COLORADO WATER

Newsletter of the Water Center at Colorado State University

FEBRUARY 2001

FARMERS AND RESEARCHERS LOOK AT SALINITY PROBLEMS IN THE LOWER ARKANSAS RIVER BASIN
See page 9

Clockwise from lower left: Luis Garcia, Civil Engineering, CSU, and Jim Valliant, Cooperative Extension, CSU, talk with farmer Ed Blackburn about water levels and salinity near LaJunta, Colorado; Jim Valliant, Luis Garcia, Ed Blackburn, and CSU graduate students Ayman Elhaddad and Manny Torres review research plans; Luis in salt-damaged field near LaJunta, Colorado

Photography by William A. Cotton, Publications and Printing, Colorado State University

Colorado State University

Knowledge to Go Places

WATER ITEMS AND ISSUES . . .

COLORADO WATER

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EDITORIAL

MEASURING UP!

by

Robert C. Ward, Director

Interest in water information grows as the competition for water in Colorado intensifies, due to such factors as population growth, changing public values, environmental regulations, and interstate demands. Two meetings announced in this newsletter reflect the concern of water information professionals and volunteers about supplying the needed information in an effective and efficient manner.

On March 15-16, 2001, the Colorado Water Quality Monitoring Council and the Colorado Section of the American Water Resources Association will cosponsor a meeting at the Mount Vernon Country Club entitled: "The Future of Water Quality Monitoring in Colorado: Collaboration, Cooperation and Communication".

On May 3, 2001, the State Engineer's Office, the U.S. Geological Survey and the Colorado Water Resources Research Institute will cosponsor a "Colorado Streamgaging Symposium" in Breckenridge, Colorado.

These meetings reflect a number of trends in water information. First, as information technology advances, it is rapidly changing the acquisition, processing, sharing, analysis, and reporting of water information. Second, the public is demanding information about water conditions in ways not experienced in the past (e.g., rafting flows, snow making, endangered species protection, and water quality enhancement). The need to widely distribute water information, when combined with new information technology, encourages those who design and operate both water quantity and quality monitoring systems to have in place sophisticated information systems for the benefit of large numbers of people, as opposed to traditional 'monitoring' systems that narrowly supported internal agency decision-making.

As organizations attempt to share data with each other and the public, it becomes necessary to merge data sets to obtain a more complete 'picture' of water conditions. During a recent meeting of the Colorado Water Quality Monitoring Council (CWQMC), a 'data swap' was held for the Henderson site on the South Platte River and for the entire Clear Creek Watershed. Holly Huyck, CWQMC Coordinator, will describe the data swap during the water quality monitoring meeting on March 15. Sixteen organizations were involved in the Clear Creek Watershed data swap, but duplication in data acquisition appeared minimal. It was obvious that agencies are interested in sharing data to reduce costs while obtaining more information. Data swaps beg a number of questions, perhaps the most pressing being the format in which data are stored electronically. For example, should agencies desiring to share data use the same database template or should each use its own format to facilitate internal use of the information? How should data/information be placed on the internet for public use?

The fact that Colorado is hosting two meetings on water data and information, one on water quantity and another on water quality, may appear yet another duplication. If agencies want to share water data, why not have one meeting and discuss sharing quantity and quality data and information at the same time? This is obviously desirable, but the management of water in Colorado works in two dimensions: (1) Management of state-based property rights (water quantity); and (2) Management of water quality (directed by federal legislation). The type of information needed by each, while overlapping in some cases, is different in terms of scale and attributes measured. In addition, water quantity and quality information systems have significantly different histories and make use of new information technology in different ways. Thus, there is a need for two different meetings at this point in the development of water information systems in Colorado. However, it is not too unrealistic to foresee a day when there will be one water information meeting in Colorado where measurement of water quantity and quality attributes are discussed in an integrated manner, even if the uses of the information remain separate — for example, with respect to water rights and water quality.

Water information in Colorado appears to be moving into a more collaborative phase – a phase that promotes data

sharing and enhanced communication. If you collect, use or need data and information about Colorado's water resources, the two meetings provide an excellent opportunity to gain, and share, insights into recent changes and developments in Colorado's water measuring/information systems.

CWRRI

REQUEST FOR PROPOSALS
FY2001 National Competitive Grants Program

The National Institutes for Water Resources (NIWR) and the U.S. Geological Survey (USGS) have issued a Request for Proposals for the FY2001 National Competitive Grants Program (authorized under Section 104 of the Water Resources Research Act of 1984). The RFP is available only electronically, for reading and/or downloading, at http://www.niwr.org/NIWR/app_no/. Proposals must be submitted on the website at http://www.niwr.org/, and may be submitted through this website beginning January 22, 2001. Prospective applicants (PIs) must register at that site prior to submitting an application and may do so now. **The deadline for proposals is March 19, 2001**. Following that date, the proposals must be reviewed by the CSU Office of Sponsored Programs and CWRRI must approve them for submission to the National Competitive Grants Program no later than March 23, 2001.

Any investigator at an institution of higher education in the U.S. is eligible to apply for a grant through a Water Resources Research Institute established under the provisions of the Water Resources Research Act.

A total of $1 million is available under this program. At least $500,000 is to be spent on topics addressing non-point source pollution. The remaining funds are to be focused on research in the areas of water use and water-quality sensors. Proposals may be for projects of 1 to 3 years in duration and shall not request total federal funds exceeding $250,000 per project.

The FY2001 National Competitive Grants Program, funded at a $1 million level, requires a one-to-one match with non-federal funds. University overhead is normally used as one component of the non-federal match.

CWRRI ADVISORY COMMITTEE FOR WATER RESEARCH POLICY MEETS

The Colorado Water Resources Research Institute's Advisory Committee for Water Research Policy (ACWRP) met October 16, 2001, to hear progress reports on FY 2000 research projects and to select projects for FY 2001 funding. The ACWRP met again on November 2, 2001, to draft a Request for Proposals for the FY 2002 program.

Two continuing projects, again, will receive the majority of CWRRI's FY 2001 funding. The continuing projects are:

- Description and Interpretation of Salinization in the Lower Arkansas Valley, project director Prof. Tim Gates.
- Distribution, Habitat and Life History of Brassy Minnow, project director Prof. Kurt Fausch.

This is the third and final year of funding for the two projects.

With a small amount of research funding remaining, the ACWRP decided not issue a Request for Proposals for FY 2001. Instead, the remaining funds are being used to match funding from local Colorado water organizations in support of research the local organizations deemed critical to their operations.

- Enhancements to the South Platte Mapping and Analysis Program including development of an expert system for a biological component, Prof. Luis Garcia project director. Matching funds come from the Northern Colorado Water

Conservancy District, Groundwater Appropriators of the South Platte, Central Colorado Water Conservancy District and City of Fort Collins.

- Assessment, using existing data, of nutrients in reservoirs along the front-range of Colorado, Profs. Jim Loftis and John Stednick serving as project directors. Matching funds are being provided by seven Front Range water providers.

With the continuing projects ending in February 2002, the ACWRP examined a number of options for issuing a Request for Proposals for FY 2002, when all CWRRI research funding will again be available for awarding. A 'Solicited Research' format, with a few, highly targeted topics, will be employed in the FY 2002 Request for Proposals. Three topics, selected as the focus of CWRRI's FY 2002 Request for Proposals, are:

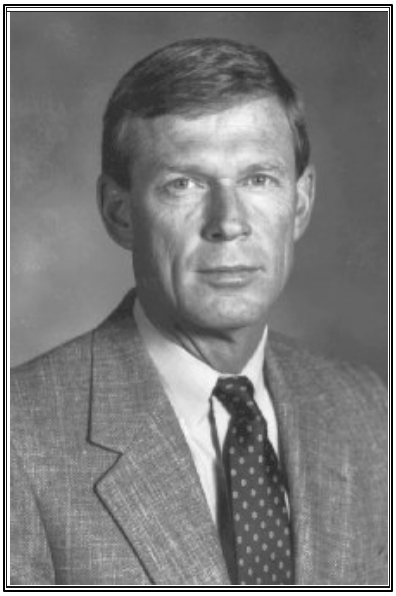
1. Non-point source pollution control from: ·Forest management practices ·Septic tanks
2. Water quality implications of ground water recharge.
3. Salinity mitigation options for the lower Arkansas Valley.

A draft CWRRI Request for Proposals is currently being circulated among potential cosponsors for further refinement and matching fund considerations. The formal FY 2002 Request for Proposals will be issued June 2001 with a September 28, 2001, deadline for submission. To review the draft FY 2002 Request for Proposals, refer to the CWRRI web site (**www.CWRRI.ColoState.edu**). Please be aware that these are drafts and the final Request issued in June may be different. Refinements in the research descriptions and cosponsorships are encouraged.

FY2000 Principal Investigators update members of the CWRRI Advisory Committee on Research Policy on their research: clockwise from top left -- Kurt Fausch and Julie Scheurer, Graduate Student; Justin Twenter, Graduate Student; Tim Gates, and Lee MacDonald.

Summary
Strategic Plan for Water Outreach and Research at Colorado State University

EDITOR'S NOTE: This article is a follow-up to the article in the December 2000 issue of COLORADO WATER titled, "CSU Unveils Strategic Plan for Water Outreach and Research." The December article described efforts at CSU to provide a tighter linkage of the water programs of Cooperative Extension, the Agricultural Experiment Station, and the CSU Water Center.



Dan H. Smith, Co-Chair of CSU Internal Planning Committee and Professor of Soil and Crop Sciences

Cooperative Extension (CE) and the Agricultural Experiment Station (AES) launched a strategic planning effort during 1999 - 2000 to determine future outreach and research needs for water resources programming directed by these agencies. An internal committee consisting of CE specialists and agents and AES researchers developed recommendations for improving the effectiveness of CSU's outreach and research activities. This internal committee also solicited input from an external group selected to represent Colorado's diverse community of water professionals. The external panel gave their views on past and future efforts by CE and AES in water resources programming. The final plan was designed to provide a vision of how CSU's water outreach and research programs should be structured over the next 15 years to meet the growing needs for water information in Colorado. Although the specific roles of CE and AES were emphasized in the planning effort, the planning committee considered the entire scope of CSU's water faculty and resources in formulating a unified mission for water outreach and research.

To implement this vision and mission, two key strategies were proposed. The first strategy emphasized water resources education and outreach and CSU's desire to work more closely with the Colorado water community to provide these programs. The second focused on water research programs of the AES. Specific elements associated with each of these key strategies and the specific activities related to these elements are given below.

Key Strategy 1: Water Resources Education and Outreach

Goal: Provide leadership for internal water education programs and collaborate with outside agencies to improve the effectiveness of water education programs throughout Colorado.

Overview: CSU traditionally has played a key role in meeting the state's water information needs, particularly in the area of agricultural water use. But new information needs in water outreach and education are emerging because of rapid population growth, changing public values, and increased competition for limited water resources. In addition, we acknowledge the need to engage in greater involvement with stakeholder groups and water agencies and address public issues affecting the state's water resources.

Strategy Element 1.1: **Provide for water education needs of Extension Agents and other CSU personnel involved in outreach programs.**

Activities: CE should initiate an annual water short-course focused primarily on the water information needs of Extension Agents and new CSU faculty working in agriculture and natural resources disciplines. The institution also should initiate and maintain a web-based catalog or directory of existing water information and data relevant to Colorado. The visibility of CE water information should be increased by dual-listing existing Fact sheets on water under a new topic heading of "Water." Additional new Fact sheets under this topic should be developed on subjects of critical need. As needed, CE should coordinate the development of white papers to address specific water issues of broad public interest.

Strategy Element 1.2: Initiate a Water Leadership Program for Colorado.

Activities: CSU should assume leadership for the planning, development, and initiation of a state Water Leadership Program. Specific activities in support of this effort include development of a grant proposal to obtain initial funding and the initiation of a development campaign to permanently fund a Water Leadership Program.

Enhancing collaboration among agencies to provide public education and outreach programs for the public will be a key component of the program.

Strategy Element 1.3: Enhance collaboration among agencies to coordinate water education programs directed toward the general public.

Activities: Enhancing collaboration among agencies to provide public education and outreach programs for the public will be a key component of the program. CSU faculty should establish contacts with other agencies and groups involved in water education programs. CE should acquire appropriate publications produced by outside agencies and groups for distribution. Working through the Water Center, CE and AES should assign faculty representation at key water board and commission meetings. In addition, CSU faculty attendance should be encouraged at state water meetings sponsored by outside agencies. Efforts to maintain a web-based directory of existing water information and develop white papers on water issues of broad public interest will also enhance activities under this strategy element.

Strategy Element 1.4: Improve delivery of outreach programs directed toward agricultural, urban landscape, and small acreage water uses.

Activities: Outreach objectives and CE faculty involvement should be required in all proposed AES water projects. Efforts to maintain a web-based directory of existing water information will also enhance activities under this strategy element.

Key Strategy 2: Water Resources Research in Agriculture and Horticulture

Goal: Promote active research programs related to agricultural and urban water use that will provide critical information required by various water constituencies.

Overview: As competition for limited water supplies increases, the information required for improvements in agricultural water management and urban horticultural water uses will intensify. Historically, AES has been very active in its support of water resources research. In the future, water information from basic and mission-oriented research programs will be essential in meeting the public's needs for understanding water uses and consequences, resolving water conflicts, protecting water quality, conserving water resources, and managing the ecological health of the state's watersheds.

Strategy Element 2.1: Enhance the effectiveness and visibility of AES-funded water resources research.
AES should establish an internal competitive grants program in water resources and appoint PI's of AES water projects to serve on Water Working Group.

Strategy Element 2.2: Develop systems for determining water research priorities.

Activities: An annual review of water research needs should be conducted using feedback from AES and CE faculty and the

Water Center, with input from state water leaders. All proposed AES water projects should be screened for relevance to current priorities.

Strategy Element 2.3: Improve linkages between AES and Cooperative Extension.

Outreach objectives and CE faculty involvement should be required in all proposed AES water projects. AES and CE should designate funds to jointly sponsor the specific outreach activities of the AES water projects.

Implementation of Key Strategies

To conduct activities described under **Key Strategy 1**, the strategic plan recommended that CE should staff a Regional Water Resource Specialist in each of the 5 regions and **one state-level Water Resource Specialist**. Permanent funding for regional specialists is in place only in the northeast and southeast regions. The other regions either have water specialists on grant funds or have no position in water resources. CE administration recognizes the need for a full complement of regional water positions and is considering several options for staffing. One opportunity being pursued in the near term is through the funding initiatives being submitted to the legislature by CE, AES, and the Colorado State Forest Service. The objective of the funding initiative process is to obtain supplemental base funding in high priority areas. Water issues in Colorado were identified as one area of critical need for additional funding.

The position of State Water Resource Specialist has been created through redirection of funding, and staffed by moving Reagan Waskom into this position. Troy Bauder will become director of the SB 126 program, the position formerly occupied by Reagan. New or redirected staff time is needed to produce the web-based catalog of water resource materials and to conduct public interface and facilitation activities under **Key Strategy 1**. The Water Center has agreed to redirect some of its current part-time staffing to the task of upgrading its current web page to incorporate some elements of a web-based catalog. Various options for obtaining resources for long-term maintenance of this catalog are being considered.

The strategic planning committee recommended the formation of a Water Working Group to implement the key strategies. This group, lead by a core team consisting of the CE State Water Resource Specialist, an appointed AES faculty member, and the Director of the Water Center, will be the focal point of water outreach and AES research activities at CSU. The core team currently consists of Reagan Waskom, Dan Smith, and Robert Ward. The overall Water Working Group to be appointed by CE and AES agency heads will comprise a group of campus and county faculty who represent the water needs of the state from regional, local, and state-wide perspectives. This group will serve to identify research priorities and outreach needs, and act as a catalyst for grant proposal teams. **The core team of the water working group will be given responsibility for the organization and management of the state Water Leadership Program**.

The most significant initiative involving media to be implemented under the strategic plan is to develop a new Extension fact sheet series dedicated to water within the CE publications catalog. This will be accomplished by dual-listing existing Fact sheets on water under a new topic heading of "Water" and developing new Fact sheets as needed **on topics of critical need such as** water policy and law, water conservation, urban water use, water quantity issues, water terminology, and small-acreage water use. Other media-related issues are being considered for their potential to more effectively reach new and under-served clientele and further expand the University's outreach impact. Examples include enhancements to the Water Center Newsletter, "Colorado Water,"and use of various distance education delivery modes such as web conferencing, satellite downlinks, and TV.

Colorado State University Agricultural Experiment Station

MONITORING AND MODELING SALINITY AND ITS IMPACTS ON IRRIGATED FIELDS IN COLORADO'S LOWER ARKANSAS RIVER BASIN

by

Luis A. Garcia, Ayman Elhaddad, Nathan Foged, Ahmed Eldeiry and Robert Lange
Department of Civil Engineering, Colorado State University

The decline of agricultural civilizations due to soil salinity has been repeated throughout history. For example, the earliest known South Asian civilization flourished in the Indus Valley from 3000-1500 B.C. in what is now Pakistan and India. Archaeologists agree that the decline of this civilization began in 1400 B.C. due to agricultural failure caused by saline soils.

Salinity, defined as the soluble mineral salts present in water or soil, is also taking its toll on agricultural regions in the state of Colorado and especially in the Arkansas Valley located in southeastern part of the state. The Arkansas River is one of the most saline rivers of its size in the United States. Salinity levels increase from 300 mg/L near Pueblo to over 4,000 mg/L at the Colorado-Kansas border (Ghassemi et al., 1995). Water from the Arkansas River is used to irrigate crops in the valley, and farmers are facing decreases in crop yields due in part to these high levels of salinity.

In a project supported by the Colorado Agricultural Experiment Station, Civil Engineering researchers at Colorado State University are studying the spatial and temporal variation of salinity at the field scale in the Arkansas Valley. The focus of this research effort is to provide farmers in the Arkansas Valley tools to evaluate the impact of soil salinity on crop production, and to evaluate alternatives to improve crop yields at the field scale. It is estimated that over 200,000 acres in the valley are being irrigated with water that contains greater than 1,400 mg/L salinity concentrations (Miles, 1977). This value represents the highest classification for salinity hazards, according to the U.S. Salinity Laboratory (USSL, 2000).

Farmers in the lower Arkansas River Valley are experiencing declining productivity, but the economic implications have been relatively isolated up to this point. However, reduced crop yields due to salinity are becoming more widespread in the valley (Figure 1), and farmers are becoming aware of the possible long-term implications and the need for corresponding long-term solutions.

The resources of individual farmers are inadequate to address the salinity problem in detail, since addressing the problem requires the ability to accurately determine locations where crop yields are diminished due to high soil/groundwater salinity and/or high water tables at specific times during the growing season. This data is highly variable spatially and temporally, and therefore the use of computer tools to communicate research findings is becoming very valuable in assisting farmers to plan long-term strategies for reducing impacts to crop production.

Farmers might need to change irrigation methods, add drains to their land, or reduce seepage from canals to improve crop yields. Using Geographic Information Systems (GIS), salinity measurement devices and groundwater monitoring wells, an accurate picture of the distribution of salinity in individual fields over time can be produced. This information can be extremely valuable in identifying the most promising alternatives and developing long-term strategies for farmers.

For this study, five fields have been selected in areas known to have salinity problems in the Arkansas Valley (Figure 2).

In each of these fields between 7 and 13 wells were installed to determine water levels and measure groundwater salinity. The location of each well was determined by Global Positioning Systems (GPS) so they could be incorporated in the Geographic Information System (GIS). In all the fields rainfall gauges were installed, and in some of the wells automatic water-level recorders were

Colorado State University Agricultural Experiment Station

Figure 1. Corn field in the Arkansas Valley near Rocky Ford

Study Site in the Arkansas Valley

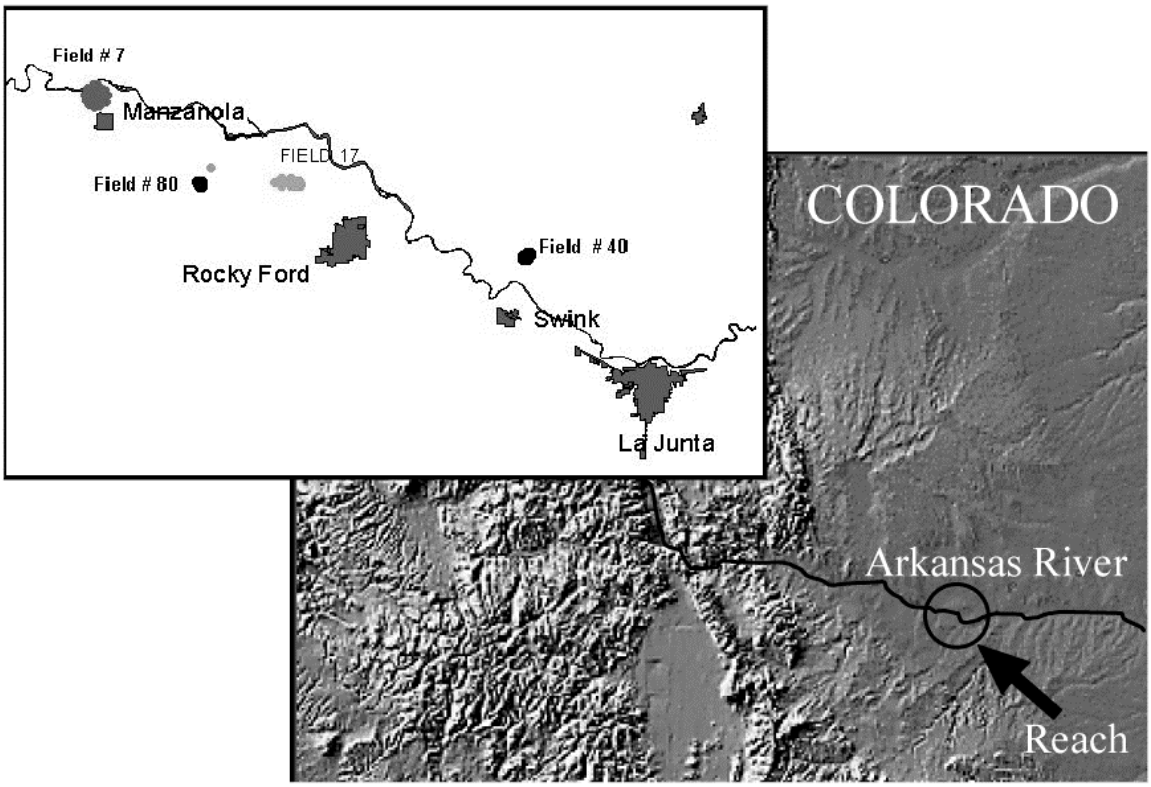


Figure 2: Study Sites, with Four of the Five Fields Displayed

Colorado State University Agricultural Experiment Station

installed. Soil salinity was measured three times a year (early season, mid season, and late season) at multiple points throughout the field (between 40-100 points) and the location of each point was determined using a differentially corrected GPS unit (Figure 3). This data was then entered into a GIS system supported by ArcView and the spatial distribution of salinity, depth to water table and salinity of the groundwater were estimated by interpolation. At the end of the season crop yield samples were collected at different points in two of the fields to generate a crop yield maps.

A spatial model is being developed that uses the three data layers (soil salinity, depth to water table, and water table salinity) as wells a the irrigation schedule to determine the expected crop yield. This model is being calibrated using the data from the two fields where crop yield was measured. The plan is to use the model this year to estimate the spatial crop yield reduction in all five fields as well as additional six fields in the area around Holly, Colorado. The model will also be used to evaluate water quality impacts, since this area is very near the Kansas border. The spatial variation on the different layers can be seen in Figure 4.

Right - Figure 3. Luis Garcia and Ayman Elhaddad check a groundwater well

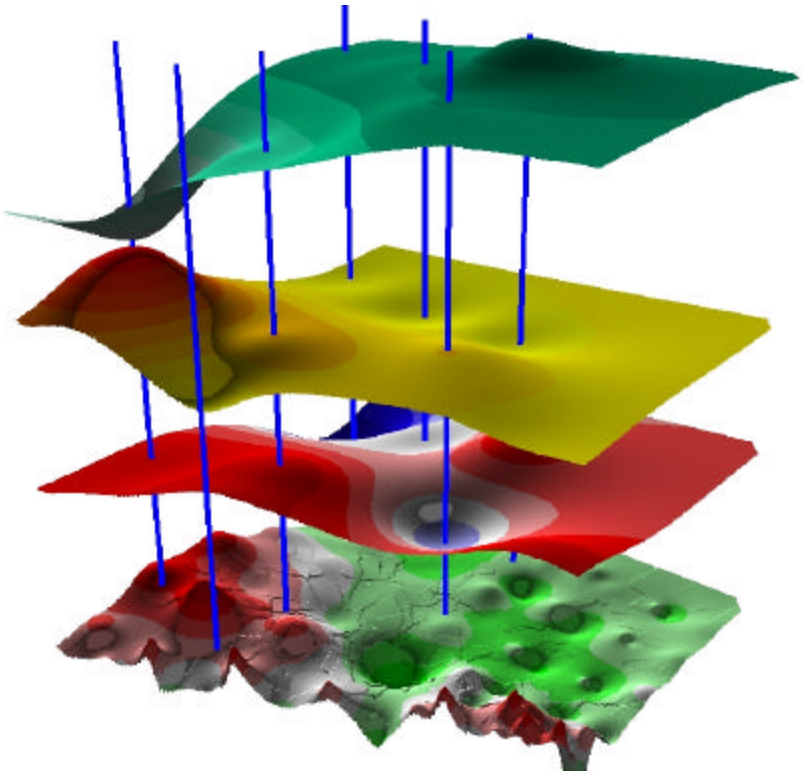


Figure 4: Data Layers Collected for Field 80 which Grows Corn

Parameters impacting crop yields change spatially as well as temporally. For example, as fields are irrigated the water level will typically rise more in specific areas of the field creating the potential to reduce crop yield in certain locations in a field (Figure 4). Therefore, a series of images was created for each layer throughout the growing season to see how parameters change spatially and temporally. Individually, these images were interesting but hard to evaluate because they are snap shots in time. Therefore, a number of computer tools have been developed that allow for the creation of animations. These animations have proven to be very valuable in showing the spatial and temporal variations at the field scale. An example of these animations can be viewed at the following URL http://www.ids.colostate.edu/projects/arkansas/Field_17.html.

The combination of displaying the spatial and temporal change of parameters provides a valuable tool for farmers looking for specific practices and to determine the optimal time to implement the practice needed to reduce impacts from salinity and waterlogging. As can be seen from Figure 4, the actual crop yields are lower where the groundwater, soil salinity and the water levels are the highest.

The method to create crop yield maps will be validated by obtaining satellite images for the growing season and comparing estimated crop yields at different times to those calculated with the GIS procedure using the images. The satellite estimates will be supported by crop yields calculated by traditional field methods. The hope is to develop a strong relationship between salinity and groundwater levels and crop yields that can be used as a tool to target management options to locations and times when they will be the most effective.

An additional benefit of this research is that it is linked to a regional study of soil salinity presented in the June 1999 and June 2000 issue of Colorado Water (Gates, 1999 and Burkhalter et al., 2000). These articles describe an approach to identify areas of concern for soil salinity, and a way to evaluate management scenarios including the reduction of irrigation groundwater pumping rates or increased recharge activities. For the regional model to work correctly it must accurately consider the spatial and temporal variability at the field scale, this research will contribute this component and provide a way to validate the model if some of the recommendations are followed.

The regional project also addresses the issue of water quality downstream from agricultural lands. If there is an increase in drainage from saline areas, there is a potential to introduce water quality problems as salinity issues are addressed at the field scale. This potential water quality problem emphasizes the importance of developing accurate field-scale models to consider various farming practices and optimize the implementation of strategies to reduce field salinity. The potential benefit from an optimized approach would be to minimize impacts on water quality while farmers are improving crop yields for a specific field.

Findings from this research are being presented to farmers who own the fields being studied. In addition, the conclusions drawn from these case studies are being presented in regional meetings setup by Colorado State University Cooperative Extension to benefit farmers in other locations within the Arkansas Valley. To learn more about this project, please see our website at **http://www.ids.colostate.edu/arkansas**.

We need a "blue revolution" in agriculture that will increase productivity and bring "more crop per drop," to borrow an increasingly popular phrase...People and governments alike need to commit themselves to a new ethic of conservation and stewardship of Earth's water.

Kofi Annan, Secretary-General of the United Nations

Colorado State University® Cooperative Extension

USING GIS TECHNOLOGIES TO MONITOR THE OGALLALA AQUIFER

by Drs. Raj Khosla and Luis Garcia
Colorado State University Cooperative Extension

The Ogallala Aquifer (pronounced Oh-ga-la-la) is one of the largest aquifer systems in the world, stretching across parts of the eight states of South Dakota, Nebraska, Wyoming, Colorado, Kansas, Oklahoma, New Mexico and Texas. It underlies about 174,000 miles of these eight states.(Figure 1). About 12,000 square miles are in Colorado, stretching across the eastern border of the state from the Wyoming border in the north all the way to the Oklahoma border in the southeast. About half the state's irrigated corn and wheat crops are grown on the 500,000 acres of farmland on the Eastern Plains that are irrigated by the Ogallala aquifer. There are about 4,100 wells that draw water from the Ogallala aquifer in Colorado.

The amount of water in storage in the aquifer is dependent on the actual extent of the formation's saturated thickness. In 1990, the Ogallala aquifer in the Great Plains contained 3.270 billion acre-feet of water. The water in the formation generally flows from northwest to southeast at a rate of about 150 feet per year. The High Plains area represents 65 percent of the total irrigated acreage in the United States. About 30 percent of the ground water used for irrigation in the U.S. is pumped from the High Plains aquifer. Irrigation withdrawals in 1990 were greater

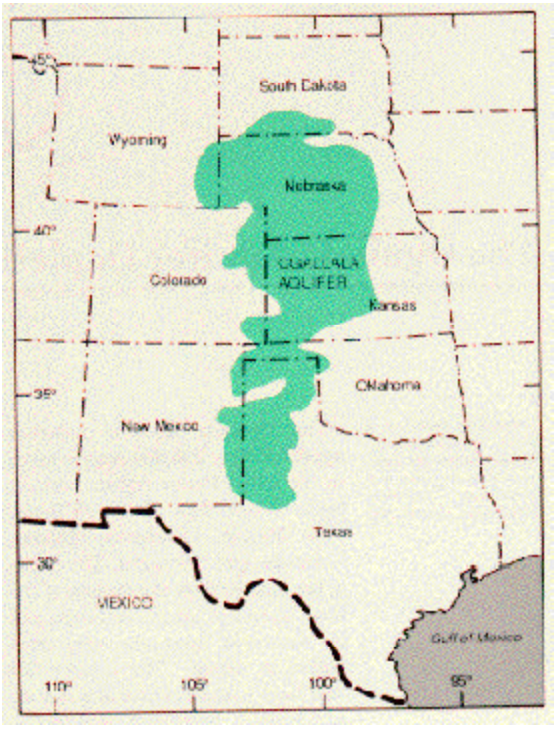


Figure 1. The Ogallala Aquifer

Figure 2. Sampling ground water wells

than 14 billion gallons per day. In 1990, 2.2. million people were supplied by ground water from the High Plains aquifer with total public-supply withdrawals of 332 million gallons per day. The quality of water pumped from the aquifer is suitable for irrigation. However, in some places the water does not meet U.S. Environmental Protection Agency (EPA) drinking water quality standards. The water contains concentrations of sulfate, chloride, selenium, fluoride, nitrate, and dissolved solids.

Geographic Information Systems (GIS) is a widely used tool for display, analysis and manipulation of spatial information. This GIS technology is commonly combined with the Global Positioning Systems (GPS) which is used to locate sampling points, such as ground water wells scattered around the Ogallala aquifer surface (Figure 2). The GPS location data is imported into a commercially available GIS database (ArcInfo®, **MapInfo®) t**o use in generating data layers as shown in figure 3.

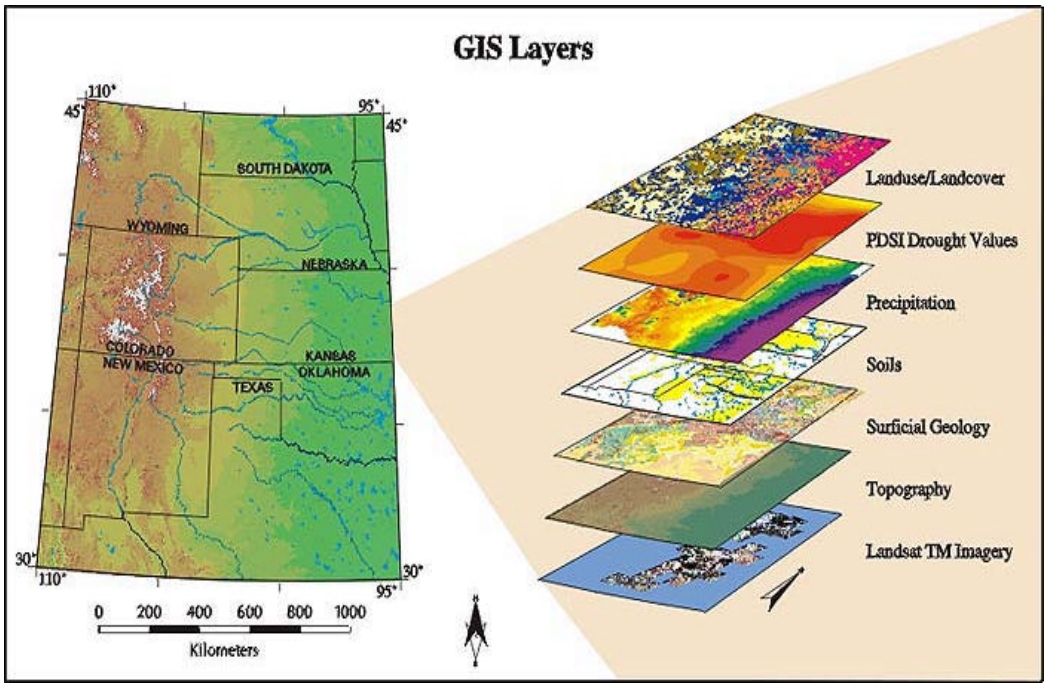


Figure 3. Generating Data Layers

Monitoring of the water levels, or the depth-to-water, in the aquifer's southern high plains area showed rapid declines in the water table in the early 1950s, the 1960s and the 1970s. Declines of a foot or more per year were recorded throughout the 1940s, and during the late 1950s, at the peak of irrigation development, some monitoring wells declined as much as five feet in a single year. This rapid decline rate began to slow in the mid 1970s. By 1985, the Ogallala aquifer began to stabilize and water levels have risen in some areas.

Using the capabilities of GIS technology, spatial surface maps (for example, a depth to water table) can be generated from the data gathered from the geo-referenced ground water monitoring wells. Similar surfaces can be generated to estimate the concentration of various water quality parameters such as nitrates, sulfate, chlorides, etc. Such information is valuable in identifying areas that have exceeded the EPA drinking water quality standards. Likewise, surface maps showing temporal changes in water quality parameters can also be generated to estimate the rate of change over time. Such information surfaces can be overlaid on land use or land cover GIS data layers to model spatial correlation and to identify the impact of land use on different parameters being monitored in the aquifer.

The use of this technology could have an immediate application in Colorado, given a Nebraska suit claiming that Colorado was draining the Ogallala aquifer. If the Supreme Court agrees with Nebraska, Colorado might be forced to impose rules and regulations restricting, or shutting down, some wells that are determined to contribute to lowering the flow in the Republican River. Maps can be generated to show the change in the water table in the aquifer for different periods as well as identify areas of concern.

References:

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Dispute imperils irrigation on plains: **http://www.denverpost.com/news/news0972h.htm**
High Plains regional ground water (HPGW) study: **http://webserver.cr.usgs.gov/nawqa/hpgw/HPGW_home.html**
Land use study database: **http://cires.colorado.edu/cses/research/landsat7proj_page2.html**
The Ogallala Aquifer:: **http://www.hpwd.com/ogallala.html**

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Email: igwmc@mines.edu URL: **http//www.mines.edu/igwmc/**

igwmc

2001 Short Course Schedule

Plan to Learn More Modeling Skills

Polishing Your Ground-water Modeling Skills	MAR 13-16	$1345	$1545 after 2/23
Applied Environmental Statistics	MAY 21-24	$1395	$1495 after 5/11
Zero to Kriging in 30 hours	JUN 7-10	$1245	$1445 after 5/24
MODFLOW: Introduction to Numerical Modeling	SEP8-11	$895	$1095 w/o Modflow 2001*
Subsurface Multiphase Fluid Flow and Remediation Modeling	SEP 9-11	$895	$1095 w/o Modflow 2001
UCODE – Universal Inversion Code Automated Calibration of "Any" Code	SEP 10-11	$795	$995 w/o Modflow 2001
Practical Simulation/Optimization Modeling for Optimal Groundwater Management	SEP 10-11	$845	$1045 w/o Modflow 2001
Model Calibration Using PEST	SEP 14-16	$795	$995 w/o Modflow 2001
MT3DMS Workshop	SEP 15	$395	$495 w/o Modflow 2001
Advanced Modeling of Water Flow and Solute Transport in the Vadose Zone	SEP 15-16	$495	$595 w/o Modflow 2001

* MODFLOW 2001 Conference will be held on the Colorado School of Mines Campus in Golden, Colorado September 11-14, 2001.

FOR INFORMATION CALL (303) 273-3103 -- FOR REGISTRATION CALL (303) 273-3321
VISIT http://www.mines.edu/igwmc/ FOR MORE INFORMATION

CU WATER NEWS

UNIVERSITY OF COLORADO AT DENVER
College of Engineering and Applied Science offers
Advanced Urban Stormwater Modeling

Course Overview: NCES 8235 — This two-day course will provide a comprehensive review and practice with the stormwater modeling methodology and procedures using the Colorado Urban Hydrograph Procedures in combination with the Urban Drainage Stormwater Model, a kinematic flood routing model. The course will focus on hands-on uses of the latest versions of the personal computer models CUHP98 and UDSWM2000; the latter originated from the Runoff Block of the EPA Stormwater Management Model. Model developers and experienced practitioners in the use of these models will describe and discuss the methods, advanced applications, and pitfalls in their use. Workshops will be conducted using local urban watersheds as examples covering many urban drainage features, such as streets, sewers, road-side ditches, diversions and detention basins and the application of these models in drainage design and analysis.

Who Should Attend: This course is intended for civil and drainage engineers, hydrologists, water resources specialists and stormwater management professionals working for city and county engineering departments, consulting firms, and other agencies that have interests in stormwater management and design.

Course Description: The course is designed to expose students to the theoretical background and practical applications of urban stormwater modeling. The course will concentrate on: Watershed Drainage Characteristics, Unitgraph Method, Drainage Network Modeling, Watershed Diversions, Detention Basin Modeling, Comparisons between CUHP98 and UDSWM2000. Each lecture will be followed by a workshop designed to provide hands-on practice. Upon completion of

the course, the participants will have working knowledge of the models and their application to complex urban systems.

Instructors: James C.Y. Guo, Ph. D., P. E., is an Associate Professor of Civil Engineering at the University of Colorado at Denver. He has published more than thirty technical articles in the area of Stormwater Modeling and Analysis and has developed several stormwater prediction methods and modeling.

Ben Urbonas, P. E., Chief, Master Plan Program, Urban Drainage and Flood Control District, is the author of two textbooks and many papers on Stormwater Management. He has led an effort for consistent and updated applications of the CUHP 98 and UDSWM 2000 computer models and stormwater design methods developed for urban areas.

Course Details - Dates: March 22 and 23, 2001; Thursday and Friday; Times: 8:00 a.m. - 5:00 p.m.
Location: Auraria Campus, downtown Denver
CEUs: 1.6 Continuing Education Units -- Cost: $645

Registration: Registrations may be taken over the phone by the University of Colorado at Denver Continuing Engineering Education Program at (303)556-4907. A registration form is posted on our website: www.cudenver.edu/public/engineer/cont and can be faxed to 303-556-6688.

Web Site: Interested in other courses by the Continuing Engineering Education Program? Log onto the website at: **www.cudenver.edu/public/engineer/cont**

Colleen Anderson, Marketing/Program Coordinator, Continuing Engineering Education Program
Campus Box 115, P.O. Box 173364, Denver, Colorado 80217-3364
Voice: 303-556-4907 Fax: 303-556-6688 E-Mail csanders@carbon.cudenver.edu

SEMINARS

For listings of seminars and colloquia scheduled at Colorado State University, the University of Colorado, and the Colorado School of Mines, consult the following web pages.

COLORADO STATE UNIVERSITY

Atmospheric Science	http://www.atmos.colostate.edu/dept/seminar/semscheds01.htm
Earth Resources	http://www.cnr.colostate.edu/ER/seminars/index.html
Fishery & Wildlife Biology	http://www.cnr.colostate.edu/FWB/ click on Grad-Faculty Seminar
Forest Sciences	http://www.cnr.colostate.edu/ASPRS/home1.html click on Spring 2001 topics
History	http://www.colostate.edu/Depts/Hist/events.html
Hydrologic and Environ. Sciences and Engineering	http://www.engr.colostate.edu/depts/ce/ click on New and Notable
Microbiology	http://www.cvmbs.colostate.edu/microbiology/seminar.htm
Nat. Resources Ecology Lab	http://www.nrel.colostate.edu/grad_student/seminars.html
Soil and Crop Sciences	http://www.colostate.edu/Depts/SoilCrop/extension/Soils/SoilCalendar.html#Upcoming
Statistics	http://www.stat.colostate.edu/seminars.html

COLORADO SCHOOL OF MINES

Geology and Geological Engineering	http://www.mines.edu/Academic/geology/van_tuyl/van_tuyl.shtml
Environmental Science and Engineering	http://www.mines.edu/Academic/envsci/about/happenings.PDF

cont'd on next page

Institute of Behavioral Science, University of Colorado at Boulder

Schedule of Speakers for Spring Workshops

All workshops meet in the Institute of Behavioral Science # 3 conference room from approximately 12:00 noon to approximately 1:15pm.

January 22	Professor Kenneth Strzepek, Civil Engineering	The World Water Vision Process and Its Accomplishments
February 5th	Dr. Douglas Kenney, Natural Resources Law Center	"Water and Growth in Colorado"
February 19	Dr. Thomas Schmidin, Department of Geography, Kent State University	"Surviving the Tornado:Lessons from the Field"
March 5	TBA	TBA
March 19	Dr. Larry MacDonnell,PC and former Director, Natural Resources Law Center	Organizing Watershed Organizations in Colorado: Processes and Prospects
April 2	Dr. Joel Smith, Stratus Consulting, Inc.,Boulder and Coordinator, IPCC Working Group II	The Intergovernmental Panel on Climate Change (IPCC): Procedures and Findings"
April 16	Ms. Ann May, Ph.D. Candidate in Anthropology	"Rural-to-Urban Migration Patterns in Tanzania with Emphasis on Children"
April 30	TBA	Proposed Panel: The Report of the World Commission on Dams: Findings and Critique.

For more information contact: Charles W. (Chuck) Howe, Professor of Economics and Professional Staff, Environment and Behavior Program, Institute of Behavioral Science, Campus Box 468, University of Colorado at Boulder, Boulder, CO 80309-0468. Phone: (303) 492-7245. FAX: (303) 492-1231 E-mail: **Charles.Howe@Colorado.edu**.

SEMINARS cont'd.

UNIVERSITY OF COLORADO

CenterWest	http://www.centerwest.org/inside/calendar.html
College of Engineering and Applied Science	http://ecad100.colorado.edu/event_calendar
Cooperative Inst. For Research in Environmental Sciences	http://cires.colorado.edu/announcements.html
Environmental Engineering	http://civil.colorado.edu/web/grad/environ/seminars.htm
Environmental Population and Organismic Biology	http://www.colorado.edu/IBS/news/colloquia.html
Geography Department	http://www.colorado.edu/geography/colloq.html
Geological Sciences	http://www.colorado.edu/IBS/news/colloquia.html
Institute of Arctic and Alpine Research	http://instaar.colorado.edu/other/seminar_mon.html
Institute of Behavioral Science	http://www.colorado.edu/IBS/news/colloquia.html
Natural Resources Law Center	http://www.colorado.edu/law/NRLC/events.html

NEW FACULTY PROFILES

Dr. John P. Crimaldi
Department of Civil, Environmental and Architectural Engineering
University of Colorado

Dr. John P. Crimaldi began his Assistant Professorship in January 2000, for the Civil, Environmental, and Architectural Engineering Department at the University of Colorado, in Boulder.

A 1987 graduate of Princeton University's Mechanical and Aerospace Engineering program, John Crimaldi later attended Stanford University where he earned his Master's degree in the Water Resources Program from the Department of Civil Engineering. He also performed his Doctoral and subsequent post-Doctoral research at Stanford, where he specialized in Environmental Fluid Mechanics. For his dissertation, he investigated the effect of turbulence on grazing of phytoplankton by benthic invertebrates. His postdoctoral research concentrated on the transport of chemical signatures in turbulent boundary layers.

Dr. Crimaldi's research interests revolve around the interaction of fluid mechanics with biological systems and ecosystem dynamics. He has also been active in developing and refining experimental tools and techniques used for the study of turbulent chemical transport. Much of his current research is focused on how aquatic animals make use of turbulent water-borne odor signals in order to determine the location of food, mates, and predators. The Navy is funding this research with hopes of developing autonomous undersea robots capable of locating the source of various chemical signatures.

Dr. Rajiv Bhadra
Chemical Engineering Department
Colorado State University

Dr. Rajiv Bhadra, new assistant professor in CSU's Chemical Engineering Department, asks difficult questions regarding hazardous chemical pollutants such as,

- "How will they impacts worms, fish, and humans who eat the fish in the end?"
- "How does the contaminant behave in the environment and how can we focus biotechnology to clean it up or to get within the legal limits?"
- "How do we treat the water that's been contaminated with pharmaceuticals that perform a specific biological activity?"
- "How can we use biotechnology to prevent pollution?"

Rajiv Bhadra is an honors graduate in chemical engineering from the Indian Institute at Kharagpur, and a PhD graduate in chemical engineering from Rice University. He focused on biotechnology, and became fascinated with its environmental applications; more specifically, how biotechnology can be used to clean up contaminants. As a research engineer at Rice University, he worked on multi investigative projects discovering the power of living organisms to take care of environmental problems. More recently, he has been involved in the design and analysis of biocatalytic technologies for the Department of Defense base cleanup programs. Rajiv creates engineering processes to treat water and soil to get rid of the chemical contaminants. He develops specific phytoremediation processes that are very particular to hazardous chemicals and solves how plants can be used to take care of them. In his research he often collaborates with investigators from other fields, and finds colleagues from other disciplines very eager to listen and get involved.

Dr. Bhadra's current research interests include several areas of biocatalysis and environmental analysis. The focus on the environment includes phytoremediation, anaerobic bioremediation, sequential process design, and the analysis of pollutant fate, availability and risk-reduction. In the area of biocatalysis for sustainable outcomes, his interests lie in conventional and cellular (metabolic) engineering for high-value and value-added applications.

In laymen's terms, he is trying to find phytoremediation solutions for emerging problems important to the western states including arsenic, heavy metals, and mine wastes. He is concerned with removal of ammonium perchlorate and pharmaceuticals in drinking water and is also, interested in how biotechnology can be used to prevent pollution for the future.

Continued from page 17, listed below are some of the seminar highlights for this Spring.

Date & Time	Title & Speaker	Location
	Hydrologic and Environmental Sciences and Engineering, CSU	
Feb. 22	**Measuring and Modeling Runoff Generation in Steep Humid Watersheds,** Dr. Jeff McDonnell, Richardson Chair in Watershed Science and Professor, Department of Forest Engineering, Oregon State University, Corvallis, Oregon	LSC 208
Mar. 1 12:10pm	**And So What Do Hydrologists and Engineers Really do in Practice?** Dr. Pedro J. Restrepo, Optimal Decisions, Boulder, CO	LSC 208
Apr. 19 12:10pm	**Linking Fluvial Geomorphology and Water Quality in Urbanizing Watersheds**, Dr. Brian Bledsoe, Research Associate, Civil Engineering Department, CSU	LSC 208
Apr. 26 12:10pm	**Scale Influences on the Representation of Snowpack Processes**, Dr. Charlie Luce, Research Hydrologist, Rocky Mountain Research Station, U.S. Forest Service, Boise, ID	LSC 208
	Fishery and Wildlife Biology, CSU	
Mar. 2 4:10pm	**Climate change: Implications of the Recovery of the Greenback Cutthroat Trout**, Scott Cooney, Colorado State University	133 Wagar
	Institute of Arctic and Alpine Research, CU	
Feb. 26 12-1pm	**The floor of Yellowstone Lake is anything but quiet: Preliminary results from bathymetric and seismic reflection surveys of West Thumb and northern Yellowstone Lake, Yellowstone National Park**, Lisa Morgan, USGS -- LOCATION: RL-3, 6th Floor Auditorium, Room 620, INSTAAR	
	Geology and Geological Engineering, CSM	
Mar. 1 4:30pm	**Vulnerability of Colorado Aquifers to Pesticide Contamination**, Dr. John McCray, Geology and Geological Engr. Dept., CSM	108 Berthoud Hall
Mar. 8 4:30pm	**Waterborne Disease Trends in the U.S.**, Dr. Dennis Goldman, Executive Director for IEE, Geological Society of America	108 Berthoud Hall
Apr. 19 4:30pm	**Water And Radionuclide Movement Through The Unsaturated Zone At Two Low-Level Radioactive-Waste Disposal Sites**, Rich Healy, USGS, Water Resources Division, Denver CO	108, Berthoud

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

TITLE	PI	DEPT	SPONSOR
CloudSat	Stephens, Graeme L	CIRA	NASA
Population & Environment in the U.S. Great Plains	Parton, William J	NREL	Univ. of Texas-Austin
Riparian Vegetation Studies on the Green & Yampa Rivers	Cooper, David J	Earth Resources	USBR
Effects of Brook Trout on Colorado River Cutthroat Trout	Fausch, Kurt D	FWLB	CDOW
Conservation Prioritization Ranking for Colorado Vertebrate Taxa	**Melcher, Cynthia P**	**FWLB**	**CDOW**
Boater Recreation at Falls, & Jordan Lake & North Central Portion of the Nutbush Arm of Lake Kerr	Haas, Glenn E	NRRT	DOD - US
Tropical Rainfall Measuring Mission Sounding Studies	Johnson, Richard H	Atmos. Science	NASA
Park County Biological Assessment	Spackman, Susan	FWLB	Var. Non-Profit Sponsors
Management Practice Study II - County Land Use Impacts on Irrigation Districts	Wilkins-Wells, John R	Sociology	USBR
Developing a Decision Support System for the South Platte Basin	Ward, Robert C	CWRRI	Var. Non-Profit Sponsors
Studies of Homogenous & Heterogeneous Ice Formation in Upper Tropospheric Conditions	Demott, Paul J	Atmos. Science	NSF-GEO-Geosciences
Spatial Interactions Among Fuels, Wildfire & Invasive Plants	Omi, Philip N	Forest Sciences	BLM
Analysis of Data from Tropical Rainfall Measuring Mission to validate Tropical Rainfall Measuring Mission…	Rutledge, Steven A	Atmos. Science	NASA
Stochastic Analysis Modeling & Simulation-2001	**Salas, Jose D**	**Civil Engr.**	**USBR**
Collaborative Research with Department of Energy's Center for Research on Enhancing Carbon Sequestration in Terrestrial..	Paustian, Keith H	NREL	Battelle, Pacific NW Labs.

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

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

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

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

TITLE	PI	DEPT	SPONSOR
Assessment of Sediment Quality Criteria for Heavy Metals	Clements, William H	FWLB	Wright State Univ.
Economically Optimal Spatial Scales for Integrated Assessment of Agricultural Production Systems	**Paustian, Keith H**	**NREL**	**Montana State Univ.**
Application of Sewage Sludge to Dryland Wheat	Barbarick, Kenneth A	Soil & Crop Sci.	City of Littleton
Sediment Production from Forested Areas in the Central Sierra Nevada	**Macdonald, Lee H**	**Earth Resources**	**USDA-USFS-Pacific SW**
Empirical Climate Prediction	**Gray, William M**	**Atmos.Science**	**NSF-GEO-Geosciences**
Catostomid Key: Computer-Interactive Key to Sucker Larvae & Early Juveniles of the Upper Colorado River Basin	**Snyder, Darrel E**	**FWLB**	**CDOW**
Strategies to Reduce the Effects of Brook Trout on Cutthroat Trout Restorations	Fausch, Kurt D	FWLB	DOI
Arkansas River Basin Watershed Forum	Valliant, James C	Coop. Extension	USBR
Water Management Research	**Whitt, Douglas E**	**Civil Engr.**	**USDA-ARS**
Identification, Public Awareness, & Solution of Waterlogging & Salinity in the Arkansas River Valley	Gates, Timothy K	Civil Engr.	USBR
Collaborative Research at ALOMAR (Arctic Lidar Observatory for Middle Atmospheric Research) Observatory: Dynamics…	She, Chiaoyao	Physics	CoRA - CO Research Assoc.

UNIVERSITY OF COLORADO
BOULDER, COLORADO 80309

An Exploratory Assessment of the Potential for Improved Water Management by Climate Information in Three Western States	Howe, Charles	IBSE	NOAA
International Research Workshop on Integrating GIS and Environmental Modeling: Problems, Prospects, and Research Needs	**Parks, Bradley**	**CIRES**	**US Bureau of the Census**
Predicting Sediment Delivery and Stratigraphy on Marginal Slopes and Shelf Basins	Syvitski, James	IAAR	DON
Watershed and River System Management Program Decision Support for Yakima Basin Operations and Planning	Zagona, Edith	CADSWES	USBR
Experimental Forecasting of Major Bangladesh Floods: Science and Applications	**Webster, Peter**	**PAOS**	**USAID**
Deepwater Physical Oceanography Reanalysis and Synthesis of Historical Data	Kantha, Laksmi	ACAR	Texas A&M
The Role of Shallow, Tundra Lakes in Arctic Land-Atmosphere Interactions and Feedbacks	**Zhang, Tingjun**	**CIRES**	**Univ. of Alaska**
Profiling CO2 and Water Vapor Through the Atmospheric Boundary Layer and Lower Troposphere in Support of the Ameriflux	Birks, John	CIRES	Univ. of Nebraska
Reservoir Stratigraphy and its Controls on Reservoir Architecture and Performance: An Investigation of Key Surfaces and Fabrics in Marginal Marine Environments	Pulham, Andrew	Geol. Sci.	Various Oil Companies
Two-Phase Immiscible Fluid Flow in Fractured Rock: The Physics of Two-Phase Flow Process in Single Fractures	Rajaram, Harihar	CEAE	DOE

Theoretical and Experimental Studies of Hydrological Properties of Rock Fractures During Active Deformation`	Spetzler, Hartmut	CIRES	DOE
Standard Global Snow Cover Products From Satellite Remote Sensing	Armstrong, Richard	CIRES	NASA
Global and Regional Impacts of Mesoscale Variability in Air-Sea Fluxes	Webster, Peter	PAOS	NASA
The Niwot Ridge Long-Term Ecological Research Program 1998-2004: Controls on the Structure, Functions and Interactions of Alpine and Subalpine Ecosystems of the Colorado Front Range	Bourgeron, Patrick	IAAR	NSF
Predictability of the Coupled Ocean-Atmosphere System on Intraseasonal and Interannual Time Scales…	Webster, Peter	PAOS	NOAA
Quantification of Humic Electron Transfer Reactions in Natural and Contaminated Marine Sediments	McKnight, Diane	IAAR	DON
Characterization of Stream Ecosystem in Snake River Basin for the Snake River Task Force	McKnight, Diane	IAAR	Keystone Center

WATER SUPPLY

While the early season snowpack was good, providing hope that the next runoff would produce more water than received last spring and summer, snowfall decreased through late December into January, which began to reduce the snowpack accumulation as measured against long-term average. However, much of the winter season snowpack accumulates after January 1, so next spring's conditions are still subject to change. Water use is low during winter, although reservoirs do store water during this time. Most eservoirs that normally store during the winter are doing so now. Most rivers are flowing at near to slightly below normal rates.

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 stream flow, reservoir storage, and precipitation for the summer period (May through October). During the summer period, stream flow 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, 2001, and reflect conditions during the month of December, 2000.

Basin	1/1/01 SWSI Value	Change from the Previous Month	Change from the Previous Year
South Platte	-0.8	-0.9	-1.7
Arkansas	-1.0	-0.8	+1.8
Rio Grande	+1.0	-0.4	+4.7
Gunnison	-1.3	-0.5	+2.0
Colorado	-0.5	-1.3	+1.6
Yampa/White	+0.5	+1.9	+3.0
San Juan/Dolores	-0.6	-1.1	+2.7

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

WATER NEWS DIGEST

by Marian Flanagan

Colorado/Gunnison Rivers

California to limit Colorado River use

California has formally agreed that within 15 years it will stop taking more Colorado River water than its entitlement. Interior Secretary Bruce Babbitt signed a "record of decision" to hold California to the agreement to reduce its use of the river, which has averaged 5.2 million acre-feet annually in recent years, down to its 4.4 million acre-foot legal share under the Colorado River Compact. California also has agreed that it has a responsibility to reduce its use to the compact limit. This culminates 10 years of negotiations among all seven Colorado River Basin states and the federal government. California will be forced to transfer large amounts of water from agricultural use to municipal uses and to quantify historic agricultural rights that have always been open-ended. The plan allows for a 15-year phase-in period because of the enormous cost and complexity facing California, such as lining the All-American Canal and installation of drip water systems throughout the Imperial Valley, which will be needed to achieve the savings.

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The Pueblo Chieftain, 1/19/01

Park files for water right

The National Park Service has filed for a federal reserved water right for the Black Canyon of the Gunnison National Park. The claim focuses on river flow to meet park needs, but it also obligates the Secretary of the Interior to consider outside needs, such as protecting flood-prone areas around the City of Delta as well as operations of reservoirs. A 1978 Water Court decree entitled the park to a water right with a priority date of 1933, but it did not quantify that right. The action is an attempt to do that.

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Denver Post, 1/19/01

Drought

Survey to be initiated

To lay a solid foundation for a state drought plan, assistant state engineer Jack Byers announced that the Division of Water Resources plans a $350,000 survey of all entities that store or supply water. Byers told fellow members of the Colorado Drought Task Force the money is necessary to a assure a meaningful survey with a complete response from all municipalities, irrigation districts, ditch companies, homeowner associations and other entities. The survey is expected to take 18 months to complete.

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Denver Post, 1/23/01

Endangered Species

Environmental groups raise concerns about water project

Two environmental groups say a local irrigation expansion project approved for financing by the Colorado Water Conservation Board could threaten sensitive fish species in the lower Dolores and San Juan rivers. Trout Unlimited said the Colorado pike-minnow in the lower Dolores near the Colorado River could suffer from saline poisoning if the project goes ahead and also questions whether the $7.2 million sale of 6,000 acre-feet of water by the Montezuma Valley Water Company to the Dolores Water Conservancy District is legal. The Rocky Mountain Chapter of Environmental Defense also expressed concerns about potential downstream pollution as a result of increased agriculture, but emphasized that solutions should be sought that allow for expanded farming and river-habitat protection. The group wants the water, slated for delivery to 4,000 acres of dryland farms, to continue to flow down the Dolores River from McPhee Reservoir for environmental purposes. If used on the new acreage, the runoff water will reach the San Juan River instead, which Trout Unlimited said would increase damaging salt and mineral build-up there. Melinda Kassen, Trout Unlimited's Colorado director for western water projects, said the plan to expand irrigable lands uses "salvage water" saved as a result of a federally funded desalination contract created to increase irrigation efficiency and reduce salt-loading from return flows. Lining canals to prevent waste and using sprinklers rather than flood irrigation are the two main tactics for salinity control. Kassen said the proposal by the Dolores Water Conservation District to purchase Montezuma Valley Irrigation Company water, which she said is reserved for downstream fisheries, should go to the state water court for resolution. All sides are awaiting a biological opinion being prepared by the Bureau of Reclamation in conjunction with the U.S. Fish and

Wildlife Service about the downstream environmental impacts. The DWCD argues that the water in question has already been allocated but has not been used for some time because of the irrigation company's limited delivery capacity.

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Durango Herald, 12/7/00

Flood Protection

Group tries to prep Basalt for 100-year flood

The River Stewardship Roundtable, comprised of citizens, professional planners and engineers, has begun developing a new master plan to manage the Roaring Fork River through Basalt in the event of a 100-year flood. The Roaring Fork River runs down a steep, incised channel for most of its course from Aspen to the Wingo Junction Bridge. Then, it enters a broad flat area and meanders a bit. In addition to the river's changing course, it is moving through an area that is filled with round river rock, piled up through the eons and now 30 feet deep. The Roundtable's objective is to allow the 100-year flood to make its way through town without causing any safety problems or property damage, along with maintaining the riparian environment, and public access to the river for recreational purposes. The group has heard tales of both the 1957 flood and the 1983 flood. The river also flooded in 1918, 1921 and 1995. Members will consider issues and tradeoffs that may have to be made. For example, the Emma Bridge used to be the main auto bridge across the river. Today, it serves as a pedestrian bridge. The upper Basalt Bypass Bridge is also causing problems. Engineers from the Colorado Department of Transportation originally thought the bridge's abutments would cause the river to scour a deeper channel under the bridge. Instead, riverbed material is piling up under the bridge on one side, and rushing water is scouring the riverbank on the other. Some values associated with the river, like easy access, may need to be sacrificed to some degree for safety reasons. The roundtable hopes to present the river master plan to the Basalt trustees by June or July 2001.

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Aspen Times, 12/4/00

Reservoir Management

Major project under way for managing Ruedi, Fryingpan

The Roaring Fork Conservancy is working with the Ruedi Water and Power Authority and the Colorado River Water Conservation District to produce data on the economic benefits derived from the river and its biological assets. The information can be used to evaluate proposals that would change Fryingpan flows and how the Fryingpan River and Ruedi Reservoir will be managed. Anglers and other recreational users of the river valley and the reservoir will be surveyed to gather information about visitors' spending, how often they visit, and whether fishing on the Fryingpan is the main purpose of their visit. Anglers more familiar with the river will also be questioned about how different water levels affect the quality of their fishing experience. The biological study and computer modeling techniques will investigate and project how increased diversion of water from the Fryingpan drainage and different water levels would affect the river's ecosystem. The cities of Aurora and Colorado Springs are studying the possibility of pumping 20,000 acre-feet of Ruedi water over the Continental Divide each winter, the cheapest of several possible schemes that would bring water needed for growth in the two cities. Another factor already affecting Ruedi and the Fryingpan is the release of water to aid the recovery of four endangered fish species in the Colorado River near Grand Junction. Such releases are required in a recovery plan, written in accordance with the Endangered Species Act.

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Aspen Times / 1/01/01

Water Quality

Arkansas River's waste water better now

Good planning and divine timing have combined to shield the Arkansas River from suffering measurably from the effects of Pueblo's growing pains. With tons more sewage being treated today, treated effluent discharged into the Arkansas is cleaner than it's ever been. The City of Pueblo has expanded sewer and water operations, in part to meet growing demands and to meet stricter federal and state standards. Degradation of water quality related to routine runoff and even storm runoff hasn't been a problem since the city completed a massive storm drainage improvement project that separated storm drains from sewer drains to avoid spilling raw sewage into the Arkansas during major rains. The largest quality problem on the Arkansas is high salinity levels, caused in part by salt in underground aquifers and in part by agricultural runoff.

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The Pueblo Chieftain, 12/28/00

Avondale water deemed safe to drink

Tap water in Avondale is safe to drink, according to the Pueblo Chemical Depot and the state health department. A press release issued by the depot said a granular-activated carbon filtration system on Avondale's water supply has been operational since Christmas Eve. The filtration system was "flushed" to assure that no contaminants were left behind in the water supply's tank, cistern or line, before testing was conducted. Water filtered through the system was tested for 16 chemicals known to be present in water around the depot, including 2,4-dinitrotoluene, a compound found in Avondale's water supply in dangerous levels during tests conducted in late November. The 16 compounds the state tested for have been found in past testing of wells and ground water. They are believed to be residual of the washout operation housed at the Pueblo Ordnance Depot from 1948-72, when TNT and other munitions were destroyed. The Army has supplied residents of Avondale with bottled water since December 7, the day after test results confirmed the town's water supply contained enough 2,4-DNT to cause health problems after years of ingestion. There will be a continued effort to monitor water by the state health department.

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The Pueblo Chieftain / 12/27/00

Is heavy development fouling local waters?

Pitkin County Commissioners will contribute $20,000 to a study to determine if growth and development in the upper valley may be polluting the local watershed. It is possible the study could lead to new restrictions on land use. The first phase of the study will be an analysis of the surface and groundwater resources from the North Star Nature Preserve to Basalt. It is designed to show what happens to a drop of water from when it falls to the ground until it flows down the Roaring Fork River. The study is being conducted by Ken Kolm, an associate professor from the Colorado School of Mines, in conjunction with the environmental division of the Argonne National Laboratory and the EPA. The first phase is expected to take three to four months to complete. An engineering and analytical review of the county's water system will be conducted first. The next phase of the study will be to determine what the appropriate responses should be, if any, and whether the responses should be in the realm of engineering, such as new wastewater treatment facilities, or in the realm of land-use regulations. The information could also lead to new requirements for developers, such as an analysis of how new septic systems might influence the local aquifer.

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Aspen Times, 1/2/01

Upper Gunnison undergoes triennial water quality review

The triennial review of water quality standards by the State of Colorado will review the Gunnison River Basin along with the Lower Colorado, Lower Yampa, White, Green, Uncompahgre and Lower Dolores Rivers in March. Four stakeholders must reach consensus on stream and river usage in the Gunnison Basin to reach a February deadline for pre-hearing statements. A local taskforce consisting of the Upper Gunnison River Water Conservancy District, Gunnison County, High Country Citizens Alliance and Gunnison County Stockgrowers Association is working to formulate a thumbnail sketch of waterways in the Gunnison Basin. This group and interested individuals must come up with a statement supporting the state's proposal or one of their own. The Colorado Water Quality Control Commission has developed a proposal for changing recreation classification for an area covering almost the entire Western Slope. When the CWQCC adopted Regulation 35, a reclassification of all waterways to Recreation 1a, all waterways are now assumed swimmable unless shown otherwise. "Swimmable" is defined as primary contact activities such as swimming, rafting and kayaking which could lead to the accidental ingestion of water.

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Gunnison Country Times, 1/5/01

Water quality an issue in Rocky Ford Ditch sales

Colorado water law holds that, when diversions are made, other users on a given stream are not harmed. This goes to the quantity of water left in the stream, and gives the user with the oldest water right first priority over others using water for the same purpose. But the issue of water quality is not addressed. The City of Aurora now is seeking court permission to buy most of the remaining shares of the Rocky Ford Ditch. There are concerns among the remaining non-sellers about their ability to receive their just amounts of water, and now concerns are being raised about what this sale would do to the overall quality of water in the Arkansas River, already the most over appropriated river in the state. If the sale were approved, the water would have to be exported to the Platte River from near the top of the Arkansas. Thus there would be less water in the stream to dilute salts and other contaminants in the stream.

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Pueblo Chieftain, 12/24/00

Water Supply/Development

Trinidad faces water debate over subdivision

The City of Trinidad water system report concluded that the city will have more than enough water for the proposed Stone Ridge planned community at its build-out in 10-15 years, and water demand will not exceed the city's supply. The City utility superintendent said that the city's biggest obstacle is expanding water distribution systems, not finding new sources for water. He would like to see a public educational forum where water issues could be discussed in depth - where the city gets its water, how it gets here, how it's treated, how much is used during peak demand periods and what new sources are being developed by the city. The Chamber of Commerce is willing to host such a forum. A plan and implementation of water system upgrades for additional pumping facilities will be required by 2005 and again by 2020. Raw water supplies (mostly from North and Monument Lakes) are reportedly more than adequate through 2005. Another issue facing the city is the higher than average, unaccounted for land-use water in the system. The city will have to spend a lot of money to expand and upgrade its 50-year-old water treatment plant and build new transmission lines. The developer of Stone Ridge is trying to build community support for his project which he says is providing a lot of capital for the city to develop new water transmission and storage infrastructure.

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The Pueblo Chieftain, 1/19/01

Annex to pump up water supply

The Longmont City Council has approved an annexation proposal from the Northern Colorado Water Conservancy District that requests a 2.8-acre annexation north of Clover Basin Drive, south of Quail Road and east of Airport Road. A water-pump station in a 21-foot-tall facility would be built on the property. The annexation is in Boulder County, but it would be rezoned to the city for the pump site. The proposal is a part of the Southern Water Supply Project, and it is necessary to increase pipeline capacity for the city north of Quail Road. The pump is also needed more immediately to help with water supplies in growing areas such as Broomfield and Erie. Council members who voted against the measure believe it isn't fair for Longmont to have to inconvenience its residents to compensate for the growth of its southern neighbors. Residents listed concerns about the building's visual appearance, site maintenance and noise from the pumps, decreased property values and that vandalism would lead to a chain-link fence around the building's perimeter.

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The Longmont Daily Times-Call, 1/24/01

Colorado River Water Conservation District files objection to Colorado River diversion

The Colorado River Water Conservation District (CRWCD) has filed a formal objection to the amount of Colorado River water being diverted to the Front Range by the Colorado-Big Thompson Project. The objection is supported by a hydrologic study commissioned by the district, which indicates the CBT project could reduce the amount of Western Slope water being diverted to the east by 40,000 to 50,000 acre feet annually and still deliver plenty of water to Front Range customers. That amount of water, if left on the Western Slope, would significantly improve the Colorado River ecosystem and hasten the recovery of the endangered fish, according to the study. But Earl Wilkinson, general manager of the Northern Colorado Water Conservancy District (NCWCD), said his organization is entitled to all the water it is diverting, and more. NCWCD is authorized to take 310,000 acre-feet annually, and has averaged 228,000 acre-feet in recent years, he said. NCWC D doesn't always take all the South Platte water it's entitled to because of significant mechanical changes that must be made to switch from Western Slope water to Eastern Slope water, Wilkinson claimed. The CRWCD has asked the U.S. Bureau of Reclamation and the Colorado State Engineer to look at the way the Colorado-Big Thompson Project is being run. NCWCD operates the Colorado-Big Thompson project under contract to the USBR, which owns the project's infrastructure. USBR also has an interest in the success of the recovery program for the four endangered fish, and is required by law to protect them. The regulations that govern the 16-year-old federal program to preserve the endangered fish in the Colorado River indicate the project should never "impair the yield or reliability of existing projects."

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Aspen Times, 12/14/00

Wetlands

Breckenridge refuses variance request for wetlands

Breckenridge planning commissioners have refused to allow a developer to build three homes within a wetlands protective area in Cucumber Gulch. There are two boundaries within the Cucumber Gulch Preventive Management Area (PMA). One is a 100-foot setback from the wetlands, the other a 300-foot setback from primary bodies of water. The two were created after three consultants advised town planners to avoid the wetlands to protect the boreal toad, a state-endangered amphibian. The toad is an indicator species, meaning it is the first to die or move when environmental conditions begin to deteriorate. Scientific Applications International Corp. of Boulder has completed two studies. Colorado School of Mines is currently conducting a third. The Army Corps of Engineers said the gulch is one of

the most biologically diverse sites in Summit County. Additionally, it was cited by the EPA as an Aquatic Resource of National Importance.

Summit Daily News, 12/21/00

Miscellaneous

Uniform fire code presents challenge

The uniform fire code, a national document, and its requirement for 180,000- gallon water supplies for industrial buildings, was recently adopted by Chaffee County and all the fire departments within its boundaries. The Chaffee County Commission Chairman believes adoption of the uniform fire code can be done in segments, with entities omitting portions that don't apply in a particular area. The Building Inspector highlighted a requirement of the South Arkansas Fire Protection District that industrial buildings need the capacity to store enough water to supply 1,500 gallons per minute for two hours. The fire protection requirement code is specific and presents a challenge to the growth in this area. The impact on commercial construction will make it cost prohibitive.

Salida Mountain Mail, 12/28/00

Boulder toughens penalties

The city's Public Works Director has asked the City Council to strengthen penalties for people caught stealing water from city fire hydrants. Fines for stealing water range from $300 for a first-time offender to $1,000 after three violations. According to Boulder's city code, no one other than city workers can operate a fire hydrant without permission from the city manager. Taking water without permission or directions on how to operate hydrants can also result in damage to the water system. Water pipes buried 40 feet deep can get uplifted after someone closes a hydrant too quickly, creating a pressure wave that reverberates back through the pipeline, so a more enforceable law is needed.

The Boulder Daily Camera, 1/18/01

1999 Annual Report, National Park Service, Water Resources Division. Natural Resources Report

The Water Resources Division 1999 Annual Report provides a summary of programs and activity areas supported by the National Park Service Water Resources Division. The 1999 Annual Report also identifies accomplishments during the 1999 calendar year. The Division is responsible for providing water resources management policy and guidelines, planning, technical assistance, training, and operational support to units of the National Park System. Program areas include water rights, water resources planning, regulatory guidance and review, hydrology, water quality, watershed management, groundwater, fishery management, and aquatic ecology. The National Park Service disseminates the results of biological, physical, and social research through the Natural Resources Technical Report Series. Natural resources inventories and monitoring activities, scientific literature reviews, bibliographies, and proceedings of technical workshops and conferences are also disseminated through this series.

Copies of the report, NPS/NRWRD/NRR-00/09, are available from either office shown at the right:

This report is also available on line at **http://www.nature.nps.gov/wrd.**

National Park Service Water Resources Division 1201 Oak Ridge Drive, Suite 250 Fort Collins, CO 80525 Phone: (970) 225-3500	National Park Service Technical Information Center Denver Service Center P.O. Box 25287 Denver, CO 0225-0287 Phone: (303) 969-2130

CALLS FOR PAPERS

21st Annual American Geophysical Union
HYDROLOGY DAYS
April 2-5, 2001
Lory Student Center, Colorado State University
Fort Collins, Colorado, USA
Sponsored by
Hydrology Section of the American Geophysical Union

OVERVIEW: Hydrology Days has been held on the campus of Colorado State University each year since its establishment in 1981. Hydrology Days provides a forum for scientists, professionals and students involved in basic and applied research on all aspects of water to share ideas, problems, analyses and solutions. Papers are welcome on all topics in hydrology and hydrology-related fields of science and engineering.

Land surface-atmosphere interactions
Environmental river mechanics
Environmental hydrogeology
Wetlands
Water pricing
Water policy
Applications of GIS in hydrology.
Groundwater and surface water interaction
Regional scale dynamics of soil moisture processes
Hydrological impacts of forest management practices.
Transport and coupled processes in the vadose zone
Role of hydrologic models in the TMDL process.
Multi-phase flow in heterogeneous porous media.
Scaling issues: scale dependence and scale invariance in hydrology
Models of river basin geomorphology and landscape evolution
Nonlinear dynamics and multiple scale processes in hydrology
Coupled hydrologic, ecologic and atmospheric modeling
Hydrological, fisheries, economic and social impacts of dam removal.
Modeling reservoir operations with biological constraints.
Quantifying hydrological needs of endangered species.
Measurements and estimation of aquifer recharge in large basins.
Estimation of hydraulic properties of porous media.
Statistical analysis of water quality data: are 'standard' methods evolving for specific management information purposes?
New methodological developments in stochastic hydrology
Agricultural hydrology for irrigated crop production

CONFERENCE FORMAT: A four-day program for Hydrology Days will include contributed papers; a few invited papers; student papers (1½ days); and a poster session. Oral presentations will be scheduled for 30 minutes, including discussion. Standard audio-visual equipment (overhead and slide projectors and computer projection equipment) will be provided. Written papers are not mandatory.

STUDENT AWARDS: Awards and prizes will be given for the best student papers as oral and poster presentations in the following categories: B.S., M.S. and Ph.D. Criteria for judging: clarity of presentation, technical soundness and originality of contribution, relevance to hydrologic practice, and quality of written paper if submitted for the Proceedings.

ABSTRACT SUBMITTAL: Submit your abstract online or send three hard copies (original plus two copies) of abstract(s) on a single page without a specific format, but font 12 minimum: title, author name, affiliation, full mailing address, telephone, fax, e-mail, and indication of student status (B.S., M.S., Ph.D.) if applicable. Include a cover letter indicating presentation preference (oral or poster). Indicate special audio-visual needs. The deadline for abstracts has been extended to February 23, 2001. Submit to: Professor Jorge A. Ramirez, Civil Engineering Department, Colorado State University, Fort Collins, Colorado, 80523-1372. Telephone: (970)491-7621 Fax: (970) 491-7727 E-mail: hydrologydays@engr.colostate.edu PAPER SUBMITTAL Deadline to submit a written paper for inclusion in the Proceedings is February 23, 2001. (See manuscript preparation and submittal guidelines.) The published Proceedings will be available at the conference.

REGISTRATION FEES: Regular: $240 by March 9, 2001; and $270 after March 9, 2001. 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. The registration package includes: technical sessions; exhibits, posters, lunch (if held on day registered); refreshment breaks and two copies of the Proceedings. Students FREE by March 9, 2001 (full-time student); $30 after March 9, 2001 (full-time student). Registration includes: technical sessions, exhibits, posters and refreshment breaks. Luncheon tickets and copies of the Proceedings will be available for purchase.

COSPONSORS: American Geophysical Union (AGU) Hydrology Section and the Front Range Branch, American Society of Civil Engineers (ASCE), Water Resources Engineering Division, and the Colorado Section , American Water Resources Association.

MEETINGS

The American Water Resources Association (AWRA) Colorado Section and
Colorado Water Quality Monitoring Council
Announce a Joint Conference on

The Future of Water Quality Monitoring in Colorado: Collaboration, Cooperation, and Communication

March 15-16, 2001
Mount Vernon Country Club
24933 Clubhouse Circle
Golden, Colorado (303) 526-0616

The following is the preliminary conference program outlining the schedule of oral and poster presentations for this one and one-half day conference. Through these presentations, we hope to further the goals of the Colorado Water Quality Monitoring Council by sharing local, state, and federal perspectives and experiences regarding water quality monitoring. We have been fortunate to assemble a set of experienced and eminent spokespersons at this event, including our keynote speaker Dr. Robert Hirsch, Associate Director for Water, U.S. Geological Survey. In addition, a free tour of the new USGS National Water Quality Laboratory is planned for the afternoon of March 16th. We look forward to your interest and effort in contributing to the future of water quality monitoring in Colorado.

PRELIMINARY CONFERENCE PROGRAM

8:15 a.m **March 15, 2001** **Conference Registration and Continental Breakfast**

AWRA Colorado Section, Brief Business Meeting
Matthew J. Cook, P.E. Colorado Section President
President's Annual Report and Introduction of New Officers and Board
Annual Report Available: **http://www.awra.org/state-studentindex.html** Then click on Colorado Section

8:45 a.m. **Keynote Speaker: Dr. Robert Hirsch**, Associate Director for Water, U.S. Geological Survey

"A" Sessions will be held downstairs in the Canyon Trail Room
"B" Sessions will be held upstairs in the Aspen Room

THURSDAY MARCH 15, 2001

1A – Public Awareness and Stakeholder Outreach

9:50 a.m. *Utilizing Volunteers in Water Quality Monitoring*, Paul F. Hempel, Water Quality Coordinator, Roaring Fork Conservancy, Basalt, CO

10:10 a.m. *Expanding Volunteer Water Quality Monitoring in Colorado*, Chris Rowe, Executive Director, Colorado Watershed Network, Denver, CO

1B – Data Synthesis

9:50 a.m. *Retrospective Analysis and Synthesis of Water Quality Data for Watersheds in Western Colorado*, Paul Von Guerard, U.S. Geological Survey, Grand Junction, CO; David Merritt, Colorado River Water Conservation District, Glenwood Springs, CO

10:10 a.m. *Data Management Program for Local Watershed Partners*, Thomas Grant, Environmental Planner, Denver Regional Council of Governments, Denver, CO

10:30-11:00 a.m. **BREAK**

2A – Water Information Strategies

11:00 a.m. *Water Quality Monitoring System Effectiveness: Denver Water Case Study*–Justin Twenter, Jim C. Loftis, Ph. D., Robert C. Ward, Ph.D., Colorado State University, Ft. Collins, CO; Stephen Lohman, Denver Water Department

11:20 a.m. *Integrated Assessment of Water Quality and Stream Ecology in the Eagle River Watershed* Kirby H. Wynn, Hydrologist, U.S. Geological Survey, Denver, CO

11:40 a.m. *Data Analysis Considerations in Producing 'Comparable' Information for Water Quality Management Purposes*, Lindsay Martin Griffith, Assistant Engineer, Brown and Caldwell, Denver, CO; Graham McBride, Principal Scientist, National Institute of Water and Atmospheric Research, Hamilton, New Zealand; Robert C. Ward, Ph.D. and Jim C. Loftis, CSU, Ft. Collins, CO

2B – Monitoring Interactions Among Watershed Components

11:00 a.m. *Ground Water Monitoring for Agricultural Chemicals in Colorado*, Reagan Waskom, Troy Bauder, Colorado State University Cooperative Extension, Ft. Collins, CO; Robert Wawrzynski, Daniel Hurlbut, Colorado Department of Agriculture, Denver, CO; Bradford Austin, Colorado Department of Public Health and Environment, Denver, CO

11:20 a.m. *Recent Improvements to Ground Water Vulnerability Mapping Methods*, Michael G. Rupert, U.S. Geological Survey, Pueblo, CO

11:40 a.m. *Implementation and Operation of a Water Quality and Quantity Monitoring Program – A Case Study at a Gravel Pit Mine in Boulder County, Colorado,* Chris Sanchez, P.G., Senior Hydrogeologist, Bishop Brogden Associates, Inc. Englewood, CO; Timothy D. Steele, Ph.D., President, TDS Consulting Inc., Evergreen, CO

12:00-1:30 p.m. **Buffet Luncheon**
LUNCHEON SPEAKER: Dr. Emery T. Cleaves, Maryland State Geologist

3A – Methods and Data Comparability: Lakes

1:45 p.m. *Water Quality Monitoring Results for Colorado Front Range Drinking Water Reservoirs*, Kelly DiNatale, P.E., CLM, Water Resources and Treatment Manager, City of Westminster, CO

2:05 p.m. *Development of Water Quality Monitoring Plan for Cherry Creek Reservoir (tentative)*, Joni Nuttle, Biologist, Colorado Water Quality Control Division, Denver, CO

2:25 p.m. *Water Quality Assessment for Blue Lake*, John Keahey, Utility Engineering, Denver, CO

3B – Methods and Data Comparability: Quantity and Quality

1:45 p.m. *The Importance of Streamflow Monitoring at Water Quality Sampling Locations*, David K. Mueller and Dennis R. Helsel, U.S. Geological Survey, Denver, CO

2:05 p.m. *The Role of Hydrologic Monitoring in Integrated Water Resources Management – Concepts and Case Study*, Timothy D. Steele, Ph. D., President, TDS Consulting Inc., Evergreen, CO

2:25 p.m. *23 Cooks Don't Spoil the Broth: Water Quality Monitoring in the Clear Creek Watershed – Standley Lake Watershed,* Kipp Scott, Water Quality Administrator, City of Westminster, CO

2:45-3:15 p.m. **BREAK**

4A – Methods and Data Comparibility: State and National Efforts

3:15 p.m. *National Methods and Comparability Board (Tentative Title),* Charlie Peters, Co-Chair, National Methods and Comparibility Board, U.S. Geological Survey, Madison, WI

2:45-3:15 p.m. **BREAK**

4A – Methods and Data Comparibility: State and National Efforts

3:15 p.m. *National Methods and Comparability Board (Tentative Title),* Charlie Peters, Co-Chair, National Methods and Comparibility Board, U.S. Geological Survey, Madison, WI

3:35 p.m. *The Colorado Water Quality Monitoring Council – Exploring the Who, What, Where, and When of Monitoring in Colorado* Robert McConnell, Chairman, CWQMC; Monitoring Unit Manager, Colorado Water Quality Control Division, Denver, CO

3:55 p.m. *Data Swap Case Study: Henderson Gage and Clear Creek Watershed (tentative)*, Holly L.O. Huyck, Ph.D., Coordinator, Colorado Water Quality Monitoring Council

4B – Methods and Data Comparability: Stormwater

3:15 p.m. *Runoff Event Monitoring – Novelty or Necessity?,* Michael Crouse, Clear Creek Consultants, Golden, CO.

3:35 p.m. *A Cooperative Approach to Design and Implementation of a Stormwater Quality Monitoring Program in the Denver Metropolitan Area, Colorado,* John T. Doerfer and Ben R. Urbonas, P.E., Urban Drainage and Flood Control District, Denver, CO

3:55 p.m. *Monitoring and Evaluating BMP Effectiveness During Highway Construction – Turkey Creek and Highway 285,* Jerry F. Kenny, Ph.D., P.E., Managing Engineer, Exponent-Failure Analysis Associates, Boulder, CO; Timothy D. Steele, Ph. D., President, TDS Consulting Inc., Evergreen, CO; and Rob Herschfeld, Colorado Department of Transportation, Denver, CO

4:15 – 6:15 p.m. **Afternoon Reception** – Cash bar and hors d'oeuveres *All participants are encouraged to attend this reception and enjoy the refreshments!! Don't miss this excellent networking opportunity!!*

FRIDAY MARCH 16, 2001

5A – Institutional Collaboration: Mountain Watersheds

9:00 a.m. *The Summit Water Quality Committee – A Longstanding Example of Institutional Collaboration on Water Quality,* Zach Margolis, Lane Wyatt, and Robert Ray, Northwest Colorado Council of Governments, Silverthorne, CO

9:20 a.m. *Collaborative Monitoring The Good, The Bad, and the Future – A Case Study: Fraser River,* David J. Gloss, U.S. Forest Service, Ft. Collins, CO; Mike Repucci, Esq., Johnson, Repucci & Berg, Boulder, CO; Bill McKee, Water Quality Control Division, Denver, CO; and Robert Ray, NWCCOG, Silverthorne, CO

9:40 a.m. *Developing a Scientific Basis for Source Water Protection Policies in the Salt Lake City Watershed Canyons,* Michelle M. Wind, P.E., Brown and Caldwell, Denver, CO

5B – Institutional Collaboration: Front Range Entities

9:00 a.m. *Big Dry Creek Watershed Association Develops Sound Scientific Understanding of Stream Conditions through Joint Monitoring Effort,* Jane Clary, Wright Water Engineers, Denver, CO

9:20 a.m. *Collaboration in Water Quality Monitoring – The Big Thompson Watershed Experience,* Ben Alexander, City of Ft. Collins, CO; Rob Buirgy, Coordinator, Big Thompson Watershed Forum, Loveland, CO; Doug Cain, U.S. Geological Survey, Denver, CO

9:40 a.m. *Quality Control for a Monitoring Program Implemented by Multiple Agencies – The Big Thompson Watershed Cooperative Monitoring Program,* Adrienne I. Greve, U.S. Geological Survey, Denver, CO

10:00-10:30 a.m. **BREAK**

6A – New Methods Development for Water Quality Monitoring

10:30 a.m. *Overview,* Robert B. Green, Chief, Methods Research and Development Program, USGS National Water Quality Laboratory, Denver, CO

10:45 a.m. *Nutrient Analyses at the National Water Quality Laboratory - Recent developments, work in progress, and capabilities on the horizon,* Charles J. Patton, Research Chemist, Methods Research and Development Program, USGS National Water Quality Laboratory, Denver, CO

11:00 a.m. *New Methods for Analysis of Pesticides and Pesticide Degradates in Filtered Water Samples,* Mark W. Sandstrom, Research Chemist, Methods Research and Development Program, USGS National Water Quality Laboratory, Denver, CO

11:15 a.m. *New Methods for Pharmaceuticals and Other Emerging Organic Contaminants in Water Quality Monitoring,* Edward T. Furlong, Ph.D., Research Chemist, Methods Research and Development Program, USGS National Water Quality Laboratory, Denver, CO

11:30-1:00p.m. **Buffet Luncheon**
LUNCHEON SPEAKER: Charles Spooner, U.S. Environmental Protection Agency (Invited)

2:00 to 3:00 p.m. **Tour of USGS National Water Quality Laboratory**

POSTER PRESENTATIONS

Mapping the Distribution of Elevated Nitrate Concentrations and Evaluating the Mass of Nitrate in the Unconfined Aquifer in the San Luis Valley, Colorado, R.W. Stogner, Sr., U.S. Geological Survey, Denver, CO

Provisional "Implementation Guidance for the Determination of Impacts to Aquatic Life in Streams and Rivers Caused by the Deposition of Sediment" A Case Study: Fraser River, David J. Gloss, U.S. Forest Service, Ft. Collins, CO; Lori Martin, Water Quality Control Division, Denver, CO; Ann Gray Koch, U.S. Forest Service, Idaho Springs, CO

World-Wide Web Access to Water-Quality Data, Eagle River Watershed, Colorado, David Litke, U.S. Geological Survey, Denver, CO; Marianne August, U.S. Geological Survey, Pueblo, CO

Long-Term Water Quality Monitoring in High Elevation Areas of Colorado, M. Alisa Mast, D.H. Campbell, D.W. Clow, G. P. Ingersoll, and L. Nanus, U.S. Geological Survey, Denver, CO

Colorado Water Quality Monitoring Council: An Introduction, Holly L.O. Huyck, Ph.D., Coordinator, Colorado Water Quality Monitoring Council

Daylighting: New Life for Buried Streams

Rocky Mountain Institute has published "Daylighting: New Life for Buried Streams," by Richard Pinkham, a water resource management expert and adjunct research scholar at RMI. The report shows how communities across the U.S. and abroad are discovering the benefits that result from bringing streams out from culverts and other underground channels to enhance public spaces, improve water quality, and expand stream channel capacity. The term "daylighting" describes projects that deliberately restore to the open air some or all of the flow of a previously covered river, creek, or stormwater drainage. Daylighting projects liberate waterways that were buried in culverts or pipes, covered by decks, or otherwise removed from view.

The 62-page, spiral-bound report from RMI documents 18 projects that have daylighted over 14,000 feet of waterways in the U.S. and lists another 23 projects in various stages of consideration. The case studies include the background, actions, results, economics and challenges and lessons from each project, which range in length from a residential backyard project in Rowley, Massachusetts to a 4,000 foot restoration in an Urbana, Illinois park, and cross the spectrum from rural Omak Creek in eastern Washington to highly urbanized Arcadia Creek in downtown Kalamazoo, Michigan.

The report has two purposes: one, to show that daylighting projects are exciting and doable; and two, to show that they require an appropriate site, excellent design, and extensive community involvement. There is a huge potential for the daylighting of long-buried and long-forgotten streams in the U.S., and now communities are working to bring back these buried resources. But daylighting is not a simple task. The report emphasizes the importance of working with a team of planners, engineers, landscape architects, biologists, and citizens to plan and implement a project.

"Daylighting: New Life for Buried Streams" is available on line in PDF format at no charge on RMI's website, **http://www.rmi.org**, or the illustrated, spiral-bound report may be ordered for $12 plus shipping and handling from RMI's online bookstore, or by contacting RMI's publications department at 1/800/333-5903.

Please complete the registration form below and send it with your payment (made payable to AWRA – Colorado Section) to:

AWRA – Colorado Section
P.O. Box 988, Denver, Colorado 80209-0881

For conference planning, it is strongly urged that reservations be received by March 2, 2001.
Registration is limited to the first 170 people, so don't wait!!

For further information contact: Matt Cook at 970-667-8690 or via email at mcook@waterconsult.com. Please distribute copies of this announcement to colleagues who may wish to attend this enlightening conference.

Yes! I wish to register to attend and to participate in the AWRA-CO Section Symposium The Future of Water Quality Monitoring in Colorado: Collaboration, Cooperation, and Communication

Name: _____

Affiliation: _____

Address: _____ **(street/suite)**

_____**(city/state)**

Phone: _____ **e-Mail:** _____

Full Registration (15th and 16th):
(check one)
_____ $100 – AWRA-CO Section Member
_____ $50 – Student member
_____ $115 – Non-member
_____ $55 – Non-member student
(non-member rates, both regular and student, include a 1-year membership in the AWRA Colorado Section)

One-Day Registration (15th):
(check one)
_____ $60 – AWRA-CO Section Member
_____ $25 – Student member
_____ $75 – Non-member
_____ $30 – Non-member student
(non-member rates, both regular and student, include a 1-year membership in the AWRA Colorado Section)

Note: The Conference registration fee includes continental breakfast and buffet lunch (15th and 16th) and afternoon refreshments (15th).

I would like to reserve an exhibit table at no extra charge:_____
[Please contact Matt Cook at 970-667-8690; only limited spaces are available.]
I am interested in participating in the tour of the USGS National Water Quality Laboratory scheduled for 2:00 to 3:00 p.m. on March 16, 2001 _____

American Water Resources Association, Colorado Section
P.O. Box 9881
Denver, Colorado 80209-0811

COLORADO STREAMGAGING SYMPOSIUM

Sponsored by the
Colorado Water Resources Research Institute
State Engineer's Office
U.S. Geological Survey

May 3, 2001
Village at Breckenridge, Breckenridge, Colorado

Information on stream flow conditions in Colorado is critical to the interests of many Colorado citizens and businesses. The Colorado Streamgaging Symposium will provide an opportunity for sharing of information about:

1. The major streamgaging programs in the State;
2. The importance and various uses of the streamflow data;
3. The historic and current coverage of streamflow gages in Colorado and perceived deficiencies in the current coverage; and,
4. Opportunities that may be available to the water community to diversify and perhaps increase overall investments made to support the collection, dissemination, and archiving of streamflow information.

Beginning with the first streamflow gage operated by the U.S. Geological Survey (USGS) in 1881, the number of streamflow gages in Colorado has grown to well over 600 today. Statewide streamgaging programs now are administered by both the State Engineer's Office (SEO) and the USGS, with support from more than 60 cooperating organizations. Those programs are closely coordinated between the SEO and USGS to help ensure the data are comparable and easily accessible to everyone, including the provision of real-time data on the World Wide Web. Other organizations, including the U.S. Bureau of Reclamation and Forest Service, Northern Colorado Water Conservancy District, and the Urban Drainage and Flood control District, also collect streamflow information to support their project needs and make those data available to water users and managers.

The following topics will be included on the symposium agenda:

- Past and Present – History of steamflow data collection in Colorado;
- The evolving uses and importance of streamflow information;
- Current access to streamflow information;
- User perspectives on information uses, needs, and priorities; and,
- Opportunities for improvement in gage network coverage and dissemination of streamflow information.

To register for the Symposium, please fill out the attached form and return to:

Colorado Streamgaging Symposium
USGS Colorado District Office
P.O. Box 25046, MS 415
Denver Federal Center
Lakewood, CO 80225-0046
Attn: Eric Hensel

Space is limited so please send in your registration form early. All registered attendees will receive another mailing with directions and further details. Additional information can be found on the CWRRI homepage: www.CWRRI.Colostate.edu under 'Upcoming Events'.

Draft Program
Colorado Streamgaging Symposium
May 3, 2001 -- Village at Breckenridge, Breckenridge, Colorado

8:00-8:30 Registration

8:30-8:45 Welcome and Introductory Remarks
Robert Ward, CWRRI *Hal Simpson, SEO* *Bill Horak, USGS*

8:45-10:00 Streamgaging history, purpose, measurement locations, and funding in Colorado
"USGS's Streamgaging Programs in Colorado" – *Ron Steger and Bill Horak, U.S. Geological Survey*
"Colorado Division of Water Resources Streamgaging Programs" – *Jack Byers, State Engineer's Office*
"Overview of Site-specific Streamgaging activities in Colorado" – *Kevin Stewart, Urban Drainage and Flood Control District*

10:00-10:30 Break (Showing of Streamgaging Video)

10:30-11:00 Access to Streamgaging Data in Colorado
Bob Boulger, USGS
Doug Stenzel, Information Technology Section, SEO

Panel Discussions on two broad topics:
1. Perspectives on the use of streamflow data; and
2. Needs for improvement in gage network coverage and dissemination of streamflow data and information.

11:00-12:15 Panel One: Moderator: *Robert Ward, CWRRI*
Doug Greer, RTI
David Graf, Division of Wildlife
Sarah Johnson, Water Quality Control Division, CDPHE
Jon Altenhofen, Northern Colorado Water Conservancy District

12:15-1:00 Box Lunch (included in registration fee)

Panel Discussions on two broad topics:
1. Perspectives on the use of streamflow data; and
2. Needs for improvement in gage network coverage and dissemination of streamflow data and information.

1:00-2:15 Panel Two: Moderator: *Bill Horak, USGS*
Ed Pokorney, Denver Water (invited)
Chris Rowe, Colorado Watershed Assembly
David Merritt, Colorado River Water Conservation District
Dan Merriman, Instream Flow Program, CWCB

2:15-3:00 General Discussion of Streamgaging Needs Involving Audience

3:00-3:30 Break

3:30-4:30 Panel Discussion: Opportunities to Initiate Improvements in Colorado's Streamgaging System
Moderator: Hal Simpson, SEO
Mickey Messer and Doug Cain, USGS
Jack Byers, SEO
Phil Saletta and Scott Mars, Colorado Springs Utilities

4:30-5:00 Concluding Remarks: *Robert Ward, Colorado Water Resources Research Institute*
5:00 Adjourn

Colorado Streamgaging Symposium
May 3, 2001
Village at Breckenridge, Breckenridge, Colorado

Registration Form
Please fill in the following information and return to:

Colorado Streamgaging Symposium
U.S. Geological Survey
Colorado District Office
P.O. Box 25046, MS 415
Denver Federal Center
Lakewood, CO 80225-0046
Attn: Eric Hensel
or
Fax to (303) 236-4912

Name: _____

Organization: _____

Address: _____

City: _____ **State:** _____ **Zip:** _____

Phone: _____ **Fax:** _____

E-mail: _____

Special dietary needs: _____
(Box lunch, chicken club croissant sandwich, included in registration fee)

- **Registration Fee - $30 (by April 20, 2001)**
- **Late Registration Fee - $40**

_____ **I have enclosed payment for registration.**

_____ **I will bring the registration fee to the meeting.**

Make checks payable to: Eric Hensel

Please describe your general interests in, and specific uses of, streamgaging data in Colorado

(This information will be summarized and presented during the Streamgaging Symposium)

Hotel Reservations
Should be made directly with:

The Village at Breckenridge
535 South Park
Breckenridge, CO 80424

A block of rooms have been reserved under the name: Colorado Division of Water Resources for arrival on May 2, 2001.

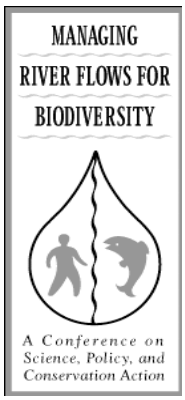
The rates are as follows:

Lift Side Studio—$82.00 a night (includes single and double rate)
Village Hotel Q/B—72.00 a night (includes single and double rate)
Village Hotel Q/Q—$72.00 a night (includes single and double rate)

Individuals will need to show a tax-exempt form or government ID at the time of check-in.
Reservations will need to be made individually by April 2, 2001 - after this date the remainder of rooms will be released to the normal price.

To reserve rooms, please call: 1-800-800-7829

For more information, check the CWRRI Homepage (www.CWRRI.Colostate.edu) under 'Upcoming Events' or contact Robert Ward, e-mail: Robert.Ward@Colostate.edu, or phone (970) 491-6308.



MANAGING RIVER FLOWS FOR BIODIVERSITY
July 30 - August 2, 2001
Colorado State University, Fort Collins, Colorado

Agenda

The **Managing River Flows for Biodiversity Conference** is designed for water managers, staff from non-governmental organizations that work to influence water management decisions, and the attorneys, scientists, and other consultants that advise these groups. Attendees will have an opportunity to examine the real and perceived conflicts between meeting ecosystem needs and human demands for water; discuss the state of science with respect to flow requirements for biodiversity conservation; hear case studies where practitioners are working to meet human demands for water while also providing for ecological needs; and attend a field trip to nearby Rocky Mountain rivers.

Day One - Monday, July 30	
7:00am-8:45am	Breakfast
7:00am-8:45am	Registration

Day 1 cont'd.

8:45am-9:45am	Keynote	Key note speaker(s) to address the purpose, goals, and content of conference, as well as individual themes within conference: science, policy and conservation action.
8:45am-9:00am	Break	
10:00am-12:00pm	State of Science Plenary	Panelists discussing current state of science regarding managing rivers flows for biodiversity.
12:00pm-12:30pm	Questions	Question and answer session for panelists / audience.
12:30pm-2:00pm	Lunch	
2:00pm-4:00pm	State of Policy Plenary	Panelists discussing current state of policy regarding managing rivers flows for biodiversity.
4:00pm-4:15pm	Break	
4:15pm - 4:45pm	Questions	Question and answer session for panelists / audience.
4:45pm - 5:00pm	Closing remarks	Closing remarks for Day One and review of schedule for Day Two.
6:00pm - 6:45pm	Reception	
6:45pm - 9:30pm	Dinner	
Day Two - Tuesday, July 31		
7:00am	Breakfast	
8:30am	Field trip	After a brief overview of the field trip, participants will depart in touring buses.
4:00pm	Poster session	
6:00pm	Dinner	Western cook out

Day Three - Wednesday, August 1		
7:00am-8:30am	Breakfast	
8:30am-10:15am	Concurrent Case Study Symposia	Roanoke River - 1st half
		Apalachicola - Chattahoochee - Flint River Basin - 1st half
		Upper Colorado River Basin - 1st half
		Missouri River - 1st half
10:15am-10:35am	Break	
10:35am-12:20pm	Concurrent Case Study Symposia	Roanoke River - 2nd half
		Apalachicola - Chattahoochee - Flint River Basin - 2nd half
		Upper Colorado River Basin - 2nd half
		Missouri River - 2nd half
12:20pm-1:45pm	Lunch	
1:45pm-3:30pm	Concurrent Case Study Symposia	Klamath River - 1st half
		San Francisco Bay - Delta - System - 1st half
		Zion National Park - Virgin River - 1st half
		San Pedro River - 1st half
3:30-3:50pm	Break	

Day 3 cont'd.

3:50pm-5:35pm	Concurrent Case Study Symposia	Klamath River - 2nd half
		San Francisco Bay - Delta - System - 2nd half
		Zion National Park - Virgin River - 2nd half
		San Pedro River - 2nd half
Day Four - Thursday, August 2		
7:00am-8:30am	Breakfast	
8:30am-10:45am	Concurrent Case Study	Beaverkill - Willowemoc Watershed, Insights from South Africa (Pongolo River)
		Insights from Brazil (Pantanal Basin), Trinity River
10:45am-11:00am	Break	
11:00am-12:15pm	Remarks	Synthesis of conference sessions
12:15pm-1:30pm	Lunch	
1:30pm-3:00pm	Next steps for attendees and conference organizers (audience participation)	

Register for the Conference: Attendance is limited to 350 people who register for this conference. Registration includes all sessions, the field trip, and all meals during the conference except dinner on August 1.

- ***Early Registration is $350. If you wish to take advantage of the reduced early registration fees, please make sure to send your payment postmarked no later than May 1, 2001***
- ***Late Registration must be postmarked and paid by July 2, 2001. The cost for those who register late is $425.***

* Registration fees will be refunded, minus a $20 processing fee, if cancellation is received by 5:00 pm, MDT, Friday, June 15, 2001. Refunds will not be possible after this date. To register for the conference, please download the printable registration form (105kb pdf file)

Sponsors: This conference is made possible by the generous support of the following agencies and foundations: American Rivers, Charles Steward Mott Foundation, National Science Foundation, Northern Colorado Water Conservancy District, The Nature Conservancy, The Nature Conservancy's Freshwater Initiative, U.S. Geological Survey, Biological Resources Division, U.S. Geological Survey, Water Resources Division, U.S. Bureau of Reclamation, Hydropower Reform Coalition, and the U.S. Environmental Protection Agency.

CALENDAR

Mar. 8-9	WESTERN WATER LAW: Water Rights, Quality and Policy in the West, Denver, CO. See CLE Water Law Institute Website at: http://www.cle.com.
Mar. 15-16	THE FUTURE OF WATER QUALITY MONITORING IN COLORADO: COLLABORATION, COOPERATION, AND COMMUNICATION, Golden, CO. Contact: Matt Cook at 970/667-9690 or via E-mail at mcook@waterconsult.com.
Mar. 22-23	ARKANSAS RIVER BASIN WATER FORUM, Lamar, CO. Contact: Tom Pointon at 719/456-0413.
Mar. 26-28	FRACTURED ROCK 2001, An International Conference addressing groundwater flow, solute transport, multiphase flow, and remediation in fractured rock, Toronto, Ontario, CANADA. Contact: Alina Martin, SAIC MS R-4-3, 11251 Roger Bacon Dr., Reston, VA 20190. Phone 703/318-4678 ext. 1, FAX 703/736-0826, E-mail martinali@saic.com, Website http://www.fracturedrock2001.org.
Apr. 30-May 2	AWRA ANNUAL SPRING SPECIALTY CONFERENCE, WATER QUALITY, MONITORING, & MODELING, San Antonio, TX. Contact: Michael J. Kowalski, AWRA Director of Operations, AWRA, 4 W. Federal St., PO Box 1626, Middleburg, VA 20118-1626, Phone 540/687-8390, FAX 540/687-8395, e-mail: mike@awra.org.
3-May	COLORADO STREAMGAGING SYMPOSIUM, Breckenridge, CO. Contact: Eric Hensel at USGS District Office, PO Box 25046, MS 415, Denver Federal Center, Lakewood, CO 80225-0046; FAX 303/236-4912, or see the Website at http://cwrri@colostate.edu (go to Upcoming Events).
June 27-30	JOINT AWRA/UCOWR SUMMER SPECIALTY CONFERENCE, DECISION SUPPORT SYSTEMS FOR WATER RESOURCES MANAGEMENT. Snowbird, UT. Contact: Direct inquiries as follows: Technical Program Chairperson Donald F. Hayes, Civil and Environmental Engr., Univ. of Utah, 122 So. Central Campus Dr., Ste 104, Salt Lake City, UT 84112, Phone 801/581-7110, FAX 801/585-5477, e-mail: hayes@civil.utah.edu. Conference General Co-Chairperson Mac McKee, Utah Water Research Lab, Utah State Univ., UMC8200, Logan, UT 84322-8200, Phone 435/797-3188, FAX 435/797-3663, e-mail: mmckee@cc.usu.edu, Website http://www.awra.org.
Aug. 19-24	LINKING STORMWATER BMP DESIGNS AND PERFORMANCE TO RECEIVING WATER IMPACTS MITIGATION, Snowmass, CO. Contact: Ben Urbonas at 303/455-6277; 303/455-7880, Email burbonas@udfcd.org.
Aug. 19-Sept 13	17th International Seminar on FOREST AND NATURAL RESOURCES ADMINISTRATION AND MANAGEMENT, Fort Collins, CO. Contact Ann Keith, Coordinator, Phone 970/482-8098, FAX 970/490-2449, E-mail IFS@cnr.colostate.edu, Website http://www.fs.fed.us/global/isfam.
Sept. 5-6	WETLANDS & REMEDIATION, Second International Conference, Burlington, VT. Contact: The Conference Group, 1989 W. 5th Ave., Suite 5, Columbus, OH 43212-1912, Phone 800/783-6338 or 614/424-5461, FAX 614/488-5747, E-mail conferencegroup@compuserve.com.
Sept. 9-12	DAM SAFETY 2001, Assoc. of State Dam Safety Officials Annual Conference, Snowbird, UT. Contact: ASDSO, 450 Old Vine Street 2nd Floor, Lexington, KY, 40507. Phone 859/257-5140, FAX 859/323-1958, E-mail info@damsafety.org, Website http://www.damsafety.org (go to conferences and training).

Mark Your Calendar!

COLORADO WATER WORKSHOP -- July 25-27, 2001, Western State College, Gunnison, CO 81231

Lucy High at 970/641-8766 -- E-mail: water @western.edu -- web: www.waterinfo.org/workshop.html

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