Van Buren (Colorado Division of Wildlife); and Eutrophication of Reservoirs on the Front Range, Laurel Saito (CSU).



The idea of including a technical symposium with the tour was conceived by Ben Alexander (City of Fort Collins), Ken Kehmeier (Colorado Division of Wildlife) and Brett Johnson and Laurel Saito (Colorado State University). Symposium organizers hope this event spawns future workshops, meetings, and collaborations.

Bus transportation and a picnic lunch were provided for participants by NCWCD. For more information about the tour see http://www.cnr.colostate.edu/~brett/cbt_tour/.

(Photos by Jim Loftis, Department of Civil Engineering, CSU) -- Left, from top down: 1) at the West Portal, Adams Tunnel; 2) Granby Reservoir; 3) Grand Lake; 4) participants hear a presentation at Grand Lake; 5) Windy Gap Reservoir and Pumping Plant.



NEW FACULTY PROFILES

**SANDRA WOODS, HEAD
Department of Civil Engineering
Colorado State University**

*by
Marian Flanagan*

Sandra L. Woods, Colorado State University's new Head of the Civil Engineering Department, earned her undergraduate degree in Civil Engineering from Michigan State University in 1976. She attended the University of Washington, where she obtained her M.S. and PhD in Civil Engineering in 1980 and 1985, respectively. In 1984, she began her career at Oregon State University as an assistant professor, and held a variety of positions while specializing in Environmental Engineering. During the 16 years she spent at OSU, she gained

valuable administrative experience. Dr. Woods served as Faculty Associate to the Provost, where she worked on special projects, coordinating environmental programs across campus, creating new programs and getting programs to work together. She led the development for accreditation of an environmental engineering degree, and acted as part of a group who put together an environmental science degree.

With faculty from Natural Resources, Toxicology, Forestry and other departments at OSU, she worked to create a vision for environmental programs at the university. She formed programs for Women and Students of Color in Engineering, where her efforts produced a special residence hall living group for Women in Engineering, creating an environment to encourage interaction among peers in an otherwise non-traditional field. Dr. Woods developed funding resources for underrepresented engineering doctoral students, gathering 60 years of PhD student support for five departments; two-thirds of which went to women and students of color. She led a committee to identify a structure for distance education and continuing education and became the first Dean of that program, creating both graduate and undergraduate programs.

Dr. Woods' research has focused on remediation of groundwater and wastewater contaminated with chlorinated organics, and bioremediation and biological treatment of chlorinated aromatic compounds. Chemical disposal practices of wood treatment facilities in the Pacific Northwest, for instance, had in the past led to widespread contamination of groundwater. Her research has largely dealt with pathways and kinetics using processes of reductive dechlorination to break compounds down to smaller, more degradable components. She has years of lab experience studying environmental factors that speed up degradation. Preceding her arrival at CSU, in February 2001, she demonstrated the successful remediation of groundwater below a wood-preserving facility.

A dedicated and motivated achiever, Dr. Woods has enjoyed research and teaching, especially working with faculty, putting together teams, and getting cooperation from many different people to write proposals and develop new programs. She excels at putting together large multi-department and multi-institution proposals, and derives pleasure from trying to leverage the work of many different people, while she makes it easier for faculty to get things done. She especially enjoys being department head, because she can help faculty become more productive. While finding enough time to do everything is difficult, she says, her challenge is, "to maintain the number of faculty in the department and maintain growth in the amount of research we generate, and to grow support for students so that there will be good enrollments and continued excellent graduate and undergraduate programs."

Sandra Woods and her husband have two sons, ages 9 and 11. They enjoy the outdoor winter activities of snowboarding and skiing, and river sports such as kayaking and canoeing, which she hopes they can find time for this year, now that they have settled in. Her parents also will move here soon from Michigan.





CHRISTIAN D. KUMMEROW
Department of Atmospheric Science
Colorado State University

by
Marian Flanagan

Christian D. Kummerow joined the Colorado State University Faculty as Associate Professor for the Department of Atmospheric Science in June 2000. Professor Kummerow received his Bachelor of Science degree in physics from the University of California, Berkeley in 1982. He earned his Ph.D in atmospheric physics from the University of Minnesota in 1987.

Prior to that, Dr. Kummerow worked at the NASA/Goddard Space Flight Center in Greenbelt, Maryland, where he served as the NASA Project Scientist for the Tropical Rainfall Measuring Mission (TRMM). He remains a member of the Joint TRMM Steering Team, is a member of the Advanced Microwave Scanning Radiometer (AMSR) team and also plays an active role in planning and defining new space-borne missions geared toward a better understanding of the Global Water and Energy Cycle.

Dr. Kummerow's interests are in remote sensing of clouds and precipitation. His focus on developing a better understanding of the global hydrologic cycle examines how climate change may or may not impact the availability of water. His current research interests, determining global precipitation and its physical characteristics as seen from space- and ground-based sensors, include hydrological parameters that involve the adaptation of cloud-scale and meso-scale models. Representative cloud profiles created by the models, and the blending of these with radiative transfer computations and satellite observations, give a complete picture of rainfall processes that are physically and dynamically consistent, and an integral part of his study of the Global Hydrologic Cycle and Climate Change.



Colorado's largest reservoir is:

- Blue Corn
- Glenwood Hot Springs
- Ruedi
- Blue Mesa

Are you a water wizard? Test your knowledge of water with the Water Wizard quizzes.

See The Colorado Water Quiz
Colorado River Water Conservation District
<http://www.crwcd.gov/quiz/quiz.html>





HAPPENINGS AT CSM

MODFLOW 2001 and OTHER MODELING ODYSSEYS

The International Ground Water Modeling Center is hosting the MODFLOW 2001 and OTHER MODELING ODYSSEYS Conference on the Colorado School of Mines Campus in Golden, Colorado, U.S.A. September 11-14, 2001.

Featured Presentations by the Organizing and Technical Advisory Committee Members

<p>Arlen Harbaugh, USGS: Directions for Ground-Water Model Development by the USGS</p> <p>Mary Anderson, University of Wisconsin: Modeling Groundwater Fluxes at Interfaces: Is MODFLOW up to the Challenge?</p> <p>William Woessner, University of Montana: New Lessons from Post-Audits?</p> <p>Michael McDonald, McDonald-Morrissey Associates: Some Thoughts on the Logic of Modeling</p> <p>Frank Schwartz, Ohio State University: Analysis of Research Impacts in Hydrology and Ground-Water Modeling</p> <p>Tom Prickett, Thomas A, Prickett & Associates: MODFLOW in Court - Experiences of an Expert Witness</p> <p>Keith Beven, Lancaster University, United Kingdom: Model Uncertainty as Landscape to Model Space Mapping</p> <p>John Doherty, Watermark Computing, Australia: Parameterizing a Groundwater Model - Space Age Technology or Science Fiction?</p> <p>David Steward, Kansas State University: Developing Understanding of Horizontal Wells Using an Analytic Model</p> <p>Theo Olsthoorn, Amsterdam Water Supply, Netherlands: Some MODFLOW Experiences and Odysseys</p>	<p>Mary Hill, USGS: Guidelines for Effective Model Calibration (Any Model!)</p> <p>David Parkhurst, USGS: Reaction-transport Modeling of a Sewage Plume at Cape Cod Massachusetts: A Convergence of Research Themes</p> <p>Chunmiao Zheng, University of Alabama: Analysis of solute transport and remediation in flow fields influenced by decimeter-scale preferential flow paths</p> <p>Graham Fogg, University of California, Davis: Future Directions in Transport Modeling: Thoughts on Assessment of Vulnerability and Remediation</p> <p>John McCray, Colorado School of Mines: Quantifying the Uncertainties Associated with Traditional Analytical Model Approximations in Vapor-Phase Pump-Test Analysis</p> <p>Rien van Genuchten, USDA Salinity Laboratory: Rosetta: A Hierarchical Pedotransfer Model to Predict the Unsaturated Soil Hydraulic Properties from Soil Texture and Related Data</p> <p>Eileen Poeter, IGWMC, Initial Conditions, Sensitivities and Other Reflections on the Modeling Odyssey</p>
--	---

Session Topics

<ul style="list-style-type: none"> - MODFLOW-2000, developments, connections, limitations - Typical problems encountered in modeling and their solutions - Model calibration and parameter estimation - Modeling of surface-water/ground-water interaction - New developments in graphical user interfaces, visualization, GIS, and database software - Constraining models using hydrogeologic information - Modeling in fractured environments 	<ul style="list-style-type: none"> - Case histories involving unusual applications of models - Stochastic approaches and applications - Ground-water management and remediation design optimization - New approaches and innovations in contaminant transport modeling & coupling flow & reactive transport modeling - Unsaturated zone and multiphase modeling - Variable density flow - Educational issues in ground-water modeling
---	--

Location

The Conference will be held on the Colorado School of Mines Campus in Golden, Colorado. There are many hotels in the nearby Golden and Denver areas in which reservations can be made.

For lodging, <http://www.mines.edu/research/igwmc/events/modflow2001/hotel.shtml>.

Registration

The Conference registration fee is \$595 (US), which includes the conference proceedings, evening receptions, lunches, and breaks. A reduced fee will apply for students registered for a degree. Address questions about the conference to IGWMC at 303/273-3103, fax 303/384-2037, e-mail: igwmc@mines.edu. For registration, contact: Colorado School of Mines, Office of Special Programs and Continuing Education at 303/273-3321, fax 303/273-3314, e-mail: space@mines.edu.

Get the registration form from <http://www.mines.edu/research/ /events/modflow2001/registration.shtml>.



SHORT COURSES

IGWMC will be offering several short courses during the conference where you will have the opportunity to improve your modeling skills. For more short course information, please visit <http://www.mines.edu/research/igwmc/short-course/>.

Short Courses	Instructors	Start date # days	End date Times	Fee with/without MF2001 Registration
MODFLOW: Introduction to Numerical Modeling	Eileen Poeter Evan Anderman	Sept 8 4 days	Sept 11 8am-5pm	\$895 / \$1095
Subsurface Multiphase Fluid Flow and Remediation Modeling	John McCray Ronald Falta	Sept 9 2.5 days	Sept 11 8am-5pm	\$895 / \$1095
UCODE - Universal Inversion Code for Automated Calibration	Eileen Poeter Evan Anderman	Sept 10 2.5 days	Sept 11 8am-5pm	\$795 / \$995
Practical Simulation/Optimization Modeling for Optimal Groundwater Management	Richard Peralta Jim Rumbaugh	Sept 10 2 days	Sept 11 8am-5pm	\$845 / \$1045
Model Calibration and Predictive Analysis Using PEST	John Doherty	Sept 14 2 days	Sept 16 8am-5pm	\$795 / \$995
MT3DMSWorkshop	Chunmiao Zheng	Sept 15 1 days	Sept 15 8am-5pm	\$395 / \$495
Advanced Modeling of Water Flow and Contaminant Transport in the Vadose Zone	Rien van Genuchten Jirka Simunek	Sept 15 2 days	Sept 16 8am-5pm	\$495 / \$595

**HAPPENINGS AT CU**

**THE NATURAL RESOURCES LAW CENTER
UNIVERSITY OF COLORADO SCHOOL OF LAW**

**invites applications for the
EL PASO ENERGY CORPORATION LAW FELLOWSHIP
Spring Semester 2002 · Fellowship Award: \$25,000**

The Natural Resources Law Center invites applications for the El Paso Energy Corporation Law Fellowship for the spring semester (January-May) 2002. The Fellowship is funded by the El Paso Energy Foundation.

The El Paso Energy Corporation Law Fellow will spend the spring 2002 semester in residence at the University of Colorado School of Law working on a research project on oil and gas, mineral, energy, public lands, or other areas of natural resource law and policy. The emphasis is on legal research, but applicants from law-related disciplines, such as economics, engineering, and the natural and social sciences, as well as lawyers, are invited to apply. Candidates may come from business, government, legal practice, or universities.

While in residence, the Fellow will have opportunities to exchange ideas with faculty and students at the Law School, as well as the broader university and legal and policy making community in the Denver-Boulder area. The fellowship includes a stipend of \$25,000, administrative and part-time research assistance, office space in the Law School, and use of University libraries and other facilities. Fellows are expected to produce a written project suitable for publication in a professional journal, present at least two lectures or seminars on their research, and participate with Center staff on projects and activities at the Center relevant to their research.



Candidates should submit a proposal in the form of a letter or statement describing the candidate's proposed research project, along with a resume. Candidates should arrange for two or three letters of support to be sent directly to the Center on their behalf. Applications and letters should be submitted to:

Gary Bryner, Director, Natural Resources Law Center, 401 UCB, Boulder CO 80309-0401.

NRLC will begin reviewing applications on August 31, 2001. Criteria for evaluation of proposals include the applicant's professional and educational qualifications, demonstrated research and writing ability, importance and relevance of the proposed project, and the likelihood the project will result in publishable research that will contribute to better understanding of issues and improved policy making.

In addition to the El Paso Energy Corporation Law Fellowship, the Center invites, on an ongoing basis, applications for fellowships without stipends in all areas of natural resource law and policy. The application process is the same as for the El Paso Fellowship.



ENVIRONMENTAL AND RESOURCE ECONOMICS WORKSHOP HELD IN BRECKENRIDGE

The CU Environmental and Resource Economics Workshop 2001 was held in Breckenridge on July 16 and 17, 2001. The workshop is organized annually by Nick Flores of the University of Colorado's Economics Department with support from the U.S. Environmental Protection Agency to bring together regional resource and environmental economists and particularly to give young professionals and grad students an opportunity to take part in a professional exchange. The following papers were presented at the workshop:

- "Market Transactions Evidence on Environmental Values of Water in the West: A Public Hedonic Model," by John Loomis, Agricultural and Resource Economics, CSU, co-authored with graduate student Katherine Quattlebaum.
- "The Effects of Economic and Social Conditions on the Functioning of Water Markets," by Chuck Howe, Environment and Behavior Program, Institute of Behavioral Science, CU, and economics graduate student Chris Goemans.
- "Obtaining Unbiased Contingent Values: Further Tests of Entreaties to Avoid Hypothetical Bias," by Tom Brown, Rocky Mountain Forest and Range Research Station.



Diane M. McKnight, faculty member at the University of Colorado, is a member of the new Water Science and Technology Board. Diane is an Associate Professor in the Department of Civil, Environmental and Architectural Engineering, Associate Director of the Mountain Research Station and Fellow of the Institute of Arctic and Alpine Research (INSTAAR). She received her PhD in 1979 from the Massachusetts Institute of Technology. Her special areas of interest are limnology and biogeochemistry of lakes and streams. Diane's research focuses on interactions among hydrologic, chemical and biological processes in controlling the dynamics in aquatic ecosystems.

(*WSTB Newsletter*, Vol. 18, No. 2, May-June 2001).



...water is the forgotten issue in the growth debate. Most Coloradans think that water comes from a faucet. But for many citizens, especially in the south metropolitan area, water really comes from mines. Sure, we call those mines "aquifers." But like mines, aquifers host valuable but nonrenewable resources.

Bob Ewegen
Denver Post
7/28/01



RESEARCH AWARDS

A summary of research awards and projects is given below for those who would like to contact investigators. Direct inquiries to investigators c/o indicated department and university. The list includes new projects and supplements to existing awards. The new projects are highlighted in bold type.

COLORADO STATE UNIVERSITY, FORT COLLINS, CO 80523

Awards for period May 23-July 26, 2001

Title	P.I.	Department	Sponsor
Land Development Over Time & Space: Economic & Hydrologic/Geomorphic Drivers of Ecological Structure	Poff, N. Leroy	Biology	Maryland Univ.
Public Attitudes Toward Agriculture in Colorado	Wallace, George	NRRT	CDOA
Research for Mitigation for Lost Production of Naturally Reproducing Salmonids in the Sacramento River	Fausch, Kurt	FWB	USBR
Rocky Mountain National Park Visitor Use in Wilderness	Titre, John	NRRT	NPS
Spatial Integration of Regional Carbon Balance in Amazonia	Denning, A Scott	Atmos. Science	NASA
Habitat Management Programming in Wyoming	Roath, L Roy	Rangeland Ecosystem Science	Wyo. Game & Fish Dept.
Mississippi River Dike Field Investigation	Watson, Chester	Civil Engr.	USDA/USFSRMR
Training & Education for Agricultural Chemicals & Groundwater	Waskom, Reagan	Soil & Crop Sci.	CDOA
Environmental Quality Incentives Program Priority Area: Montrose Unit	Champion, Daniel	Coop. Extension	USDA/NRCS
Evaluation of the Long-term Effects of Biosolids on Revegetation in Northwestern Colorado	Paschke, Mark	Rangeland Eco. Sci.	CDPHE
Activities & Participation in DMSR Satellite Data Processing & Analysis	Vonderhaar, Thomas	CIRA	NOAA
GOES-I/M Product Assurance & Advanced Product Development for a Demonstration Project...	Vonderhaar, Thomas	CIRA	NOAA
Parameterizing Subgrid-Scale Snow-Cover Heterogeneities for Use in Regional & Global Climate Models	Pielke, Roger	CIRA	NOAA
Geophysical Data Center Data Repository, Processing & Management	Matsumoto, Clifford	CIRA	NOAA
The Physics of Hurricane Intensity Change	Gray, William	Atmos. Science	NSF
Partial Rootzone Drying - A New Deficit Irrigation Strategy for Apples & Pears	Caspari, Horst	W. CO Res. Ctr.	Washington Tree Fruit Res. Commiss.
Use of Tropical Rain Measuring Mission Data to Test an Improved Parameterization of Stratiform Precipitation	Randall, David	Atmos. Science	NASA
TRMM Precipitation Radar & Microphysics: Interpretation & Precipitation Estimation	Venkatachalam, C.	Elec. & Comp. Engr.	NASA
Tropical Rainfall Measuring Mission Sounding Studies	Johnson, Richard	Atmos. Science	NASA

FEDERAL SPONSORS: BLM-Bureau of Land Management, COE-Corps of Engineers, DOA-Department of the Army, DOD-Department of Defense, DOE-Department of Energy, DON-Department of the Navy, DOT-Department of Transportation, EPA-Environmental Protection Agency, HHS-PHS-Public Health Service, NASA-National Aeronautics & Space Administration, NBS-National Biological Survey, NOAA-National Oceanic & Atmospheric Admin., NPS-National Park Service, NRCS-Natural Resources Conservation Service, NSF-National Science Foundation, USAID-US Agency for International Development, USBR-US Bureau of Reclamation, USDA/ARS-Department of Agriculture, Agricultural Research Service, USDA/NRS-Department of Agriculture, Natural Resources Service, USFS-US Forest Service, USDA-USFS-RMRS-Rocky Mountain Research Station, USFWS-US Fish & Wildlife Service.

STATE/LOCAL SPONSORS: CDA-Colorado Department of Agriculture, CDNR-Colorado Department of Natural Resources, CDPHE-Colorado Department of Public Health and the Environment, CDWL-Colorado Division of Wildlife, NCWCD-Northern Colorado Water Conservancy District.

OTHER SPONSORS: AWWA-American Water Works Assn., CID-Consortium for International Development.

UNIVERSITY DEPARTMENTS, INSTITUTES AND CENTERS: Colorado State: BSPM-Bioagricultural Sciences & Pest Management, CBE-Chemical & Bioresource Engr., CIRA-Cooperative Inst. for Research in the Atmosphere, DARE-Dept. of Agric. & Resource Economics, FWB-Fishery & Wildlife Biology, HLA-Horticulture & Landscape Architecture, NREL-Natural Resource Ecology Lab, NRRT-Nat. Resources Recreation & Tourism, RES-Rangeland Ecosystem Science. University of Colorado: ACAR-Aero-Colorado Center for Astrodynamics Research, AOS-Atmospheric & Oceanic Sciences, CADSWES-Center for Advanced Decision Support for Water and Environmental Systems, CEAE-Civil, Environmental, and Architectural Engineering, CIRES-Cooperative Institute for Research in Environmental Sciences, EPOB-Environmental, Population & Organismic Biology, IAAR-Institute for Arctic & Alpine Research, IBS-Institute of Behavioral Science, ITP-Interdisciplinary Telecommunication Program, LASP-Lab. For Atmos. And Space Physics, PAOS-Program in Atmospheric and Oceanic Sciences.



Title	P.I.	Department	Sponsor
Characterization & Improvement of Earth Observing Systems	Hanan, Niall	NREL	Univ. of Neb.
Conversion of Perennial Ryegrass Fairways to Kentucky Bluegrass	Koski, Anthony	Hort. & Landscape Arch.	Golf Course Superintendents Assn of America
Interannual Variability of UV Irradiance, Ozone, Aerosol Chemistry in the Arctic	Slusser, James	NREL	Univ. of Alaska at Fairbanks
Development & Operational Use of Fire Weather Forecast Support from a High-Resolution Mesoscale Forecast Model	Cotton, William	Atmos. Science	UCAR/NCAR/COMET Atmos. Tech. Div.
Atmospheric CO2 Inversion Intercomparison Project	Denning, A Scott	Atmos. Sci.	NOAA
Kokanee in Blue Mesa Reservoir: Causes for their Decline & Strategies for Recovery	Johnson, Brett	FWB	NPS
Adapting the Complementary Relationship for Mountainous Areas of the U.S.	Ramirez, Jorge	Civil Engr	USDA/USFS/RMRS
Tropospheric Impact of Waves & Flows Generated by Landscape Heterogeneity: A Theoretical Investigation	Pielke, Roger	Atmos. Science	NSF
Effects of Heavy Metals in Sediments	Clements, William	FWB	CSM
Genetic Diversity of Gila Cypha within the Colorado River Ecosystem	Douglas, Marlis	FWB	USGS
Precision Farming to Protect Water Quality & Conserve Resources	Westfall, Dwayne	Soil & Crop Sci.	USDA/ARS
Evaluation of Stage Fluctuations on Colorado Pikeminnow	Beyers, Daniel	FWB	USBR
Lower Green River Colorado Pikeminnow Abundance Estimation	Bestgen, Kevin	FWB	USBR
Riparian Vegetation on the Floodplains of the Green & Yampa Rivers	Binkley, Daniel	Forest Sciences	USGS
Water Quality Monitoring for Northern Colorado Plateau Network, Assessment & Planning	Laituri, Melinda	Earth Resources	NPS
Publication of Electrofishing and Its Harmful Effects on Fish	Snyder, Darrel	FWB	USBR
Synthesis, Digitization, & Analysis of Clean Water Act Impairments & Use Designations for National Park System Water	Loftis, Jim	Civil Engr.	NPS
Establishing the Status & Trends of Impaired, Threatened, & Outstanding National/State Resource Waters...	Loftis, Jim	Civil Engr.	NPS
Larval Fish Laboratory Involvement in Implementing Recovery Actions for the Endangered Fish...	Bestgen, Kevin	FWB	USBR
Computer Interactive Key to Sucker Larvae and Early Juveniles of the Upper Colorado River	Bestgen, Kevin	FWB	USBR
Cooperative Agreement for Hydrologic Model Development & Maintenance	Labadie, John	Civil Engr.	USBR
Development of a Monitoring Plan for Stocked Fish	Bestgen, Kevin	FWB	USBR
Assessment of Drifting Larval Fishes in the Yampa & Green Rivers	Bestgen, Kevin	FWB	USBR
Colorado Pikeminnow Abundance Estimation	Bestgen, Kevin	FWB	USBR
Yampa River Non-native Fish Control: Northern Pike Spawning & Nursery Habitat Evaluation	Hawkins, John	FWB	USBR
Support & Maintenance of Natural Diversity Information System	Hobbs, N. Thompson	NREL	CDOW
Nonnative Fish Control	Bergersen, Eric	Coop. Fish & WL Res.	CDOW
Consumptive Irrigation Water Use in the Upper Gunnison River Basin	Smith, Danny	Soil & Crop Sci.	Upper Gunnison River Water Conservancy
Habitat Management Programming in Wyoming	Roath, L Roy	Rangeland Ecosystem Sci.	Wy. Game & Fish Dept.
Descriptive Study: Black Canyon of the Gunnison	Wohl, Ellen	Earth Resources	NPS
Developing a Decision Support System for the South Platte Basin	Garcia, Luis	CWRI	Various "Non-Profit" Sponsors

Title	P.I.	Department	Sponsor
Integrated Modeling & Assessment for Balancing Food Security, Conservation, & Ecosystem Integrity	Ellis, James	NREL	Univ. of Calif. at Davis
Fiber Optic Biosensors for Containment Monitoring	Reardon, Kenneth	CBE	Camp Dresser McKee
Identifying Ecosystem Controls on Biodiversity: US & UK Project (Collaborative Research)	Wall, Diana	NREL	NSF
Quantifying the Change in Greenhouse Gas Emissions Due to Natural Resource Conservation...	Paustian, Keith	NREL	USDA/NRCS
01/02 Aquatic Studies - Two River Whirling Disease Investigations...	Bergersen, Eric	Coop Fish & WL Res.	CDOW
01/02 Pike Spawning...	Bergersen, Eric	Coop Fish & WL Res.	CDOW
01/02 Zimmerman Lake Greenback...	Bergersen, Eric	Coop Fish & WL Res.	CDOW
Sequential Electrolytic Degradation of Energetic Compounds in Groundwater	Sale, Thomas	CBE	DOD
Training & Education for Agricultural Chemicals & Groundwater	Waskom, Reagan	Soil & Crop Sci.	CDOA
Validation & Enhancement of AMSR-E Cloud & Precipitation Products	Stephens, Graeme	Atmos. Science	NASA
Close Coupling of Ecosystem & Economic Models: Adaptation of Central U.S. Agriculture to Climate Change	Paustian, Keith	NREL	Montana State Univ.
Membrane Behavior of Clay Soil Barrier Materials	Shackelford, Charles	Civil Engr.	NSF
Development of a Forward Model for Hurricane Initialization	Schubert, Wayne	CIRA	UCAR/NCAR/COMET Atmospheric Tech. Div.
Land-Use Change in Temperature East Asia: Land Cover Changes: Impacts on Carbon Fluxes & Land Productivity	Ojima, Dennis	NREL	NASA
Hydraulics: Specialized Training	Fontane, Darrell	Civil Engr.	Union Corp. (Japan)
Survey of Critical Wetlands & Riparian Areas in Mesa County	Culver, Denise	FWB	CDOW
Statewide Boreal Toad Surveys & Monitoring	Lambert, Bradley	FWB	CDOW
Aquatic GIS Program Manager Task Order, Fiscal Year 02	Lavender, Amy	FWB	CDOW

UNIVERSITY OF COLORADO, BOULDER, COLORADO 80309
Awards for May-June, 2001

Title	P.I.	Department	Sponsor
Accounting for Spatial Variability of Clouds and Water Vapor in Large-Scale Models	Pincus, Robert	CIRES	DOE
Fate of Nitrogen During Transport Through Agriculturally Impacted Rivers	Smith, Lesley	CIRES	USGS
Research Support Services in Hydrology and Water Resources	Peterson, R.J.	Graduate School	USGS
Variability and Forcing of Climatic Parameters on the Greenland Ice Sheet...	Steffen, Konrad	CIRES	NASA
Scaling and Allometry in River Networks Coupling Rainfall, Topography, and Vegetation with Hydrological Extremes	Gupta, V.K.	CIRES	NASA
Standard Global Snow Cover Products from Satellite Remote Sensing	Armstrong, Richard	CIRES	NASA
Climatological Studies with Doppler Radar	Mapes, Brian	CIRES	NASA
El Nino and the Tropical Maximum SST	Sun, De-Zheng	CIRES	NASA
Exploratory Study for coupling biota, energy and the Hydrological Cycle in Simple Nonlinear Models...	Gupta, V.K.	CIRES	NSF



History and Evolution of the Siple Coast Ice Stream System as Recorded by Former Shear-Margin Scars	Scambos, Theodore	CIRES	NSF
Fire and Landscape in No. Patagonia, Argentina: Integrating Landscape Heterogeneity, Land Use, and Climate Variability	Veblen, Thomas	Geography	NSF
Anisotropic Flow, Depth-Age Relationships and Stratigraphic Disturbances in Polar Ice Sheets...	Fletcher, Raymond	Geological Sci.	NSF
Isotopic Characteristics of Precipitation Across the U.S. – Patterns and Processes	White, James	IAAR	NSF
Toward a Realistic Estimate of Sea-Level Rise and Global Water Balance Due to Glacier Wastage	Dyurgerov, Mark	IAAR	NSF
Identifying Ecosystem Controls on Biodiversity: US/UK Project	Seastedt, Timothy	IAAR	NSF
Columbia Glacier Photogrammetry	Pfeffer, Tad	IAAR	NSF
Atmosphere-Land Surface Interaction Over a Midwest Watershed...	Grossman, Robert	PAOS	NSF
Treatability of Perchlorate-Containing Waters by Osmosis and Nanofiltration	Amy, Gary	CEAE	AWWA Res. Fdn.
Using Global Terrestrial GPS Measurements to Unravel Emerging Altimetric Record of Global Sea-Level Change	Nerem, Robert Steven	ACAR	Jet Propulsion Laboratory
Refinement and Verification of a Climatological Forecast Model of the Loop Current and Associated Eddies	Kantha, Lakshmi	ACAR	Marathon Oil Co.
Micro and Ultrafiltration Performance Specifications Based on Microbial Removal Efficiency	Amy, Gary	CEAE	Montgomery-Watson
McMurdo Dry Valley Long-Term Ecological Research	McKnight, Diane	IAAR	Ohio State Univ.
Evaluation of Snow Simulation in the 2nd Phase of the Atmospheric Model Intercomparison Project	Barry, Roger	CIRES	Rutgers
Influence of Aerosol-Cloud Interactions on Climate Feedbacks in the Arctic	Pinto, James	CIRES	Univ. of Alaska
Role of Shallow, Tundra Lakes in Arctic Land-Atmosphere Interactions and Feedbacks	Zhang, Tingjun	CIRES	Univ. of Alaska
Information Management of Hydrologic and Reservoir Data for Support of Lower Colorado River Operations...	Zagona, Edith	CADSWES	USBR
Decision Support for Watershed and River Systems Management	Zagona, Edith	CADSWES	USBR
Channel Monitoring to Evaluate Geomorphic Changes on the Mainstem Colorado River	Pitlick, John	Geography	USBR
Global Land Ice Measurements from Space	Scharfen, Gregory	CIRES	NASA
Global and Regional Impacts of Mesoscale Variability in Air-Sea Fluxes	Webster, Peter	CIRES	NASA
Ecophysiological Roles of Plants, Mycorrhizae, and Soil Microbes in Early Spring Nitrogen Dynamics	Schmidt, Steven	EPOB	NSF
NE Sector of the Laurentide Ice Sheet-Dating Outlet and Local Glacier Moraines at Clyde...	Miller, Gifford	IAAR	NSF
Measurement and Interpretation of D13C Atmospheric Methane from the Law Dome Ice Cores	White, James	IAAR	NSF
Measurements of Stable Isotopes in Atmospheric Gases from the Northgrip Ice Cores	White, James	IAAR	NSF
Archeology of Alaska Glaciers and Snowfields	Dixon, E. James	IAAR	NSF
Hydrologic Response of Siberian Major Rivers to Climate Change and Variation	Zhang, Tingjun	CIRES	Univ. of Alaska
International Intercomparison of Arctic Regional Climate Models	Lynch, Amanda	PAOS	Univ. of Alaska
Integrating Algal Physiological Ecology and Paleolimnology to Decipher the Effects of Atmospheric Deposition and Climate Change on Alpine Lakes	Wolfe, Alexander	IAAR	Univ. of Wisconsin
Changing Seasons? Detecting and Understanding Climate Change	Balaji, R.	CEAE	Utah State Univ.

COLORADO SCHOOL OF MINES, GOLDEN, COLORADO 80401

Research Awards

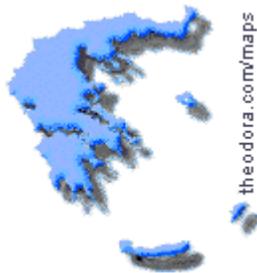
August Colorado Water Newsletter

Submitted by John McCray

Title	PI	Dept.	Sponsor
Microbial stabilization of Pu in soils	Honeyman, Bruce	Environ. Sci. Engr.	NABIR/DOE
Doctoral Fellowships in Computational Contaminant Hydrogeology	McCray, John	Geol. & Geol. Engr.	U.S. Dept. of Education
Field Test of Chemical Enhanced DNAPL Remediation	McCray, John	Geol. & Geol. Engr.	U.S. Dept. of Defense
Location of Monitoring Wells for Colorado Agricultural Chemicals -Groundwater Protection Program	McCray, John	Geol. & Geol. Engr.	CDA /CSU
Natural Attenuation of CAH Contaminants in Landfills	McCray, John Thyne, Geoff	Geol. & Geol. Engr.	Parsons Engr. Science
Use of Low-Cost Data to Simulate Fractured-Aquifer Watersheds for Management of Water Quality and Quantity	Poeter, Eileen	Geol. & Geol. Engr.	USGS-NIWR
Quantifying Site-Scale Processes and Watershed-Scale Cumulative Effects of Decentralized Wastewater Systems	Siegrist, Robert	Environ. Sci. Engr.	U.S. EPA
Contaminant Chemistry of Solid Waste Municipal Landfills	Thyne, Geoff	Geol. & Geol. Engr.	Palm Beach County Solid Waste Authority

GREECE

The word for water in Greek is “Nepó.”



Located in Southern Europe, Greece is bordered by the Aegean Sea, Ionian Sea, and the Mediterranean Sea, between Albania and Turkey. Slightly smaller than Alabama, Greece's total area is 131,940 sq. km. The terrain consists mostly of mountains ranges extending into sea as peninsulas or chains of islands. The climate in Greece is temperate, with mild, wet winters. The summers are hot and dry and can be sunny or cloudy. Snow cover is frequent at higher mountain levels during the winter. Only 23 percent of the land is suitable for plowing. In 1989, an estimate of irrigated land covered 11,900 sq km. Current issues of the country are air pollution and water pollution.

In recent years, Greece has become increasingly aware of its environmental wealth and the global significance of conservation. Important work is being done in Greece to safeguard a land largely unchanged since classical times. It was thanks to the Ramsar Convention (*Convention on Wetlands of International Importance* held in Ramsar, Iran and now ratified by 90 countries) that local governmental organizations and scientific research teams first began to focus on the biological, cultural and economic wealth nestling in Greek wetlands. Three decades after the convention, "wetlands" is a household term in Greece. A milestone in the study of Greek wetlands was the April 1989 meeting for the *Protection and Exploitation of Greek Wetlands* in Thessaloniki. Some 30 Greek and foreign specialists representing universities, ecological organizations and the public sector attended. Three subsequent 'Open Meetings' were organized in Athens, Xanthi and Patras.

One of the proposals unanimously adopted by all participants was the inception of a specialized foundation for Greek wetlands. In 1990, this proposal was adopted by the Greek Ministry of Environment, and submitted to the European Commission for co-funding. In September 1991, the Goulandris Museum of Natural History founded the Greek Biotope/Wetland Centre (EKBY) in Thessaloniki. A major issue the Centre faced was the actual definition of wetlands. EKBY charted 400 wetlands, covering a total area of 500,000 hectares. These consist of river deltas, marshes, lakes, lagoons, springs, rivers and artificial lakes. Endangered migrating birds, fragile and diverse eco-systems, the exploitation of wetlands for farming and fishing, and their contribution to micro-climactic stability and bio-chemical continuity, irrigation and power plants, are just some of the issues tackled by the Greek Biotope/Wetland Centre.

**WATER NEWS DIGEST**

by Marian Flanagan

DAMS**Dillon dam stable, but officials still ponder worst-case scenario**

Dillon dam, which holds 85 billion gallons or 250,000 acre-feet of water, was built in the early 1960s. Jim Weldon, a safety engineer for Denver Water, is confident that the dam was so well constructed and is so well maintained, that it's virtually impossible for it to fail. Because of the very small possibility of failure, however, a full-scale dam breach exercise occurs every 10 or 15 years. Representatives from 35 local, state and federal agencies react to a scenario in which the dam breaches and then triggers a failure of Green Mountain dam about four hours later. Planning includes keeping an updated list of emergency agencies, from dispatchers to firefighters to leaders in communities that would be affected by a dam rupture. In theoretical studies conducted by Denver Water, the flooding is widespread, all the way to Eagle. A rupture of the dam would not happen instantly, because it does take time for an earth dam to erode completely away. It's more likely to fail from seepage that begins to erode away the dam. In a scenario based on the caretaker noticing something leaking very severely, they predict the maximum stage below Dillon almost two hours after the event, giving emergency officials time to evacuate Silverthorne and Heeneey. The dam does seep, releasing about 50 gallons a minute from an area above Anemone Trail East in Dillon, a very minor amount compared to other dams. Unfortunately, Denver Water's concerns for the dam are based on an historical tragedy. In the mid-1970s, Wyoming's Teton Dam failed while it was under construction. That incident triggered the formation of the National Dam Safety Program, which instructs the Army Corps of Engineers to inspect dams in the United States on a regular basis. It also inspired Denver Water to begin an internal dam inspection program in 1979. Additionally, a state and a federal engineer test the dam annually. Every five years, an independent consulting firm is hired to do a separate inspection. This month's inspection, conducted by the Federal Energy Regulatory Commission, was routine.

Summit Daily News, 5/30/01

Instream flows

...Colorado has a new law recognizing Recreational In-Channel Diversions. Senate Bill 216 was passed this past legislative session, and as a result the Colorado Water Conservation Board (CWCB) has a new responsibility to consult with the water court on these types of water rights filings. To meet its responsibility, the CWCB will develop rules to guide the evaluation and review process to be used in developing its findings. The CWCB's recommendations will then be submitted to the water court for consideration. The public is encouraged to participate in this rulemaking process. The first public meeting to discuss rule development will be held in conjunction with the CWCB's July meeting in Montrose. Additional meetings are planned through the state; consult the InStream Colorado calendar or the CWCB web site for places and times.

Search for instream flow and natural lake rights on-line. The databases provide name, location and decree information for each water right; they also provide information about donated/acquired water rights. <http://cwcb.state.co.us/>: click on the "Stream and Lake Protection" button, and select the "Water Rights Database" link at the top of the page.

InStream Colorado, Vol. 4, Issue 3, July 2001; Director's Corner

A tug of war over water in the forest

The dispute about water and federal lands has simmered for decades in the West. This is partly because of the state's fast growth and partly because the state's water laws reject the idea that water left in streams has value. In its draft plan of 1999 for the White River National Forest, the Forest Service set a goal of leaving 10 percent of waters in the streams. The final document is scheduled for release in September.

National forest lands in Colorado were set aside a century ago by presidential proclamation. Congress authorized the set-asides, seeking to stop the unregulated cutting of forests that was threatening water supplies. However, Congress did not clearly address whether the federal government had authority over water, or whether it intended for the Forest Service to work within the state laws that adjudicated water. That was of little consequence until the 1960s and 1970s, when Congress passed additional laws specifically directing the Forest Service to protect the environment. When Congress did so in ways that involve keeping water in streams, however, those efforts were opposed by Western states. The Forest Service's best argument in Colorado is bypass flows. The USFS has required bypass flows only 15 times among 8,000 special-use permits involving water given to towns, ranchers, and others. In 1992, Agriculture Secretary Edward Madigan sent a letter to then-Colorado Sen. Hank Brown promising that new bypass flow requirements would not be imposed on

existing water supply facilities. Bypass flows, he said, would apply to only new water diversions on national forests. This was a compromise, and it affected projects important to Brown's native constituency in and around Greeley and Fort Collins. These farms and cities have depended for a century on water projects that regulate snowmelt on the national forests below Rocky Mountain National Park. One practical repercussion is that the Forest Service agreed that no water needed to be released from Long Draw Reservoir during winter, allowing two miles of Poudre Pass Creek to become dry. Colorado Trout Unlimited sued the Forest Service in 1995, charging that the agency had abandoned its responsibility to the environment.

This is an important test case, and some expect the U.S. Supreme Court to ultimately decide it. Representative Scott McInnis is watching the case carefully, and stands ready to attack the issue legislatively, says McInnis spokesman Josh Penry. Glenwood Springs is epicenter for the White River plan. The city's primary water supply comes from Grizzly and No Name creeks with rights filed about a century ago, contemporaneous to creation of the White River national forest. The city has a concrete dam, a steel pipe, and a tunnel. Because this is on national forest, the city must get a special-use permit. Two years ago, putting in new pipe, the city applied for a renewed permit. The Forest Service agreed, but this time the Forest Supervisor asked that the city negotiate with the agency for bypass flows. The city owns 20 cubic feet per second of water, enough to probably dry up Grizzly Creek in low-flow months. Aquatic biologists are deciding how much water should remain in the creek. This water supply easily meets the needs of the 9,200 full-time residents, plus the town's sizable summer crowds. But if bypass flows are substantial, if Glenwood continues to grow rapidly, and if there's a drought, could the city come up short? That's a long line of ifs, but Chris Treese, spokesman for the Glenwood-based Colorado River Water Conservation District, says it could conceivably cause the city to invest millions in an expanded water network. Robin Millyard, public works director for Glenwood, says "It has the potential to impact, but of the magnitude I'm not going to speculate," he says.

Bypass opponents say Colorado should rely upon the state's minimum instream flow requirements. That program worked to defeat a water-development proposal that would have impaired the beauty of Hanging Lake, also in Glenwood Canyon. However, in most cases minimum stream flow rights are junior, as in the 3 cfs the state filed at Grizzly Creek. Those 3 cfs have a seniority of 1985, compared to the city's 1908 rights. Grizzly Creek's water could be gone before the state's minimum stream flows kick in. Another approach is for the federal government to buy water rights. To ensure water in streams at the new Great Sand Dunes National Park, Congress is doing just that.

The real argument is about when water becomes even scarcer, as the West fills with people. "The real issue is one of control," says Bennett Raley, Denver-based water lawyer who recently was appointed to a position in the Interior Department. "As a state, we have spent, over the years, hundreds of millions of dollars in adjudicating the water system. If bypass flows can be imposed by the Forest Service with respect to water on the national forest, those water rights are meaningless." Steve Maloch, counsel for Trout Unlimited, sees a different pivotal question. That is whether Western laws developed during mining booms of the 19th century will serve those states during the 21st century as migrations premised on recreational and environmental quality swell populations.

Vail Daily, 7/4/01

LITIGATION

Colorado water tab cut in half

The U.S. Supreme Court recently awarded roughly \$22 million to Kansas that Colorado must pay to end the damage phase of the two states' Arkansas River Compact case. The 16-year-old case is all but ended now, except for court supervision of compliance and some minor disputes over river depletions since 1996, when Colorado started requiring metering of well permits. The decision means this state will not have to pay Kansas the pre-judgment interest from 1969-85 that would have added \$20 million to the damages. Kansas filed the lawsuit in 1985, originally seeking \$322 million for Colorado having depleted the downstream state's compact entitlement by unrestricted irrigation well pumping in the Lower Arkansas Valley. The Supreme Court found that Colorado depleted the river flow into Kansas by 428,005 acre-feet from 1950 to 1996. Since the damages will be court-ordered, they are exempt from Taxpayer's Bill of Rights limits and may be taken from the TABOR surplus, rather than from the state-operating budget. The \$22 million destined for Kansas will cause a one-time reduction in the state capital construction budget.

Pueblo Chieftain, 6/12/01

PEOPLE

Aurora's Tom Griswold dies

Tom Griswold of Aurora died at his home on July 11. Griswold was with the City of Aurora for 28 years, the last 15 as utilities director. Griswold dedicated his professional life to providing quality water to Aurora. The city acquired 77 percent of its current water supply under his leadership. Mayor Paul Tauer said, "He had a way of bringing people together to work out solutions to problems... What he did for this city is something that will last years and years into the future."

Denver Post, 7/13/01



RECREATION

Water Court rules for Golden

On June 19, a state water court ruled that Golden could have a massive recreational water right to mountain peak flows on Clear Creek through the city's nationally known course. Steve Sims, first assistant attorney general who represented the state, said the ruling is the first to allow a city to "essentially claim all the water in the stream." Glenn Porzak, Golden's water attorney, said, "It's the essence of what this state is all about. It's recreation."

Denver Post, 6/20/01

Lyons may get kayak course

Kayakers and tubers may soon have another Front Range whitewater option if plans for a river park in the town of Lyons are approved. Construction of the park could begin as early as next fall and will require the movement of tons of boulders to a 1,200-foot stretch of the North St. Vrain River. The park's designer, who also designed the whitewater parks built in Boulder and Golden, claims the pools and drops will benefit fish and other wildlife living in the river as they provide excitement to humans floating down it. His aim is to mimic nature and undo some of the damage humans caused to the river as vegetation was removed from its banks and water was forced into an unnatural channel. The project faces two remaining obstacles. First, the town of Lyons must receive permission to alter the river from the U.S. Army Corps of Engineers; second, the project needs funding -- cost for work on the river is estimated at about \$80,000.

Boulder Daily Camera, 6/28/01

Landowners, river-rafting groups collide

According to the Denver Post, Colorado is the only state in the union that has yet to resolve the issue of floating on waters bordered by private property. Every other state has resolved this issue, each falling on the side of the floaters. Technically, a rafter, kayaker or floating fisherman who floats past private property is a criminal trespasser in Colorado, according to a decision by the State Supreme Court in 1979. No Colorado court has ever challenged that decision, and landowners hold it up as *the* answer. In 1983, at the request of the head of the Department of Natural Resources, then-Attorney General Duane Woodard issued an opinion on what the law on floating is, and that has been Colorado's primary legal source since that time. The essence of the law is that if you touch terra firma -- or terra muddy for that matter -- a trespass can occur. But if you can float, then that is OK. The rule got around the traditional rule of what is a navigable river, since Colorado would be hard pressed to find many water features that fit the federal common law definition. Floaters hold up this opinion as *the* answer. And, although a floater who refrains from touching the banks or bed has not committed criminal trespass, that floater may be committing civil trespass by violating an inherent tenet of property ownership that gives landowners the right to choose who can have access to their land. No Colorado court has ever addressed the concept of civil trespass on a waterway. And if a floater is committing civil trespass, wouldn't landowners have the right to block the river? There is a Colorado law that says no one can "obstruct a...waterway...to which the public or a substantial group of the public has access." No court has ever addressed that issue either. The issue boils down to a battle of rights. The right to float, as outlined in federal laws based on English common law, vs. property rights that date to the creation of the U.S. Constitution.

Denver Post, 7/1/01; Fort Collins Coloradoan, 6/24/01 (Ronald Rutz's Legal Q&A)

So many rafts, so little river

Last summer 73,000 people paid to go for a ride in a raft through the Shoshone rapids on the Colorado River above Glenwood Springs. It was a record year for the popular stretch of river and it may have been too much. Over the winter, a group of commercial raft company leaders held a series of meetings to discuss ways to better manage the growing number of commercial trips on Shoshone. The result will be a few changes in how commercial trips are run this summer, and it could mean a cap on the number of trips in Shoshone in the near future. Companies operating out of Vail, Aspen and Glenwood Springs have permits from the Forest Service to run commercial trips down Shoshone, which offers a series of Class III rapids just below the Shoshone power plant in Glenwood Canyon. Each permit carries with it a certain number of user days totaling 55,000 user days for the Shoshone section. A person taking a raft trip counts as one user day. Also, each operator is allowed a certain number of what are called temporary-use days, which were structured to allow about a 10-percent increase above the number cited on a permit. However, the number of temporary-user days has been growing over the years and it has climbed to as high as 50 percent for some operators. Operators this year agreed to limit the temporary-user days to 30 percent, and they agreed to stage their raft trips at either end of the canyon and not at the Grizzly take-out. The companies also volunteered to limit the number of "doubles" and "triples" they do on Saturdays. The Shoshone run often consists of about a 20-minute run through a series of four or five rapids and then about an hour-and-a-half float through Glenwood Canyon to the Two Rivers take-out. But some companies have found that their customers prefer to run the rapids, take out at Grizzly, go back to Shoshone and run the rapids again. That's a "double." Do it again and that's a "triple." Doubles and triples are especially popular with rafting companies from Vail, which have to bring their clients the farthest and want to give them their money's worth. This summer, the companies have agreed to limit the number of boats they use when they do run doubles and triples. In the future, some limits might be placed on the number of trips that can be run on peak days. Although maxing out the number of trips taken on peak days, like July 4, might be good for business,

it is not the best long-term approach to managing the resource. There is a similar plan in place on the Arkansas River, which is the most popular rafting river in the country. Each of the 64 companies that run commercial trips on the Arkansas are limited to a certain number of boats they can run, especially on Saturdays. A similar system may be put in place on Shoshone.

Aspen Daily Times, 5/28/01

WATER BANKING

Water bank project readied for launch

Gov. Bill Owens has signed a water-banking bill for the Lower Arkansas Valley. Senator Lewis Entz teamed with Representative Diane Hoppe on HB1354, authorizing a pilot project to see if water banking would help farmers and ranchers make enough to stay on the land by leasing water, rather than selling their water rights permanently. The project will be conducted in the Arkansas River Basin, with participation by the Southeastern Colorado Water Conservancy District headquartered in Pueblo. The governor also signed SB216 by Entz and House Majority Leader Lola Spradley for Colorado Water Conservation Board review of recreational water rights applications before they go to water court. Already decreed or filed recreational water diversions are grandfathered, so SB216 applies only to future filings that affect existing rights upstream from the proposed kayak and boat runs.

Pueblo Chieftain Denver Bureau, 6/7/01

WATER DEVELOPMENT/SUPPLY

A-LP funding jumps U.S. House hurdle

Sixteen million dollars in funding for the Animas-La Plata project was included in a fiscal 2002 Energy and Water Development spending bill that sailed through the House Appropriations Committee without controversy. The Energy and Water Development Subcommittee approved the A-LP funding the week before. The Senate has not yet begun to formally craft its version of the \$23.7 billion Energy and Water Development appropriations bill, which will go before the full House next. The White House requested \$12 million for Animas-La Plata pre-construction; the committee added \$4 million above that request. Congress authorized the A-LP project late last year, but specific funds must be appropriated on a year-by-year basis. The project is expected to cost the federal government \$343.8 million; \$275.8 million of that is for new costs, such as construction, and \$68 million has been spent on past studies. Opponents of the project argue that it wastes taxpayer dollars and will be harmful to the Animas River, but no opposition was voiced in the Appropriations Committee meeting Monday.

Durango Herald Washington Correspondent, 6/26/01

Highlands Ranch hopes to divert water from Park County

Park County officials have opened negotiations with Highlands Ranch's water utility to provide water to the town. The Centennial Water and Sanitation District hopes to divert about 500 acre-feet of water from the Cline Ranch near Como to Highlands Ranch. The district will take steps to avoid drying out the hay meadows by pumping additional water into Tarryall Creek in the fall, when the water level is at its lowest, by monitoring hay meadows to ensure native species flourish, rather than weeds, and also, by donating \$100,000 to the county to acquire easements on riparian land. Park County commissioners are regulating the project through a state law that allows local governments to oversee matters of state interest.

Aurora Sentinel, 7/17/01

Renewable water source sought for Douglas County

Douglas County Commissioners are expected to approve the Parker Water and Sanitation District's plans to build a dam southwest of Parker that will have one-third the capacity of Cherry Creek Reservoir. Frank Jaeger, District manager, said that if approved, the Rueter-Hess Reservoir would capture water diverted from Cherry Creek and Newlin Gulch during low water-use months and store it for use during periods of drought. Like most of Douglas County, about 85 percent of the water district's supply comes from underground aquifers – a source that can't be replenished. Another 15 percent comes from Cherry Creek. Plans call for a 135-foot-high, 5,300-foot-long dam capable of holding 16,200 acre-feet of water. The district expects to have the dam in use by 2005, Jaeger said. The Army Corp of Engineers began an environmental impact study of the project in 1999, and it is expected to be completed by fall.

Denver Post, 7/22/01

Park County to keep aquifer water

Park County residents have won a 5-1/2-year legal case over a proposal by Aurora to pump millions of gallons of water from beneath the Sportsmen's Ranch and allow it to be replenished in wet years. In June, Water Court Judge Jonathan Hayes ruled that Aurora failed to prove downstream communities and ranches would not be harmed by the water withdrawal.

Denver Post, 7/15/01



Shared water line planned

Broomfield and Erie may split the cost of a pipeline that would bring water to their communities. The proposed 10-mile pipe would connect a reservoir that Broomfield plans to build. Broomfield officials have asked Erie leaders to consider splitting the cost of the pipeline, which the town could use to connect its water treatment plant to a reservoir site it is eyeing. Both towns use Windy Gap and Colorado Big Thompson water, which comes from the western slope and is pumped into Carter Lake, serving about 12 Denver metro area communities. Both are planning to store some of that water in their future reservoirs. Broomfield approved the pipeline plan June 19 and wants to have the pipe and reservoir built in five years. While the plan makes sense, it also has some problems. A common pipeline probably would mix treated Colorado Big Thompson water with untreated Windy Gap water. While Broomfield's water system can process such a mix, Erie's system cannot. No cost estimates were available for the project.

Boulder Daily Camera, 7/5/01

Water district buys extra storage rights

The Upper Arkansas Water Conservancy District has purchased long-term storage rights in the future expansion of two area reservoirs. The district secured 1,000 acre-feet of new storage rights from the Southeastern Colorado Water Conservancy. The agreement does not provide 1,000 acre-feet of water annually, but only storage for water the district already owns. The UAWCD will initially pay approximately \$70,000 for the storage rights, and an additional \$20,000 (\$20 per acre-foot) yearly. Reoperations storage refers to space in a reservoir that is not being used by the existing owners. Expansion of Pueblo Reservoir is planned for 2013, while Turquoise has been slated for 2025. Any expansion is tentative, because Congress must approve the plans before expansion of either reservoir can begin.

Salida Mountain Mail, 7/16/01

WATER QUANTITY/QUALITY**\$25,000 grant to pay for groundwater study**

The Colorado Water Conservation Board has awarded a \$25,000 grant to Las Animas County to cover the county's share of the cost of a U.S. Geological Survey study of groundwater in the Purgatoire River Basin. The two-phase study will continue through Sept. 30, 2002 to determine current available water levels and quality and to assess the possible effects of coalbed methane gas production and injection on the aquifers. The study will also determine whether some of the wasted water being pumped out of the aquifers by oil and gas drilling companies could be saved, stored or used in a more constructive way. A more comprehensive planning study of the Purgatoire River basin's regional water resources would help local officials address water supply issues related to energy development and growth in the basin area, but would require additional funding. The Raton-Vermejo and Dakota aquifers in Huerfano and Las Animas Counties supply groundwater for agricultural, domestic and industrial use. About 50 wells in Huerfano County and 600 wells in Las Animas County have been drilled into the coal-bearing zones, resulting in wasted ground water. Long-term availability of groundwater in the aquifers could be adversely affected by increased groundwater withdrawals or degradation in quality associated with coalbed methane production and injection. Despite being greatly impacted by the energy industry, Las Animas has not been getting its share of state severance tax distribution paid to the state by the oil and gas operators doing business there. The commissioners hope the county will be able to acquire its fair share of severance tax distribution from the state.

The Pueblo Chieftain, 6/6/01

High ammonia levels found in creek

Population growth and increased industrial use caused Boulder's wastewater treatment plant to dump excessive levels of ammonia into St. Vrain Creek last month, according to city officials. The slightly higher levels of ammonia measured in the creek in May "have had no apparent impact on St. Vrain Creek," a city statement claimed. The high levels were thought to come primarily from the city's industrial customers, which account for 15 percent of the system's capacity. Plant officials are investigating the source of the problem. The plant has required 13 industrial companies to obtain wastewater permits because of their levels of waste. Only three of them have been permitted since 1998. A city statement generated by plant officials said they anticipate the state health department will issue a notice of permit violation. But an enforcement officer with the state department said none would be issued because the situation appeared to be under control. Ammonia is normally present in wastewater, and the wastewater plant is designed to remove most of it. Concentrations of ammonia in the plant discharge decreased in June but remain close to the permit levels. Officials expect a major expansion project, scheduled to be completed late next year, to provide additional treatment capacity and operational flexibility to meet current and future permit limits. In the meantime, the plant's industrial pre-treatment coordinator will investigate whether the influx of ammonia is coming from an industry.

Boulder Daily Camera, 6/13/01

Local golf courses continue water quality testing

For the fifth summer, the Eagle Valley Golf Course Environmental Group is funding and participating in a water quality-testing program

at golf facilities in Eagle County. All 13 courses between Vail and Gypsum are involved in the voluntarily testing program to sample and analyze surface waters as they pass through golf properties. The project has been aided and supported by Colorado State University's Cooperative Extension in Eagle, Continental Analytical Services of Salina, Kansas, Eagle Valley High School, and Audubon International. These businesses, schools and organizations have offered information, technical support and direction on organizing and carrying out the water quality testing. CSU extension agent Megan Gross has a valuable resource for area superintendents, helping to pull samples, test them and interpret the results. Water quality is an important issue in Eagle County, and many local courses border rivers, streams and lakes. Proper application rates of fertilizer preclude surface water contamination. Many courses have become members of other nationally recognized environmental programs, such as the Audubon Cooperative Sanctuary Program, Audubon International and have even become certified cooperative sanctuaries. Several other area courses are working to achieve certification. This Audubon program requires each course to document and implement positive environmental practices associated with water quality, in addition to environmental planning, wildlife habitat management, integrated pest management, water conservation and community outreach and education. Members of the group also have contributed to scholarships for local students, donated to memorial funds for colleagues, set up golf tournaments and participated in Audubon's Adopt-A-School program in which environmental education is stressed to school children in Eagle County.

Vail Daily, 6/24/01

Mercury in fish

Eight lakes and reservoirs in Colorado are posted with fish advisories for mercury contamination. They are: McPhee, Narranguinnep, Sanchez, Navajo, Teller, Ladora, Mary and Lower Derby; the last three are at the Rocky Mountain Arsenal. A new draft EPA study of McPhee and Narranguinnep links mercury in those reservoirs to power plant emissions and runoff from abandoned mines. Certain fish species accumulate more mercury than others. Predatory fish, such as bass, tend to have higher concentrations than fish that eat bugs or other forage food. Older fish also tend to have higher levels. Some fish most favored by anglers such as trout or kokanee salmon in McPhee Reservoir don't accumulate as much mercury. Risks to human health are based on long-term, cumulative effects rather than high concentrations in individual fish.

Rocky Mt News, 7/9/01

Snowmaking area water quality within standards

Snowmaking at Keystone ski area is spreading heavy metals from old mines but so far has not caused any significant damage. Keystone uses water from the Snake River, and the river basin is known for its old mining claims. Three years ago, the resort began monitoring water quality. The latest study was a cooperative effort between Keystone Resort, the U.S. Forest Service, and an agency-approved consulting firm, Hydrosphere Resource Consultants Inc. Technicians took samples from areas where snowmaking is used and compared them to reference sites using only natural snow. Samples were collected for five months during the 1999-2000-ski season. The biggest concentrations of metals were found in wetlands, but in most cases levels did not exceed EPA limits, and plant life was noted to be healthy. "During early snowmelt, most of the runoff infiltrates to the ground and is routed through soils before it reaches the streams...The soils have the capacity to absorb and filter out some percentage of the metals," the study reported. The USFS requested the study after 28 years of snowmaking at Keystone, and study results come as the ski area has proposed to expand its snowmaking system into Jones Gulch. USFS's Dillon Ranger District will continue to monitor levels for further study and will work with Keystone in developing a better drainage plan. Future research may include more in-depth studies of how metal ions behave once they're in the soil. Keystone will be involved in the cleanup effort in conjunction with the Snake River Task Force and will continue working with the Forest Service to learn more about the science of this issue. The ultimate solution is to clean up the Snake River.

Summit Daily News, 7/5/01; *Denver Post*, 7/4/01

WETLANDS

Wetlands to be restored, trash removed

A wetland in the Animas Valley, partially covered by asphalt- and concrete-laden debris will be cleaned up under an agreement being worked out between the property owner and the U.S. Army Corps of Engineers, a Corps official said Monday. The Corps began investigating the wetland just north of Durango city limits, in early June after receiving calls that truckloads of dirt were being dumped on the fragile ecosystem. The dumping stopped after the Corps stepped in. An environmental consultant was hired by the property owner to determine the extent of the dumping and the boundaries of the wetland. After the dirt is removed, some sort of permanent barrier will be installed to mark the wetlands for the future. Neither the city nor the county has jurisdiction over the wetlands. Just outside city limits, the land is in the county, but is not included in the Animas Valley Land Use Plan zoning area, which has regulations about wetland destruction. No fines have been discussed, and none are expected.

Durango Herald Staff Writer, 6/26/01



MISCELLANEOUS

Fluoride benefits debated across state

Debate over whether to put fluoride in drinking water is heating up along the Front Range, decades after many communities decided it was a good way to keep children's teeth healthy. Foes of fluoridation have long resented what they call the mass medication of the public by the government. They are now armed with studies that say fluoride is not that effective and could be a health threat if ingested for a long enough time. Also, there is no way to monitor the amount of fluoride we are getting. Fluoridation is voluntary in Colorado, according to the state. The Boulder City Council is expected to take up the issue after a dozen residents debated the merits of fluoride before the environmental board last week. The city voted to add fluoride to its drinking water in 1969. Durango's director of public works said the city voted on it and has fluoridated water since sometime before 1971 to boost the total concentration from its natural state of 0.3 to 1.0 milligram per liter. He said he is unaware of any objection to doing so in the past 30 years. In Fort Collins, the engineering committee of the city's water board has recommended an end to fluoridation. Parents in Colorado Springs are hoping to block plans to add fluoride to the water in northern and eastern portions of the city. The arguments have left many officials searching through piles of conflicting studies. The Environmental Protection Agency, American Dental Association and most public-health agencies back fluoridation as the best way to prevent cavities in the teeth of growing children. More than 170 million people, or 62 percent of the nation's population, drink water with fluoride, which is commonly found in groundwater but lacking in surface water. Detractors point out that a union of scientists with the EPA and some independent dentists claim fluoride can be linked to birth defects, certain cancers and increased bone fractures in kids. "The preponderance of evidence for fluoride surfaced in the '40s and '50s," a Boulder dentist said. "The preponderance of evidence against it developed in the '80s and '90s."

Durango Herald & The Associated Press, 6/21/01

Mild winters linked to fast-spinning Arctic air

Relatively mild winters in North America over the last 20 years can be traced to a fast-spinning ring of air over the Arctic that acts like a dam to block frigid air from moving south, atmospheric science researchers at Colorado State University contend. The spinning Arctic winds, known as the North Atlantic Oscillation, have far-reaching climatic effects that rival those of the better-known El Niño phenomenon. Global warming may have contributed to recent mild winters, but the role of the Arctic winds may be greater. The scientists analyzed 40 years of Northern Hemisphere climate data and summarized their findings in the journal *Science*. The North Atlantic Oscillation seesaws between positive and negative phases. The negative phase is linked to near-record cold and widespread snow over much of the Northern Hemisphere. In the negative phase, the ring of Arctic air spins more slowly and is more easily disturbed, allowing cold air to spill south into the mid-latitudes. In the positive phase, the ring of Arctic air spins faster and blocks the movement of frigid air to the south. Winter temperatures rise and snowfall totals drop across the mid-latitudes -- including places such as Colorado, just as we have seen for the last two decades.

Longmont Daily Times Call, 7/7/01

Dispute over how to restore fish population in lake

Residents of the area damaged by last summer's Bobcat Gulch fire and the U.S. Forest Service disagree over plans to restore the fish population in a small lake. The private, two-acre lake, built in 1968, had served as a gathering spot and fishing hole until the rains came about a month after the 10,600-acre blaze. The waters sent tons of dead pine needles, chunks of charred trees and gallons of slimy ash down the valley and settled in the little pond. It caked the bottom with 12 feet of decaying muck, depleting the dissolved oxygen content, and killing \$5,000 worth of newly stocked rainbow trout. One resident contends the Forest Service should lend a hand, saying the blaze started on government property. Others say they can dredge the lake themselves. All they want is a place to dump the debris. A district ranger who oversees the area said, "The homeowners want to dredge the lake and deposit the ash on forest land, but we don't have an area that is environmentally stable enough for that," although residents dispute that claim. The lake remains a local concern.

Pueblo Chieftain (AP) 6/10/01

The legal framework for use of Colorado's waters is the product of a lengthy history of water-related legislation and judicial decisions. Federal and state rules and regulations regarding flood control, water quality, hydroelectric power, water supply, drinking water, soil conservation, reclamation, forestry recreation and research also impact the allowable use of Colorado's waters. Additionally, nine interstate compacts shape the river's usage and dictate state-line delivery requirements. Colorado's constitution dedicates all surface waters in the state to the public subject to appropriation for beneficial use. This so-called "Prior Appropriation Doctrine" governs Colorado's water law, which means that the application of water to beneficial use is governed by the order in which the use occurred (i.e., first in-time, first-in-right). Most western states follow some form of Prior Appropriation Doctrine, but typically require a state permit to appropriate water. Colorado is unique in the absence of a state permit system. Colorado water rights are determined by the actual use of the water and certified by the courts.

From the Colorado River Water Users Association website at http://crwua.mwd.dst.ca.us/co/crwua_co.htm.

PUBLICATIONS



CWRRI PUBLICATIONS

◆ **Institutional Adjustments for Coping with Prolonged and Severe Drought in the Rio Grande Basin**, by Frank A. Ward, Robert Young, Ronald Laceywell, J. Phillip King, Marshall Frasier, J. Thomas McGuckin, Charles DuMars, James Booker, John Ellis, Raghavan Srinivasan; technical completion report for a regional project conducted under the auspices of the U.S. Geological Survey National Grants Program by the State Water Institutes of New Mexico, Texas, and Colorado. New Mexico WRRRI Technical Completion Report No. 317. Feb. 2001.

The complete report, **Institutional Adjustments for Coping With Prolonged and Severe Drought in the Rio Grande Basin**, can be downloaded at the following website: <http://wrrri.nmsu.edu/publish/techrpt/tr317/download.html>



U.S. GEOLOGICAL SURVEY PUBLICATIONS

Contact the U.S. Geological Survey, Box 25046, MS415, Denver Federal Center, Lakewood, CO 80225. Phone 1-888-ASK-USGS or 303/202-4700 (unless another source is provided). Website: <http://webserver.cr.usgs.gov>.

◆ **Streamflow and Water Quality in Tarryall Creek Downstream from Park Gulch, Park County, Colorado, April 1997-March 2000**. USGS Fact Sheet FS-145-00, March 2001.

◆ **Water-Level Changes in the High Plains Aquifer, 1980 to 1999**, by V.L. McGuire. USGS Fact Sheet FS-029-01, March 2001.

◆ **Land-Use Changes and the Physical Habitat of Streams -- A Review with Emphasis on Studies Within the U.S. Geological Survey Federal-State Cooperative Program**, by Robert B. Jacobson, Suzanne R. Femmer, and Rose A. McKenney. USGS Circular 1175.



PUBLICATIONS FROM OTHER SOURCES

◆ **Envisioning the Agenda for WATER RESOURCES RESEARCH in the Twenty-First Century**, prepared by the Water Science and Technology Board, Division on Earth and Life Studies, National Research Council. 2001. The report discusses major research questions related to critical water issues facing the U.S. and lays out an interdisciplinary research portfolio and agenda-setting process that can maximize the nation's ability to prioritize and conduct water resources research. The report's objectives are to:

- Draw attention to the urgency and complexity of water resources issues facing the United States in the twenty-first century;
- Broadly inform decision makers, researchers, and the public about these issues and challenges;
- Identify needed knowledge and corresponding water resources research areas that should be emphasized immediately and over the long term; and
- Describe ways in which the setting of the water research agenda, the conduct of water research, and investments devoted to such research should be improved in the next few decades.

Copies of the report are available from the Water Science and Technology Board, National Research Council, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

◆ **Colorado Climate, Fall 2000, Vol. 1, No. 4**. Published four times per year -- Winter, Spring, Summer and Fall, subscription rates are \$15 for four issues or \$7.50 for a single issue. Contact the Colorado Climate Center, Atmospheric Science Department, Colorado State University, Fort Collins, CO 80523-1371. Phone 970/491-8545, FAX 970/491-8293.

◆ **HYDROLOGY DAYS**, Proceedings of the 21st Annual American Geophysical Union, by Jorge A. Ramirez. Held April 2-5, 2001 at Colorado State University, Fort Collins, CO. Contact: Marilee Rowe, Phone 970/491-6308, E-mail mrowe@engr.colostate.edu.



WEB PATHS



Description	Website
<i>Streamlines</i> , the quarterly newsletter published by the Colorado Division of Water Resources, is now available at:	http://water.state.co.us/default.htm
HAZARD Websites Federal Emergency Management Agency (FEMA) -- used to encourage the spread of emergency management-related education	http://www.fema.gov
Coping With Floods -- North Dakota State University Extension	http://www.ag.ndsu.nodak.edu/flood/home.htm
Colorado Watershed Assembly	http://www.coloradowatershed.org/CWA.htm
River Watch -- (Colorado Division of Wildlife) contains summarized water quality data for 30 Colorado watersheds.	http://riverwatch.state.co.us
Colorado Alliance for Environmental Education	http://www.caee.org
Northern Colorado Water Conservancy District -- access NCWCD meeting agendas on the web site	http://www.ncwcd.org
Learn about Colorado's Instream Flow Program and the Colorado Water Conservation Board	http://cwcb.state.co.us and http://cwcb.state.co.us/isf/Programs/Instream.htm

<p>Preface</p> <p>Research Workshop Objectives</p> <p>Summary, Conclusions and Recommendations</p> <p>Supporting Organizations</p> <p>Workshop Participants</p> <p>Abstracts</p> <p>Full Papers</p> <p>Pictures of Extreme Floods</p> <p>Home</p>	<p>URL: http://www.engr.colostate.edu/ce/faculty/salas/us-italy/</p> <p>HYDROMETEOROLOGY, IMPACTS, AND MANAGEMENT OF EXTREME FLOODS</p> <p>Nov 13-17, 1995, WARREDOC (La Colombella), Perugia, Italy</p> <p>J.D. Salas¹ and F. Siccardi², Editors ¹Colorado State University and ²University of Genova</p>
---	--

CALLS FOR PAPERS

**INTEGRATED TRANSBOUNDARY WATER MANAGEMENT
TRAVERSE CITY, MICHIGAN -- JULY 23-26, 2002**

The 2002 Annual Conference of the Universities Council on Water Resources (UCOWR), held jointly with the ASCE Environmental Water Resources Institute, U.S. Army Corps of Engineers Institute for Water Resources and National Ground Water Association, will explore the technical, cultural, legal, economic, social and political facets of integrated transboundary water management. Electronic submission of abstracts is preferred. They may be submitted on the web site <http://www.uwin.siu.edu/ucowr/> or via e-mail to ucowr2002@siu.edu. Deadline for submission of abstracts is October 1, 2001. For further details access the web site, or to receive all future announcements and program information, e-mail ewri@asce.org or ucowr2002@siu.edu, or call UCOWR headquarters at 618/536-7571.



MEETINGS

**COLORADO LAKE AND RESERVOIR MANAGEMENT
ASSOCIATION FALL CONFERENCE
October 3, 2001, from 9:30 am – 3:30 pm
Westminster Recreation Center, 10455 Sheridan Blvd., Westminster, Colorado**

The theme for the fall conference is "Challenges of Managing Limited Water Resources in Colorado Lakes and Reservoirs." We will have an exciting and dynamic program with topics including water quality criteria, water quality in Front Range Reservoirs, the monitoring program in Barker Reservoir, an evaluation of stormwater best management practices to reduce bioavailable phosphorus, information on the Three Lakes project, and impacts of the Summitville Mine on the Alamosa River fishery below Terrace Reservoir. We also plan to have a discussion panel on conflicting use restrictions for recreation in drinking water reservoirs with representatives from several Colorado communities such as Boulder, Aurora, Westminster, Denver, Fort Morgan, and Steamboat Springs. Please plan to join us! Registration cost is \$75 per person and includes a continental breakfast, hot lunch, and afternoon cookies! Contact Sharon Campbell at 970-226-9331 for further information or a registration form.



**12th Annual South Platte Forum
WASSUP IN THE SOUTH PLATTE BASIN
October 24-25, 2001
Raintree Plaza, Longmont, Colorado**

Keynote Speakers

**Russell George, Director, Colorado Division of Wildlife
Senator John Evans, Colorado State Legislature**

Sessions

**Water Banking: Making a deposit for the future
Well Augmentation: Balancing the account
What's in the Water? A water quality update
Chutes, Ramps and Ladders: A recreation quantity discussion
Fishable, Swimmable, Irrigatable: A recreation quality discussion
Use Less, Reuse More: Saving water for tomorrow**

Registration fees include proceedings, meals, refreshments and the networking hour. The forum will be held at the Raintree Plaza Conference Center in Longmont, Colorado, located on Hwy. 119, east of Twin Peaks Mall.

Overnight Accommodations: The Raintree will offer the rate of \$89/night to conference attendees. Please make room reservations through the Raintree Plaza at 303/776-2000 before Oct. 10.

Registration Fees: Early Registration by Oct. 1 -- \$70; Registration after Oct. 1 -- \$85; Additional invoicing fee if necessary -- \$20

TO REGISTER, PLEASE DETACH FORM AND SEND WITH PAYMENT TO:

**South Platte Forum
C/O No. Colo. Water Conservancy District
PO Box 679
Loveland, CO 80539**

Name _____ Organization _____

Address _____

Phone _____ Amount Enclosed _____ Lunch Request Meat Vegetarian



SECOND ANNUAL CONFERENCE OF THE COLORADO WATERSHED ASSEMBLY

September 7-8, 2001 – Frisco, Colorado

Representatives from Colorado watershed groups along with nonprofits and governmental agencies have recently formed the Colorado Watershed Assembly. The Assembly serves to formally link together the growing number of people and entities committed to collaborative, watershed-based approaches to conserving Colorado's lands, waters, and other natural resources.

The mission of CWA: The Colorado Watershed Assembly supports collaborative efforts to protect and improve the conservation values of the land, waster, and other natural resources of Colorado watersheds.

This year's meeting will be at the Holiday Inn in Frisco, Colorado, and will provide a wide range of information about current and upcoming watershed issues, as well as highlighting the activities of watershed groups throughout the state and the roles of and resources available from state and federal agencies and nonprofit organizations. Panel sessions will include:

- **What Local and Regional Watershed Activities are Occurring** – Moderator Rob Buirgy, Big Thompson Watershed Forum;
- **What Private Interests and Property Owners Are Doing to Promote Watershed Management** – Moderator Chuck Wanner, Friends of the Poudre; and
- **Reports from State and Federal Agencies Involved in Watershed Management** – Moderator Marc Alston, Environmental Protection Agency.

The luncheon keynote speaker will be Russell George, Director, Colorado Division of Wildlife. For more information about the meeting agenda and registration procedures, see the Colorado Watershed Assembly web site at:

<http://www.coloradowatershed.org/CWA.htm> or contact any member of the conference committee – Marc Alston at 303/312-6356, Dan Beley at 303/692-3606, or Chuck Wanner at 970/484-0810.



CALENDAR



Aug. 23-24	COLORADO WATER CONGRESS - SUMMER CONVENTION, Steamboat Springs, CO. Phone: (303) 837-0812, fax: (303) 837-1607, E-mail macravev@cowatercongress.org , website http://www.cowatercongress.org .
Aug. 26-Sept. 13	17th International Seminar on FOREST AND NATURAL RESOURCES ADMINISTRATION AND MANAGEMENT, Fort Collins, CO. Contact Ann Keith, Coordinator, Phone 970/482-8098, FAX 970/490-2449, E-mail IFS@cnr.colostate.edu , Website http://www.fs.fed.us/global/isfam .
Aug. 27-31	WETLANDS ENGINEERING and RIVER RESTORATION CONFERENCE, Reno, NV. View the program and register online at http://www.asce.org/conferences/wetlands2001 .
Sept. 7-8	2 ND ANNUAL CONFERENCE, COLORADO WATERSHED ASSEMBLY, Frisco, CO. Contact: Chris Rowe at Phone 303/291-7437 or E-mail cwn@coloradowatershed.org .
Sept. 9-12	DAM SAFETY 2001, Assoc. of State Dam Safety Officials Annual Conference, Snowbird, UT. Contact: ASDSO, 450 Old Vine Street 2nd Floor, Lexington, KY, 40507. Phone 859/257-5140, FAX 859/323-1958, E-mail info@damsafety.org , or go to web site http://www.damsafety.org (go to conferences and training).
Sept. 10-11	WATER LAW SEMINAR sponsored by Colorado Water Congress. Held in the Colorado Water Congress Conference Room, 1580 Logan Street, Suite 400, Denver, Colorado. Phone: (303) 837-0812, Fax: (303) 837-1607, E-mail macravev@cowatercongress.org , website http://www.cowatercongress.org .
Sept. 22-26	GROUND WATER PROTECTION COUNCIL ANNUAL MEETING, Reno, NV. Conference information is online at http://www.gwpc.org .
Oct. 10-12	SYMPOSIUM ON THE SETTLEMENT OF INDIAN RESERVED WATER RIGHTS CLAIMS, St. George, UT. See: Western States Water Council web site http://www.westgov.org/wswc/ .



Oct. 17-19	THE NATIONAL URBAN WATERSHED CONFERENCE, Costa Mesa, CA. Contact: National Water Research Institute, PO Box 20865, Fountain Valley, CA 92728-0865. Phone 714/378-3278, FAX 714/378-3375, Email NWRI-2@worldnet.att.net .
Oct. 17-19	2001 ROCKY MOUNTAIN WATERSHED ROUNDTABLE, Casper, WY. For information contact Richard Fox at twp@treeswaterpeople.org .
Oct. 29-30	COLORADO NPS FORUM 2001. Contact the Colorado Department of Public Health and Environment at 303/692-3571 for further details.
Nov. 7-9	2001: A LAKE ODYSSEY, Madison, WI. For information see the web site http://www.nalms.org or E-mail Yvonne Feavel, Chair, Host Committee at jvfeavel@execpc.com , or phone 715/258-8034.
Nov. 11-13	NASULGC 2001, 114th Annual Meeting, Washington, DC. Call national office at 202/478-6050 or see NASULGC web site at http://www.nasulgc.org/am2001 .
Nov. 12-15	AWRA ANNUAL WATER CONFERENCE, Albuquerque, NM. Contact: Michael Campana, AWRA, at Phone 540/687-8390 or access website at http://www.awra.org .
Nov. 16	THE ENDANGERED SPECIES WORKSHOP. Held in the Colorado Water Congress Conference Room, 1580 Logan Street, Suite 400, Denver, Colorado. Phone: (303) 837-0812, Fax: (303) 837-1607, E-mail macravev@cowatercongress.org or see web site http://www.cowatercongress.org .
Jan. 27-30	CONFERENCE ON TAILINGS AND MINE WASTE '02, CSU, Fort Collins, CO. Contact: Linda Hinshaw at Phone 970/491-6081, FAX 970/491-3584, E-mail lhinshaw@engr.colostate.edu , or see website at http://www.tailings.org .

Colorado Water Resources Research Institute
Colorado State University
Fort Collins, CO 80523

PRESORTED
STANDARD
US POSTAGE PAID
FORT COLLINS CO 80523
PERMIT NUMBER 19

