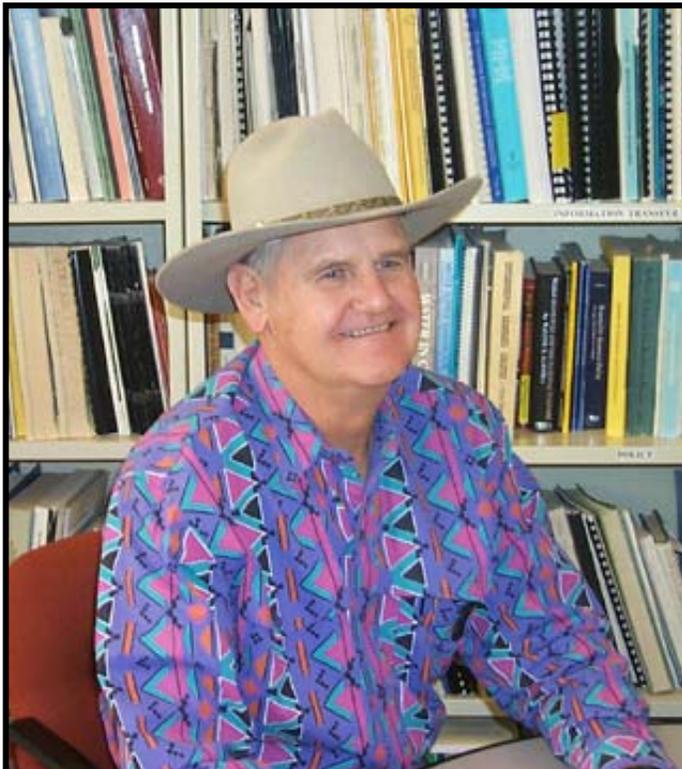




COLORADO WATER

Newsletter of the Water Center at Colorado State University

FEBRUARY 2002



Jim Valliant, Regional Irrigation Specialist for Cooperative Extension in Colorado's Southeast area, will retire in April, 2002. Jim reflects on his career and achievements with Robert Ward, CWRI Director, and Reagan Waskom, CWRI Water Resources Specialist, on page 11.

***Upcoming Meetings
see page 39***

**March 6-7
HIGH ALTITUDE
REVEGETATION WORKSHOP**

**March 15
AWRA COLORADO SECTION
ANNUAL SYMPOSIUM**

**April 1-4
HYDROLOGY DAYS**

**April 9
WELLS – ARE THEY
A DEPENDABLE WATER SUPPLY?**

**June 7-8
ARKANSAS RIVER BASIN WATER
FORUM – PEAKS TO PRAIRIES:
SHARING A WATERSHED**

**June 11-14
ALLOCATING AND MANAGING WATER
FOR A SUSTAINABLE FUTURE...**

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EDITORIAL



IMPROVING AGRICULTURAL PROFITABILITY IN THE LOWER ARKANSAS VALLEY

by Robert C. Ward, Director

Members of the Stephen Long Expedition to Colorado, in the summer of 1820, summarized their observations of the aridity of the lower Great Plains, including the Arkansas River Valley, by labeling the area on their maps as the 'Great American Desert.' This label prevailed until gold discoveries and transportation systems generated a large influx of European settlers in the 1860s and 1870s. The settlers initiated irrigation systems to overcome the lack of sufficient rainfall to support agriculture, thus, in the minds of many settlers, debunking the 'desert' label. The dust bowl days of the 1930s, however, reminded many of the settlers' descendants that the lack of water was severe and, while not necessarily a desert, did indicate to them why Long developed the "desert" label for the area. Something had to be done to ensure sufficient water, especially in periods of drought, to support a viable agricultural economy. Dams and trans-mountain water diversions were constructed during the mid-1900s to assist in supplying water in the Arkansas Valley.

The Long Expedition also noted another feature of the Arkansas Valley that has caused irrigators of the Arkansas Valley problems – excessive salt. With respect to the quality of the Arkansas River, Long's journal observes, on July 18, 1820, "At the mountains the water was transparent and pure, but soon after entering the plains it becomes turbid and brackish." Salinity's impact on crop production in Colorado's lower Arkansas Valley is estimated to reduce yields from 10 to 25 percent. Efforts of university scientists to define the exact nature of the problem (salinity in soils and groundwater, as well as surface water applied to the land) are helping quantify not only the extent of the salinity problem, but also its variation over the valley soils.

Low agricultural prices, when combined with crop reductions due to high saline conditions, are negatively impacting agricultural profitability in the Lower Arkansas Valley. The combined impacts are placing intense economic pressure on the valley's irrigators. The severity of the problem may be calling for concerted action not unlike that taken to solve water quantity problems faced 60 years earlier.

This issue of *Colorado Water* reports on several projects that may help improve the profitability of irrigated agriculture in the lower Arkansas Valley. First, Professor Eric Schuck, who recently joined the CSU faculty, summarizes his observations of water conservation efforts around the West. These observations provide a context for viewing Colorado's current efforts to establish a pilot water bank in the Arkansas Valley. Then, Professor Bill Cotton presents an

update on research that may lead to improved seasonal forecasts of snowmelt and river runoff.

As new technology, science and institutional arrangements are developed and proposed, the interface between new water management approaches and actual practice becomes critical. Jim Valliant, Extension Irrigation Specialist, has served at this interface in the Arkansas Valley for the past ten years. Jim will retire from Cooperative Extension April 30, 2002. His service to Cooperative Extension's mission has been outstanding, and given the water issues facing the lower Arkansas Valley, *Colorado Water* interviewed Jim on January 11, 2002. Jim's thoughts and opinions on the future of a profitable irrigated agriculture in the lower Arkansas Valley are, as always, positive, and in many ways, inspiring.

CWRRI announces the selection of five new research projects for FY 2002 on page 4 of this issue of *Colorado Water*. The five projects, recommended by the CWRRI Advisory Committee, include a new project to examine ways to mitigate the impact of salinity on agricultural profitability in the lower Arkansas Valley. Thus, CWRRI will continue searching for ways to improve both water quality and conservation in the valley. While the new water extension specialist in the Arkansas Valley has big shoes to fill in connecting university water research to the needs of the valley, he/she will benefit greatly from the very positive interface between research and practice that Jim Valliant fosters and which is continuing in new CWRRI projects.

The human perception of water availability and use in the lower Arkansas Valley has changed several times since 1820, and undoubtedly it will change again in the future. With a strong partnership between university research expertise and valley farmers, focused carefully on aspects of the change, there is no doubt that the future of the Arkansas Valley remains bright. If you don't believe this, just ask Jim Valliant!





CWRI ANNOUNCES FY 2002 PROJECTS

CWRI's Advisory Council on Water Research Policy (ACWRP) met in Denver in November to hear updates on research in progress and to review water research proposals for FY2002. Following peer review of the proposals received in the water research competition, the ACWRP identified five projects to receive funding for 2002-03. During the November 5, 2001 meeting, two of the proposals were deemed by the ACWRP to be in need of revision before final acceptance. The proposals were revised using the peer review and Advisory Committee comments. The projects receiving CWRI FY 2002 funding are described below.



Above: ACWRP members review water research proposals at Denver meeting, November 5, 2001. From left: John Porter, Dolores Water Conservancy District; Don Ament, Colorado Commissioner of Agriculture; Ralph Curtis, Rio Grande Water Conservation District; Representative Diane Hoppe; Fred Anderson, former Colorado Legislator; and Sara Duncan, Denver Water.



Left: John Stednick, Professor of Earth Resources (middle), describes his research to John Porter, Dolores Water Conservancy District (left) and Don Ament, Commissioner of Agriculture (right).

Managed Ground Water Recharge for Habitat Restoration: The Development of a Biological Component to the South Platte Mapping and Analysis Program (SPMAP)

A series of managed groundwater recharge projects (referred to as the Tamarack Plan) is being developed in the lower South Platte River in Colorado that will re-time flows to assist with water augmentation management and provide Colorado's water contributions to a Platte River Endangered Species Program. The groundwater recharge projects developed under the Tamarack Plan divert excess river flows, using a system of wells, pipes and/or ditches, to groundwater recharge basins in upland areas. This research will develop a rule-based expert system that will identify-flow related parameters for habitat benefits during various life cycle phases of several target species. The expert system will be incorporated into a biological module for SPMAP, the program currently used by wildlife managers and water user groups in the South Platte Basin. The inclusion of habitat benefits in the Tamarack Plan recharge projects is a priority for the water users in the region. *Principal Investigator: Luis Garcia, Civil Engineering Department.*



Enhancements to the South Platte Mapping and Analysis Program (SPMAP)

Local water management organizations in the Lower South Platte have sought the development of computer-based tools tailored to the modeling needs of this unique area. Specifically, there is a need to upgrade current technology used to manage the conjunctive use of ground and water resources in the South Platte Basin and to determine augmentation requirements. These systems are complex and require data and models that can work with both large and small areas and time periods. Computer tools can be used to manage this data and run models specifically designed for this problem. Current SPMAP tools are proving themselves to be very valuable, but there is a need to maintain the spatial database to run these tools as well as develop additional enhancements to better address the needs of local water providers. This project will continue the close cooperation with water managers that has been established over the last five years and allow the SPMAP tools to be improved and maintained. Water user groups consider the SPMAP effort as the foundation of the future South Platte Decision Support System (SPDSS) now being scoped by the State of Colorado. The enhancements in this proposal will provide a package of computer tools that the State of Colorado can consider incorporating as part of the SPDSS. *Principal Investigator: Luis Garcia, Civil Engineering Department.*

Quantifying the Effectiveness of Best Management Practices (BMPs) in Controlling Non-Point Source Pollution From Forestland Uses

Within the state of Colorado and nationally, the use of Best Management Practices (BMPs) is the accepted approach to control non-point source pollution. Non-point source pollution usually enters the stream from precipitation or runoff events in a diffuse nature. The runoff event and location of entry into the stream make modeling of non-point source pollution and BMP effectiveness difficult. In forested areas, the majority of non-point source pollution tends to be sediment or sediment related (Stednick, 2000). Sources of sediment include roads, logging, grazing, off-highway vehicle use, and other recreation. To address this question, this research will use an in-stream sampling scheme that will monitor individual structural BMPs along Trout Creek, near Pikes Peak National Forest in Colorado, and assess cumulative effects within the watershed. *Principal Investigator: John Stednick, Earth Resources Department.*

Determining the Fate of Non-source Pollution from Septic Tanks in Turkey Creek Basin, Colorado, and Delineating Improved Management Practices

This project will evaluate whether septic system drainage is flowing laterally in high permeability material overlying fractured bedrock, thus short-circuiting to streams. The project site is Turkey Creek Basin, Colorado, and Jefferson County will cooperate in the study. If short-circuiting of septic system return flows is occurring, alternative drain field designs will be recommended to facilitate deep percolation of return flows. If this process is not documented, alternative causes for the observed changes in water quality and water levels will be hypothesized and the observed behavior of return flows will be documented. Results of this project will benefit the county, residents of the basin and down-stream users of water from the Turkey Creek Basin. The EPA is working to have the contributors of non-point source contamination to streams bear the cost of their impact. If the septic return flows are impacting the streams and practices can be changed to alter that situation, everyone will benefit from cleaner streams at lower cost. If this mechanism is not active, we will be closer to knowing the causes of the observed conditions. *Principal Investigators: Eileen Poeter and John McCray, Department of Geology & Geological Engineering, Colorado School of Mines.*

Evaluating Strategies to Mitigate Waterlogging and Salinization in Colorado's Lower Arkansas River Valley

This research project focuses on one of the most salinity-affected irrigated regions in the United States, the Lower Arkansas River Basin in Colorado. If agricultural production is to be sustained, well-designed and economical changes must be made in fields and sub-regions along the entire Lower Arkansas Valley. Old irrigation habits will have to be altered to become more efficient, aging water-delivery infrastructure will need to be rehabilitated and modernized, subsurface drainage systems must be installed and maintained, and new and more salt-tolerant crop varieties will need to be adopted. This project presents an approach that builds upon ongoing studies to apply and refine sound modeling tools, rooted in and calibrated by extensive field data, and founded upon strong working relationships with numerous agencies and with over 80 valley farmers. The goal is to build a framework for evaluating strategies to support a productive irrigated agriculture in a salinity-threatened valley. *Principal Investigators: Tim Gates and John Labadie, Civil Engineering Department.*



RESEARCH



ALTERNATIVE ECONOMIC WATER CONSERVATION TOOLS AROUND THE WEST

by *Eric Schuck*

*Department of Agricultural and Resource Economics
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Water scarcity is a fact of life in the western United States. Historically, dealing with chronic water shortages meant redistributing water spatially through dams, canals, and diversion projects. While effective, moving and storing water often comes at significant environmental cost and in recent years has become less politically feasible. As a result, water policy across the western United States is shifting from moving water to where it is needed in favor of encouraging water use efficiency, which means making do with that water which is available. To an economist, water use efficiency is defined as sending available water to its “highest and best use.” “Highest and best use” means providing water to whatever uses maximize total social benefits, including profits from agriculture, benefits to municipal governments, and environmental benefits. Some of these benefits are monetary, and some are amenity values associated with quality of life. It is important to note that economists include both consumptive and non-consumptive uses of water in their measures of benefits, so a balance is struck between competing uses for water. From a policy standpoint, the question is how to create social institutions that can effectively reallocate water across competing uses such that it achieves its highest and best use in a particular region.

Numerous economic mechanisms exist for encouraging the “highest and best use” of water. Conservation pricing, water marketing and water banking are among the more popular institutional alternatives being tried across the West today. As currently used in other states, some of these methods are compatible with Colorado water law; some are not. The applicability of each tool depends largely on drawing a distinction between publicly and privately held water. In states where ownership of water is largely public, i.e., where water is held by either the U.S. Bureau of Reclamation or a state water agency like the California State Water Project, price can be an effective policy tool because the government reserves control over water charges to end users. In a state like Colorado, where most water is owned privately, conservation pricing generally is not an option, while markets and banks are. However, all three institutions represent different approaches to a common problem. Each will be briefly discussed here.



Conservation Pricing

For the most part, conservation pricing is of limited usefulness in Colorado since most water in the state is privately held. However, it is very common in other states and is the simplest economic tool for encouraging water use efficiency. It involves charging a price for water that accurately reflects the cost of the water. The roots of conservation pricing trace back to the 1982 Reclamation Reform Act, and it is now required in the largest federal water project, the Central Valley Project in California (U.S. Bureau of Reclamation, 1997). There are numerous variations on conservation pricing. Some conservation pricing systems rely on charging a single price equal to the cost of providing the last acre-foot of water. Others rely on using a tiered pricing system where the price that an irrigator pays for water increases in steps as water consumption increases (U.S. Bureau of Reclamation, 1998). Another approach is to use drought-contingent prices that are constant during a given growing season, but can change from year to year as water supplies fluctuate (Schuck and Green, forthcoming).

The advantage of conservation pricing is that it is relatively simple to implement, and is highly effective in promoting



water conservation in very small geographic areas where water is being reallocated within a given type of use, such as would be seen in an irrigation district. It can also fully meet its costs. However, while it may reduce water consumption or diversions in a region, it may not make water available for use by other sectors of the economy. As such, it may not be an appropriate policy tool when the policy goal is to shift water from one sector of the economy, i.e. agriculture, to another, i.e., municipal and industrial use. Additionally, conservation pricing can promote adoption of alternative irrigation technologies that increase water consumption and reduce return flows (Wichelns, 1991). This may have adverse downstream flow impacts (Huffaker et al., 1998). Lastly, differences in water rights across and even within states may make it difficult to adopt conservation pricing (Michelsen et al., 1998). As a result, conservation pricing can be an economically efficient means of reallocating water, but it is not necessarily the most efficient alternative (Brill, Hochman, and Zilberman; 1997).

Water Marketing

Another alternative, which has seen extensive use in California, Montana, Idaho, and Washington, is water marketing. In a water market, irrigators with surplus water make their water available for sale to water users who are water-short. The water users who purchase water may be other irrigators, environmental interests, or municipalities. Additionally, they may be seeking water for diversion or for instream flow augmentation. Working in a willing buyer/willing seller format, the two water users then negotiate to a price. By allowing water to move from people who have water to people who need water, a water market can promote water use efficiency. First seen in California during the 1987-1991 drought, water markets have become a prominent fixture across California. While early water markets relied on bulletin boards, more modern water markets use computer dial-up services or internet applications to facilitate trades (Olmstead et al., 1997). What is most unique about a water market is that the price of water is not fixed. Consequently, irrigators can sell their surplus water at whatever price the market will bear. This can be a potentially significant source of additional revenue for irrigators, and can promote adoption of less water-intensive irrigation systems as irrigators try to reduce water diversions and make more water available for sale on the water market. Lastly, water markets can operate in areas where water rights do not allow irrigation districts to use conservation pricing or where out-of-basin water transfers are desirable. As such, it is a policy tool that can be employed virtually anywhere.

Water markets do have their faults. To start, for a water market to work water transfers in a market must be recognized as a beneficial use. Without that recognition,

water users may avoid participation for fear of forfeiting water rights. Additionally, water markets in California tend to promote sales that are "less than arm's length" (Olmstead et al.), so the actual transfers may not promote use efficiency. A water market's efficiency is also strongly dependent upon who is allowed to participate in the market. Water markets in some states may or may not allow sale of water to out-of-basin or non-agricultural interests. This can present a serious impediment to moving water between sectors of the economy. Conversely, water markets in some states – notably Washington – are designed primarily to purchase water solely for environmental purposes (Landry, 1998). As such, it cannot be used to shift water within irrigation districts or between irrigators. Lastly, water markets can be influenced by the initial allocation of water rights. Water markets generally promote sales from older rights holders to junior rights holders, and can lead to a transfer of profits from more efficient producers to less efficient producers. Consequently, while water markets can move water resource to their highest and best use, they may also dissipate the profits that provide incentives for water users to engage in trades. That is a crucial consideration when contemplating water markets.

Water Banking

The last type of institution that is receiving increased use around the West is a water bank. Structurally, water banks are similar to water markets in their operation. However, while water markets allow willing buyers and sellers to negotiate to a price, water banks insert a broker between the two. The broker is the water bank, and is typically a state agency. As a practical matter, this means the broker sets the price received by water sellers and paid by water purchasers. The advantage of a water bank is that it does not rely on finding a willing buyer/willing seller like a water market. As a result, it will be possible for water sellers to make water available on a different timetable than water purchasers demand the water. This difference in timing of water supply and water demand through the water bank is the primary advantage of a water bank relative to a water market. Additionally, since a state agency typically serves as a broker between buyers and sellers, there are reduced opportunities for arbitrage and speculation in a water bank than a water market. This implies greater water price stability for both sellers and buyers. Lastly, depending upon the administrative price set by the broker, a water bank can provide the same incentives for adopting more efficient irrigation practices than a water market will by making irrigators aware of the value of reducing water applications.

The potential pitfalls to a water bank are generally similar to those of water markets. As with water markets, water sold into a bank must be considered a beneficial use. Indeed, in Idaho water banking only became a viable water

conservation tool with the recognition of water banking as a beneficial use in 1979. Impacts on downstream users are also a crucial concern in water banks. By switching the timing and location of water diversions and consumption, water banks can adversely impact downstream users (Green and Hamilton, 2000). Additionally, the overall effectiveness of a water bank in promoting water conservation will depend upon both the administrative price used by the water bank and the rules that govern participation in the bank. If the price is too low, irrigators may choose not to participate in the bank and no conservation will be achieved (Green and Cho, 2000). Similarly, if all users face the same price, variations in soil productivity, crop selection, and water rights will influence participation rates. If these factors come into play, participants in the bank may or may not be those irrigators most capable of conserving water (Ise and Sunding, 1998). The last potential issue with a water bank is its operational cost. While a water market connects willing buyers and sellers, a water bank cannot guarantee that water sellers will find buyers (or vice versa). As such, the agency placed in the broker's role may incur significant costs.

Consequently, water banks typically require strong financial reserves.

Conclusion

There are so many different economic institutions available for promoting water conservation across the West today that familiarity with all of the alternative conservation policies is useful, even those of limited use in Colorado. Conservation pricing, water markets, and water banking all see use, and each method has relative strengths and weaknesses. For any given region, the appropriateness of each tool depends upon both the location's legal institutions and on the conservation goals being met. As a result, a tool that is useful in one location may not be appropriate in another, while a tool that has been unsuccessful in one place may be highly useful in another. The end result is that before adopting any alternative water distribution mechanisms, the compatibility of the proposed institution with the goals and institutions of a particular place must be evaluated.

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 **WORKSTATION-BASED MESOSCALE
PRECIPITATION PREDICTION
TO OPTIMIZE AGRICULTURAL WATER RESOURCES**

*by William R. Cotton
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operations and irrigation scheduling to optimize water resource management for agricultural applications.

Background

RAMS has been used for real-time forecasting at Colorado State University since 1991 (Cotton et. al., 1994). Originally a simple 'dump-bucket' scheme (Cotton et. al., 1995) was used to generate quantitative precipitation forecasts (QPF), but starting in the fall of 1995 real-time forecasts used the bulk microphysics scheme available with RAMS. Gaudet and Cotton (1998) showed that the bulk microphysics improved the forecasting of the areal extent and maximum amount of precipitation, especially when compared to the snow telemetry (SNOTEL) automatic pillow-sensor stations which are found at locations more representative of the model topography. The current prototype realtime forecast version of RAMS at CSU is based on version 4.29. Model output products can be viewed on the web at

<http://rams.atmos.colostate.edu/cases/>

The model is set up on a 21-processor cluster of 450 MHz Pentium PCs. The forecast model configuration has three interactive nested grids. Grid #1 has 48 km grid spacing and covers the entire U.S.; Grid #2 has 12 km grid spacing and covers all of Colorado, most of Wyoming, and portions of adjacent states; and Grid #3 has 3 km grid spacing covering a 150 km x 150 km area that is relocatable anywhere within Grid #2.

Vertical grid spacing on all grids starts with 150-km spacing at the lowest levels and is stretched to 1000m aloft, with a total of 36 vertical levels extending into the stratosphere. The model is initialized with 00UTC ETA model analysis fields and runs for a period of 48 hours, with the lateral boundary region of the coarse grid nudged to the ETA 6-hourly forecast fields. A 48-hour run takes about 4 hours of CPU.

We are currently assessing the value added to the forecasts using the 3 km grid. Preliminary analysis suggests that the model is able to forecast the formation and propagation of individual convective storms, especially those originating

Introduction

This research project is designed to assist in the optimization of water resource management in the agricultural community using high-resolution computer weather forecasts. The project involves the development of new physics and parameterizations to improve high-resolution numerical forecasts using the Regional Atmospheric Modeling System (RAMS) developed at Colorado State University. Forecast parameters of use to agriculture include precipitation, land-surface temperatures, surface winds, and surface evapotranspiration rates. Precipitation not only includes forecasts of precipitation over a 48-hour period, but also the forecast accumulation of wintertime snowpack water content. Improved forecasts of these parameters should aid in daily decisions in farm



in the mountains, and severe downslope windstorm events (see Cotton et al., 1995). The model exhibits a consistent over-prediction bias on precipitation. Although "false alarms" of precipitation events are forecast, they occur relatively rarely.

Recent Model Improvements

We are currently in the process of implementing RAMS Version 4.3 as the forecast model. It includes several improvements that we anticipate will improve model forecasts:

The source of the precipitation over-prediction bias has been traced to a logical inconsistency in the formulation of sedimentation of hydro-meteors that underestimates sub-cloud evaporation of precipitation, particularly on long time steps used in the coarser grids.

Improvements in the LEAF2 (Walko et al., 2000) land-surface model include:

changes in soil conductivity to more recent values,

redefinition of land-use classes, access to improved soil data files, and

improvements in the stomatal conductance model.

These changes have resulted in reduction of the previous lag in after-sunrise forecast surface temperatures and the values of forecast maximum temperatures. They also should show improvements in forecast evapotranspiration rates, although this has not been evaluated yet.

Future Plans

Tracy Depue, a new M.S. student, is developing a parameterization for hail forecasting. She is analyzing the June 20, 2001 Denver/DIA hailstorm that produced extensive hail damage. This case will be used as a test case, since the CHILL multi-parameter radar had excellent coverage of this storm. RAMS is being rerun for this case with cloud-resolving grid spacings to examine the potential for predicting such storms. New algorithms for hail prediction will be developed for use in the coarser grids of RAMS.

We also plan to interface RAMS with a runoff/routing model and then begin testing of the feasibility of producing seasonal forecasts of snowmelt and river runoff for several major Colorado River basins.

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PUBLICATIONS

Dictionary of Water Words, Great Basin Research. June 2001. View portions of this publication at <http://www.gb-research.com>. Cost per copy, including priority postage and handling, is \$50.00 (U.S.) (Nevada residents add appropriate sales tax.) Quantity discounts are available. Order by check or money order through: Great Basin Research, 4245 Primavera Ave., Reno, NV 89502-5373.

Two Decades of Water Law and Policy Reform: A Retrospective and Agenda for the Future. Conference Report, Natural Resources Law Center, University of Colorado School of Law, Boulder, CO. June 13-15, 2001. Phone 303/492-1286, E-mail nrlc@spot.colorado.edu, web site <http://www.colorado.edu/Law/NRLC/>.





EXTENSION IRRIGATION SPECIALIST JIM VALLIANT SEES BRIGHT FUTURE FOR ARKANSAS VALLEY

I can talk about water all day!

Jim Valliant

Editor's Note: Jim Valliant has lived in the Arkansas River Valley for 18 years, serving for 10 years as Regional Extension Irrigation Specialist for the Arkansas River Valley. Jim will retire in April, 2002. Robert Ward, CWRRRI Director (left); and Reagan Waskom, CWRRRI Water Resources Specialist (right); sat down with Jim in January to reflect on his career achievements and ask him how he views the future of the Arkansas River Basin.



Question: How did you come to be the Regional Irrigation Extension Specialist in the Arkansas Valley? In other words, what career path led you to this job?

Jim Valliant: I was born in Pecos, Texas, which gets about 8 inches of rain per year. When we saw water come, we knew how important it was, and at that particular time I knew that I needed to be in a water profession. Water is an area of such importance, but we take it for granted: we turn on a faucet or pump a well and out it comes -- until the faucet and well go dry.

I got into research down in Texas, working first with Texas Tech University and then with the High Plains Research Foundation, and emphasized water. I went to work for the High Plains Research Foundation in Halfway, Texas. While I was in undergraduate school, I had an opportunity to work with artificial groundwater recharge. The Ogallala Aquifer water was being depleted, and if you have ever

flown over the Texas High Plains after a rain, you see thousands of lakes and a very high volume of water. We saw it as an opportunity to put the water back underground to reduce and slow, if not reverse, the decline of the water table. Then, after I had some experience in the field, I realized that I needed additional education, and got a Masters degree.

Then I got into farm management and found that I could use the information I had gained through research and make it really work. When I had an opportunity to get back with a university, to get back into research and Extension, I thought, "How can you turn down something you have wanted to do all your life?"

Question: You are viewed by many of us working in higher education as the quintessential extension specialist. You work very closely with your clients and when you are unable to solve a problem, you bring it to campus and literally force faculty and students to incorporate the problem into their teaching and research. If you had to describe the three characteristics of a successful extension specialist, what would they be?

Jim Valliant: The very first is education. I think one needs education to have the versatility to talk intelligently with a wide range of people. Second thing is to be a people person -- to like people and have an optimistic view. I have not had a turndown in any of my approaches to University personnel, in my approaches to the Administration and,

with farmers, I have had an excellent rapport because I look for their problems. And that is the third ingredient: be a person who is sincerely interested and who wants to leave a contribution. Maybe some things I have done will influence how we better utilize this precious resource called water.

Question: What have been the most enjoyable aspects of the job? What have been the least enjoyable aspects?

Jim Valliant: The most enjoyable aspect is the people I work with. If I go to someone with a problem, I want them to know that I am sincerely interested. The least enjoyable

part of my job is that sometimes funding puts a limitation on what you can do, especially when you want to do more.

Question: What programs, on which you have worked, are you particularly proud?

Jim Valliant: I am particularly proud that I have brought people in the Arkansas Valley together to discuss their water problems. For instance, I started the Arkansas River Basin Water Forum. People sometimes were not talking with each other – fishermen who want low flows, boaters who want high flows, those who fish and boat and want to leave the water in the reservoir, those who want to take it out to irrigate – and getting them together to talk to each

other I consider one of my greatest accomplishments. I am also extremely proud that I have made people more aware of some of the problems -- the loss of water, the misuse of water, how can we better use water – just awareness, which is the first criterion for Extension. Now we have people aware of the problems and we are starting to work on solutions.

Question: What are the major irrigation/water resource problems in the Arkansas Valley today?

Jim Valliant: Salinity is particularly a problem. Another is the way we continue to administer water. I think we must make some changes. We cannot continue to use the philosophy, “Use it or lose it.” I realize there are problems with the compact, but at the same time there are ways to get people to cooperate in such a way that we would not go against the compact but yet maximize the use of water. Whether you are in Kansas, Colorado, New Mexico or Texas, we must stop fighting each other and start working together. We must find a way that is more effective. When I say effective, I do not necessarily mean efficient; we must

maximize the use of water for optimum returns from the land and to the community.

The other day I got a letter from my water association that said our selenium was in excess of the standards set by the Health Department. Gary Banuelos, one of the top people in selenium in the world, told me that one of the following things behind salinity is selenium. Taking the word of an expert, I think if we don’t recognize selenium is a problem it will get worse – and it already has.

Question: How do your efforts to improve the science and technology of irrigation in the valley interface with efforts to improve the structural and institutional arrangements for managing water in the valley (e.g., water banking pilot study)?

Jim Valliant: I am excited about the potential of water banking to help work toward a solution or at least an improvement of our water use. It may start to give us the flexibility that will allow us to realize that some of our laws are not effective. If, for instance, we could move water from low-productive land that is nearly impossible to reclaim and put it on productive land outside our present upper and lower boundaries, then we could maximize the use of that water.

uniformity of irrigation is the advance rate. Using PAM, you can increase the advance rate, reduce runoff, and still get more uniform application of water. Using surge irrigation combined with PAM has reduced tailwater up to 52 percent and has resulted in higher yields with more uniform application of water. This, to me, is the key to efficiency: higher yields, reduced runoff maintaining the productivity of the soil, plus you are getting more money for the amount of water that you apply.

We have seen tremendous growth in the use of PAM throughout the entire State of Colorado and the southwest, not only as erosion control and to increase infiltration, but in different ways – putting it in bags and pellets and pulling it behind center-pivot systems and using it to seal dirt conveyance ditches and in laterals and canals to reduce seepage, which very bluntly is one of the main culprits in salinizing the land. One of the limiting factors in the

I would say SDI, Subsurface Drip Irrigation, also has a place. We are looking at a system that is 95 to 98 percent efficient. As an example, one individual in the Valley reduced his water usage on cantaloupe from 30 inches using furrow irrigation to 9 inches using drip and increased his yield from 400 to 800 boxes per acre. The potential is also there for alfalfa and corn, and Kansas State is doing work on that.



Question: How has the Kansas/Colorado lawsuit over the Arkansas River Compact changed irrigation in the valley?

Jim Valliant: The compact, by restricting pumping, has influenced the groundwater use. The biggest impact has not so much been that we can't pump as much water anymore, but that it has caused us to be afraid to think outside the box. We have ideas and we have technology,

but we are afraid that they might cause another lawsuit. That is where I think it is so terribly important that we work together as citizens of the United States and not just citizens of Colorado, Kansas, or wherever it might be.

Question: How have out-of-basin transfers affected irrigation in the valley? In particular, how have the transfers affected the water users and the economics of agriculture?

Jim Valliant: Fortunately we have had only one trans-basin transfer – Aurora. I used to work for Foxley Cattle Company, but if you recall, their water sales were to Colorado Springs, so that water actually stayed in the basin. If you take that water that has been sold outside the basin and divert that water above its previous point of diversion, it will cause deterioration of the water quality. That is one of the concerns I have. We cannot continue to deteriorate

the quality of the water. Of course, it affects the quantity, too, but my main concern is that it has dried up areas that at one time were productive. For example, in Crowley County there is land that with the new technology we have today – LEPA on center pivot systems, or subsurface drip irrigation – would be highly productive. Anytime you move water out of an area, as the old boy said, "You ain't never gonna bring it back."

Question: You organized the Arkansas Basin Forum and the Arkansas River Technical Group. What do you see as the contributions of these groups?

Jim Valliant: The Forum brings people together to talk. Now, we have people talking who never talked before. We have people working together who never did before. We have organizations that had limitations – for example, the U.S. Geological Survey could go this far, the Natural Resource Conservation Service could go this far, but when you put them together you went a longer distance more effectively. The tech group was a sounding group, and we continued to use it this year with the salinity/selenium

program. This has brought some of the top expertise in the world into our area to help, discuss, and be knowledgeable about our problems and have a willingness to work with us, because they know us as friends and as people who are receptive. For example, Gary Banuelos (USDA-ARS in California) said, "Jim, your people all are talking together. Sometimes we can't even get our people to sit at the same table." I thought that was quite a compliment for our area.

Question: You have served as Regional Irrigation Extension Specialist during a particularly wet period in the history of irrigation in the Arkansas Valley. How well can the valley handle a drought? What are the implications of such preparation to additional water storage and to future of water banking in the valley?

Jim Valliant: I agree it has been a wet period. We have had excessive storage – 200 percent sometimes, and that has been the key to it. We do need additional storage which will allow us to take full advantage of water banking. But I do feel that we have the tools out there to do a better job of irrigation. We still have some of the old timers here who used to sleep in the fields and when the water hit their feet or rump they woke up and changed the water. Now, we may do it electronically with a sensor, but

I think we will have people who are more aware – and already are more aware. We have put in many miles of underground pipe, and more gated pipe goes in every day. We are seeing center-pivot systems spring up and drip irrigation being installed. One of the ideas I have been working with is to conserve the water that we are losing through seepage out of the ditches. I think we have the technology and the temperament to cope with drought.

Question: Does the concept of a water bank, in any form, have a role in the future of irrigation in the Arkansas Valley?

Jim Valliant: I think a water bank could be a very useful tool if it is designed properly. If the bank is operated right and we start thinking outside the box and take full

advantage of what "water banking" could mean, it could be a tremendous asset.



Question: Given your irrigation work and experience in the Arkansas Valley, what institutional, organizational and technological changes do you see happening in the Valley over the next 20 years?

Jim Valliant: I think we are at a point where we are going to make changes. I am an optimist. We have a lot of people thinking, "We'll buy water and put it in a pool, so if a farmer wants to sell his water, great, but we are not going to move it out of the area." If we continue that kind of attitude and can take advantage of the tools that we have – the new technologies, and I am including the water bank with the tweaks that we talked about, I am optimistic that it will be one of the most productive areas in the State of Colorado and the southwest. Now, there are several

reasons I say that. Many areas of the Ogallala are running out of water, or, I might say that their ability to produce crops economically just won't be there. The river is a renewable resource, and if we maximize the use of it through drip or center pivots with drags or whatever it might be, this could make us one of the more productive agricultural areas even though we have limited rainfall. With those thoughts in mind and with new technology yet to come, we might be able to grow different, higher income crops in areas of the valley that we cannot consider now.

Question: What role do you see for the university and higher education in assisting water users and managers in the valley?

Jim Valliant: There are many research opportunities. What are the new crops to grow? What is the new technology? Is there another PAM out there somewhere

that the university can do the research on? That is the beauty of having a university – it can do things that a producer can't do.

Question: The valley water regime has been altered over the years by reservoir construction, out of basin transfers, the change in the flow characteristics of Fountain Creek, changes in water quality, etc. How can institutional policies, laws, and operating procedures be adjusted to meet these new realities?

Jim Valliant: We have to change laws, but we have to change people's attitudes first, and then we can work together. Let's say they want to put in a reverse osmosis plant at Fowler. I ask, "What will you do with the salt?"

"Well, we are going to dump it in the river." They need to be aware that this is not a good idea, even though they may be allowed by law to do so.

Question: Would you elaborate on the idea of using new methods of delivering water to lands above the canals as an approach to maintain ag production in the valley?

Jim Valliant: I like the idea they have of piping domestic water down the valley. That is a good idea. So why can't we move water for irrigation in a pipe? Our forefathers didn't have that choice. They put water in a canal because all they had three mules standing in front of them to scoop that soil out to dig the canal. They didn't have access to the equipment or technology that we have. We have lift pumps that are highly efficient. We have tools now that can help us with leaching and decision support tools that we didn't have just a few years ago. I like almost instant results which could happen with moving water outside the perimeter and then "healing the sore" down in the valley by having a wonderful game reserve. If there were more water in the river and we didn't divert as much, it is a twofold value: We don't have as much seepage, and we have better quality water going down to help the junior user.

because I had to have 50 lbs. of pressure. Now we are talking about 12 lbs. to 20 lbs. And, with drip irrigation, even less than that. The volumes of water that we may need to move will be 90 percent efficient versus 45 percent efficient. Also, we can give the land time to heal. We can plant it to grasses -- we have already seen healing throughout areas in Crowley County – and with substantial increases in wildlife like pheasant, quail, geese, and deer. So, if we take advantage of those bad areas, retire them, take that water and use it efficiently somewhere else, we have done two things: we have saved as much as 50 percent of the water (if I might use that term) that at one time might have been applied to it; and we have helped this individual get rewarded for owning the water and putting that land out of production. In the meantime, we have that land where we can put salt-tolerant grasses, or whatever the crop might be, that will eventually draw the salts out. Diverting water outside "the present valley" may take the water longer to get back to the river but could lower water tables because we are not putting the volume of water on

I bought water out of the river years ago when I was a farm manager. We pumped low-volume wells into a pressure well and took it up to four center-pivots, but that was



the land. We may not affect the river for 30 or 40 years and some may not like that idea, but if you are just

diverting less, that means more stays in the river to improve the quality of the water.

Question: What are the current barriers to making this happen?

Jim Valliant: Basically, the law. We are changing the place of use and/or point of diversion and return flow. And, to do this, we have to go through water court, a very costly process. Also, physically moving the water would be costly but there are always innovative and imaginative people that would do this if it were made legal without a court “fight”. And, if we left the “extra” water in the river, it would be instantly available. I know we are using the aquifer as a storage unit, but we would *still* be using it. We are not talking about taking all the water here and moving it over there – we are talking about taking the *bad*

places out. How long did it used to take you to sample a field for salinity? Now, we can do it at eight miles per hour, getting a reading every two or three seconds from 0-1 and 0-3 feet – and, using GPS, can get a near exact location of each of these readings in the field. So, we have the technology now to designate the “bad and good” lands, but we are not utilizing it because we have laws that say you can’t do practices we know are more effective without changing that law. I am saying that we cannot afford to continue to waste water on unproductive areas.

Question: What will ag look like in the valley in 20 years?

Jim Valliant: I am an optimist. I think we will come together and realize that agriculture is an important industry and we don’t want to depend on food from foreign countries. Someone says, “Now wait a minute – there are only 300,000 acres of irrigation in the Ark Valley and millions of acres pumping from groundwater aquifers.” That is true, however; in 25 years, as we just discussed, they may be out of water in the Ogallala and other similar aquifers and we may be the major producing area. If we don’t make changes we won’t be, but I am optimistic enough to think that all the people involved in water will come together and say, “We have to save this water. We have to work together, because we really have the Garden of Eden right here.” We have an opportunity to increase our yield from 400 to 800 boxes per acre with one-third as much water. I think we will see an attitude change. One of

the questions I asked Frank Milenski before he passed away was, “Frank, is this the same river it used to be?” He said, “No, it is not the same river. That is what I have been trying to tell some of these people -- it is not the same river.” Frank was instrumental in my working with the Catlin Canal to look at ditch seepage. Are there ways we can reduce ditch seepage? WE DID! I am very optimistic.

We had a company come in and buy the Milenski land, and they have some beautiful alfalfa there. And they are looking for better ways to grow it. We could have feedlots and dairies in that area; we already have the services. I could be totally wrong, but I think it will be an area that will be a Garden of Eden. – or I wouldn’t have invested there or plan on spending the rest of my life there.

Question: Any parting thoughts?

Jim Valliant: We have some real opportunities with irrigation, not just in the Arkansas Valley but throughout the State of Colorado and the United States and especially the arid West. Some say we don’t need irrigation in the West, but we do. If you eat what is produced by dryland instead of what is produced by irrigation, you will be eating a lot more wheat, corn, and millet and a lot less of fruits and vegetables. We need to sit down – legislators,

administrators, people in general, wherever they are located –and think about the future and the potential for “the good life” that it offers. The whole thing is keyed on water -- you cannot have “the good life” without water. And, if we have the mentality that we are going to fight instead of work together, we will not have “the good life” anywhere. If we work together, we can have growth and “the good life.”

HEADWATERS NEWS EXPANDS ITS SERVICE

Headwaters News (www.headwatersnews.org) – the Center for the Rocky Mountain West’s online regional news service, has just expanded its web site and now features a weekly news analysis, a guest column by a regional writer on a timely issue, and a moderated forum. It will soon provide readers with a searchable archive of news, columns, and opinion. You are encouraged to participate in the new forum, launched on January 23, which will spotlight a key western topic each week.

CWRRI UNIVERSITY OF COLORADO WATER NEWS

JIM MARTIN NAMED NEW DIRECTOR AT NATURAL RESOURCES LAW CENTER

Following a national search, Jim Martin was named Director of the Natural Resources Law Center at the School of Law at CU-Boulder. He took over duties in early January. Martin replaces Gary Bryner, who stepped down as director last spring to pursue fieldwork for NRLC as a staff member in Utah.

Founded 20 years ago, the Natural Resources Law Center is a research and educational program at the University of Colorado School of Law. The mission of the Center is to promote sustainability in the rapidly changing American West by informing and influencing natural resource laws, policies, and decisions. Through a comprehensive program of research and education, the Center seeks to inform and influence legal and policy decisions on western natural resources.

Martin brings two decades of experience in natural resources fields to this position. Before joining NRLC, he was a senior attorney at Environmental Defense, where he specialized in energy, air quality, water resources allocation and endangered species issues in the Western United States. In addition to managing the organization's energy project in 2001, he worked for Environmental Defense from 1984-1986, during which time he appeared before the Federal Energy Regulatory Commission in a major case involving a hydropower electric plant proposal, participated in administrative and judicial proceedings regarding uranium mill wastes, and helped to develop a multi-state recovery plan for endangered fish species of the upper Colorado River.

From 1986-1992 he served Congressman and then-Senator Tim Wirth as counsel for energy, environment and natural resources, and as the senator's state director. In the mid-1980s, he represented a coalition of Columbia River Indian tribes in efforts to protect their treaty-reserved rights to both anadromous fish and water resources.

Martin holds an undergraduate degree in biology from Knox College, and a Juris Doctorate, Magna Cum Laude, with a certificate in environmental and natural resources law from Northwestern School of Law of Lewis and Clark College.

At a ceremony marking his appointment, Martin said, "My goal as director is a simple one: to build and expand upon the work the Center has done, and to maintain its pride of place among institutions that are working to sustain the West's environment, natural resources, economies and communities."

Kathryn Mutz, a native of Colorado, joined the Center's professional staff in September, 1996. Kathryn's background is in both law and natural resources management. She holds a B.A. in Geography from the University of Chicago and an M.S. in Biology/Ecology from Utah State University. As a biologist, Kathryn specialized in wetlands,



Jim Martin, Director of the Natural Resources Law Center, University of Colorado's School of Law.

endangered species, and reclamation of disturbed lands. More recently, her legal research has focused on government regulation of coal and placer mining and oil and gas development.

Douglas Kenney, also a native of Colorado, joined the Center's professional staff in July, 1996. Doug has a B.A. in Environmental, Population, and Organismic (EPO) Biology from the University of Colorado, an M.S. in Natural Resources Policy and Administration from the University of Michigan's School of Natural Resources and Environment, and a Ph.D. in Renewable Natural Resource Studies from the University of Arizona's School of Renewable Natural Resources in 1993. Doug specializes in the analysis of institutional arrangements for the governance, administration, and field-level management and use of natural resources.



NATURAL RESOURCES LAW CENTER

*Allocating and Managing Water for a Sustainable Future:
Lessons from Around the World*
23rd Summer Conference, June 11-14, 2002
Fleming Law Building, Boulder, Colorado

Purpose: The purpose of the conference is to examine innovative water allocation laws, policies and institutions from around the world that provide lessons for sustainable water management. In keeping with the Center's focus on natural resources issues of the Western United States, the conference will focus its attention on problems applicable to the American West. Sessions will focus on innovative legal and institutional developments and lessons that can be transferred across different regions, countries, cultures, economies, and water systems. The lessons will provide examples from a variety of geographic scales, ranging from international rivers to irrigation systems and watershed management. International speakers and case studies will be drawn from world regions that share the American West's challenges of managing uncertain and variable water supplies.

Theme: The theme of the conference is adapting for sustainability -- how the design of Western water law and policy and the management of water resources can be ecologically and economically sustainable. By sustainable water management, we mean the extent to which policy makers and managers are able to:

Accommodate demands for human use and consumption with environmental values such as preserving biodiversity,
Integrate cultural and environmental values,
Adapt successfully to uncertainties such as climate change,
Revise laws and policies to allow for human needs while preserving natural systems, and
Develop new institutions of governance that successfully solve problems.

See the Natural Resources Law Center Web Site
<http://www.colorado.edu/Law/NRLC/2002Conference.html>

NATURAL RESOURCES LAW CENTER

HOT TOPICS

March 5 **Colorado Water Trust**
May 20 **Non-Federal Hydropower Re-licensing**

All "Hot Topics" are offered from noon-1:30 at Holland & Hart Law Offices, 555 – 17th St. Ste. 2900, Denver, Colorado. Main Phone No.: 303/295-8000. Each earns one CLE credit.



Environmental, Population, and Organismic Biology Colloquium Series *Spring 2002 Colloquium Schedule*

Note: All sessions meet in the conference room of building IBS # 3 (second building north on Broadway from Starbucks' Coffee) on Mondays, from 12:00 to 1:30.

Feb. 25: Professor **Russ McGoodwin** of Anthropology will discuss "Icelandic Fishing Peoples' Adaptive Responses to Climatic and Environmental Variability: Implications for Fisheries Management and Future Fisheries Policies."

March 11: Professor **Lori Hunter** of Sociology and Research Assistant **Jeannette Sutton** will discuss results from their USDA sponsored project "Migration and Hazardous Waste in Rural America."

April 1: Ms. **Rebecca Huntington**, Scripps Fellow in the CU Center for Environmental Journalism and public lands reporter for the Jackson Hole Guide will discuss "... articles on the artificial feeding of elk and bison on the National Elk Refuge adjacent to Jackson, Wyoming."

April 15: Professor Emeritus of EPO Biology **David (Wilson) Crumpacker** will report on a CU/CSU/UNC project sponsored by the National Geographic Society which involves the development of a middle and high school curriculum on "Conservation and Biodiversity in the Eight-County Denver Metro Area."

*April 30: Professor **Paul Mohai** of the University of Michigan's School of Natural Resources will speak on "Spatial and Temporal Analyses Applied to Understanding Racial Socioeconomic Disparities in the Location of Environmental Hazards." *Note that this session, which is joint with Sociology, meets on Tuesday, 12:30-2:00. Site will be announced later.

See the EPOB Web Site at: <http://www.colorado.edu/epob/events/colloq.html>

For listings of seminars scheduled at the University of Colorado, consult the following web sites.

CU SEMINARS

http://instaar.colorado.edu/other/seminar_mon.html — Institute for Arctic & Alpine Research. INSTAAR Noon Seminars are held 12-1 PM Mondays, RL-3, 6th Floor Auditorium, Room 620. For directions to RL-3, see INSTAAR Map pages. These seminars are open to the public. All are welcome!

<http://paos.colorado.edu/seminars.html> — Program in Atmospheric & Oceanic Sciences. PAOS series seminars are on Wednesdays at 4:00 p.m. in the Duane Physics Building, 11th Floor, Gamow Tower Lounge. There is a short reception prior to the seminar, starting at 4:00 pm.. Food and beverages are provided.

<http://bechtel.colorado.edu/web/grad/environ/seminars.htm> — Dept. of Civil, Environmental and Architectural Engineering, Environmental Engineering Seminar Series. Seminars are held Wednesdays, 11 am to 12 pm, Engineering Center CE 1B41. Administered by Prof. JoAnn Silverstein.

<http://www.colorado.edu/che/homepage/patten/seminar.html> — Department of Chemical Engineering James and Catherine Patten Seminar Series meets Thursdays and some Tuesdays at 2:00 pm in ECCR 150 in the Engineering Center.



Colorado School of Mines Water News

International Ground-Water Modeling Center
Colorado School of Mines, Golden, Colorado, 80401-1887, USA
Telephone: (303) 273-3103 / Fax: (303) 384-2037
Email: igwmc@mines.edu / URL: <http://www.mines.edu/igwmc/>



International Ground-Water Modeling Center 2002 Short Course Schedule

POLISHING YOUR GROUND-WATER MODELING SKILLS
May 7 -10, 2002 -- Instructors : Dr. Peter Andersen and Dr. Robert Greenwald

This course is designed to provide significant detail on practical ground-water flow modeling concepts and techniques. It will explore development of conceptual models for complex sites or regions, how to convert these conceptual models to appropriate ground-water flow models, and how to apply supplemental MODFLOW modules to effectively solve such problems. This course takes the user



beyond topics covered in introductory modeling courses and beyond courses that teach the mechanics of applying various pre- and post-processing software.

APPLIED ENVIRONMENTAL STATISTICS

In California – June 10 -14, 2002

In Colorado – August 12 -16, 2002

Instructors : Dr. Dennis Helsel and Dr. Ed Gilroy

This five day course develops hands on expertise for all environmental scientists who interpret data and present their findings to others. The course emphasizes: when each statistical method is appropriate; plotting and presenting data; assumptions and implications behind statistical tests; how to build a good regression model, and trend analysis with common pitfalls. Our Goal: for you to make sense of your data.

PRACTICAL SIMULATION OF VARIABLE-DENSITY FLOW, SOLUTE TRANSPORT, AND SEAWATER INTRUSION

October 21 - 25, 2002 -- Instructors : Dr. Clifford I. Voss and Dr. Craig T. Simmons

The aim of this course is to familiarize attendees with: 1) the basics of solute transport processes for both constant and variable-density flow, 2) numerical aspects of simulating constant and variable-density flow with solute transport, 3) setting up, running, post-processing and evaluating flow and transport models, and 4) practical aspects of transport modeling and case studies. Attendees will learn to run a variable-density flow and solute transport simulator (U.S. Geological Survey's SUTRA code) using a graphical interface.

MODFLOW: INTRODUCTION TO NUMERICAL MODELING

October 23 - 26, 2002 -- Instructor : Eileen Poeter

This course is designed for the hydrogeologist and environmental engineer familiar with ground-water flow concepts, but who have limited or no experience with ground-water flow modeling. Basic modeling concepts: conceptual model development, definition of boundary and initial conditions, parameter specification, finite-differencing, gridding, time stepping, and solution control using MODFLOW-2000 and UCODE. Basic modules of MODFLOW are explained and concepts are reinforced with hands-on exercises. Calibration is presented via the public domain universal inversion code, UCODE.

UCODE: UNIVERSAL INVERSION CODE FOR AUTOMATED CALIBRATION

October 25 - 26, 2002 -- Instructor : Eileen Poeter

If you have a working knowledge of ground-water flow modeling and some knowledge of basic statistics, you will benefit the most from this short course. This course introduces ground-water professionals to inverse modeling concepts and their use via UCODE, relying heavily on hands-on exercises for automatic calibration of ground-water models to promote understanding of UCODE and avoid "black-boxing."

FOR INFORMATION CALL (303) 273-3103

FOR REGISTRATION CALL (303) 273-3321

VISIT <http://www.mines.edu/research/igwmc/short-course/>

UPCOMING CONFERENCE

The International Conference ModelCARE 2002

4th International Conference on CALIBRATION AND RELIABILITY IN GROUNDWATER MODELING:

A few steps closer to reality

Prague, Czech Republic, 17-20 June 2002

June 17-20, 2002

See the IGWC web site at the address above



**2002 Darcy Distinguished Lecture
Wednesday, March 6, 2002
Colorado School of Mines, Golden Colorado
Berthoud Hall, Room 108**

Refreshments at 4PM, Lecture begins at 4:30

Dr. David Hyndman

**Efficient Large-Scale Bioremediation in a Heterogeneous Aquifer:
The Schoolcraft Bioaugmentation Experiment**

Dr. Hyndman's presentation will examine how ground water flow and contaminant transport models can be used to design bioremediation systems and evaluate the influence of heterogeneities. The Schoolcraft bioremediation system, a collaboration between hydrogeologists, microbiologists, and environmental engineers, has achieved more than 95 percent efficiency over a period of three years.

Hyndman received his B.S. in hydrology from the University of Arizona, and his M.S. and Ph.D. degrees in hydrogeology from Stanford University. He has worked for the Water Resources Division, USGS, and Oak Ridge National Laboratory, and he serves as an associate editor for both the journals Ground Water and Water Resources Research. His research focuses on:

- ◆ Aquifer characterization methods using three-dimensional seismic, radar, and tracer data.
- ◆ Modeling the impacts of land use on water quality.
- ◆ Imaging contaminant plumes using ground penetrating radar.
- ◆ The influence of seasonal recharge pulses on REDOX zonation.
- ◆ The design of bioremediation systems.
- ◆ Modeling microbial transport and contaminant biodegradation.

The lecture series, sponsored by the National Ground Water Educational Foundation through a grant from NGWA, is named in honor of Henry Darcy's 1856 discovery of the basic law governing ground water flow. He was designing sand filtration systems for the water supply of Dijon, France and conducted experiments to determine how large and thick the sand beds would need to be in order to process the necessary volume of water. He found that flow rate could be calculated from the gradient, area, and sand properties and published this as an appendix to his report. The results of his experiment are basis of the empirical law that bears his name. The lecture series was established in 1986. No fees are charged. More information on the series can be found on the NGWA Web site,

<http://www.ngwa.org/ngwef/darcy.html>, or contact:

Eileen Poeter, Director IGWMC: International Ground-Water Modeling Center
Dept. Geology and Geological Engineering, COLORADO SCHOOL OF MINES
1500 Illinois St., Golden, CO 80401
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CSU SEMINARS

COLORADO STATE UNIVERSITY	
Department	Web Site
Agricultural & Resource Economics	http://dare.agsci.colostate.edu/ (Seminars not listed on Web Site. See below.)
Atmospheric Science	http://www.atmos.colostate.edu/dept/seminar/S02seminar.htm
Bioag. Sciences & Pest Mgmt.	http://www.colostate.edu/Depts/bspm/Seminars/seminar_schedule.shtml
Biology	http://www.biology.colostate.edu/seminars.htm
Chemical Engineering	http://www.engr.colostate.edu/cheme/seminars/Spring_2002.html
Chemistry	http://www.chm.colostate.edu/
Graduate Degree Program in Ecology	http://www.colostate.edu/Depts/GDPE/weekly.seminars.htm
Earth Resources	http://www.cnr.colostate.edu/ER/seminars/index.html
Environmental Health	http://www.cvmb.colostate.edu/cvmb/thiswk.html
Fishery & Wildlife Biology	http://www.cnr.colostate.edu/FWB/FW692signup.pdf
History	http://www.colostate.edu/Depts/Hist/events.html
Horticulture & Landscape Arch.	http://lamar.colostate.edu/~jcroissa/seminar.html
Natural Resources Ecology Lab	http://www.nrel.colostate.edu/news/calendar.html
Soil & Crop Sciences	http://www.colostate.edu/Depts/SoilCrop/spring%20seminar2002.htm
Statistics	http://www.stat.colostate.edu/~tlec/Sem02Spr/

Listed below are some seminar highlights. If any of these programs arouse your interest, see the web site listed above for more information.

The Lunch Seminar Series for Spring 2002, for the Department of Agricultural and Resource Economics and Department of Economics and the U.S. Forest Service Rocky Mountain Research Station is held 12:10-1:00 p.m., Room 110 Animal Sciences. NEW THIS YEAR: Pizza and Soda served!

Feb. 25	Laura Nahuelhual, Maria Louriero and John Loomis; Dept. of Agric. & Resource Economics, CSU	Modeling WTP and WTA with a Mixture Model: Application to a Prescribed Burning Program
Mar. 18	Harvey Cutler, Steve Davies and Mike Miller; Dept. of Agric. & Resource Economics, CSU	CGE Results for Changes in Taxes, Employment & Tourism in Larimer and Weld Counties
Mar. 25	Robert Berrens, University of New Mexico	Information and Effort in Contingent Valuation Surveys: Application to Global Climate Change Using National Internet Samples
Apr. 1	Marie Livingston, University of Northern Colorado	Institutional Innovations in Groundwater Policy: An International Comparison
Apr. 8	Dave Mushinski, Dept. of Agric. & Resource Economics, CSU	Importance of Social Capital for Access to Financial Capital on the Pine Ridge Reservation
Apr. 15	Bill Breffle, Stratus Consulting	Natural Resource Restoration Scaling Based on Total Value Equivalency: Green Bay Natural Resource Damage Assessment
Apr. 22	Hal Cochrane, Dept. of Economics, CSU	Economic Myths of Natural Hazard Management
Apr. 29	Jeff Lazo, Stratus Consulting	Combining Stated Preference and Revealed Preference: An Application in the Valuation of Weather Forecasts

Atmospheric Science Seminars are located at the Department of Atmospheric Science, Foothills Campus, W. Laporte Ave., Room 101 at 3:30 pm unless otherwise specified.

Feb. 28	Prof. Ted Shepherd, Univ. of Toronto, Dept. of Physics	What Have We Learned From the Canadian Middle Atmosphere Modeling Project?
April 4	Dr. David P. Edwards, Atmospheric Chemistry Division, NCAR, Boulder, CO.	The Terra/MOPITT Mission: Technique, Validation and Early Results
April 25	Dr. Debra Krumm	CloudSat Update and Outreach Efforts

Fishery and Wildlife Biology -- <http://www.cnr.colostate.edu/FWB/FW692signup.pdf> -- Graduate Faculty Seminar (FW692v) meets Friday afternoons in the Wagar building (the exact time and location varies by semester). The seminar is open to all -- private enterprise and NGO colleagues are especially encouraged to attend.

Feb. 22	Kurt Fausch, Fishery/WL Biology, CSU	Landscapes to Riverscapes: Bridging the Gap Between Research and Conservation of Stream Fishes
April 22	Blair Prusha, Fishery/WL Biology, CSU	Sources and Effects of Dissolved Organic Carbon in the Metal-Impacted Upper Arkansas River Basin
April 26	Douglas Peterson, Fishery/WL Biology, CSU	Brook Trout Invasions of Cutthroat Trout Streams -- Population-Level Effects and Processes

Soil & Crop Sciences -- <http://www.colostate.edu/Depts/SoilCrop/spring%20seminar2002.htm> -- Seminars are held Thursdays from 12:10-1:00 in Room 200, Animal Science Bldg., Colorado State University.

March 21	Yaling Qian Horticulture Dept., CSU	Salinity and Turfgrass Management
May 2	Joel Schneekloth Extension Regional Water Mgt. Specialist	Water Management in Northeastern Colorado

CSU SHORT COURSES

Design of Water Quality Monitoring Networks -- http://www.engr.colostate.edu/ce/outreach/courses/shortcr31.html	June 3- 7, 2002
Environmental Statistics Short Course Contact Jim Loftis, E-mail Loftis@engr.colostate.edu	June 10-12, 2002
Hazardous Materials / Waste Manager Training Course -- http://www.engr.colostate.edu/ce/outreach/courses/hazmat.shtml	June 11-13, 2002
Activated Sludge Process Control http://www.engr.colostate.edu/ce/outreach/courses/shortcrs1.html	July 29-August 2, 2002

DEMAND MOUNTS FOR WATER SEMINARS

The safety of America's drinking water has become a high national priority since September 11. The U.S. Congress is finalizing amendments to the Clean Drinking Water Act that mandate water providers to develop plans to secure water treatment and storage facilities by the end of 2003. In Fort Collins, Stewart Environmental Consultants, Inc. has teamed up with Carroll Security Services to provide information for safeguarding water supplies and the infrastructure that holds and delivers them. Many things can be done that don't cost much money, they say, including greater screening of job applicants, signing in and out of facilities, using master keys that cannot be easily duplicated, and making law enforcement and neighbors more aware of any unusual activity around the facilities.

Business Report Daily, Northern Colorado's daily dose of breaking news

<http://www.businessreportdaily.com/archive.cfm?id=3910>

1/11/02

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 November 22, 2001 – January 29, 2002

Title	PI	Dept	Sponsor
Willamette River Bacteria Assessment	Loftis, Jim C.	Civil Engr.	City of Portland
The Effect of Chemical & Biological Control of Tubifex on the Incidence of Whirling Disease in Colorado...	Bergersen, Eric P.	Coop Fish & Wildlife Research	Montana State Univ.
Roan Creek Seeps & Springs Survey	Culver, Denise R.	FWLB	BLM
Mesa County Seeps & Springs Survey - Phase 2	Culver, Denise R.	FWLB	BLM
Comparison of Cloud Resolving Model Simulations to Remote Sensing Data	Randall, David A.	Atmospheric Science	NASA
Salinity Studies	Gates, Timothy K.	Civil Engr.	Bent Soil Conservation Bd.
Regional Forest - ABL Coupling: Influence on CO ₂ & Climate	Denning, A. Scott	Atmos. Science	PA State Univ.
Statistical Research for Weather Prediction & Climate Change	Lee, Chun Man	Statistics	UCAR
Snowmelt Runoff & Soil Moisture Recharge at the Fraser Experimental Forest	Laituri, Melinda J.	Earth Resources	USDA-USFS-RMRS
Bedload Transport in Gravel-bed Rivers & Channel Change	Abt, Steven R.	Civil Engr.	USDA-USFS-RMRS
Development of an Advanced Multi-Frequency Radar for Atmospheric Research	Rutledge, Steven A.	Atmos. Science	UMASS
Upper Arkansas River Rare Plants & Pollinators	Spackman, Susan	FWLB	Nat'l Fish & WL Fdn.
Collaborative Objectives-based Planning on the Grand Mesa, Uncompahgre & Gunnison (GMUG) National Forest	Cheng, Antony S.	Forest Sciences	RMRS
Developing a Decision Support System for the South Platte Basin	Ward, Robert C.	CWRRI	Various Non-Profit Sponsors

FEDERAL SPONSORS: BLM-Bureau of Land Management, COE-Corps of Engineers, DOA-Dept. of the Army, DOD-Dept. of Defense, DOE-Dept. of Energy, DON-Dept. of the Navy, DOT-Dept. 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-Dept. of Agriculture, Agricultural Research Service, USDA/NRS-Dept. 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 Dept. of Natural Resources, CDPHE-Colorado Dept. 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., CSMTE-Center For Science, Mathematics & Technical Education, 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, SCS-Soil & Crop Sciences. University of Colorado: ACAR-Aero-Colorado Center for Astrodynamical 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.

COLORADO STATE UNIVERSITY, FORT COLLINS, CO 80523
Awards for period November 22, 2001 – January 29, 2002
 (cont'd)

Title	PI	Dept	Sponsor
Long-Term Ecological Research - Luquillo Experimental Forest	Covich, Alan P.	FWLB	Univ. of Puerto Rico
Rocky Mountain Regional Hazardous Substance Research Center	Shackelford, Charles D.	Civil Engr.	EPA
Fate and Transport of Metals and Sediment in Surface Water	Julien, Pierre Y.	Civil Engr.	EPA
Remediation of Mine Drainage in a Microbially Active Permeable Barrier Reactor	Reardon, Kenneth F.	Civil Engr.	EPA
Applying Design-Based Model Assisted Survey Methodology to Aquatic Resources	Breidt, F. Jay	Statistics	OR State Univ.
Landscape-scale Fire Patterns in the Ponderosa Pine/Upland Shrub System	Savidge, Julie	FWLB	USGS
Application of Remotely Sensed Imagery to Assessing the Probabilities & Carbon Consequences of Fire	Burke, Ingrid C.	Forest Sciences	NASA
Spatial Integration of Regional Carbon Balance in Amazonia	Denning, A. Scott	Atmos. Science	NASA
Eutrophication of Reservoirs on the Colorado Front Range	Loftis, Jim C.	Civil Engr.	Various Sponsors
Analysis of Current Vegetation & Revegetation Plan for the Uncompahgre River	Lyon, Margarette J.	FWLB	Ridgway Town Council
Evaluating Recovery of Stream Ecosystems from Mining Pollution: Integrating Population, Community & Ecosystem	Shackelford, Charles D.	Civil Engr.	EPA
Toward Understanding Lifecycle of Tropical Cirrus	Stephens, Graeme	Atmos. Science	NASA
Cumulonimbus/Cirrus Interactions in the Subtropics	Cotton, William R.	Atmos. Science	NASA
Testing a High-Sensitivity ATR-FTIR Water Monitor for Ionic CWA Breakdown Products	Strauss, Steven H.	Chemistry	DOD-Army
Validation & Enhancement of AMSR-E Cloud & Precipitation Products	Stephens, Graeme	Atmos. Science	NASA
Development of Real Time Water Resources Management System	Fontane, Darrell.	Civil Engr.	Korea Water Res. Corp.
Tropical Rainfall Measuring Mission Sounding Studies	Johnson, Richard	Atmos. Science	NASA
Shipboard Radar Observations of Precipitating Convection in EPIC 2001	Rutledge, Steven A.	Atmos. Science	NSF
Global & Regional Carbon Flux Estimation Using Atmospheric CO ₂ Measurements from Spaceborne & Airborne Platforms	Denning, A. Scott	Atmos. Science	NASA
Structure & Function of Northern Ecosystems & Their Response to Global Change	Binkley, Daniel E.	Forest Sciences	USGS
CloudSat	Stephens, Graeme	Atmos. Science	NASA
The Effects of Climate Regime on TRMM Retrievals	Berg, Wesley K.	Atmos. Science	NASA

UNIVERSITY OF COLORADO, BOULDER, COLORADO 80309
Awards for October-December, 2001

Title	PI	Dept	Sponsor
Predicting Sediment Delivery and Stratigraphy on Marginal Slopes and Shelf Basins	Syvitski, James	IAAR	DOD-Navy
Quantification of Humic Electron Transfer Reactions in Natural and Contaminated Marine Sediments	McKnight, Diane	IAAR	DOD-Navy

Title	PI	Dept	Sponsor
Watershed and River System Management Program -- Decision Support for Truckee-Carson	Zagona, Edith	CADSWES	USGS
Advanced Glaciological Applications of Remote Sensing with EO-1	Scambos, Theodore	CIRES	NASA
Evaluation of Snow Simulations in the 2nd Phase of the Atmospheric Model Intercomparison Project (AMIP-II)	Barry, Roger	CIRES	NSF
Controls on the Structure, Functions and Interactions of Alpine and Subalpine Ecosystems of the Colorado Front Range	Bourgeron, Patrick	IAAR	NSF
Policy Alternatives for the Lower Colorado River: Ecosystem Restoration and Endangered Species Conservation	Magee, Timothy	CEAE	Environmental Defense
Regional Atmosphere/Forest Exchange and Concentration of Carbon Dioxide	Bakwin, Peter	CIRES	Indiana Univ.
Science Explorers: Water -- From Snow Caps to Water Taps	Hagan, Jeanne	Education	Nat'l. Geographic
Forest/Atmosphere Carbon Fluxes in a Colorado Subalpine Ecosystem	Monson, Russell	EPOB	Tulane Univ.
Profiling CO ₂ and Water Vapor Through the Atmospheric Boundary Layer and Lower Troposphere in Support of the Ameriflux	Birks, John	CIRES	Univ. of Nebraska
Modeling the Effect of Climatic and Human Impacts on Margin Sedimentation	Syvitski, James	IAAR	DOD-Navy
River Ware Model System Improvement UC -RIVERMORE Water Quality	Zagona, Edith	CADSWES	USBR
Validation of AMSR-E Polar Ocean Products Using a Combination of Observation and Modeling	Maslanik, James	CIRES	NASA
A Cedar Modeling Study of Global Change in the Mesosphere and Lower Thermosphere	Akmaev, Rashid	CIRES	NSF
Community Sedimentary Model Science Plan for Sedimentology and Stratigraphy	Syvitski, James	IAAR	NSF
Scaling and Allometry in River Networks – Coupling Rainfall, Topography and Vegetation with Hydrologic Extremes	Gupta, V.K.	CIRES	NSF
An Integrated Assessment of the Impacts of Climate Variability on the Alaskan North Slope Coastal Region	Syvitski, James	IAAR	NSF
Water Resources Issues Within the Integrated Assessment of the Human Dimensions of Global Change	Strzepek, Kenneth	CEAE	Carnegie Mellon Univ.
Merging Infrared Sea Surface Temperature with Satellite Altimetry to Map Ocean Currents in Two Coastal Domains	Emery, William	ACAR	Jet Propulsion Lab
Characterization of Stream Ecosystem in Snake River Basin for the Snake River Task Force	McKnight, Diane	IAAR	Keystone Center
New Approaches to the Understanding of Sediment Budget Components in Alpine Environments	Caine, T. Nelson	IAAR	Max Kade Fdn.
Study of Operational Alternatives for Flaming Gorge Dam	Zagona, Edith	CADSWES	Nature Conservancy
Hydrology, Hydrochemical Modeling and Remote Sensing of Seasonal Snow-Covered Areas	Williams, Mark	IAAR	Univ. of California
Long-term Observations: A Hydrological Observing System for the Pan-Arctic Landmass	Serreze, Mark	CIRES	NSF
Impact of Water Quality Parameters on Absorbent Treatment Technologies for Arsenic Removal	Amy, Gary	CEAE	AWWARF

DRIP IRRIGATION (trickle): An irrigation method in which water is delivered to or near each plant in small-diameter plastic tubing. The water is then discharged at a rate less than the soil infiltration capacity through pores, perforations, or small emitters on the tubing. The tubing may be laid on the soil surface, be shallowly buried, or be supported above the surface (as on grape trellises). <http://www.usbr.gov/edams/glossary.html>

MEETING BRIEFS

COLORADO WATER CONGRESS ANNUAL CONVENTION

Excellent attendance at the 2002 Annual Convention of the Colorado Water Congress resulted in lively discussions around a number of current water issues in Colorado, including:

- (1) Ramifications of the Empire Lodge case on the status of temporary water supply plans;
- (2) Ramifications of the 'in-channel diversions', e.g., for kayaking courses, on the ability of future water managers to execute water exchanges;
- (3) Challenges facing the Colorado Water Conservation Board; and,
- (4) Creation of a new water education initiative.

CSU Vice President for Research and Information Technology, Tony Frank, in a General Session presentation on the morning of January 25, described the strong partnership Colorado State University has developed with Colorado's water community. In particular, he cited the excellent support CSU students receive from Colorado's water users and managers in the form of summer jobs, scholarships, mentors for senior capstone experiences, and guest speakers/lectures on campus. He specifically mentioned the group of Civil Engineering seniors currently performing their senior design project with John Fetcher and the Upper Yampa Water Conservancy District Board of Directors. The students are examining the feasibility of diverting unappropriated water from Morrison Creek into Stagecoach Reservoir. Tony also thanked the water users and managers for their support of university-based research, including funding and access to sampling sites.

Evan Vlachos, CSU professor, discussed his water work in the international arena and shared observations about changes he sees taking place. Under the general theme of Integrated Water Resources Management, he noted the efforts to be more inclusive in water resources planning as well as more holistic from a disciplinary perspective. With his traditional humor, he described some of the problems created by trying to expand water planning to include more people, and disciplines, and objectives.

The CWC Convention, as always, provided university faculty and students an excellent opportunity to gain insight into current, complex water issues – issues that are demanding better data, science and institutional arrangements. The collage of pictures with this article documents some of the exchanges of water information between university faculty and Colorado water managers and users.



From left: Dr. Tony Frank, Vice President for Research and Information Technology, CSU, with John Fetcher, Upper Yampa Water Conservancy District, and W.D. Farr of Greeley.

Pictures, page 28, from top right clockwise:

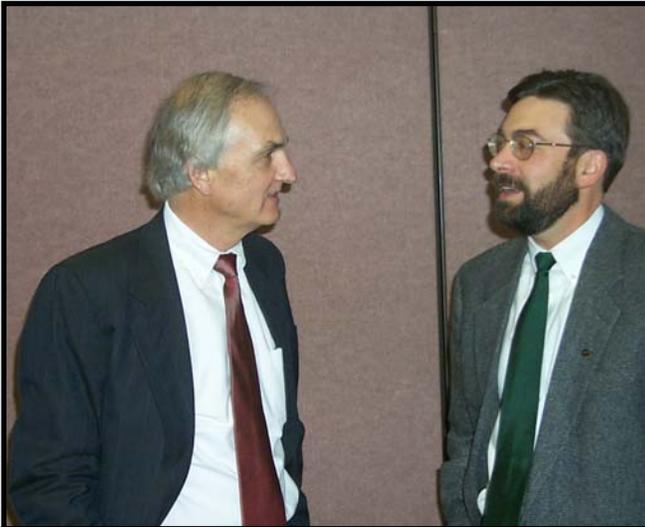
George Sibley, new coordinator of the Colorado Water Workshop (left) with Loretta Lohman, Extension Water Quality Specialist, and Chris Treese, Colorado River Water Conservation District.

Brian Hyde, Flood Control Section, Colorado Water Conservation Board (left) and John Wiener, CU faculty member, Institute of Behavioral Science.

Rita Crumpton, Ute Water Conservancy District (left), Lori Ozzello, Northern Colorado Water Conservancy District, and Reagan Waskom, CWRRRI Water Resources Specialist.

Rod Kuharich (left), George Sibley, and Dick MacRavey, Executive Director, Colorado Water Congress.

Peter Nichols, Executive Director, Water Trust, and CWCB Board member (left), with Tony Frank.



NEW FACULTY PROFILES

by Marian Flanagan



Right -- Assistant Professor Marlis R. Douglas; Above left -- Senior Research Scientist Michael E. Douglas; new members of CSU's Fishery and Wildlife Biology Department.

Colorado State University has recently added some diversity to the Fishery and Wildlife Department with a new team. Assistant Professor Marlis R. Douglas and Senior Research Scientist Michael E. Douglas arrived during the fall semester of 2001, and now direct the Conservation Genetics Laboratory in the department.

Born in Zurich, Switzerland, Marlis Douglas received her formal education in Europe at the University of Zurich, where she earned her B.S. (Biology), M.S. (Zoology), and Ph.D. (Biology). Her thesis concentrated on reproductive strategies of the commercially important European Perch, while her dissertation employed molecular genetic techniques to provide an evolutionary perspective on management of Whitefish in the Central Alpine region of Europe. After several years of post-doctoral work at Arizona State and Texas A&M universities, she accepted a position as Assistant Professor in biodiversity and conservation genetics at CSU.

Michael E. Douglas was born in Louisville, Kentucky, and received his B.S. and M.S. at the University of Louisville and his Ph.D. from the University of Georgia. After post-doctoral studies at Princeton, the University of Oklahoma and Rutgers University, he spent four years as a faculty member at Oklahoma State University, then 14 years as Curator of Collections at Arizona State University. He met

Marlis at a scientific conference in Italy. They were subsequently involved in numerous research projects within the Grand Canyon, and eventually married on its south rim.

The Conservation Genetics Lab, located in the newly renovated lower level of the Wagar building, is adjacent to the Larval Fish Laboratory. Both units work closely together. Yet, while Marlis and Michael primarily focus on projects involving fishes, they also study non-traditional wildlife species, such as rattlesnakes, amphibians, and songbirds. By quantifying molecular variation within these broadly distributed taxa, they often detect levels of biodiversity unrecognizable at the morphological level. They are also actively involved in applying molecular genetic tools to conserve and manage threatened or endangered species.

For example, one aspect of their research is the derivation of large-scale genetic patterns to determine population dynamics and interrelationships of endemic fishes in the entire Colorado River Basin. They can uncover patterns of disruption and migration over the past ten or twenty thousand years by coalescing levels of genetic variability from the present into the distant past. This approach often provides a broader management perspective than traditional capture-recapture techniques because it utilizes events of the distant past to guide management of future populations.

In this regard, Marlis and Michael work closely with the Colorado Division of Wildlife to acquire molecular data that can be used to conserve and manage state-threatened species.

Michael explained, "The molecular techniques we now use are spin-offs from the human genome project. They have trickled down as powerful tools in applied fields such as fisheries and wildlife management. For instance, we now use an automated sequencer in the conservation genetics lab to actually determine the base composition of extracted and amplified DNA. We then test rapidly evolving regions of the nuclear or mitochondrial genome in an effort to identify specific lineages of organisms. One of the goals of our research is to determine relationships among individuals and populations, and to use these data in adaptively managing the ecosystems within which the organisms reside."

In summary, Marlis explained, "What we are trying to do is to build a program or component that will help strengthen the Fisheries and Wildlife Department. In this sense, the addition of a molecular ecology and conservation genetics component will provide students with a cutting-edge curriculum that will advance their capabilities and spark their imagination. In addition, many research managers will have to deal with conservation genetics issues in the very near future, if not already. We were brought to CSU to establish such a research program, to spark undergraduate interest in molecular ecology, and to train graduate students in molecular conservation. We look at ecology and management from a large-scale perspective, and ask, 'How did circumstances come to be the way they are? What are the processes that underlie the patterns we now see?' We feel the use of this approach will help diversify our degree program and make it stronger."



WATER SUPPLY

Low SWSI values throughout the state are influenced by low January 1, 2002 snowpack figures. The Natural Resources Conservation Service (NRCS) reports a statewide average snowpack of 65 percent of normal. The Rio Grande basin has the lowest snowpack at 48 percent of normal, while the Gunnison River basin has the highest at 77 percent of normal. Reports from the Division Engineers' offices are that conditions were dry during December with little precipitation occurring during the month to boost the low snowpack that existed at the start of December. Reservoir storage and stream flows are also below normal across the state. Early NRCS stream flow forecasts for the irrigation season are for below normal flows.

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 snowpack, reservoir storage, and precipitation for the winter period (November through April). During the winter period, snowpack 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 January 1, 2002, and reflect the conditions during the month of December 2001.

Basin	1/1/02 SWSI Value	Change from the Previous Month	Change from the Previous Year
South Platte	-1.6	+0.8	-0.8
Arkansas	-1.8	+0.2	-0.8
Rio Grande	-2.1	+0.7	-3.1
Gunnison	+0.6	+1.8	+1.9
Colorado	-1.3	+0.5	-0.8
Yampa/White	-1.8	-0-	-2.3
San Juan/Dolores	-1.6	-0.5	-1.0

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



**RESEARCH EXPERIENCES FOR UNDERGRADUATES
PROGRAM IN WATER RESEARCH
AT
COLORADO STATE UNIVERSITY
Summer 2002**



PROGRAM DESCRIPTION

The Water Center at Colorado State University is seeking applications for its 2002 NSF Research Experiences for Undergraduates Program in Water Research at Colorado State University. Fifteen selected undergraduate students will undertake an individual research project in water research under the supervision of a Colorado State University faculty member. The research will be performed at Colorado State University during 8 weeks in the summer (June and July).

In addition to their research experience, students will participate in weekly workshops, seminars and discussions on topics in water research, and field excursions to introduce them to important water issues. Students will present the results of their research (in the form of papers or posters) at an end of program symposium. Students will be encouraged to present their work also at the CSU Student Water Symposium during Fall Semester 2002, and to participate in the 2003 edition of the AGU Hydrology Days at Colorado State University.

REU students will receive a stipend of \$2,400 for participation in the program. Students will be provided with housing during the 8-week summer program. Reimbursement for child care expenses may be available on request.

ELIGIBILITY REQUIREMENTS

- At least a junior standing in an appropriate major at the time of application with good academic standing. Students must have at least one semester left prior to graduation as of June 1, 2002.
- Application form completed and submitted on-line with a copy of transcripts and two letters of reference.
- One to two page essay describing student's interest in water research.

APPLICATION PROCEDURE

Only on-line applications will be accepted. In order to apply, point your web browser to the following URL: <http://WaterREU.colostate.edu/> and follow the directions provided. The process includes filling out a short on-line form, providing copies of official transcripts, and obtaining two letters of reference.

APPROPRIATE MAJORS FOR THE PROGRAM

The following is an incomplete list of the majors that are appropriate for this program. If you are not sure if you are in an appropriate major, contact one of the individuals listed below.

Agricultural Economics, Agricultural Engineering, Agricultural Science, Atmospheric Science, Biochemistry, Biological Science, Bioresource Engineering, Civil and Environmental Engineering, Chemical Engineering, Chemistry, Ecology, Environmental Science, Fishery Biology, Forestry, Geology, Water Resources and Hydrologic Science and Engineering, Microbiology, Natural Resources Recreation and Tourism, Range and Forest Management, Range Ecology, Soil and Crop Sciences, Watershed Science, Wildlife Biology.

For more details about the program, including a list of previous research topics, point your web browser to the following URL: <http://WaterREU.colostate.edu/>. For additional questions you may contact:

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WATER NEWS DIGEST

by Marian Flanagan

THE ARKANSAS RIVER BASIN

Water bank rules drafted for Pilot Program; rewrites expected

State Engineer Hal Simpson has drafted proposed rules governing the Arkansas River water bank pilot program, designed to assist farmers and ranchers to realize the loan or lease value of water rights without selling them outright. "Actually, the first year, we're not going to get much started other than establish the rules and create an Internet site for listing water being offered for lease or exchange," Simpson said. "Once the water bank is on-line, it's really going to hinge on how much interest there is. If it's a dry year - and it looks like it's going to be - there could be a big demand for water listed by the bank," he said. Simpson already has conducted several meetings in the basin to hear informal comments and will consult the Colorado Water Conservation Board again before formally publishing the water bank rules on March 10. After a public comment period, Simpson said, he plans to conduct a formal rule-making hearing on May 7-8. The water bank pilot program was authorized by House Bill 1354, sponsored last year by Rep. Diane Hoppe, R-Sterling, and Sen. Lewis Entz, R-Hooper. It gives Simpson until July 1 to establish the rules for the five-year pilot program, scheduled to run through June 2007. The state engineer also must report to the Legislature and governor by Nov. 1, 2005, on the feasibility of the water bank with recommendations of any changes and whether it might become a permanent program.

Simpson's choice for operating the water bank is the Southeastern Colorado Water Conservancy District, managed by former Pueblo legislator Steve Arveschoug. Simpson's draft rules would restrict the loans, leases and exchanges to winter-stored water - excluding summer-stored, direct-flow and underground water. "We're trying to create a mechanism for farmers to lease stored water through a water bank, rather than have to sell it off the land permanently," Simpson said. "Farmers could list their stored water with the bank, which then could connect them with entities that would lease the water for a year at a time." Most of the exchanges, he said, would take place on an Internet Web site, although printed listings would be available at the state engineer's office in Denver and the Division 2 field office in Pueblo. "The operator of the bank, pursuant to the rules, could act as a broker, in a sense that the bank would list the amount of water being offered for lease or exchange," Simpson said. "Before listing, the owner would make sure the water would be available for lease for up to three years at a time. Then, the bank would get involved in bringing the deal to conclusion." The operator would be authorized to charge a transaction fee to cover administrative costs, including the expense of creating and running the Internet site. "At one time, it was thought the bank might have to have a large amount of seed money to go out and buy water to offer for lease," Simpson said. "Really, it's going to be only an exchange. So the up-front money is a lot less for setting up an Internet site and marketing for a 2002-2007 pilot project."

Chieftain Denver Bureau 1/16/02

Fort Lyon Canal water eyed by speculators

Pueblo County commissioners have joined an Arkansas Valley coalition of local governments that is studying ways to protect the supply of Arkansas River water. A company called High Plains A&M has been buying options on land watered by the canal, posing the latest challenge to the supply of agricultural water in the valley. One idea discussed was getting voter approval to establish a special multi-county district that would have the authority and taxing resource to purchase water rights that would otherwise be sold out of the basin. Fort Lyon Canal represents nearly half of all the water flowing in the Arkansas River below Pueblo. It takes 44 percent of the river's 725,400 acre-feet a year, based on annual averages for the past quarter-century, according to Steve Kastner, assistant division engineer for the state Division of Water Resources office in Pueblo. The 725,400 acre-foot total includes 50,000 acre-feet of Fryingpan-Arkansas Project water. Fort Lyon has two canals. The main irrigation canal takes 252,000 acre-feet a year on average, while the storage canal takes 68,000 acre-feet a year, Kastner said. "They divert from their irrigation canal in summer and their storage canal in winter," he said. The 25-year average is close to estimates made by John Lefferdink, lawyer for Fort Lyon Canal. "We probably average somewhere around 300,000 acre-feet of diversions a year," Lefferdink said. "Historically, we take about 40 percent of the river."

Officials of the High Plains A&M are listed as Kenneth Broadhurst, former attorney, Denver real estate investor Mark Campbell and New Orleans entrepreneur Terry White. The company recently registered with the Colorado Secretary of State's Office. A spokesman for New Orleans real estate developer Hunter "Terry" White confirmed that he is one of the investors hoping to buy Arkansas Valley water. Details surrounding the water deal have been kept secret, but it has been reported that the prospective buyers want to acquire as much as 20 percent of the land and water under the canal. Lefferdink said the current situation reminds him of when Colorado was stirred into action against Denver lawyer-geologist John Huston. Then in his 20s, Huston led investors who filed water court applications for 1.5 million acre-feet of bedrock water. "Eventually, there was a decision by the Colorado Supreme Court in 1983 that concluded non-tributary groundwater was under the area of control of the Colorado General Assembly," recalled Dennis Montgomery, a partner with David Robbins in a leading Denver water law firm. "The upshot was that non-tributary ground water was not subject to appropriation (by water courts), effectively eliminating Huston's claims," Montgomery said. In 1985, the Legislature passed a bill declaring that, unlike river and stream surface flows, non-tributary groundwater is not subject to the doctrine of prior appropriation. The legislation provided that landowners, as opposed to outside speculators, could withdraw no more than 1 percent of the 100-year supply from wells on their own property. The Huston group did not own the land, proceeding on the theory that underground water could be mined, much as oil and gas mineral rights are, on a state permit. In Southeastern Colorado alone, Huston and others applied for 3,000 well permits. Bob Jackson, at the time a member of the Colorado

Water Conservation Board and a former Pueblo legislator, says, "I think it failed because of the 'can and will use' test requiring that the water be put to beneficial use," Jackson said. "I don't think there's a common thread between the two cases. Huston was trying to tie up deep water not yet drilled out of the ground. The Fort Lyon deal is going after existing surface rights," Jackson said. Even so, many people in Southeastern Colorado have reacted to both as a potential threat of outside investors gaining agricultural water rights "on spec" for the chance to sell them to more lucrative urban markets outside the Arkansas Valley.

Salazar watching Fort Lyon dealings

Colorado Attorney General Ken Salazar is concerned that more water might be taken from the Lower Arkansas Valley if farmland under the Fort Lyon Canal is bought by investors. "I'd like to know more about their plans," Salazar said of the out-of-state interests who reportedly want to buy 20 percent of the Fort Lyon Canal's water and land. "I do have an overall concern that when land is taken out of agriculture it has a significant impact on the communities left behind. There already have been significant transfers of water over the past few decades which have had severe impacts on the communities."

Chieftain Denver Bureau /12/11,14,18/01; *The Pueblo Chieftain* 1/5,9/02

Rocky Ford ditch water sale could raise salt levels

Federal researchers in southeastern Colorado say Aurora's proposed purchase of the majority of shares in the agricultural irrigation canal could cause salt levels in the Arkansas River to rise. Research shows that as the river flows from the foothills near Cañon City and across the southeastern plains, the river absorbs massive amounts of salt from the cretaceous shale of a prehistoric lakebed, according to U.S. Agriculture Department (USDA) officials. Testing by geologists at the La Junta office of the USDA's Natural Resources Conservation Service show that salt levels in the river measure about 240 parts per million near Cañon City but reach 3,800 parts per million at the point where the river flows over the Kansas border. High salt levels in irrigation water have a serious effect on crop yields, said Mike Bartolo, a research scientist at Colorado State University's agricultural research station in Rocky Ford. "That can have an economic effect and can affect municipal water because of the higher cost of processing it and staying within clean water standards," Bartolo said. Doug Kemper, acting director of Aurora's utilities department, said water quality in the Arkansas River is an issue on the minds of city officials. "Water quality in the Arkansas River is clearly an important issue," Kemper said. For about 10 years, the city has participated in a water monitoring program and a \$1 million water study by the USGS. "We have agreed to continue to participate in that as part of an intergovernmental agreement with the Southeastern Colorado Water Conservancy District," Kemper said. "But as far as water quality issues, there are so many different things to look at to get an accurate picture of the health of the river ... one of the issues that's out there is the quality of return flows from agriculture itself." Kemper said a primary factor in the river's increasing salt level as it flows east is runoff from farms. Substances such as pesticides and fertilizers used on farms also will contribute to the salt level in the river. "Typically, agricultural irrigation's field efficiency is about 65 percent," Kemper said. "That means that 35 to 50 percent of water applied to a farm is returned back to a river and that water is laden with quite a number of things that affect water quality as well." Aurora's purchase would remove about 2,700 acres from agricultural irrigation from the ditch, causing the levels of salt and other substances affecting water quality to decrease, he said.

Aurora Sentinel 12/12/01

Southeastern Colorado in lead for new power plant

Tri-State Generation officials expect to get preliminary reports this week on of feasibility studies they've commissioned on a proposed power plant for the eastern part of the state. It's a project valued at as much as \$1.2 billion that would mean jobs, annual purchases and property taxes and a lock for the Arkansas Valley on the Consolidated Ditch water. The Tri-State Generation and Transmission Association is a not-for-profit consortium of 44 cooperative power suppliers in Colorado (including the San Isabel Electric Association), New Mexico, Wyoming and Nebraska. The proposed new plant also is expected to be a partnership with Xcel and other utilities. Xcel's role could be a factor in locating the plant near Las Animas. Xcel, formerly Public Service Co. of Colorado, purchased the rights to the Consolidated Canal several years ago for a potential generating station, but never built the plant. Those rights would provide enough water for the minimum proposal under study, a 1,200-megawatt plant, according to Jerry Demel, Tri-State's vice president for external affairs. If the plant is bigger, he added, "We've talked to local folks and they've assured us that there's more water available if the plant goes beyond the 1,200-megawatt size." Tri-State hasn't made a final decision on the Las Animas location. The other possible location of the plant would be in the Platte River basin.

The Pueblo Chieftain 12/15/02

Kansas, Colorado agree to keep talking on water

Representatives from Colorado and Kansas agreed again to try to resolve their differences over keeping track of water in the Arkansas River basin. Representatives of the Arkansas River Compact Administration plan to meet again in the spring to resolve concerns submitted to chair Aurelio Sisneros by both states. Depending on their success, the two states also may use a third-party mediator to help them agree on the river's accounting. Kansas won the last round after suing Colorado for letting lower-valley well owners take too much water from the basin, and Colorado has been ordered to pay Kansas \$22 million in damages. Kansas continues to disagree with how Colorado water officials keep track of water in the river system as it flows through various ditches, reservoirs accounts and even the underlying aquifer. There was no decision on the issue of where to hold future yearly meetings, but members did agree to hold the spring meeting in Garden City, Kansas.

Pueblo Chieftain 12/12/01



INSTREAM FLOWS

Trout in Snowmass Creek threatened, group says

The trout population in Snowmass Creek could be in deep trouble if Snowmass Village does not upgrade its water system to meet new demands, a local political group says. But a local Snowmass water utility says it is planning to upgrade the water system and it takes conservation goals into account. Currently, the great majority of water used by Snowmass Village is directly pumped from Snowmass Creek, threatening its long-term vitality, said Sue Helm of the Snowmass-Capitol Creek Caucus. A recent publication titled "A Dry Legacy -- The Challenge for Colorado's Rivers," by Trout Unlimited, uses Snowmass Creek as one of 10 case studies of development impacts on the state's rivers and streams. TU wants Snowmass Village to build a water retention and distribution system that will meet development needs and not continue making direct draws on Snowmass Creek. The Snowmass Water and Sanitation District, which provides water mainly to Aspen Skiing Co. for snowmaking and to Snowmass Village, is currently observing a state-held water right that keeps the creek instream flow at seven to 10 cubic feet per second, Helm said. "The district could legally reduce the flow to about four cubic feet per second, seriously impacting all life in the Snowmass Creek," she said. The water district takes the goal of maintaining a seven-to-10-cfs stream flow very seriously and is currently planning some additional water storage facilities, said Robert Garcia, the water district manager. "It's not the district's goal to go below seven cfs, but sometimes we have to do what is necessary to supply water demands," Garcia said. "The district would take additional steps to mitigate the impact of high demands, he said. They would include implementing water conservation practices, using other available water sources, public education and continuous pumping to even out withdrawal impacts on Snowmass Creek," he said.

Aspen Daily 1/9/02

Bill would broaden instream flow rights

State Sen. Ken Gordon says he will seek a change in Colorado water law to allow individuals and groups to hold instream flow water rights. Gordon's legislative initiative is in response to a report issued by Trout Unlimited that says growth and archaic state water law dry up streams and endanger the state's fish, wildlife, recreation and economy. "A Dry Legacy: The Challenge for Colorado's Rivers," calls on Colorado to adapt its water policies to meet the 21st century, using existing law more aggressively and changing other laws. The root of the problem is the state's "use it or lose it" water rights system, which is based on the assumption that the only beneficial uses of water are away from the stream, and that water left in the stream is wasted, says the report. David Nickum, executive director of Trout Unlimited in Colorado, noted that fishing in Colorado is a \$1.3 billion business, and rafting contributes another \$122 million to the state's economy. Gordon announced Monday that he will introduce a bill in the 2002 Legislative session to remedy one of the restrictions TU criticized: ownership of instream flow water rights. At present, only the Colorado Water Conservation Board, a state agency, is allowed to file for and hold instream flow water rights. "My bill would allow other entities to own instream flow rights," Gordon said. An environmental or sportsman's group could hold an instream right to boost flows for fish, or an individual could convert an existing water right to an instream flow and continue to own it. Gordon is aware that the proposal raises an ideological conflict. TU's report is available online at www.cotrout.org and at public libraries.

Grand Junction Daily Sentinel 1/8/02

WATER DEVELOPMENT/SUPPLY

Water could dry up in small districts

The Fountain City Council is expected to approve an agreement in its partnership with Colorado Springs for a \$400 million project to bring water from Pueblo Reservoir. The pipeline project ultimately will bring about 26 billion gallons of water a year to the Pikes Peak region. About 85 percent of the water will flow to Colorado Springs, Fountain will get 12.5 percent, and the Security Water District will get about 1.8 percent. Many of the county's fast-growing water districts, which rely solely on groundwater, are left out of cities' pipeline hookup. Concerned about how to plan for the future, the county's water districts formed the El Paso County Water Authority. A handful of the county's water districts hope to import groundwater from the San Luis Valley by having it pumped into the Arkansas River upstream of Pueblo Reservoir. Conceivably, that would allow the districts to use the cities' pipeline to move the water north. But residents of the San Luis Valley so far have blocked the export of the groundwater, leaving Springs-area water districts with no water to add to the pipeline project, scheduled to be completed by 2008.

The Colorado Springs Gazette 12/18/01

Thornton accepts Aurora's bid

The City of Thornton announced in autumn that it would auction part of its annual renewable supply of 8,300 acre feet of water. The water supply is now under contract with Aurora. Water providers in Douglas County and Aurora late last year submitted the only bids for a portion of Thornton's water supply that was on the auction block. The Douglas County bid was put together, on deadline, by a consortium of water providers in the area called the Douglas County Water Resource Authority. The group is focusing on developing alliances with both Denver and Western Slope water interests with renewable supplies. Highlands Ranch, Castle Rock, Castle Pines North, Roxborough, The Pinery, Cottonwood, the East Cherry Creek Valley and Inverness water providers joined in the bid. Most providers in the area, not including Highlands Ranch, rely primarily on nonrenewable, underground water supplies. Each provider pledged to subscribe, paying for percentages of water rights if the group was the successful bidder. Not all members of the authority joined the bid. Aurora previously leased the annual renewable water supply from Thornton. No one is leasing the 8,300 acre feet now. The water flows Thornton sold are on the South Platte

River mountains on a ranch in South Park. Northglenn, Brighton, Lakewood, Englewood and Wheat Ridge formally inquired about the sale, but did not bid. Thornton water resource manager Mark Koleber would not publicly compare the two bids, and said he could not comment on the water supply sale price. "Until the final agreement by the end of this year, we need to keep details confidential," he said.

Douglas County News Press 1/16/02

Water district asks court to toss records request

The Southwestern Water Conservation District has asked the District Court in Durango to throw out an open records request filed by a grassroots group opposed to the Animas-La Plata Project. In response, Citizens Progressive Alliance, a nonprofit group based in Colorado and northwest New Mexico, filed a motion to quash the lawsuit on Dec. 17. On Friday, the group filed a petition with the court asking it to dismiss the lawsuit and order the district to immediately produce the documents. No hearing dates have been set on any of the filings.

Durango Herald 12/29/01

Fountain wants more of Lake Pueblo

The city of Fountain has filed an application in Pueblo water court asking to secure additional water storage rights in Lake Pueblo. Pueblo officials plan to also file a claim in an effort to establish in-stream recreational water rights in the Arkansas River and a guaranteed flow of between 350 cfs. and 1,000 cfs. If Pueblo acquires a sizable recreational right in the river, that right will supersede later claims for water in Lake Pueblo. It could also adversely affect Fountain's ability to provide more water for growth. Fountain has applied in court for a water exchange that would allow it to swap 60 cfs of flow in Fountain Creek for an equal amount of storage in Lake Pueblo. Fountain already has the right to up to 2,000 acre-feet of Fryingpan-Arkansas Project water, and is participating in the plans to expand Lake Pueblo. While Pueblo's effort to acquire in-channel recreation rights will probably succeed in some measure, it could prompt the filing of applications from other parties that want to crowd ahead of Pueblo's application if possible. Meetings continue in an effort to find some common agreement that will satisfy the city as well as the future needs of everyone who depends on the river. When the city does file its application in water court, it will also have to file the application with the Colorado Water Conservation Board - which will make a recommendation to the water court. Opponents of Pueblo's claim can contest the city's application in front of the water board as well as in court.

The Pueblo Chieftain 12/10/01

Treated-water reservoir in planning stages

Within the next 10 years, Castle Rock could have its own reservoir, thanks to an agreement between the town, Plum Creek Wastewater Authority and Castle Rock Bank. The reservoir water would be used for irrigation. The town has set a goal of having 50 percent of its water supplied from renewable sources by 2020. One way to reach that objective would be to use treated water for irrigating golf courses and other large landscaped areas. The proposed reservoir could hold 1,320 acre-feet of water, or about 430 million gallons, says the assistant manager of the Plum Creek Wastewater Authority. Design of the reservoir will probably include the town looking at ways to build the infrastructure needed to bring the treated water back into Castle Rock to use for irrigation, and working around the Preble's meadow jumping mouse habitat in the area, which may be difficult. Listed as an endangered species, the Preble's meadow jumping mouse habitat is found in riparian areas. Because of its classification as endangered, development that might disturb the mouse's habitat must be approved by the U.S. Fish and Wildlife Service.

Douglas County News Press 12/26/01

WATER QUALITY

Group works to stop open-pit gold mining

Dr. Colin Henderson, president of the Alliance for Responsible Mining, said Wednesday a bill will be introduced this year in the Colorado Legislature to stop new open-pit cyanide heap-leach gold mines from being permitted in Colorado. According to Henderson, Montana passed a bill in 1998 prohibiting any new open-pit cyanide gold mines. The bill addressed the "persistent problems of cyanide spills and heavy metal contamination" of rivers caused by open-pit cyanide gold mines similar to the one at Summitville, Henderson said. The alliance is a grass-roots coalition of concerned Colorado residents who want to pass similar legislation.

The Pueblo Chieftain 1/4/02

Gore Creek study results published

Like most streams in the arid West, Gore Creek has more people claiming water rights on it than the flow of the creek can support. Fortunately, Gore Creek has some storage reservoirs at its headwaters on Vail Pass that help ensure there will be minimum stream flows. Minimum flows occur in winter, when snowmaking and consumptive uses in Vail are highest. In winter, for example, creek flows are often about 10 cubic feet per second (cfs), which contrasts sharply with snowmelt-charged flows in the spring that approach 1,800 cfs. The U.S. Geological Survey recently released a 72-page report of a four-year study of Gore Creek. The study's purpose was to discover the breaking point in the health of the stream. While there were clearly impacts, there were also some significant recoveries by the time the water reached



the creek's mouth. The resilience of Gore Creek to the impacts of the sand was surprising. The study noted 4,000 tons of coarse sand and gravel is washed into Gore Creek each year. In peak periods as much as 4 tons of sand per day was measured. The process of sanding the interstate resulted in accumulation of sediment in streams reducing the available habitat for brown trout spawning, as well as over-wintering habitat for fish, bugs and other creatures. This issue could affect the local fishing industry, as the last 4 miles of the stream have been designated a Gold Medal Trout fishery because of the number and size of the trout that live there. Trout lay their eggs in gravel of a particular size and type. If sediment covers that spawning bed, it will smother the eggs. The 19-mile-long Gore Creek drains an area of 102 square miles and produces an average of 185,000 acre-feet of water annually. Most of that water is used by downstream water users in the Colorado River drainage, which serves five Western states. Recreational use of the stream, by kayakers and rafters, fishermen and others, is significant. That pressure has changed the character of the stream. Increased algae growth was found upstream of the wastewater treatment plant that has changed the type of macro-invertebrates living there. Strict federal wastewater effluent standards have contributed to the health of the creek. While the Vail wastewater treatment plant has exceeded state regulations for dissolved metals several times, levels of the metals in the effluent stream are now lower than what is allowed in drinking water. Meanwhile, the geological study continues in an effort to keep its finger on the pulse of the creek. This study is part of a more comprehensive study that will eventually be conducted on all of the state's waterways. Studies are under way on the Eagle, Blue, Upper-Gunnison and Roaring Fork rivers.

Vail Daily News 12/18/01

Cotter site improved, but won't be removed from Superfund list yet

The U.S. Environmental Protection Agency has started the process of eliminating surface soils from the Lincoln Park Superfund list, but officials want to postpone completely taking the site off the list because of lingering groundwater concerns. The Lincoln Park neighborhood, located south of Canon City, has been the subject of cleanup efforts since it became part of a Superfund site in 1988. The neighborhood was contaminated by Cotter Uranium Mill more than two decades ago. From 1958 to 1979 Cotter did not use environmental controls such as lined tailings-containment ponds that are now in place. EPA and Colorado Department of Public Health made it official that they will not require Cotter officials to do additional work to clean up soils at the site by signing a record of decision. "Based on the data we have seen, there is no problem with surface soil and you should be comfortable that it is safe," said Barry Levene, an EPA director who oversees Superfund programs in Colorado. In removing the Lincoln Park soils from the national priority list, the EPA will issue a public notice and offer an opportunity for public comment. During a public meeting in November, Levene told local residents, "Our current thinking is to postpone doing anything with ground water until we see what data shows us in the future," to ensure existing cleanup actions remain effective. Although ground water was contaminated with uranium and molybdenum, the quality of the water has improved over the years. EPA officials also hesitate to take the entire cleanup site off the list because new, more stringent drinking water standards were passed a year ago. Allowable uranium levels have been changed from 0.035 milligrams per liter to 0.03 and that "makes a difference," Levene said. Interested citizens can review the recently-released record of decision at the Canon City Public Library.

The Pueblo Chieftain 1/5/02

WHIRLING DISEASE

Hatchery installs tents to deter birds

Recently installed tents covering the nurse ponds at the Durango Fish Hatchery are the latest efforts to keep birds from feasting on fish fry and spreading the deadly trout whirling disease. Birds transfer the disease by ingesting worms that host the disease spores and depositing the spores in waterways. Gary George, superintendent of the hatchery, operated by the Colorado Division of Wildlife (CDOW), said a new design should be installed by spring. The vinyl vaults and netting are an expanding effort to keep the hatchery clean of whirling disease, which infected the hatchery in 1997. The breakout led to a 15-month quarantine and \$800,000 cleanup effort, which included draining and disinfecting the hatchery with strong bleach and shipping about 150,000 10-inch rainbows to the Front Range instead of stocking them in local waters. The cleanup also involved ceasing use of any water from the Animas River or Junction Creek for the raceways – runoff from the hatchery infected the Animas River with the tubifex worms that host the disease. The hatchery now exclusively uses spring water. Since the amount of available water is limited, the hatchery installed a new circulation and filter system, and stringent disinfecting standards were also implemented. Workers now wear plastic shoe covers and wade through disinfectant when entering the indoor hatchery. Trucks transporting the fish are frequently sterilized. Despite these measures, the river will likely remain home to the tenacious worms, which can survive up to 30 years in less-than-opportune conditions, said Mike Japhet, fisheries biologist with the CDOW. This year, the hatchery's goal is to produce 140,000 10-inch catchable trout and 150,000 each of subcatchable 3- to 6-inch brook trout and Snake River cutthroat. The hatchery will also receive about 100,000 Colorado River rainbow trout eggs early for raising to subcatchable size this summer and will do a Colorado River cutthroat brood program using the spawn of genetically pure trout. Cement block is now being laid for a quarantine hatchery for raising wild cutthroat trout. The building, located west of the hatchery offices, will contain four troughs and four tanks and is expected to be operating by April 1, George said.

Durango Herald 1/10/02

MISCELLANEOUS

Yale will donate funds from pending sale of Baca Ranch to Dunes park

The Denver Post reported on Jan. 24 that at least \$15 million of Yale University's endowment fund was used to create Vaca Partners, a company that teamed with Farallon Capital Management in 1995 to buy the Baca Ranch from American Water Development Inc.



Farallon is a San Francisco-based investment firm that manages \$500 million of Yale's \$10.1 billion endowment. Yale endowment money also funded two 1998 Colorado ballot initiatives, backed by Stockman's, that were designed to limit agricultural use of water in the valley. On Jan. 25, Yale announced it would donate several million dollars in profits from the pending sale of the Baca Ranch to expand the Great Dunes National Monument.

Denver Post 1/24-25/02

PEOPLE

Jorge Ramirez, Civil Engineering Department, CSU (right), has been elected an At-Large Member of the Executive Committee of the Consortium of Universities for the Advancement of Hydrologic Science, Inc (CUAHSI). CUAHSI's Board of Directors announced the election at the group's first annual meeting held in San Francisco, California on December 13. Ramirez is also CSU's official CUAHSI Representative. CUAHSI was formed to provide support for hydrology and other closely related sciences. At a meeting of interested scientists hosted by the National Science Foundation in January 2001, several priority programs were formulated that are stated in CUAHSI's mission statement: *To facilitate advancements in the hydrologic sciences, in the broadest sense of that term, by:*



- (1) providing university scientists conducting research in the hydrologic sciences access to data and information at wide ranges of spatial and temporal scales, as well as access to the most appropriate instruments and technologies for the creation of hydrologic understanding to address a list of pressing national and international problems;
- (2) nurturing general understanding of hydrologic sciences through programs of education and outreach; and
- (3) assuring applicability of the advances through a program of technology transfer.

The consortium was incorporated in the District of Columbia on June 25, 2001, and as of February 1, 2002 CUAHSI had 47 Member Universities, including Colorado State University. The CUAHSI Board of Directors appointed Dr. Marshall E. Moss of Tucson, Arizona, as Executive Director of CUAHSI and President of its Corporation. Prof. John Wilson of New Mexico Tech and Kenneth Potter of the University of Wisconsin were elected Chair and Vice-Chair of the Executive Committee, respectively. For further information about the consortium and its programs, visit the consortium's web site: <http://www.cuahsi.org/> or E-mail memoss@worldnet.att.net.

NGWA presents awards to David McWhorter and Robert Longenbaugh

The National Ground Water Association has presented its M. King Hubbert Award 2001 to **David McWhorter** (right). McWhorter is Professor Emeritus of CSU's Agricultural and Chemical Engineering Department (now Chemical Engineering). The award is presented annually by NGWA to a person who has made a major science or engineering contribution to the knowledge of groundwater. McWhorter has been involved in contaminated site cleanups at some of the most critical



sites in the country. He also worked internationally for the UN and FAO, and for the governments of Kuwait and Brazil, advising them on problems of water supply and contamination. **Robert Longenbaugh** (left) was given a NGWA Life Membership Award, which is presented to active members who have retired or are of retirement age and who have contributed special service in the furtherance of the ground water industry and/or to NGWA. Longenbaugh was a researcher and instructor at CSU, where he produced some of the very first digital ground water simulation models. After leaving CSU, he served as Colorado's Assistant State Engineer, where he was responsible for administration of Colorado's ground water resources and also had litigation and enforcement responsibilities.

Maurice Albertson and Gordon Kruse honored by USCID

The U.S. Committee on Irrigation and Drainage recognized **Maurice Albertson** (left) and **Gordon Kruse** (right) during 2001 for their outstanding contributions to USCID and to the profession. Albertson was awarded the USCID Service to the Profession Award in a ceremony that took place during the USCID Transbasin Water Transfers Conference in June.



He is known throughout the world for his contributions in the areas of water resources and irrigation engineering, hydropower engineering and constructed wetlands and, more recently, his work in sustainable village-based development. A feasibility study prepared by Albertson and colleagues at CSU led to the formation of the Peace Corps in the early 1960s. Gordon Kruse received his award, the USCID Merriam Improved Irrigation Award, during a private ceremony in November. He was honored for his innovative research in advancing the science of irrigation and drainage engineering with emphasis on irrigation water supply, control and distribution, and on improving irrigation water applications to increase efficiency and to reduce environmental problems. Kruse was employed by the Agricultural Research Service, USDA, until his retirement in 1993.



The four award winners above have participated in many CWRI water research projects funded through the State Water Institute Program since the program's inception in 1965.

MEETINGS

OGALLALA AQUIFER SYMPOSIUM

Economics of the Ogallala Aquifer

February 21, 2002

Northeastern Junior College, Sterling, Colorado

<p>General Session - 8:30 a.m. Current Colorado Water Issues, Bill Fronczak, Moderator Water as a Resource Water Banking in Colorado Hydrology of the Ogallala Aquifer</p>	<p>Kent Holsinger Rep. Diane Hoppe Jim Goeke</p>	<p>Session 3 - 1:15 p.m. Managing Your Water and Nutrients Ron Neher, Moderator The 10 Commandments for Manure Mgmt. Irrigating with High Nitrate Water Ogallala Aquifer Vulnerability to Nitrate Contamination – Risk Assessment- Prevention Tools</p>	<p>Jessica Davis Dennis Francis Troy Bauder</p>
<p>Session 1 - 10:30 a.m. Rural Community Water Issues, Alex Pieper, Moderator Water Quality Drought Management. Water Supply Management</p>	<p>Tony Krajewski Rick Rigel Joe Finley</p>	<p>Session 4 - 1:15 p.m. Water - Ogallala's Gold, Joel Schneekloth, Moderator Land Value vs. Water Policy Water Banking in the Upper Republican: A Status Report Limited Water Management</p>	<p>Marshall Frasier Bob Hipple Joel Schneekloth</p>
<p>Session 2 - 10:30 a.m. Impacts of Republican River Litigation, Devin Ridnour, Moderator Update on Republican River Litigation Republican Water Flow Model Power Implications for NE Colorado</p>	<p>Hal Simpson Matt Landon Dave Mazour</p>	<p>2:45-3:15 p.m. – Break and Exhibit Viewing 3:15-4:15 p.m. – Open Forum Our turn to hear your voice</p>	
<p>12:45 p.m. South Platte Compact Update -- Don Ament</p>			

Registration Fee: Lunch, Breaks & Handouts

\$30/person or \$40/couple

Payable to: Golden Plains Area Extension Fund
 181 Birch Avenue, Akron, CO 80720

For information contact:

Joel Schneekloth, 970/345-0508

Gisele Jefferson, 970/345-2287

Ron Meyer, 719/346-5571

15TH HIGH ALTITUDE REVEGETATION WORKSHOP

March 6-7, 2002 – Fort Collins, Colorado

Keynote speaker is Dr. Randy Westbrook, Invasive Plant Coordinator for the U.S. Geological Survey. The workshop includes a tour on March 7 to observe and demonstrate the use of equipment used in soil preparation and planting for successful revegetation. The workshop will also include papers and exhibitor displays. Contact: Gary Thor (garythor@lamar.colostate.edu or 970/484-4999).

USCID WATER MANAGEMENT CONFERENCE – HELPING IRRIGATED AGRICULTURE ADJUST TO TMDLS

October 23-26, 2002 – Sacramento, California

The announcement is available online at www.uscid.org/~uscid -- link to Meetings; or contact Larry D. Stephens at Phone 303/628-5430, FAX 303/628-5431, or E-mail stephens@uscid.org.

AMERICAN WATER RESOURCES ASSOCIATION – COLORADO SECTION

Annual Symposium, March 15, 2002, Mt. Vernon Country Club, near Golden, Colorado

Water Resources in Colorado: Success through Cooperation – What has worked (and what hasn't?)

The goal of this symposium is to draw on the experiences or expertise of individuals, groups, or entities who have tried to resolve conflict through cooperation. What has worked? How and why did it work? Are there some common principles in each successful resolution? What hasn't worked and why not? Have there been successes arising from the ashes of failure? For further information, contact Bill Bates at 303/628-6547 (E-mail bill.bates@denverwater.org).

WELLS – ARE THEY A DEPENDABLE WATER SUPPLY?**April 9, 2002 – Fort Collins, Colorado**

The Colorado Water Well Contractors Association (CWWCA) and the Colorado Division of Water Resources are sponsoring a day-long educational program at the Lincoln Community Center in Ft. Collins on April 9, 2002. The emphasis will be on small capacity wells serving domestic or household purposes. The meeting will provide a forum for well drillers, pump installers, engineers, geologists, realtors, planners, sanitarians, attorneys and Division of Water Resources staff to discuss updated information on obtaining well permits, constructing wells in compliance with current rules and satisfying local county rules on the use of wells and septic systems. Speakers will describe where and how to obtain well permits and data for existing wells. The limits on water usage to comply with permit and statutory conditions will be reviewed. Emphasis will be placed on proper well construction and well testing to develop a dependable supply. Local counties permit the septic systems and that may impact where wells can be drilled. Testing of wells for water quality will be discussed. The meeting will be informal. Questions from the attendees will be encouraged. The people encountered at the meeting will provide valuable future contacts. A brochure containing program details and registration instructions will be available after February 20, 2002. Attendance will be limited to the first 200 persons pre-registering. Approval for eight hours of continuing education credits for realtors and lawyers is being sought.

For further information contact CWWCA at 8674 West Warren Drive, Lakewood, CO, 80227, phone 303-986-5035, fax 303-986-8375, E-mail office@cwvca.org.

AMERICAN SOCIETY FOR ENVIRONMENTAL HISTORY**Annual Conference****March 20-24, 2002 -- Denver, Colorado**

You are invited to attend the annual conference of American Society for Environmental History, which will meet in Denver on March 20-24, 2002. To register on-line or to view the program, please visit <http://www.du.edu/specpro> and click on the Special Events menu. In addition to academic historians, the conference generally draws a fair number of humanities/social science scholars, scientists, journalists, politicians, and activists, whose perspectives contribute to the vital interdisciplinary nature of the field. This year's conference is entitled "Producing and Consuming Natures," and it will include sessions on cultural studies, gender, consumption, and popular images of nature that should be of interest to scholars in a variety of disciplines beyond history. The keynote speaker will be the physicist Amory B. Lovins. There will also be receptions at Denver University, the Denver Public Library, and Colorado's Ocean Journeys, as well as field trips to several sites of environmental interest in the Denver Metro Area and a workshop on environmental leadership outside of academia.

Contact Jared Orsi at (jared.orsi@colostate.edu) or Mark Fiege (mark.fiege@colostate.edu) if you have questions.

**COLORADO WATER CONGRESS
FALL WORKSHOP SCHEDULE**

The Colorado Water Congress prepares a series of six to ten workshops each fall for the purpose of increasing and updating water knowledge both for the actively involved water community and general public knowledge.

These workshops are all held in the Colorado Water Congress Conference Room, 1580 Logan Street, Suite 400, Denver, Colorado. A 2002 Water Law Seminar will be held on September 9-10, 2002, and our fall workshops will be announced as they are scheduled.

The 2002 Summer Convention will be August 22-23, 2002 in Vail, CO
The 2003 45th Annual Convention will be January 23-24, 2003 in Northglenn, CO
The 2003 Summer Convention will be August 21-22, 2003 in Steamboat Springs, CO
The 2004 46th Annual Convention will be January 29-30, 2004 in Northglenn, CO

CONTACT: Dick MacRavey, Executive Director, at Phone 303/837-0812, FAX 303/837-1607, E-mail macravey@cowatercongress.org. Web site: www.cowatercongress.org

Hydrology Days 2002

22nd Annual
American Geophysical Union

Hydrology Days 2002

April 1-4, 2002
Cherokee Park Room
Lory Student Center
Colorado State University
Fort Collins, Colorado USA

Dedicated to
Professor
Ignacio Rodríguez-Iturbe

For Questions or comments regarding Hydrology Days contact
Prof. Jorge A. Ramirez
hydrologydays@engr.colostate.edu
Or browse
<http://HydrologyDays.ColoState.edu/>



On behalf of the Organizing Committee of Hydrology Days, I would like to invite you to participate in the Year 2002 edition of the AGU Hydrology Days, which will be held at Colorado State University during April 1-4, 2002.

For detailed information about the Year 2002 edition of Hydrology Days please point your web browser to our web page at the following URL address:

<http://HydrologyDays.ColoState.edu/>

The web page also provides information about on-line registration, and on-line submission of abstracts and papers. Please share this invitation with your friends and colleagues and encourage them to participate.

OVERVIEW -- Hydrology Days has been held on the campus of Colorado State University each year since 1981. Hydrology Days is a unique celebration of multi-disciplinary hydrologic science and its closely related disciplines. The Hydrology Days vision is to provide an annual forum for outstanding scientists, professionals and students involved in basic and applied research on all aspects of water to share ideas, problems, analyses and solutions. The focus includes the water cycle and its interactions with land surface, atmospheric, ecosystem, economic and political processes, and all aspects of water resources engineering, management and policy.

HYDROLOGY DAYS AWARD – The Hydrology Days Award is presented each year to an outstanding individual in recognition of his/her contributions to hydrology and related fields. In recognition of his outstanding contributions to hydrologic science in the areas of surface hydrology, hydro-climatology, fluvial and river basin geomorphology, dynamics of fractal processes, eco-hydrology, and analysis and modeling of space-time rainfall fields, the 2002 Hydrology Days Award will be presented to **Professor Ignacio Rodríguez-Iturbe**. The award will be presented during a special technical session in which Professor Rodriguez-Iturbe will present a talk titled: "**Hydrologic Dynamics and Ecosystem Structure**".

REGISTRATION FEES -- Regular: \$240 by March 8, 2002; and \$270 after March 9, 2002. Registration includes: technical sessions, exhibits, posters, two luncheons, refreshment breaks and two copies of the Proceedings. One-day: \$130/day and \$140/day, lunch included. The one-day fee applies if pre-registered or on-site.

Students FREE by March 8, 2002 (full-time student); \$30 after March 8, 2002 (full-time student). Registration includes: technical sessions, exhibits, posters and refreshment breaks. Luncheon tickets and copies of the Proceedings will be available for purchase.

I am looking forward to your participation.

Best regards, Jorge A. Ramirez, Chair, Organizing Committee

CALENDAR



Feb. 21	OGALLALA AQUIFER SYMPOSIUM--ECONOMICS OF THE OGALLALA AQUIFER, Sterling, CO. Contact: Joel Schneekloth at 970/345-0508.
Mar. 6-7	15TH HIGH ALTITUDE REVEGETATION WORKSHOP, Fort Collins, CO. See website at www.highaltitudereveg.com or call Gary Thor at 970/484-4999, E-mail garythor@lamar.colostate.edu .
April 1-4	HYDROLOGY DAYS, Fort Collins, CO. Contact: Jorge Ramirez, Phone 970/491-8650, E-mail Ramirez@engr.colostate.edu , web site http://HydrologyDays.ColoState.edu/ .
Apr. 9	WELLS -- ARE THEY A DEPENDABLE WATER SUPPLY?, Fort Collins, CO. A day-long educational program sponsored by the Colorado Water Well Contractors Assoc. (CWWCA) and the Colorado Div. of Water Resources. For information contact CWWCA at 8674 West Warren Drive, Lakewood, CO, 80227; Phone 303/986-5035, FAX 303/986-8375, E-mail office@cwwca.org .

May 7-9	HARDROCK MINING 2002 -- Issues Shaping the Industry, Westminster, CO. Contact: Alina Martin, Phone 703/318-4678, FAX 703/736-0826, website http://www.epa.gov/ttnr/mrl/hardrock.htm
Mar. 15	AWRA-Colorado Section Annual Symposium, WATER RESOURCES IN COLORADO: SUCCESS THROUGH COOPERATION -- WHAT HAS WORKED (AND WHAT HASN'T), Golden, CO. Contact Bill Bates at 303/628-7547 or E-mail bill.bates@denverwater.org .
June 11-14	ALLOCATING AND MANAGING WATER FOR A SUSTAINABLE FUTURE: LESSONS FROM AROUND THE WORLD, Boulder, CO. Contact: Jeannie Patton, Event Coordinator at Phone (303) 492-1288 or FAX 303/ 492-1297 or See the Natural Resources Law Center web site at http://www.colorado.edu/Law/NRLC/2002Conference.html .
June 17-20	4TH INTERNATIONAL CONFERENCE ON CALIBRATION AND RELIABILITY IN GROUNDWATER MODELING: A FEW STEPS CLOSER TO REALITY, Prague, Czech Republic. For information call the International Ground-Water Modeling Center, Colorado School of Mines at 303/273-3103, FAX 303/384-2037, or visit the IGWMC web site at http://www.mines.edu/research/igwmc/ .
June 7-8	ARKANSAS RIVER BASIN WATER FORUM--PEAKS TO PRAIRIES: SHARING A WATERSHED, Colorado Mountain College, Leadville, CO. For information contact Charlie and Becky Goff at hollygoff@yahoo.com or by phone at 719/942-4688. The Forum web site is located at: http://partners.uscolo.edu/arkriver/
June 24-28	22ND ANNUAL MEETING AND CONFERENCE, U.S. Society on Dams, San Diego, CA. Contact: Larry Stephens, Phone 303/628-5430, FAX 303/628-5431, or E-mail stephens@ussdams.org
July 1-3	AWRA Annual Summer Conference, GROUND WATER/SURFACE WATER INTERACTIONS, Keystone, CO. For inquiries and questions contact: Jerry F. Kenny, Chair, Conference Technical Program Committee, Phone 303/764-1525, FAX 303/860-7139, E-mail jkenny@hdrinc.com ; Patricia A. Reid, AWRA Program Coordinator, Phone 540/687-8390, FAX 540/687-8395, E-mail pat@awra.org ; Michael J. Kowalski, AWRA Director of Operations, Phone 540/687-8390, FAX 540/687-8395, E-mail mike@awra.org . The AWRA web site can be found at www.awra.org .
July 10-13	ENERGY, CLIMATE, ENVIRONMENT AND WATER -- ISSUES AND OPPORTUNITIES FOR IRRIGATION AND DRAINAGE, San Luis Obispo, CA. Contact: Larry Stephens at Phone 303/628-5430, FAX 303/628-5431, E-mail stephens@uscid.org . Internet: http://www.uscid.org/~uscid .
July 23-26	INTEGRATED TRANSBOUNDARY WATER MANAGEMENT, Traverse City, MI. For further details, access the website at http://www.uwin.siu.edu/ucowr/ . To receive future announcements, E-mail ewri@asce.org or ucowr2002@siu.edu , or call UCOWR headquarters at 618/536-7571.
July 24-26	COLORADO WATER WORKSHOP, Gunnison, CO. Contact: George Sibley Coordinator, Colorado Water Workshop, Western Water Workshop, Gunnison, CO 81231, Phone 970/641-8766, FAX 970/641-6280, E-mail water@western.edu .
Oct. 23-26	USCID WATER MANAGEMENT CONFERENCE, Helping Irrigated Agriculture Adjust to TMDLs, Sacramento, CA. Contact: Larry Stephens at Phone 303/628-5430, FAX 303/628-5431, E-mail stephens@uscid.org . Internet: http://www.uscid.org/~uscid .

Colorado Water Resources Research Institute
Colorado State University
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