

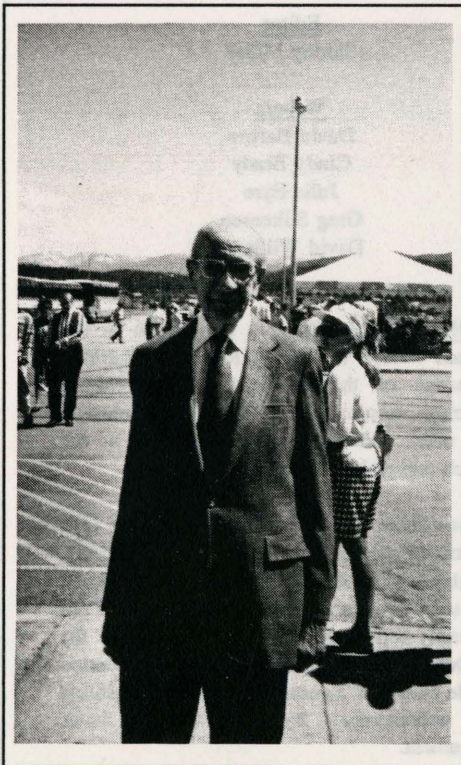
Colorado Water

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

WATER ITEMS AND ISSUES . . .

August 1994

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W.D. Farr honored -- Granby Pump Plant renamed Farr Pump Plant at June 18 ceremony.

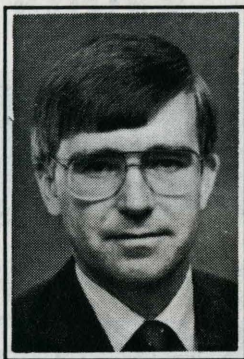


l-r: Skip Underwood, U.S. Forest Service,, Lee Carlson, U.S. Fish & Wildlife Service, and Frank Stephens, City of Greeley at Colorado Water Workshop, July 20-22, 1994. See page 22 for a summary of this year's workshop.

August 25, 1994 -- AWRA Colorado Section presents: THE STANDLEY LAKE PROTECTION PROJECT. Contact Steve Forvilly at Metro Wastewater Reclamation District 303/286-3325.

WHAT WOULD YOU HAVE US DO?

by Robert C. Ward



Despite the continuing uncertainty about federal funding for CWRRRI next year, we are proceeding to identify the top water research priorities for CWRRRI's 1995/96 research program. The research priorities are a critical component of CWRRRI's Request-for-Proposals (RFP) that is issued each October to

faculty in Colorado's higher education system. Identifying water research priorities involves a lot of listening, reading and the solicitation of opinions. I have attended a number of water meetings and conferences over the past year and am amazed at the number of discussions that end with the statement: "We need more information about this issue before we can proceed." I note the information need!

CWRRRI formally solicits water research priorities through its Research Planning Advisory Committee (RPAC). On page 3 of this issue of *Colorado Water* is the "ballot" that was sent to each RPAC member. In addition, *Colorado Water's* news digest section is reviewed to determine the water issues that are repeatedly mentioned in newspapers. I am also approached by water users with specific suggestions for research projects. The research needs are stated as questions to "place in context" the applied nature of the research that faculty will undertake. In addition, ballot items are stated in such a way that they can be addressed from many different disciplines, thus encouraging faculty from all areas of the university to submit proposals. I am finding that multi-disciplinary approaches often generate the most useful information for water users/managers.

RPAC votes help refine the list and at the same time narrow it down to the top 10 questions, which are then inserted into the RFP that is sent to Colorado's higher education faculty. (CWRRRI normally receives 30-35 proposals each year in response to its RFP.) I should note that some topics purposely are left off the ballot because they are currently being investigated by ongoing CWRRRI projects or projects funded by other sources. For example, the Front Range Water Forum is examining water supply issues and options for the metro areas along the Front Range. The Agricultural Experiment Station undertakes a number of agriculturally related water studies each year. There is no need for CWRRRI to duplicate studies.

Colorado Water readers are invited to help determine research priorities -- we are looking for as wide an input as possible. Simply copy the ballot, fill it out and return it to CWRRRI, call or write a letter to CWRRRI, or contact any one, or all, of the RPAC members listed on page 4 of this issue of *Colorado Water*. We welcome your input on setting research priorities.

Also, this is a good time to mention that the best way for a Colorado water user and/or manager to have his/her research need addressed by a CWRRRI research project is to offer to

match CWRRRI's funding. Money, I must admit, indicates a very high priority on the part of a water user/manager. Jointly funding projects with water users/managers makes CWRRRI's money go much further and faculty are able to undertake more in-depth research studies. Also, by working closely with a water user/manager, faculty must integrate their theory with practice, to the benefit of both. Everyone wins with such partnerships. Please contact me if you are interested in such cooperative water research efforts.

The bottom line for CWRRRI's water research program is to get the most important water research needs before Colorado's higher education faculty. Then the attention of Colorado's outstanding water oriented faculty (all 180 of them) can be directed toward helping solve the water problems faced daily by Colorado's water users and managers. Colorado water users/managers and higher education faculty working together -- it is a team that is hard to beat!

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WATER RESEARCH

CU RESEARCH PROGRAM LOOKS AT AMMONIA PROBLEMS IN COLORADO RIVERS

by William M. Lewis, Jr.

Editor's Note: The following article describes an ongoing research program at the University of Colorado that is increasing Colorado's understanding of its water quality problems.

INTRODUCTION

Five different forms of nitrogen are commonly found in the aquatic environment: particulate, dissolved organic, elemental, ammonia, and nitrate. Particulated nitrogen is typically associated with particulated organic matter, which may include either living organisms or nonliving organic debris. Dissolved organic nitrogen is a component of organic compounds such as amino acids or humic acids that are commonly found in both surface and groundwaters. Elemental nitrogen, also called dinitrogen, is abundant both in surface waters and groundwaters as a dissolved gas. In addition, both ammonia and nitrate are commonly found in surface waters and groundwaters.

Of the five major forms of nitrogen found commonly in surface waters, only nitrate and ammonia are presently subject to regulation for protection of water quality. Nitrate, which is a useful plant nutrient, is regulated because very high concentrations can present a health hazard in water supplies for human consumption. Ammonia is also an important plant nutrient, but can be toxic to aquatic life above certain threshold concentrations. Because wastewater discharges may contain large amounts of ammonia, the regulation of ammonia for protection of aquatic life is one of the most costly of all wastewater quality regulations affecting point source discharges in the United States.

AMMONIA IN SURFACE WATERS

Under natural conditions, the amounts of ammonia in surface waters are typically small (well below 1mg/l). Ammonia is supplied constantly to aquatic environments by decomposition of organic matter, which releases ammonia primarily from amino acids as they are broken down by microbes. When ammonia appears in oxygenated surface waters, it is typically converted to nitrate by a specialized group of microbes (nitrifying bacteria). In addition, ammonia in surface waters is in high demand by algae and aquatic vascular plants, because ammonia is the most efficiently used inorganic form of ammonia for the support of plant growth. Thus, accumulation of large amounts of ammonia under natural conditions is unlikely, although it may sometimes occur in deoxygenated waters.

AMMONIA IN WASTEWATER DISCHARGES

The treatment of wastewaters involves the decomposition of large amounts of organic matter. As in the natural environment,

decomposition inside a treatment plant releases ammonia through the action of microbes. However, because wastewater treatment plants concentrate organic waste, the decomposition products, including ammonia, are also more concentrated than they are in natural environments. Thus, wastewaters contain amounts of ammonia that are commonly as much as 100 times above the concentrations in unaltered surface waters.

Large amounts of ammonia in water can be toxic to aquatic organisms, especially fishes and invertebrates. Ammonia actually occurs in two different forms of water: ionized (carrying an electrical charge) and unionized (carrying no electrical charge). The unionized ammonia is responsible for toxicity, whereas the ionized ammonia (charged) is essentially harmless. Therefore, two factors affect ammonia toxicity: (1) the total ammonia concentration, and (2) the proportion of total ammonia that is unionized.

FACTORS CONTROLLING TOXICITY OF AMMONIA

The ionization of ammonia is controlled primarily by pH and temperature. As pH and temperature go up, the fraction of total ammonia that is unionized (toxic) increases. The pH effect is particularly strong. As a rule of thumb, an increase of one pH unit (e.g., from pH 7 to pH 8) raises the concentration of unionized ammonia by a factor of 10 if the total ammonia is held constant. Thus, a total ammonia concentration that may be harmless to aquatic organisms at pH 7 may be quite toxic at pH 8.

Recipients of discharge permits are expected to maintain total ammonia concentrations that are consistent with the protection of aquatic organisms. For ammonia, the calculation of this critical concentration is especially difficult because it involves not only the dilution factor caused by the mixing of the wastewater discharge with the receiving water, but also the proportion of total ammonia that is unionized. Because the proportion of ammonia that is unionized depends on both pH and temperature (which vary both seasonally and on a daily basis), the calculation of maximum allowable total ammonia can be quite difficult to estimate. A conservative approach can be taken by setting very low allowances for total ammonia. The difficulty in this approach, however, is that it may force treatment plants to make large investments in nitrification facilities that may not be actually needed. Therefore, methods for accurate calculation of ammonia discharge allowances are important both economically and environmentally.

MODELLING THE AMMONIA DISCHARGE ALLOWANCE

Studies at the University of Colorado-Boulder showed in the mid-1980s that 24-hour variation in pH and temperature is a particular problem for calculation of ammonia discharge allowances in Colorado. Streams in the state often do not have a tree canopy, tend to be very shallow for part of the year, and are subject to high solar irradiance because of Colorado's high elevation and low atmospheric moisture. For this reason photosynthesis (mainly by algae attached to rocks) is especially strong. Photosynthesis pushes the pH up in the daytime by removing carbonic acid from the water. At night, the pH falls as photosynthesis ceases. Thus, streams in Colorado are subject to especially strong 24-hour variation in pH. Temperature variation is also especially great because of the rapid heat loss of water to Colorado's clear night skies.

Because of these sources of variation, a grab sample for pH or a measurement of temperature at a particular time of day may be very misleading with respect to the 24-hour average pH or temperature. In fact, because most field information on both pH and temperature is taken toward mid-day, the pH and temperature readings are likely to be near their maximum in many field observations. This is unfavorable from the viewpoint of ammonia evaluation because it can lead to a serious overestimate of the 24-hour average unionized ammonia. This, in turn, could cause dischargers to invest in treatment facilities that might not actually be required if 24-hour estimates of pH and temperature could be factored into the calculation of discharge allowances.

In response to field observations of wide 24-hour variations in pH and temperature, William Lewis and James Saunders at the University of Colorado-Boulder began working in consultation with the Colorado Department of Health's Water Quality Control Division in the late 1980s to develop a computer model that would take into account all relevant environmental factors, including 24-hour variation in pH and temperature, to facilitate more accurate computation of ammonia discharge allowances. The result was named the Colorado Ammonia Model, and is now used by the Colorado Department of Health's Water Quality Control Division in setting ammonia discharge limits in Colorado. It gives maximum legitimate benefit to discharges, thus avoiding excessive treatment requirements for ammonia. While ammonia treatment is still essential in some situations, use of the Colorado Ammonia Model allows the Colorado Department of Health to help dischargers benefit from valid environmental factors that moderate the harmful effects of unionized ammonia.

In the early 1990s, Lewis and Saunders worked with USEPA Region VIII on a national version of the Colorado Ammonia Model. This version, which uses EPA standards rather than Colorado Ammonia standards, is dubbed AMMTOX, and is now available through EPA for dischargers around the country. The underlying philosophy is the same as for the Colorado Ammonia Model.

IMPROVEMENTS IN MODELLING

In 1993, the Colorado Water Resources Research Institute supported a project by Lewis and Saunders aimed at adding an additional level of sophistication to the ammonia models. The key question to be considered in this project involves the relationship between discharge (rate of flow) for streams, pH, and temperature. The problem can be illustrated by two extremes. If the lowest flows always coincide with high pH and high temperature, the regulating authority must assume that minimum dilution is available just at the time when the fraction of unionized ammonia is highest (i.e., least favorable). At the other extreme, the least favorable pH and temperature combinations might come when the discharge is highest. This would allow maximum dilution to offset in part the unfavorable effect of high pH and temperature in maximizing the fraction of total ammonia that is unionized. There are also various intermediate possibilities, including random association between discharge, pH, and temperature.

Lewis and Saunders studied the association between pH, temperature, and discharge at twelve sites in Colorado for which an extensive data record was available. The statistical study of the data for these sites showed no general relationship between flow, pH, and temperature. In other words, the percent unionized ammonia at any given station is not associated statistically with low flow at that station.

CONCLUSION

The findings from the statistical study of data from Colorado suggest that discharge permits could be written with modelling based on the assumption that dilution available to dischargers at the times of extreme pH and temperature combinations will be well above the lowest dilution of the entire year. This in turn would make ammonia discharge allowances more favorable, and would reduce the need for treatment of ammonia in some cases.

William M. Lewis, Jr. is a Professor in the Department of Environmental, Population, and Organismic Biology at the University of Colorado, Boulder. The completion report for his CWRRRI project is titled Improvements in the Colorado Ammonia Model by Simultaneous Computation of Extremes in Flow and Water Chemistry (see PUBLICATIONS, page 17). The research was partially supported by the U.S. Geological Survey, Department of the Interior, under Award No. 14-08-0001-G2008.

(see next page for References)

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HOW DOES SALINITY AFFECT HOUSEHOLD APPLIANCES?

by Carole J. Makela

Salinity in residential water supplies has been identified as a source of reduced effectiveness and lowered service lives of household appliances in many areas of the United States. Dissolved mineral constituents (often called salinity or dissolved solids) occur naturally in both surface and groundwater when water flows over rocks and through soils, and can be further augmented by human activities. In the Arkansas River Valley of Eastern Colorado, several communities rely on highly mineralized waters as their primary water source. Damage occurs from increased corrosion of metals in contact with water, scaling of contacted surfaces, higher costs for cleaning products, and diminished effectiveness of water during normal use.

Information on how salinity affects the service life of household appliances can be useful both to individual households and to those responsible for public policy regarding water quality. Households forced to use high-salinity water can benefit from this information when making decisions on whether to treat the water, to choose other actions (i.e., plastic components, more frequent maintenance), or to seek alternative supplies. Better information can also help public water quality agencies assess the economic merits of alternative water quality management policies.

This study developed improved techniques for measuring damage to household appliances from salinity and to test these techniques in a significant case study region. The Arkansas River basin was chosen as the study area because the range of salinity observed in household water is much wider than that addressed in previous studies. The techniques in applied statistics previously developed to study the effects of salinity on the durability of household appliances were again adapted and further extended.

This study statistically analyzed newly collected survey data obtained from the Arkansas River basin in Southeastern Colorado. Information was collected from 872 households on types and ages of water-using appliances owned and age at failure of previously owned appliances. This random sample of households was selected from communities experiencing salinity levels ranging from about 100 milligrams per liter in the mountain headwaters to 3500 mg/l in the eastern plains.

"Although marginal damages were expected to vary with salinity, it was surprising to find that they were highest at relatively low salinity concentrations (200 mg/l). Economic damages were estimated to be less than those reported in previous studies."

Employing the "accelerated-testing" method, a statistical technique developed to study the effects of operating conditions on the lives of durable equipment, the effect of salinity on appliance lives was measured. Total and marginal economic damages were then estimated. Although marginal damages were expected to vary with salinity, it was surprising to find that they were highest at relatively low salinity concentrations (200 mg/l). Economic damages were estimated to be less than those reported in previous studies. The difference in findings can be attributed primarily to technological improvements in the appliances since the last major data collection efforts. The lower damage estimates are also likely due to the employment of improved statistical techniques and to more complete data on appliance lives. The results suggest a need for reevaluating the basis for federal salinity control programs.

Carole J. Makela is Professor of Design, Merchandising and Consumer Sciences at Colorado State University. Her research is described in Completion Report No. 183, Improved Estimates of Economic Damages from Residential Use of Mineralized Water, by Guy E. Ragan, Carole J. Makela and Robert A. Young. It is available from the CSU Bulletin Room, Phone 303/491-6198. (see PUBLICATIONS, page 17). The research was supported by the U.S. Geological Survey, Department of the Interior, under Award No. 14-08-0001-G1984 and by the Colorado Agricultural Experiment Station.

RIVERINE HABITAT: CAN THE DAMAGE BE REVERSED?

by Mitch Peters

Editor's Note: This paper summarizes the context and research of Mitch Peter's M.S. research conducted under the guidance of Steve Abt, Professor of Civil Engineering at Colorado State University.

BACKGROUND

As populations increase, urban development is claiming more and more land that was once natural wetland and floodplain. Urbanization decreases the amount of water that can be absorbed (infiltrated) into the ground during rainfall events. Less infiltration is due to impervious surfaces such as asphalt and concrete which are common in developed areas. The decrease in natural infiltration leads to higher runoff levels in streams and rivers that act as metropolitan drainage facilities.

Flood control features are designed and added to rivers and streams so that they can safely convey the increased flow. The protection of life and property in populated areas is dependent on adequate flood control. An unwanted side effect of common flood control measures is that they often disrupt the delicate riparian habitat.

FLOOD CONTROL AND ECOLOGICAL INTEGRITY

Increased demand on the environment, including development and implementation of flood control modifications on natural watercourses, has upset the ecological integrity of our rivers and streams. What can be done to mitigate the damage and limit future impacts? An understanding of what constitutes desirable habitat is the first step. Implementation of habitat-compatible flood control designs and channel modifications is the goal.

Presently, methods are being pioneered that allow for evaluation of habitat quality. The implications of one such method, RCHARC (Riverine Community Habitat Assessment and Restoration Concept) will be investigated in the course of this article.

With proper care in channel design, natural stream reaches can maintain (and damaged areas can restore) ecological integrity. Tools that evaluate riparian habitat quality allow flood control project alternatives to be chosen based upon their environmental merit and their public safety attributes. Features that provide attractive habitat may be added to existing channels in order to rehabilitate habitat-impacted areas.

The advantages of considering habitat impact in flood-control design are numerous. Reduced impact to the riparian environment and creation of attractive habitat will help maintain or improve fish and wildlife populations. Outdoor activities such as biking, walking, running, picnicking, fishing, and kayaking are only a few of the positive offshoots of a well designed flood control project.

IMPACT OF DEVELOPMENT AND FLOOD CONTROL PROJECTS ON RIPARIAN HABITAT

Traditionally, the process of channelizing waterways for development and flood control has been conducted with little regard to the many natural resources and fragile habitat components of these riparian areas. Protection of life and property has always been paramount to river modification projects. Wide, straightened channels cleared of vegetation were constructed. The modified channels were hydraulically efficient and capable in conveying the high flows that flood control projects are designed for.

Figure 1 illustrates the difference between a natural cross-section and a traditional channelized cross-section.

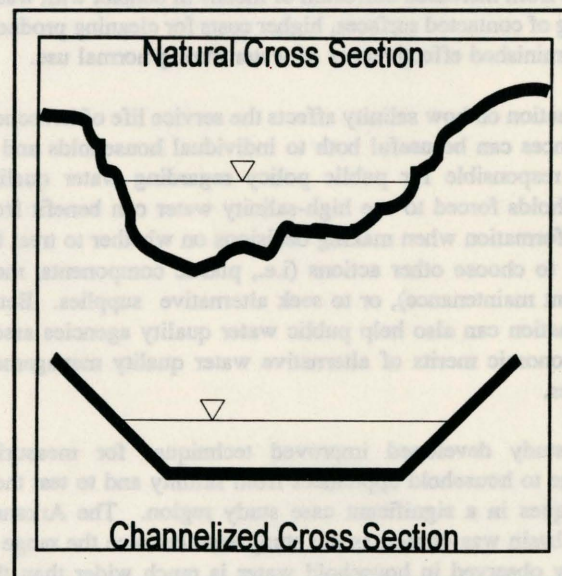


Figure 1. Cross-Section Comparison

The natural cross-section has a much more complex geometry which causes a variety of velocities and depths to occur across its width. This variation of velocity and depth leads to diverse habitat, which is more attractive to wildlife than the constant velocity and depth parameters caused by a channelized cross-section. At low-flow levels, the natural channel becomes narrow and maintains a reasonable velocity and depth distribution. At low flow, the channelized section remains relatively wide, causing low velocities and shallow depths. The low velocity,

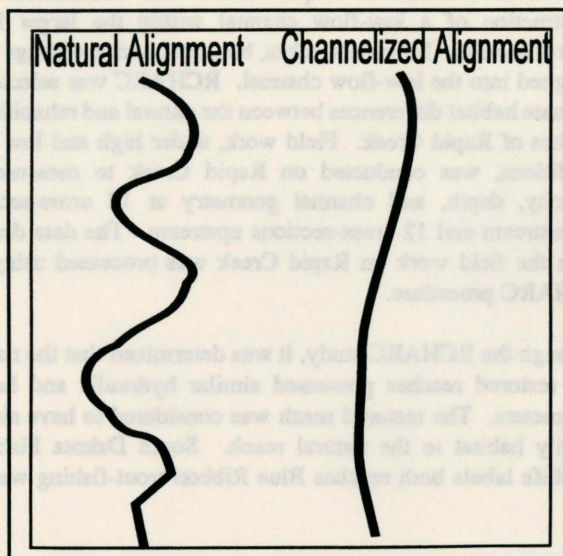


Figure 2. Alignment Comparison

shallow-depth combination of the channelized section brings about an increase in the water temperature and decrease in dissolved oxygen when compared to that of the natural section. Small changes in temperature and dissolved oxygen content in a stream may be responsible for driving fish away from a channelized area.

Straightening of the stream is another common channel modification. A natural watercourse and its straightened counterpart are shown in Figure 2. A straightened channel can be much shorter than a natural channel. By shortening the channel, the natural hydraulic equilibrium of the channel is altered. The shorter channel has a steeper bed slope which causes water velocities to increase. Increased velocities induce higher sediment transport capacity in the modified reach. A rise in sediment transport capacity may lead to problems with erosion, pier scour, and water quality.

METHODS FOR EVALUATION OF HABITAT

The increasing need to consider habitat impacts associated with channelization projects requires the development of a comprehensive methodology or procedure to compare habitat parameters. Popular modeling tools utilized by hydraulic engineers such as HEC-1 and HEC-2 do not have provisions for the evaluation of habitat differences between natural and proposed channel cases. Fluvial analyses utilizing these programs must be augmented with a separate habitat study. The Riverine Community Habitat Assessment and Restoration Concept (RCHARC) program offers hydraulic engineers an opportunity to add an environmental dimension to their studies of proposed development and flood control projects.

The RCHARC model, developed by Nestler et al. (1993), can be utilized to compare bivariate depth-velocity frequency

distributions of channel reaches to determine the difference in habitat quality of the reaches. RCHARC is a relatively simple method of habitat assessment. By ranking velocity and depth occurrence in comparison to channel reaches, RCHARC can be used to compare channel hydraulics. If habitat parameters like bed slope, bed material, water temperature, dissolved oxygen levels, and vegetation are similar between comparison reaches, the comparison of hydraulic parameters (depth and velocity) is an indication of riparian habitat similarity.

Existing methods of habitat evaluation include the Fish and Wildlife Service's Physical Habitat Simulation System (PHABSIM) (Milhous, et. al, 1989) stream classification methods, field studies, and design guidelines established by wildlife biologists and hydraulic engineers. PHABSIM investigates every life stage of every target species for the purpose of habitat evaluation. While this approach is comprehensive, it is also very complex. Stream classification studies tend to overlook subtle hydraulic differences between compared areas. Design guidelines and field experience are valuable to habitat studies, but do not account for the physical parameters of desirable habitat.

HABITAT CONSIDERATION IN THE DESIGN OF FLOOD CONTROL CHANNELS

Low-flow channels with meanders, pools and riffles, overhanging vegetation and ledges, boulders, snags, and other habitat features are being built into existing floodways and designed into proposed flood control projects. Such features have been added to the Blue River in Breckenridge, Colorado; the South Platte River in Denver, Colorado; Wildcat and San Pablo Creeks in Richmond, California; and Rapid Creek in Rapid City, South Dakota, to rehabilitate these streams where modification of their courses had been destructive to their natural habitat (Abt, Watson, et. al., 1994). The design of the habitat-enhancing structures implemented in these and many other cases has been accomplished by experienced engineers and wildlife biologists using guidelines available in existing literature, research of successful projects, and computer modeling techniques.

ADVANTAGES OF HABITAT REHABILITATION OR HABITAT CONSIDERATIONS IN DESIGN

The primary result of habitat-considerate channel design and rehabilitation projects is maintenance of natural riparian habitat. Natural or rehabilitated habitat makes possible a diverse wildlife population and conserves natural resources.

Recreational uses, including fishing, hiking, running, biking, and kayaking may be incorporated into channel rehabilitation projects. Just as changing a few hydraulic parameters causes a detrimental domino effect, habitat consideration causes a positive domino effect. Habitat rehabilitation makes an area more attractive, and people spend more time there. Communities get interested in improving wetlands and channels, and more restoration projects are initiated.

CASE STUDY; RAPID CREEK, SOUTH DAKOTA

In June 1972, heavy runoff from a 100-year precipitation event centered over the lower portion of the Rapid Creek Drainage Basin and caused massive flooding. Two hundred-thirty lives were lost, and over \$100,000,000 worth of property was damaged or destroyed in Rapid City, South Dakota.

As a direct result of this flood, and for the sake of preventing similar disasters in the future, flood control modifications to Rapid Creek were performed. High runoff and earth-moving equipment caused damage to the channel during a subsequent period of construction. A 3,000-foot reach of Rapid Creek was enlarged from an approximately 40-foot wide channel to approximately 100 feet in width (Glover and Ford, 1990). This change in channel morphology proved to be detrimental to the trout population in the area.

The in-town reach of Rapid Creek was rehabilitated by construction of a low-flow channel within the larger flood control channel. Meanders, dikes, boulders, and overhangs were designed into the low-flow channel. RCHARC was selected to evaluate habitat differences between the natural and rehabilitated reaches of Rapid Creek. Field work, under high and low flow conditions, was conducted on Rapid Creek to measure the velocity, depth, and channel geometry at 12 cross-sections downstream and 12 cross-sections upstream. The data derived from the field work on Rapid Creek was processed using the RCHARC procedure.

Through the RCHARC study, it was determined that the natural and restored reaches possessed similar hydraulic and habitat parameters. The restored reach was considered to have similar quality habitat to the natural reach. South Dakota Fish and Wildlife labels both reaches Blue Ribbon trout-fishing waters.

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WATER RESEARCH AWARDS

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

Colorado State University, Fort Collins, CO 80523

- ECOLOGY AND STATUS OF THE RIO GRANDE SUCKER IN COLORADO.**Brett Johnson and Robert Muth, Fishery and Wildlife Biology. Sponsor: Colorado Division of Wildlife.
- MONITORING AND ANALYSIS OF BANK STABILIZATION EFFECTIVENESS...**Chester Watson and Steve Abt, Civil Engineering. Sponsor: Corps of Engineers.
- BENEFITS OF STREAM RESTORATION...**John B. Loomis, Agricultural and Resource Economics. Sponsor: University of California.
- MIGRATION BARRIERS FOR MIXED WASTE LANDFILLS...**Thomas Hakonson, Fishery and Wildlife Biology. Sponsor: University of California/Los Alamos National Laboratory.
- CHANGES IN BED SEDIMENT SIZE DISTRIBUTIONS ALONG THE ATCHAFALAYA RIVER 1932-1991-...**Carl F. Nordin, Civil Engineering. Sponsor: Corps of Engineers.
- STREAM CHANNEL PROCESSES AT SQUAW CREEK AND RELATED TECHNOLOGY...**Lee H. MacDonald, Earth Resources. Sponsor: U.S. Forest Service.
- THE INDIRECT AND DIRECT EFFECTS OF HEAVY METALS ON BENTHIC MACROINVERTEBRATES...**William H. Clements and Peter M. Kiffney, Fishery and Wildlife Biology. Sponsor: Society of Environmental Toxicology and Chemistry.
- POUDRE RIVER LAND USE FRAMEWORK...**Jeffrey S. Lakey, Horticulture. Sponsor: City of Fort Collins.
- RANGE-WATERSHED TRAINING FOR NATIVE AMERICANS...**Ellsworth T. Bartlett and Freeman M. Smith, Range Land Ecosystem Science. Rocky Mountain Forest & Range Experiment Station.
- INTEGRATED MODEL FOR OPTIMIZATION OF WATER ALLOCATIONS...**Gustavo E. Diaz, Civil Engineering. Sponsor: Rocky Mountain Forest & Range Experiment Station.

- SAMPLING AQUATIC BIOTA ON U.S. FOREST SERVICE PICKET-WIRE CANYONLANDS...Kurt D. Fausch, Fishery and Wildlife Biology. Sponsor: U.S. Forest Service.
- *QUALITY ASSURANCE SUPPORT FOR THE NATIONAL ATMOSPHERIC DEPOSITION PROGRAM...David S. Bigelow, Natural Resource Ecology Lab. Sponsor: U.S. Environmental Protection Agency.
- *INTERDISCIPLINARY SCIENCE INVESTIGATION OF CLOUDS AND THE EARTH'S RADIANT ENERGY SYSTEM...David A. Randall, Atmospheric Science. Sponsor: National Aeronautics and Space Administration.
- *SYSTEMS APPLICATIONS IN AGRICULTURAL PRODUCTION...Janice G. Nixon, Cooperative Extension. Sponsor: USDA/ARS.
- *FISH HABITAT STRUCTURAL DIVERSITY INDICES AND THE RECONSTRUCTION OF LAKE BASINS AT RMA...Eric P. Bergersen, Cooperative Fish and Wildlife Research. Sponsor: U.S. Fish & Wildlife Service.
- *MODELING BIOSPHERE-ATMOSPHERE INTERACTIONS AT VARIOUS SCALES IN SUPPORT OF BOREAS, Roger Pielke, Atmospheric Science. Sponsor: NASA.
- *A STUDY OF WATER VAPOR OVER THE GLOBAL OCEANS IN COMPARISON WITH CLIMATE MODEL SIMULATION, Graeme Stephens, Atmospheric Science. Sponsor: NASA.
- AQUATIC INVENTORY DATA GOCO, Roger Hoffer, Forest Sciences. Sponsor: Colorado Division of Wildlife.
- COMPARATIVE ECOSYSTEM DYNAMICS IN RIPARIAN ZONES ALONG REGULATED & UNREGULATED RIVERS, David Cooper, Fishery and Wildlife Biology. Sponsor: National Park Service.
- MULTI-RESOURCE ECOSYSTEM MODEL REVIEW, Charles Grier, Forest Sciences. Sponsor: U.S. Forest Service-Rocky Mtn. Experiment Station.
- EVALUATION OF UPPER BEAVER MEADOW, ROCKY MOUNTAIN NATIONAL PARK, Lee MacDonald, Earth Resources. Sponsor: National Park Service.
- COMPILATION OF EXISTING INFORMATION ON FISHES IN THE SOUTH PLATTE, REPUBLICAN, AND ARKANSAS RIVERS, Robert Muth, Fishery and Wildlife Biology. Sponsor: Colorado Division of Wildlife.
- MEASURING THE ECONOMIC BENEFITS OF RIO MAMEYES ECOLOGICAL INTEGRITY, John Loomis, Agricultural and Resource Economics. Sponsor: U.S. Forest Service.
- EVALUATION OF DIMP ACCUMULATION IN FOUR VEGETABLE CROPS, Gregory Butters, Soil and Crop Science. Sponsor: GeoTrans, Inc.
- EFFECTS OF RECREATIONAL TRAIL USE ON BIODIVERSITY, Richard Knight, Fishery and Wildlife Biology. Sponsor: City of Boulder.
- *LARGE-SCALE WATER BUDGETS FOR THE UNITED STATES, Jorge Ramirez, Civil Engineering. Sponsor: U.S. Forest Service-Rocky Mountain Experiment Station.
- LOWER ARKANSAS RIVER BASIN FOLLOWUP SURVEY, Michael Manfredo, Natural Resource Recreation and Tourism. Sponsor: Colorado Division of Wildlife.
- CONSEQUENCES OF LANDSCAPE PATTERNS 7 ECOLOGICAL PROCESSES OF BIOLOGICAL DIVERSITY, Richard Knight, Fishery and Wildlife Biology. Sponsor: Colorado Division of Wildlife.
- INTERNATIONAL SATELLITE CLOUD CLIMATOLOGY PROJECT SECTOR PROCESSING CENTER FOR GOES, Thomas Vonderhaar, CIRA Admin Unit. Sponsor: National Oceanic and Atmospheric Administration.
- FIELD STUDIES AND MODELING OF CROPPING SYSTEMS AND THEIR IMPACT ON WATER QUALITY..., Gary Peterson, Soil and Crop Science. Sponsor: USDA-Agricultural Research Service.
- DEVELOPMENT OF ENHANCEMENTS TO THE INTEGRATED RIVER BASIN ENVIRONMENTAL MANAGEMENT SYSTEM..., Luis Garcia, Agricultural and Chemical Engineering. Sponsor: U.S. Bureau of Reclamation.
- MESOSCALE ANALYSIS AND FORECAST PRODUCT DEVELOPMENT FOR SEVERE STORM NOWCASTING, Thomas Vonderhaar, CIRA Admin Unit. Sponsor: National Oceanic and Atmospheric Administration.
- *CRDSS - CONSUMPTIVE USE MODEL, Luis Garcia, Agricultural and Chemical Engineering. Sponsor: Riverside Technology, Inc.
- *CRDSS - PHYSICAL CHARACTERISTICS DATABASE, Luis Garcia, Agricultural and Chemical Engineering. Sponsor: Riverside Technology, Inc.

University of Colorado, Boulder, CO 80309

- MOVING FROM PROJECT TO AREA MANAGEMENT...Lawrence J. MacDonnell, Natural Resources Law Center. Sponsor: Bureau of Reclamation.
- *THE EFFECTS OF CLIMATE VARIATION ON DISTURBANCE REGIMES AND THE DYNAMICS OF MONTANE FORESTS IN THE COLORADO FRONT RANGE...Thomas Veblen, Geography. Sponsor: National Park Service.
- IMPACT OF FLOWS AND GEOMORPHOLOGY ON FOOD WEB DYNAMICS OF THE COLORADO RIVER NATIVE FISH COMMUNITY...John Pitlick, Geography. Sponsor: U.S. Fish & Wildlife Service.
- COMPETITIVE BINDING OF POLYCYCLE AROMATIC HYDROCARBONS (PAH'S) BY AQUEOUS ORGANIC MATTER, MINERAL-BOUND ORGANIC MATTER, AND MINERAL SURFACES--EFFECTS ON GROUNDWATER...Gary Amy, Civil, Environmental, and Architectural Engineering. Sponsor: National Science Foundation.
- *CONTINUE DESIGN AND DEVELOPMENT OF THE POWER AND RESERVOIR SYSTEM MODEL (PRSYM)...Edith Zagana, CE&A Advanced Decision Support for Water and Environmental Systems. Sponsor: Electric Power Research Institute.
- *Supplement to existing award.

FEATURES

COLORADO BIG THOMPSON PROJECT CELEBRATES TWO MILESTONES

ADAMS TUNNEL "HOLIN' THRU DAY" OBSERVED

On a sunny Friday, June 10, 1994, the fiftieth anniversary of the "holing through" of the Adams Tunnel was celebrated at the Estes Park Area Historical Museum. Fifty years earlier, construction crews working from both the east and west portals of the tunnel set off the final blast linking the tunnel's portions and connecting the East and West slopes.

The Adams Tunnel is part of the Colorado-Big Thompson (CBT) project, which collects Colorado River water on the West Slope and transports the water via the Adams Tunnel to the East Slope for delivery within the Northern Colorado Water Conservancy District (NCWCD). The tunnel is named for Alva B. Adams, a former Colorado Senator who helped secure federal funding for the CBT project during the 1930s.



Estes Park Mayor Bernie Dannels speaks at "Holin' Thru" Day



Boy Scout Les Parker, whose grandfather worked on the Adams Tunnel Project, accepts plaque on behalf of his grandfather and other tunnel workers.

We must remember the conditions under which [the Adams Tunnel] was built. The nation was emerging from the Great Depression, the West was trying to survive the 'Dust Bowl' days, and World War II held the nation's attention, men, and material. The men who studied, designed, and built the Adams Tunnel and the entire CBT project showed the foresight and vision from which we all benefit today.

The commemoration included dedication of a plaque affixed to a rock acquired from tunnel construction, open houses at both the Estes Park Area Historical Museum and the Bureau of Reclamation's Lake Estes Power Plant, antique automobiles, and music from Estes Park's *Village Band*.

Colorado State historian Daniel Tyler, author of the *Last Water Hole in the West* (a history of the CBT and the NCWCD), spoke at the dedication ceremony. He emphasized the historical significance of the tunnel's completion during World War II and reminded attendees of what northeastern Colorado was like before the CBT existed:

[Eastern Colorado] was a dry country with inadequate water supplies which the early explorers labeled the 'Great American Desert.'

Approximately a dozen men who had worked on the Adams Tunnel construction project attended the ceremony. NCWCD Manager Eric Wilkinson emphasized the importance of commemorating not only the tunnel, but remembering and thanking these men who built it. "We gather today to remember and thank those from whose efforts we benefit, and we rededicate ourselves to protecting and managing those water resources which are so precious to our region."

GRANBY PUMP PLANT RENAMED



Newly renamed Farr Pumping Plant (formerly Granby Pumping Plant on Granby Reservoir, part of CBT Project)

On June 18, 1994 a ceremony was held at Lake Granby to rename the Granby Pump Plant in honor of the Farr family of Weld County. Part of the Colorado-Big Thompson (CBT) water diversion project, the Granby Pump Plant is located on the north shore of Lake Granby in Grand County on Colorado's West Slope. Originally completed in 1951, the pump plant is known as the "heart" of the CBT project, which diverts Colorado River water to the East Slope for delivery within the Northern Colorado Water Conservancy District (NCWCD).

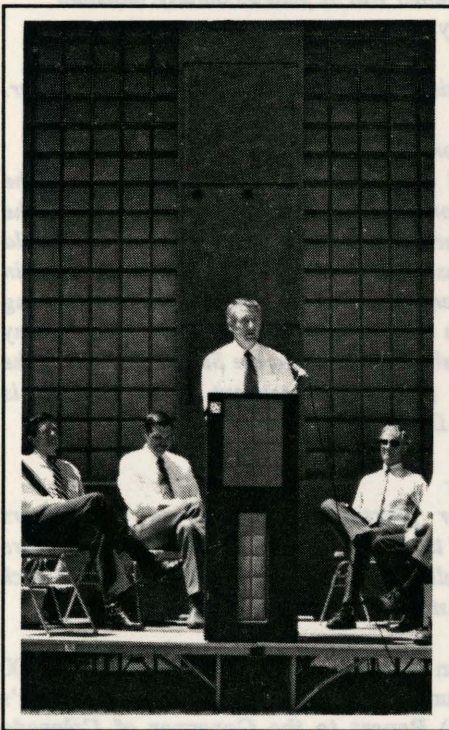
The history of the Farr family in Colorado stretches back to 1876, when William H. Farr opened a blacksmith shop in Greeley. The family later helped revolutionize farming practices and the sheep and cattle industry in Weld County. The Farris became active in water when Harry W. Farr became a strong proponent of the Grand Lake water diversion project, later known as the CBT project. W.D. Farr, son of Harry Farr, gained an education in water issues as he accompanied his father on his trips around the state to educate Coloradans about water and to promote the CBT

project. W.D. was appointed to the NCWCD's board of directors in 1955 and continues today as an active board member. In 1970 he was selected as the first president of the Municipal Subdistrict, NCWCD, a position he continues to hold today.

The renaming of the Granby Pump Plant was in part a result of passage of the Colorado Wilderness Act signed into law by President Clinton on August 13, 1993. The bill added over 600,000 acres to Colorado's wilderness system, and authorized the renaming proposal. Colorado Senator Hank Brown was instrumental in securing passage of the 1993 wilderness bill, and served as keynote speaker at the ceremony. Senator Brown praised the Farris for their foresight and hard work to plan for Colorado's future water needs:

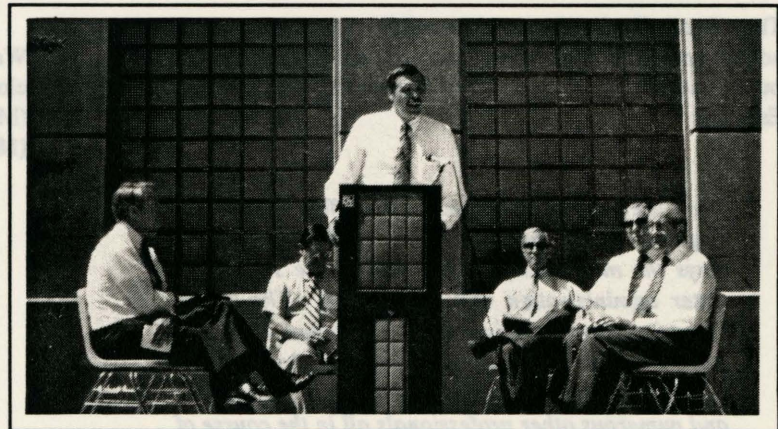
There are two types of people. One type notices only what is wrong with the world and bitterly complains, but does nothing. The second type, epitomized by W.D. Farr, his father, and grandfather, sees what needs to be done and diligently works for positive change. People like the Farris helped build this country and make it great. We cannot thank them enough.

Other guest speakers at the ceremony included Hal Simpson, Colorado State Engineer, Bob Anderson, Chairman of the Grand County Board of Commissioners, Former Colorado State



Colorado Senator Hank Brown at dedication

Senate President Fred Anderson, and Daniel Tyler, Colorado State University historian. W.D. Farr was visibly touched by the dedication ceremony, stating that the renaming of the pump plant is the greatest honor that he and his family could receive.



NCWCD Manager Eric Wilkinson at dedication

WHO REALLY "MANAGES" COLORADO RIVERS?

by John R. Eckhardt
Associate Director, CWRI

After reviewing a number of recent academic papers on the subject of river basin Decision Support Systems (DSS's), I realized that an important aspect of water management may have been overlooked or misunderstood. The term **water management**, as applied to Colorado rivers, suggests two other verbs: **administer** and **operate**. A definition of administer is "to have charge of; manage." A definition of operate is "to conduct the affairs of; manage." Finally, a definition of manage is "to direct or administer." Therefore, is operation or administration of a river the same as management of a river?

When I read that this court or that water district **manages** the river, I ask myself, "Who is really **managing** the river?" More importantly, "Who manages the wet water for maximum benefit?" When we look at the various water agencies and organizations in Colorado, the State Engineer's Office comes to mind when thinking of **administering** entire river basins. So, is the State Engineer's Office the river manager? If so, how is it done?

The State Engineer and Division of Water Resources are agencies of the State of Colorado, and operate under specific state statutes, court decrees, and interstate compacts. The mission statement is: "...to serve the needs of the public and to preserve, protect, develop, and maximize the beneficial use of the state's present and future water supplies." The duties and major responsibilities are primarily enumerated in the *Colorado Revised Statutes*, and are in large part found under Article 80 of Title 37, with such subtitles as:

- Dam Safety
- Ground Water Well Permits
- Hydrography and Water Supply Reporting
- Interstate Compacts
- Record Keeping
- Enforcement
- Water Distribution or River Administration.

The State Engineer is responsible for distribution and administration of river water, but how are these duties carried out? According to Mr. Jeris Danielson, the former State Engineer:

Of all the types of employees in the Office of the State Engineer, it is probably the Water Commissioner who plays the most indispensable role in the scheme of water administration and distribution. The Water Commissioner is required to be a diplomat, engineer, attorney, arbitrator, weather forecaster, hydrologist, geologist, geo-hydrologist, peace officer, politician, and numerous other professionals all in the course of one day.

To understand what a Water Commissioner is or does requires looking back at the history and evolution of the position. In 1879, a short time after statehood, the Colorado Legislature authorized the position of Superintendent of Irrigation (similar to today's Water Commissioner, which incidentally predates the State Engineer's position). Water Commissioners were appointed by the governor upon the recommendation of the Board of County Commissioners and paid by the county or counties in which the water district was located. Water Commissioners were usually closely aligned to party politics. Thus, a change in state's political composition could easily result in a change of Water Commissioners.

In the State Engineer's (Mr. J. P. Maxwell) **Fifth Biennial Report to the Governor of Colorado (1889-1890)**, a note "To Water Commissioners" stated:

Pay: Commissioner will be paid \$5.00/day, assistant \$2.50/day.

Commissioner will work no more than 60 days/year.

Daily Regulation:

You will observe that it is made the duty of the Water Commissioner to be actively employed on the line of the streams in his water district. He should keep himself posted daily as to the flow of water in the streams, and as to what ditches are taking water, in order that a report may be made at any time on short notice from the Superintendent of the Division (here Superintendent of the Division is same as Division Engineer).

Beneficial Use:

Wherever practical, you will see that waters supplied to ditches in accordance with priority, are beneficially and economically used, or turned back into the streams for benefit of others.

Water districts began to evolve prior to statehood and by 1900 closely resembled current water districts. The State Engineer's (Mr. C. B. Cramer) **Report to the Governor of Colorado (1893-1894)** reads in part:

I would also advise a change of the boundaries of District 17...This is a matter of the greatest importance, as it is this strip of territory on which the great battle between the people and superintendent of irrigation is fought. If the portion of the valley for forty miles east...were in one district, it would be under the control of one man, who could not shift the responsibility. As things are now, the inefficiency of the Commissioner in the upper district can militate

against the very best endeavors of the Commissioner in the lower district and of the Superintendent, besides the fact that all shortcomings are blamed on the latter party.

In the State Engineer's (Mr. E. S. Nettleton) Report to Governor of Colorado (1883-1884) the duties and qualifications of a Water Commissioner are defined as follows:

Duties:

But a few years ago, the march of the whole body of irrigators of a neighborhood, into the up-stream country to shut down head gates, and compel the "up-streamers" to let water pass, was not an uncommon occurrence. But now the whole matter is regulated: the "shot-gun" power has given place to law and order; the decisions of the courts, when put into practical effect by the acts of the Water Commissioner, will be enforced by the whole power of the State.

Qualifications:

Nor can it be expected that a person who has spent his life in "whacking bulls," or engaged in some other exclusively manual pursuit, will take Kutter's formula... determine therefrom the coefficient of mean velocity, ratio of fall to distance, area of cross section, wetted perimeter, hydraulic mean depth, then guess at the coefficient of roughness, extract the square root of one factor and raise another to the powers that be, and evolve from this labyrinth of Greek literature the velocity of water per second - at least without indulging in a degree of profanity that should not be encouraged.

In the early days a Water Commissioner "administered" or "managed" the river by being a water policeman. In fact, commissioners were deputized by the county sheriff and had statutory police powers, including the power to arrest. In some cases they even carried guns to take care of those diverters who were not in priority or wasting water. In addition, as noted in the State Engineer's Reports, a Water Commissioner had to know the current status of a stream at all locations, and provide an annual report to the State Engineer.

Water Commissioners today don't carry guns, as was required in earlier "shot gun" administration. Today Water Commissioners use something probably just as effective -- an attorney and the court system. Water law has evolved and changed within the last 100 years to meet the demands and needs of growth, particularly in the urban sector. The 1969 Water Rights Determination and Administration Act (which integrated surface and groundwater rights) has probably had the largest impact on the duties of Water Commissioners. The required abilities of a Water Commissioner may have advanced technically. However, a good "bull whacker" might be just as effective in some situations even today.

Today, typical water commissioner duties per the State Engineer's water commissioner manual include:

1. Setting River Calls
2. Regulate diversions or headgates
3. Distribute storage water
4. Distribute transbasin or transmountain water
5. Meet compact obligations
6. Inspect dams
7. Inspect wells
8. Enforce restrictions
9. Keep records
10. Compute charts
11. Read meters
12. Inspect/review water court filings
13. Assist in stream measurements
14. Respond to public concerns
15. Develop administration list
16. Develop line diagrams
17. Develop maps of water rights
18. Keep call record
19. Deliver augmentation and exchange water

With few exceptions, today's duties probably vary little from those a century ago. But today, a commissioner might be dealing with thousands of water rights and structures, thousands of wells, and hundreds of augmentation plans and exchanges.

So, how does a Water Commissioner "manage" the river? A Water Commissioner manages the river for maximum use (quantified as river calls) using knowledge of river flows at all critical points in the river system, river system losses and gains, return flows, timing of flows from one point to another, water user's critical demand needs, and water rights priorities (minimum flows, storage rights, direct flow rights, exchanges, substitute supplies, etc.). Based on the river hydraulics, several calls on one river can be set. In some cases (either excess water or futile call situations) conditional rights and undecreed rights are allowed to divert if there is no injury to decreed water rights.

What are some of the issues related to Water Commissioners and how they do their jobs? Learning a river system is easiest when a person grows up with the system. Thus, in the past a commissioner's education often began when a system was simple and the person was raised along the river. Of course, Water Commissioners do retire, and today new commissioners must face a more complex system, often without the benefit of this kind of education.

With the large number of water rights today, some Water Commissioners have a hard time getting out to the rivers to see water flowing. They're not on the river banks because they are spending more and more time buried in paper work. So-called "creative" water rights transfers, plans for augmentation, and exchanges look good on paper to the courts, water engineers and attorneys, but are becoming very difficult and complex to operate. Operations are not standardized in the exchange and

augmentation decrees. As a result, Water Commissioners must interpret what the courts, engineers, and lawyers intended.

Although the Division of Water Resources staff can assist the Water Commissioner, a good share of their time is taken up in the court system supporting the legal and constitutional issues related to these water rights transfers. Consequently, Water Commissioners are faced with the formidable task of understanding these decrees from an operations and regulations stand-point, and trying to "manage" what's becoming a "paper river."

Can the latest computer technology help commissioners manage the river? Computers will do almost anything (providing a commissioner has one). The problem is, computers are dumber than a "bull whacker." Without the appropriate software, a Water Commissioner can spend a great deal of time discussing the finer points of computing with these machines. Although the Division staff offers assistance, the problem can be overwhelming. For example, no longer does a commissioner keep diversion records by structure name in a 4- by 6-inch brown book. Instead, he must assign numbers to each diversion/water right and use numeric codes to define direct diversion, storage, exchange, etc., for computer consumption. Some commissioners have become fairly adept at this; however, it certainly takes a good share of their time. As water rights transfers increase and become more complex, a water commissioner's ability to translate "paper" water to management of "wet" water on the river is becoming intractable, and in fact is approaching what might be called "gridlock."

Another important technology is the State's satellite hydro-meteorological data collection system. Because Water

Commissioners do not get out on the river as they did 100 years ago, this has become an invaluable tool for river administration.

Unfortunately, not every water commissioner has ready access to a personal computer to utilize this information. Those who have access are doing a very good job of managing the river.

A new problem, however, has developed as a result of new technology. A Water Commissioner's river management decisions are almost immediately available to the public. As a result, the average water user, with the benefit of hind sight, can look at the satellite information and play Monday morning quarterback to question, second-guess, or criticize a Water Commissioner's decisions. In addition, river management is becoming more timely and sophisticated. For example, a one-hour rain storm potentially means that water could be made available for junior rights if the river call is set more junior for an hour or two. This is certainly maximization of the beneficial use of water, but often leads to a greater work load than a commissioner can handle. As a result, the Water Commissioner is approaching gridlock due to the "paper river" problem.

In conclusion, I believe that river basin water management, administration, and operation are being done by Water Commissioners rather than the courts or water districts. These people are the real river managers. Thus, when I see papers written or hear discussions about our court systems managing the river, or various water districts managing the river, I am not sure we understand river basin water management and the important role of a Water Commissioner. I take my hat off to all the Water Commissioners in Colorado and the great job they are doing. Unless you have been in their shoes, it is difficult to understand what a hard job they have in managing the "paper" and "wet" water within the state.

WATER PUBLICATIONS, DATABASES, VIDEOS

NEW CWRRI REPORTS

To order CWRRI reports contact the CSU Bulletin Room, 115 BRB Building, Colorado State University, Fort Collins, CO 80523; Phone 303/491-6198.

Improvements in the Colorado Ammonia Model by Simultaneous Computations of Extremes in Flow and Water Chemistry, by William M. Lewis, Jr. and James F. Saunders, III. Completion Report No. 178. Price: \$7.

Improved Estimates of Economic Damages from Residential Use of Mineralized Water, by Guy E. Ragan, Carole J. Makela and Robert A. Young. Completion Report No. 183. Price: \$9.

MISCELLANEOUS REPORTS

1993 Proceedings, Joint Annual Meeting: Four States Irrigation Council and Upper Missouri Water Users Association, Dec. 7-10, 1993. Contact: Upper Missouri Water Users Association, 1104 Westwood Drive, Pierre, SD 57501.

USGS REPORTS

Physical, Chemical, and Biological Data for Detailed Study of Irrigation Drainage in the Uncompahgre Project Area and in the Grand Valley, West-Central Colorado, 1991-92, by David L. Butler and Winfield G. Wright, U.S. Geological Survey; Dorothy A. Hahn, Richard P. Krueger, and Barbara Campbell Osmundson, U.S. Fish and Wildlife Service. U.S. Geological Survey Open-File Report 94-110. Copies can be purchased from: USGS, Earth Science Information Center, Open-File Reports Section, Box 25826, MS 517, Denver Federal Center, Denver, CO 80225.

VIDEOS

The Hidden Flood: San Luis Valley, Mitigation Project. VHS. 7 minutes. 1994. This video documents the effort and discusses the goals of the "service learning program" in which students were trained in floodproofing techniques and then sent to Conejos County to assist homeowners who were threatened with rising flood waters. The program was created by the Colorado Office of Emergency Management and the Center for Community Development and Design at the University of Colorado-Colorado Springs. Price: \$ 7. To order, contact the Colorado Office of Emergency Management, attn: Robert Kistner, 15075 South Golden, Road, Golden, CO 80401-3979. Make checks payable to: The Colorado Office of Emergency Management.

DATABASES

The Association of State Dam Safety Officials, Inc. is formulating a database on current research in dam safety. To provide information for the database, request a research summary form from ASDSO, 450 Old East Vine, 2nd Floor, Lexington, KY 40507. Phone 606/257-5140; FAX 606/323-1958. Deadline: August 31, 1994.

INFO HIGHWAY

American Rivers' news releases and other background materials are now available on Econet and Internet. On Econet, simply visit the conference <amrivers.news>. On Internet, gopher to this address: <gopher.econet.apc.org>; choose "environment," then "organizations on Econet," then "American Rivers."

WATER SUPPLY

The Surface Water Supply Index (SWSI) developed by the State Engineer's Office and the USDA/SCS is used as an indicator of mountain-based water supply conditions in the major river basins of the state. It is based on snow pack, reservoir storage, and precipitation for the winter period (Nov.-April). During the winter

WATER EDUCATION

Free Packets Provide Water Quality Information

A free information packet about water resources is available through the Soil and Water Conservation Society (SWCS) and the U.S. Department of Agriculture's Soil Conservation Service.

Originally Developed to give the readers of *National Geographic* (November 1993 issue) information about water quality, the packets have also been distributed to schools, scouts, and other youth groups. The Packet contains information that could benefit people in all areas of the country. Included are:

- * "The Water cycle: Nature's Recycling System," a beautiful color poster that includes general information about water and educational activity suggestions;
- * "Your Hometown Clean Water Tour," an attractive color fold-out poster that lists ways individuals can help protect water from pollution;
- * a "Water in Your Hands" cartoon book (also available in Spanish) that illustrates how water becomes polluted and how we can improve water quality;
- * an order form for additional water education materials;
- * information about becoming an Earth Team volunteer; and
- * a response card for comments and bulk poster orders.

To order the clean water packet, or for more information about its contents, call (800) THE-SOIL (800-843-7645).

period snow pack is the primary component in all basins except the South Platte, where reservoir storage is given the most weight. The following SWSI values were computed for each of the seven basins on July 1, 1994 and reflect conditions during the month of June.

<u>Basin</u>	<u>July 1, 1994 SWSI Value</u>	<u>Change From Previous Mo.</u>	<u>Change From Previous Yr.</u>
South Platte	+2.2	-0.4	-0.2
Arkansas	+1.7	-0.7	-0.6
Rio Grande	+0.6	-0.9	-0.7
Gunnison	+0.1	-0.6	-2.4
Colorado	-1.8	-1.4	-3.7
Yampa/White	-3.8	-0.9	-6.0
San Juan/Dolores	+0.2	-0.1	-1.9

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

WATER NEWS DIGEST

WEATHER

Northwest Colorado Driest Since Dust Bowl Era

Areas around Meeker, Colorado, including parts of both Rio Blanco and Routt counties, are the driest in sixty years, according to ranchers in the area. Little if any rain has fallen all summer. Signs of drought include abundant dust, dying vegetation, and springs and small creeks which are dry for the first time since 1934. The aridity has been a major factor in the number of wildfires in western Colorado, just as it has in other parts of the western United States. Governor Roy Romer is considering designating Rio Blanco County a disaster area, making ranchers and farmers eligible for low-interest federal loans. Ranchers have asked Romer to provide National Guard assistance to help haul water to their livestock on parched federal rangeland. Livestock are currently overgrazing any areas where they can find water, which may lead federal officials to require ranchers to pull their livestock off public land early this year. Other Colorado counties which may be considered for disaster declaration include Phillips, Sedgwick, Logan, Yuma, Morgan, Routt, and parts of Washington.

In general the northern half of the state is in worse shape than southern Colorado east and west of the continental divide. Northern Colorado rivers are at their lowest levels in 17 years. Rivers all across the state are experiencing legal calls, which allocate water by priority according to the date of a water right. On the Colorado River the Public Service Company's Shoshone Power Plant, with a 1905 senior right to water on the mainstem of the Colorado River, placed a call on the river June 29, 1994, forcing junior appropriators to cease or reduce diversions and increase releases from Green Mountain Reservoir on the Blue River. The "Shoshone call" legally cuts the amount of water available for diversion to the East Slope by Denver, Colorado Springs, and Aurora.

In addition to the Shoshone call, Grand Valley irrigators have also placed a call on the Colorado River known as the "Cameo call." The three main irrigation groups in the valley hold rights to a flow of 2,260 cfs, which make up this call. For now, the additional releases from Green Mountain Reservoir are expected to satisfy most needs. Later in August, additional releases will be made from Ruedi Reservoir on the Fryingpan River. On the South Platte River the call now stands at 1871, meaning those with water rights junior to this date cannot legally draw water from the river. State Engineer Hal Simpson expects the 1866 call to come any day. However, Simpson is unaware of any municipality that has been forced to restrict water use thus far.

Some weather observers are comparing this year to 1977, Colorado's most severe drought year in recent memory. However, snowpack this past winter was greater than that in 1977. But recent weather patterns do have state officials worried. If current conditions persist it may be necessary to

drain much of the water stored in Green Mountain Reservoir for Grand Valley irrigators during this growing season.

Grand Junction Daily Sentinel 7/6/94, 7/20/94; Denver Post 7/28/94; Pueblo Chieftain 7/7/94

WATER ALLOCATION

NCWCD Hikes Water Quota

The Northern Colorado Water Conservancy District (NCWCD) Board, responding to the continued dry weather in northeastern Colorado, increased the Colorado-Big Thompson (CBT) project's 1994 quota from 60 to 70 percent. This will make an additional 31,000 acre-feet of water available to CBT allottees within district boundaries. This means that those who own one share of CBT water can use the equivalent of 70 percent of that share. Precipitation within the district has been the lowest since records began in 1957. Streamflows within the South Platte basin are 60 percent of average, resulting in additional water being released from storage reservoirs in larger quantities and earlier in the summer than usual.

Greeley Tribune 7/9/94

Platte River Consensus Reached

The Department of the Interior has announced that Secretary Bruce Babbitt and the governors of Colorado, Wyoming, and Nebraska have reached a broad consensus "on a process to provide certainty in water supplies, protect wildlife habitat, and help prevent the listing of additional endangered species on the Platte River Basin." The memorandum of agreement will serve as the framework for negotiations on a basin-wide recovery plan. The process will address ongoing consultation on dealing with streamflow in the Platte River and possible development of future water projects within the river basin. The memorandum will be in effect for one year unless terminated by one of the signatories.

Western States Water 7/1/94

Possible Solution Found for CAP Woes

After months of debate, the Central Arizona Water Conservation District, which manages the Central Arizona Project (CAP), has adopted a plan designed to encourage Central Arizona farmers to use CAP water instead of groundwater. Over the next 10 years, a limited amount of CAP water will be offered for sale to irrigators at \$17 an acre-foot and \$27 an acre-foot, one-third the cost of actual delivery. The municipal areas of Phoenix and Tucson, in turn, will pay about \$60 an acre-foot. Reserves accumulated from property taxes will subsidize the agricultural users.

Until Arizona uses its full Colorado River entitlement, urban southern California hopes to continue to divert the unused apportionment -- just as it has since 1941. Arizona considered, but rejected for the time being, leasing water to California and Nevada because demand projections show the Colorado River supply being fully used in Arizona within the next 30 to 50 years.

Officials from the three states are pursuing a water banking arrangement in which additional Colorado River water would be stored in Arizona aquifers in wet years. Arizona, in turn, would use this water in dry years and allow California and Nevada to use more Colorado River water. Meanwhile Nevada, which has rights to the least Colorado River water among all seven basin states, is seeking ways to increase its share.

Western Water May/June 1994

Arkansas Valley Water Banking Plan Considered

A water banking scheme being contemplated by the Fort Lyon Canal Co. could provide a model for other areas of the state. The idea for a water bank developed after the Colorado Water Conservation Board's study of the canal, initiated after an unsuccessful plan by Colorado Interstate Gas to purchase a majority of shares in the canal company and pipe up to 50,000 acre-feet of water to Denver. The bank would keep water from the canal in the Arkansas Valley by linking those who want to sell their water with those who want to buy, including cities and industry.

Pueblo Chieftain 7/23/94

WATER PROJECTS

Cutbacks Urged in Animas-La Plata

Federal auditors have concluded that the costs for the controversial Animas-La Plata water project in southwestern Colorado are so high, many farmers may not be able to afford water from the project if it is ever built. As a result, the inspector general of the Interior Department has recommended that up to \$230 million of the project be canceled. The inspector general's report recommends that the Southern Ute and Ute Mountain Ute tribes consider accepting cash payments instead of irrigation improvements. Originally approved by Congress in 1968, it was revived in 1988 when the two Indian tribes advocated construction of the project as part of a settlement with state and federal officials over water rights.

Denver Post 7/13/94

WATER QUALITY

No Penalty for Silver in Wastewater

Colorado Springs will not be penalized for exceeding state standards for silver in its wastewater during much of last year. According to the city, the high silver content was indirectly caused by the construction of an advanced wastewater facility,

which required filtering of wastewater through a single treatment unit rather than two units at the Las Vegas Street plant. Construction will continue for an additional year. The state has agreed to grant the city a "relaxed" standard until the project is completed. Silver enters the wastewater from places that process film -- particularly hospitals and veterinary clinics.

Colorado Springs Gazette Telegraph 7/12/94

Clean Water Act Update

Reauthorization of the Clean Water Act this year is becoming a more unlikely prospect. Rep. Norm Mineta, Chairman of the House Public Works Committee, is finding it difficult to get sufficient votes to move a bill out of Committee. Until the House does so, Senator Baucus, Chairman of the Senate Environment and Public Works Committee, does not intend to press forward with his bill, S2093. It is unclear whether Senator Baucus has the votes needed to pass the bill on the Senate floor.

Western States Water 7/1/94

EPA to Require Nitrate Checks

Water systems in 29 Colorado counties must be monitored for nitrates -- inorganic chemicals found in both surface and groundwater. According to the EPA, 103 public water systems throughout the state require such action under the Safe Drinking Water Act. Requirements include: (1) monitoring water annually for nitrates; (2) notifying the public of any violation within three months of the violation; (3) sending copies of public notification to the state and EPA; and (4) reporting and compliance failure to the EPA within 48 hours.

Denver Post 7/24/94

Lowry Contamination Spreading

Contaminated groundwater found earlier this year at the northern boundary of Lowry Air Force Base has apparently migrated off the base north to East 16th Avenue, according to tests. Contaminants include trichloroethene, a chemical found in common cleaning solvents. While the contamination exceeds the maximum level allowed for drinking water, the nearest drinking water wells are more than two miles from Lowry. The Air Force is working with the EPA and Colorado Department of Health in the investigation.

Denver Post 7/15/94

ENVIRONMENT

Grand Mesa Environmental Assessment Released

The U.S. Forest Service has released its environmental assessment for the Grand Mesa National Forest Travel Management Plan. The draft assessment released last September drew criticism from numerous groups. Representatives of irrigation companies with ditches and reservoirs on the mesa said the plan would make their jobs more difficult if

conventional and all-terrain vehicles use was restricted. Although USFS says it never intended to restrict this kind of access, the final assessment gives authorization for this kind of vehicle use.

Grand Junction Daily Sentinel 7/6/94

Mining Royalties Proposed

U.S. Interior Secretary Bruce Babbitt has called for a sweeping overhaul of national mining laws, including new hardrock mineral royalties that would raise at least \$80 million a year to repair environmental damage from abandoned mines across the West. Mining companies currently pay no royalties for hardrock minerals such as gold, silver, and copper that are removed from federal lands. Supporters of such reform point to trout fisheries in several Colorado streams, including the upper Arkansas, the Animas, and Clear Creek which have been decimated by pollution from abandoned mines. Mining interests strongly oppose reforms. Reformers point out that coal, oil, and gas extractors have been paying royalties since 1920.

Denver Post 7/1/94

California Firm Awarded Summitville Cleanup Contract

Rust Remedial of Fremont, California, has been awarded a \$9 million contract to move an estimated 3 million yards of waste from the Cropsy Waste Pile to the north pit of the Summitville Mine. The area is polluted with heavy metals and cyanide as a result of Consolidated Mining Company's activities at the site and resulting bankruptcy. The Cropsy Waste Pile sits in the middle of a watershed, causing the heavy metals to leach into the soil and environment during spring runoff. The work should begin around August 15, 1994.

Pueblo Chieftain 7/20/94

WILDLIFE

Water Flows Secured to Protect Fish

The Colorado Water Conservation Board has agreed to file on rights to return flows in a 15-mile stretch of the Colorado River between the major irrigation diversions in Palisade and the confluence of the Colorado and Gunnison rivers. The U.S. Fish and Wildlife Service has pushed for restoring a total flow of more than 700 cfs in the 15-mile stretch to benefit four endangered fish species. The CWCB has agreed to make the filing by the end of the year on approximately 350 cfs of water. The instream flow right will discourage, but not prevent, anyone from diverting water from the 15-mile stretch.

Grand Junction Daily Sentinel 7/21/94

Proposed Fish Ladder on Gunnison Controversial

Construction of a fish ladder at the Redlands diversion dam on the Gunnison River and development of an operation plan could affect water users across the state. If built, the ladder would

force Redlands Water and Power Co. to share the shortage of water with other diverters, affecting water users as far away as Gunnison. Even Arapahoe County, which wants to construct a transmountain water diversion near the headwaters, is concerned. State and federal officials are instead pushing for an interim contract to draw water from Blue Mesa Reservoir so construction can begin. The ladder will cost an estimated \$1.5 million, and will consist of a series of ascending pools that fish will swim up to get around the Redlands Dam. At the top they will be held in a mesh basket for sorting, allowing only native fish to continue upriver.

Grand Junction Daily Sentinel 7/21/94

WATER CONSERVATION

Water Restrictions Imposed in Eagle Valley

Residents in Avon, Beaver Creek, and Arrowhead are restricted to watering their lawns three times a week, despite adequate water in the Eagle River and adjoining streams. An inadequate water treatment plant, population growth, and hot, dry weather are the main reasons for the water shortage. Officials hope to expand the local water treatment plant by November of 1995, but until then conservation efforts will remain in effect.

Colorado Springs Gazette Telegraph 7/5/94

PUBLIC LANDS

State Engineer Demands Reopening of Dam Roads

State Water Engineer Hal Simpson has requested that the U.S. Forest Service reopen six roads leading to several dams on Grand Mesa. The state has an interest in keeping some of the roads open for dam inspections. If a dam fails an inspection, its owners are required to make repairs, making access an important issue.

Grand Junction Daily Sentinel 7/22/94

LITIGATION

Pipeline Lawsuit Dismissed by Judge

A Boulder County District Court judge has dismissed a lawsuit claiming Boulder County officials didn't enforce regulations on a controversial water pipeline. The suit involved the Northern Colorado Water Conservancy District's Southern Water Supply Project (SWSP), a pipeline from Carter Lake to Broomfield currently under construction. The lawsuit, filed by the Indian Peaks division of the Sierra Club, alleged that Boulder County commissioners failed to enforce regulations adopted in Jan. 1994 allowing the county to review proposed water projects. The county said regulations went into effect after the SWSP had been approved. The judge ruled the case was not judicially reviewable, and that he could not force the county to enforce the regulations. The Sierra Club is reviewing its options.

Grand Junction Daily Sentinel 7/13/94

Tribes Plan to Sue Over Animas-La Plata and Navajo Projects

Four Southwest Indian Tribes have notified Interior Secretary Bruce Babbitt they intend to file suit over endangered fish protection measures that could hold up construction of the Animas-La Plata and Navajo water projects. The Southern Ute, Ute Mountain Ute, Jicarilla Apache tribes, and the Navajo Nation filed the notice in an attempt to change federal critical habitat for four endangered fish on tribal lands, which the tribes say endangers their water rights. A suit by the Sierra Club had forced the federal government to designate the critical habitat for the Colorado Squawfish, humpback chub, bonytail chub, and razorback sucker.

Grand Junction Daily Sentinel 7/9/94

Judge Dismisses Lawsuit Against Conoco

A lawsuit filed last year against Conoco for petroleum discharges into Sand Creek north of Stapleton Airport has been dismissed. U.S. District Judge John Kane ruled state and federal action against Conoco had begun prior to the suit's filing, precluding a civil suit. In an earlier suit, settled out of court, Conoco had agreed to spend more than \$1 million to clean up and beautify Sand Creek when it was found fish were 70 times more prevalent above Conoco's discharge point than below it.

Denver Post 5/24/94

LEGISLATION

House OKs Allard Water Amendment

The U.S. House of Representatives has approved an amendment by Rep. Wayne Allard that will protect interstate water agreements of the Colorado River Compact. The amendment says nothing in the legislation "shall be construed to amend, supersede, or preempt any state law, federal law, interstate compact, or international treaty" concerning the Colorado River. Allard considers the amendment an important protection for all states that rely on the Colorado River.

Greeley Tribune 7/15/94

Salinity-Control Projects Await Funding

Salinity-control projects in western Colorado are awaiting Congressional deliberation over lifting a \$302 million ceiling the projects have reached. The U.S. Bureau of Reclamation is lining the Highline Canal in the Grand Valley and others near Montrose to reduce salt seepage.

Grand Junction Daily Sentinel 7/19/94

House OKs Flats' Cleanup, Water Protection

The U.S. House of Representatives has approved a bill that funds cleanup at Rocky Flats and protection of municipal water supplies. The funding for Rocky Flats was less than requested

but still adequate, according to Rep. David Skaggs, D-Colo. The bill also contains \$11.4 million for a project to protect water supplies for Broomfield, Thornton, Northglenn, and Westminster from Rocky Flats contamination.

Denver Post 6/15/94

RECREATION

New Mexico Rafters Want More Rio Grande Water

New Mexico rafting groups want Colorado to send more water down the Rio Grande, but they don't want to pay for the additional water, believing instead that the San Luis Valley has a moral obligation to give up additional water for recreation. Colorado is free from obligation to deliver additional water to New Mexico and Texas under the Rio Grande Compact through the end of the year because of a water spill at Elephant Butte Reservoir in south central New Mexico. Water continues to flow in the Rio Grande across the state line, however, not enough to satisfy rafters.

Pueblo Chieftain 7/23/94

GROUNDWATER

Well Monitoring OK'd by Judge

The State Engineer's rules for monitoring wells in the Arkansas River Valley have been approved by District Judge John Tracey in Pueblo Water Court. The ruling requires owners of active wells to notify the state of measurement methods by July 1994. Wells must have either totalizing flow meters or energy coefficients to calculate water use. An estimated 2,200 wells in the valley could be affected. The new rules were adopted this spring by the state in response to a U.S. Supreme Court special master's preliminary ruling in the Colorado-Kansas lawsuit over the Arkansas River Compact. Colorado well use exploded in the 1960s, then was scaled back in the 1970s when the state began to require well owners to augment well water.

Pueblo Chieftain 7/3/94

San Juan Mapping Begins

A computer model being compiled in southwestern Colorado should help determine groundwater movement and gas contamination of water supplies which has been plaguing residents there. Late last year water wells in the Pine River Ranches subdivision were found to be saturated with natural gas. In some cases the gas had accumulated in the air to combustible levels. While there is agreement on the groundwork necessary to complete the model, scientists differ on other aspects of the problem, particularly geological faults in the region and their affect on the problem. Amoco, which owns the dozen gas wells in the Pine River study area, has spent more than \$900,000 on the research program already, but landowners in the area dispute scientists' claims about levels and timing of the gas seeps.

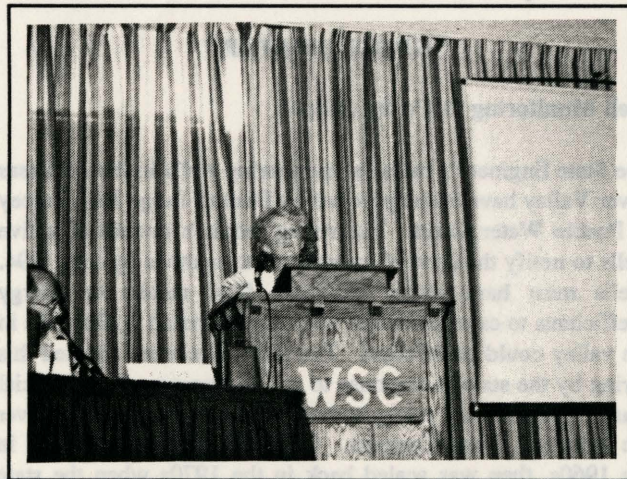
Fort Collins Coloradoan 7/2/94

The 19th Annual Colorado Water Workshop -- THE THREE C's

by Kathleen C. Klein

Cooperation, coordination, and collaboration (the three C's?) were frequently-heard terms at the 19th annual Colorado Water Workshop, held at Western State College in Gunnison July 20-22. Participants and speakers alike noted that water allocation decision-making must be built on a firm foundation emphasizing coordination between concerned parties. Whether the allocation issue involves supplying population centers -- Quenching the Urban Giant -- or providing water for endangered species or recreation, cooperative approaches were heralded as critical. This year's agenda focused on water supply issues faced by Colorado's growing municipalities. Participants were provided with examples of cooperative approaches to water supply management, statements from key parties involved in water allocation planning, and summaries of the constraints faced by water supply planners in today's water management arena.

Day one -- "Water supply planning, who decides and how?,"

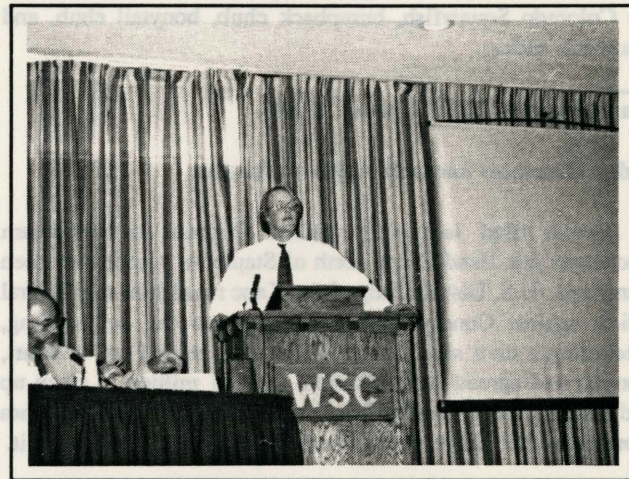


Marcia Hughes presents her views on cooperative water planning

was addressed by representatives from Denver Water, Colorado Springs, and Durango, followed by panel discussions in the afternoon. Each entity spoke of the need to meet future water demand requirements, but stressed the changes in traditional approaches to planning. Denver Water, for example, distributed a summary of its Long Range Planning Process effort. Denver Water now considers demand management to be part of doing business (not just a drought response strategy); is rethinking acceptable risk levels for customer service; and is soliciting more public involvement in its decision-making process. All of the municipalities viewed cooperation, coordination, and collaboration as key operative approaches.

Cooperative solutions to water supply planning along the Front Range were addressed by Marcia Hughes, of the Metropolitan Water Providers; Ken Salazar, of Parcel Mauro Hultin & Spaanstra, P.C.; and Doug Robotham of the Colorado

Department of Natural Resources. Marcia noted that cooperation doesn't come easily -- to achieve progress on certain issues, some loss of autonomy may be required. For example, storage for maintenance of the State's Colorado River Compact entitlement probably should be addressed on a state level, not by individual entities.

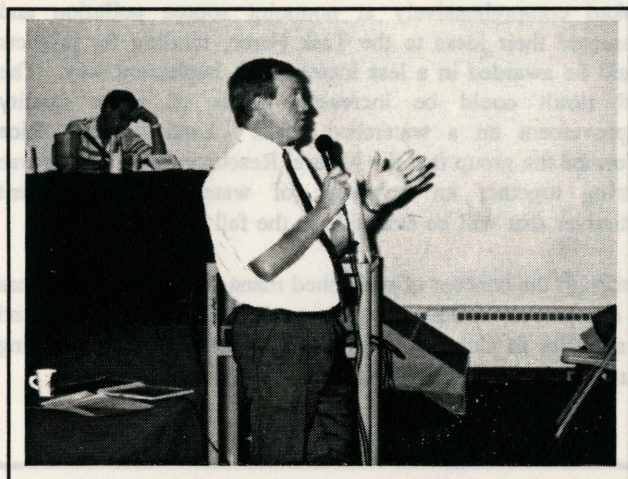


Doug Robotham fields questions at the Water Workshop

Ken Salazar and Doug Robotham reviewed the history and status of the Front Range Water Forum. The Forum is an example of Front Range communities working together to ensure that existing water resources are being used efficiently and effectively. The Front Range Forum's Technical Advisory Committee is working on four water supply management options, and is expected to report back to the Forum within about six months. The next step will be to develop specific options, at which point the state's involvement in the Forum's efforts will diminish and the members will have the option of acting on the Forum's findings.

Day two -- The role of conservation was highlighted by urban and agricultural water conservation specialists. In contrast to options for agricultural water conservation, the potential for urban conservation was described as significant. Presenters emphasized that successful urban conservation efforts are contingent upon the type of program, the goals, and the situation at hand.

Conversely, agricultural water conservation as a potential source of water to quench the giant was viewed by panelists Grant Cardon of Colorado State University, and Bart Woodward of the Riverside Irrigation District, as a non-option. They stated that if on-farm conservation measures were adopted in the South Platte Basin, there could be negative impacts on other water users because of potential changes to return flow rates and timing. But, if conservation measures were adopted to address water quality problems, or if crop consumptive use was reduced,



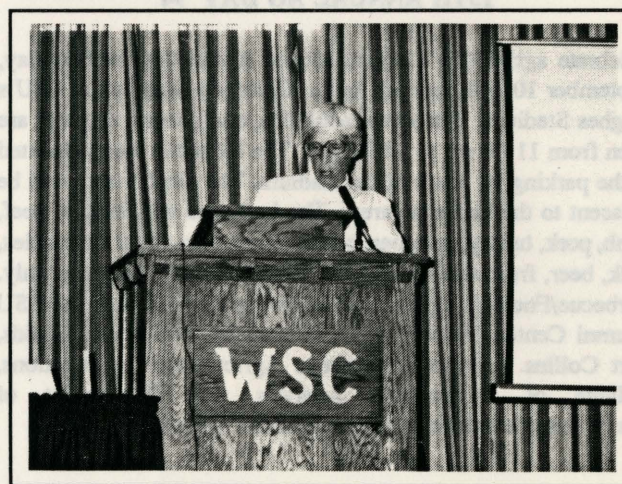
Grant Cardon discusses the viability of on-farm conservation measures

there could be benefits associated with such efforts. In areas such as the Grand Valley, where return flow maintenance is not as critical, improvements in agricultural efficiency could improve water quality and crop production.

Teresa Rice, Natural Resources Law Center, University of Colorado, described the potential benefits associated with short-term water transfers from agricultural to urban interests to meet drought needs. She also discussed measures in other states that provide incentives to use water more efficiently, water banking programs, and land fallowing agreements. These approaches are designed to create win/win situations that increase the efficient use of existing resources without significant detrimental economic or social impacts to particular user groups. Other presenters provided additional examples of cooperation between agricultural and municipal users.

Day three stressed other pertinent issues perceived by some as constraints on water supply management and planning -- water quality regulatory trends, ecosystem integrity needs, endangered species requirements, and the public trust initiative. Again, the importance of cooperative, coordinated, and collaborative approaches was stressed. Federal, state and local officials noted that doing business through the courts is too expensive, and that doing business on a case-by-case or permit-by-permit basis is not effective resource management either.

The recommended approach to dealing with "constraints" involved another C-word: *comprehensive* management! The value of comprehensive, watershed-based management was cited by participants as a "better way" to tackle issues such as water quality, ecosystem maintenance, and even federal permit distribution. However, implementing watershed-based management in Colorado is currently taking different forms, and is essentially in it's infancy.



Ruth Hutchins provides farmer's perspective

WATERSHED-BASED INITIATIVES IN COLORADO: WHAT'S REALLY GOING ON?

by Kathleen C. Klein

On July 20, 1994, during the Colorado Water Workshop, a group of individuals met on an informal basis to discuss ongoing watershed-based initiatives in Colorado. It took more than two hours just to describe the various watershed management efforts taking place statewide -- and we didn't even discuss all of them! The participants compared notes regarding ongoing programs and discussed the role of watershed management as a tool for the future. Participants were: Carl Norbeck of the Clear Creek Watershed Forum; Jeff Keidel of the Upper Arkansas Watershed Forum; Jim Valliant of the Arkansas River Forum; Gary Broetzman of the Animas River Stakeholders Group; Kathleen Klein of the South Platte Forum; Robert Ward of CWRRI; Doug Robotham of the Colorado Department of Natural Resources; Lloyd Walker of CSU Cooperative Extension; and Teresa Rice of the CU Natural Resources Law Center.

After listening to descriptions of the watershed-oriented efforts in the various basins, it became evident that although each situation varied, the common theme that emerged was cooperation. At this point, group objectives tended to consist of holding conferences or workshops to enhance cooperation, produce public information materials, and in the case of Clear Creek -- to identify watershed improvement projects and carry them out. Water quality issues were the motivational force for cooperation on the Upper Arkansas, Animas, and Clear Creek watersheds, and water quantity issues were driving cooperation in the South Platte and Arkansas River basins. Noted deterrents to the watershed-based approach included funding and defining objectives. On the positive side -- participants agreed that watershed initiatives can reduce confrontational management of water resources and enhance public participation in the process.

The other meeting participants also offered valuable insights regarding the value of "taking a watershed approach." Robert Ward noted that CWRRI is aware of the trend toward integrated watershed management and is developing research priorities with that knowledge in mind. Doug Robotham expressed state support for local, cooperative initiatives, and cited activities in the Yampa Basin as an example of a comprehensive approach. Doug also described the function of the Front Range Water Forum as an umbrella organization with a specific mandate to explore water supply options for the Front Range. The Forum is a short-term measure, the findings of which could be incorporated into more local initiatives.

Lloyd Walker pointed out the potential relationship between the State of Colorado's Nonpoint Source Task Force and watershed

based initiatives. Lloyd observed that if watershed organizations looked comprehensively at nonpoint source pollution and presented their ideas to the Task Force, funding for projects could be awarded in a less incremental, haphazard way. The end result could be increased levels of water quality improvement on a watershed basis. Lastly, Teresa Rice informed the group that the Natural Resources Law Center was putting together an inventory of watershed management initiatives that will be available in the fall of this year.

Although the concept of watershed management apparently has no accepted definition, this meeting demonstrated that the trend is a reality in Colorado. For a more detailed set of meeting minutes contact Kathleen Klein at CWRRI (491-6308).

MEETINGS

13TH ANNUAL AG DAY '94

Celebrate agriculture's environmental connection on Saturday, September 10 with football and a Colorado barbecue at CSU's Hughes Stadium. Barbecue, activities, and general displays are open from 11:00 am to 12:30 pm. The barbecue area is located in the parking lot south of the stadium. The display area will be adjacent to the barbecue area. The barbecue will include beef, lamb, pork, turkey, potatoes, beans, sweet corn, other vegetables, milk, beer, fruit, and ice cream. **Tickets sold in advance only.** Barbecue/Football tickets \$17; barbecue only \$7. Call the CSU Alumni Center, 303/491-6533, or stop by, 645 South Shields, Fort Collins. Sponsors: Colorado Agricultural Organizations, College of Agricultural Sciences and Department of Intercollegiate Athletics, Colorado State University.

WHO GOVERNS THE PUBLIC LANDS: WASHINGTON? THE WEST? THE COMMUNITY?

Second Annual Western Lands Conference
September 28-30, 1994
Natural Resources Law Center
University of Colorado School of Law

How should public land use decisions be made? Shifting policies and management approaches have sparked heated debate. What processes are underway to reach consensus and avoid a "War on the West?"

- Colorado Grazing Roundtable & Rangeland '94
- Option 9 and the Pacific Northwest Forests
- Bypass flows and Colorado national forests
- Wilderness protection in Utah
- Continuing legal education credits

Cost: \$295 before September 20; \$325 after. Discounts: government, public interest, academic. Checks payable to University of Colorado. Send to: Natural Resources Law Center, Campus Box 401, Boulder, CO 80309, TEL: 303/492-1288, FAX: 303/492-1297.

24th ANNUAL

ROCKY MOUNTAIN GROUNDWATER CONFERENCE September 26-28, 1994

Rio Suite Hotel, Las Vegas, Nevada

The 1994 conference includes an all-day field trip to the Nevada Test Site and Yucca Mountain on September 26. On September 27 there will be panel and audience discussion of state issues featuring two speakers from each state: one to discuss water quantity and the other to speak on water quality issues.

ARIZONA--Edward F. Fox, Director, Dept. of Environmental Quality; and Rita Pearson, Director, Dept. of Water Resources

COLORADO--J. David Holm, Director, Water Quality Control Division; and Steve Lautenschlager, Groundwater Section

IDAHO--Paul Castelin, Secretary-Mgr., Idaho Dept. of Water Resources; and Keith Higgonson, State Engineer

NEVADA--Lew Dodgion, Director, Dept. of Conservation and Natural Resources; Mike Turnipseed

NEW MEXICO--Marcy Leavitt, Chief, Groundwater Protection & Remediation Bureau; and Elaid Martines, State Engineer

UTAH--To be decided; and Bob Morgan, State Engineer

WYOMING--Kevin Fredereck, Environmental Quality Dept.; and Dick Stockdale, Groundwater Division

MONTANA--Both representatives to be decided

The last day of the conference will provide panel and audience discussion on important groundwater issues. The most important element of this year's conference will be the return to panel-audience participation and discussion format. Information and registration materials are available from: Juana Blackburn, Desert Research Institute, Water Resources Center, P.O. Box 19040, Las Vegas, NV 89132-0040. Phone: 702/895-0455.

A RIVER OF DREAMS AND REALITIES-- ARKANSAS RIVER BASIN WATER FORUM

Rafters want high water; people who fish want low. Boaters want full reservoirs; agriculturists need water for crops. Municipalities need water for homeowners and businesses; environmentalists want free-flowing rivers. Each has a dream for the Arkansas River; the reality is that users must work together to find ways to share the valuable resource.

A group of concerned river users currently is planning to hold the first conference of its kind that will focus on uses of the entire Arkansas Basin. Participants will explore "A River of Dreams and Realities" during the Arkansas River Basin Water Forum January 17-18, 1995, at the University of Southern Colorado in Pueblo.

Forum presentations will trace the Arkansas from its headwaters above Leadville to the Kansas border and will consider the varied uses of the river in Colorado. "We hope the Forum will encourage user groups to work together for the benefit of all," said Jim Valliant, Regional Irrigation Specialist at Rocky Ford. Representatives of agricultural, environmental, industrial, mining, municipal, recreational, and political and legal interests are on the Forum planning committee. "The Forum program will present the views of each interest group to give participants an opportunity to learn about problems, needs, and realities of other water users," said Charles L. "Tommy" Thompson, general manager, Southeast Colorado Water Conservancy District. Thompson is Forum program chairman.

For further information, contact:

Colorado State Cooperative Extension, South Central District, Pueblo at (719) 549-2049
Cooperative Extension in Otero County, Rocky Ford at (719) 254-7608
Southeast Colorado Resource Conservation and Development, Lamar at (719) 336-9421
Southeast Colorado Water Conservancy District, Pueblo at (719) 544-2040

INTEGRATED WATERSHED MANAGEMENT IN THE SOUTH PLATTE BASIN; STATUS AND PRACTICAL IMPLEMENTATION

October 26-27, 1994 -- The Ramkota Inn, Greeley, Colorado

The fifth annual South Platte Forum will explore the practical implementation issues associated with an integrated approach to water management in the South Platte Basin. This year's agenda will look at several key basinwide issues, current physical conditions in the watershed, and tools that can be used to enhance an integrated approach to management of the resource. The final session will provide examples of strategies that are or could be applied in the South Platte Basin.

Keynote Speakers

Jim Lochhead, Executive Director, Colorado Department of Natural Resources
William Yellowtail, Regional Administrator, Environmental Protection Agency, Region VIII

Sessions

Incentives for Cooperation
Defining Integrated Watershed Management
South Platte River Basin Physical Setting
Implementing Integrated Watershed Management
Integrated Watershed Management Strategies
Integrated Watershed Management, Federal Perspective

For information contact:

Kathleen Klein, Conference Coordinator
CWRRI, 410 University Services Center
Colorado State University
Fort Collins, CO 80523
Phone: 303/491-6308
FAX: 303/491-2293

Sponsored by: Colorado Division of Wildlife, Colorado Water Resources Research Institute, Northern Colorado Water Conservancy District, Denver Water, U.S. Geological Survey, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service.

PRAIRIE WETLANDS ECOSYSTEMS WORKSHOP:

**Public/Private Efforts in Protection, Restoration,
Management, and Education**

October 3-5, 1994

Radisson Inn, Bismarck, North Dakota

Topics:

Partnerships in Prairie Ecosystems, Habitat Restoration, and Management
Watershed and Wetland Inventory Projects, Research, and Delineation Efforts
Regulatory Protection of Wetlands
Private Lands, Restoration Efforts
Outreach/Education/Interpretative Programs
Mitigation Sites and Agreements
Management Strategies

Optional Field Trips: October 5, 1994--Chase Lake Prairie Project, Lonetree Management Area. Registration Fees: \$100 if postmarked before 8/30/94; \$135 afterwards. For information contact Thorne Ecological Institute, 5398 Manhattan Circle, Suite 120, Boulder, CO 80303, TEL: 303/499-3647

**FRESHWATER ECOSYSTEMS AND CLIMATE CHANGE IN NORTH AMERICA:
A REGIONAL APPROACH**

October 24-26, 1994 -- Leesburg, Virginia

Organized by American Society of Limnology and Oceanography and North American Benthological Society
Co-sponsored by U.S. Environmental Protection Agency and U.S. Geological Survey

Registration packets are available from the Office of Conference Services, Freshwater Ecosystems Symposium, Colorado State University, Fort Collins, CO 80523, Phone 303/491-6222, FAX 303/491-0667. For further information contact Diane McKnight, USGS-WRD, 3215 Marine St., Boulder, CO 80303, Phone 303/541-3015, FAX 303/447-2505; or Alan P. Covich, 303/491-2372, FAX 303/491-5091, e-mail alanc@picea.cfnr.colostate.edu.

Alan P. Covich, Head of the Department of Fishery and Wildlife Biology and member of the ASLO/NABS Steering Committee, received a grant from the U.S. Geological Survey to help organize this conference. He also is principal investigator of a CWRI project on ecological integrity and western water management.

CALLS FOR PAPERS

Water in the 21st Century: Conservation, Demand, and Supply, April 23-26, 1995, Salt Lake City, UT--Deadline: August 29, 1994. Submit 3 copies of 250-word abstract to: J. Paul Riley, Professor Emeritus, Utah State University, Logan, UT 84322-4110, Phone 801/750-2783, FAX 801/750-1185; or Lloyd H. Austin, Div. of Water Resources, 1636 W. North Temple, Suite 310, Salt Lake City, UT 84116, Phone 801/583-7257 or FAX 801/538-7279.

Water Resources at Risk, 1995 Annual Meeting, American Institute of Hydrology, May 14-18, 1995, Denver, CO--Deadline: August 31, 1994. The conference will feature sessions on subjects of current concern in hydrology, general sessions, poster sessions, short courses and field trips. The proceedings will be available at the meeting. Field trips will visit Rocky Mountain Arsenal, Rocky Flats, Rocky Mountain National Park, and the historic mining sites at Leadville,

Minturn and Idaho Springs. A post-symposium tour will visit the Carlin Trend mine dewatering site in Nevada. Contact: James R. Kunkel or Timothy D. Steele, Coordination Committee Co-Chairs, Advanced Sciences, Inc., 405 Urban St., Suite 401, Lakewood, CO 80228. Phone 303/980-0036; FAX 303/980-1206.

Workshop on Computer Applications in Water Management, May 23-25, 1995, Fort Collins, CO--Deadline September 1, 1994. The purpose of the workshop is to familiarize state and local water resource managers in the Great Plains with computer models, information exchange networks, and computer-assisted automation technology, available for the analysis and solution of complex water quantity and water quality issues. General and concurrent sessions will feature invited speakers and presenters. A resource fair will feature voluntary presenters from both the academic/professional

community and commercial companies. All presenters will be asked to submit an abstract of their presentation, as well as a full paper and/or fact sheet. Please limit papers to 10 pages single-spaced including tables and figures. Exhibitions of equipment, technology, and services are also invited. An exhibitor fee of \$400 will be charged.

Abstracts should be no more than 400 words, and contain a title, name of the author(s), their affiliation, and their mailing address. It should clearly give the purpose and contents of the poster presentation, computer demonstration, or a combination of these for model applications, and of computer-controlled automation system demonstrations. Please mail two copies of your abstract to: L.R. Ahuja, USDA-ARS, Great Plains Systems Research, 301 South Howes Street, Roo 353, P.O. Box E, Fort Collins, CO 80522, TEL: 303/490-8300, FAX: 303/490-8310.

Water Resources and Environmental Hazards: Emphasis on Hydrologic and Cultural Insight in the Pacific Rim, June 25-28, 1995, Honolulu, Oahu, Hawaii--Deadline: Oct. 28, 1994. Submit three copies of 250-word abstract to: Raymond Herrmann, Symposium Technical Program Chairperson, National Biological Survey, Colorado State University, Fort Collins, CO 80523, Phone 303/491-7825.

Water Environment Federation 68th Annual Conference (Oct. 21-25, 1995) & Exposition (Oct. 23-25, 1995), Miami Beach, FL. Deadline: Dec. 16, 1994. Submit Abstracts to:

Water Environment Federation, Attn: Conference Program, 601 Wythe Street, Alexandria, VA 22314-1994. Phone 800/444-2933. Fax submissions cannot be accepted for consideration.

1995 National Conference of the American Water Resources Association, Nov. 5-9, 1995, Houston, Texas and Reconvened Conference Nov. 10-12, 1995, Cancun, Mexico--Submit three copies of 200-word abstract to the appropriate conference or symposium technical program chairperson. For the National Conference, submit abstracts to: John S. Grounds III, General Chairperson, Bechtel, 3000 Post Oak, Houston, TX 77252-2166. Phone 713/235-4921.

For National Symposium on Water Management in Urban Areas, submit abstracts to: Mark L. Loethen, Symposium Chairperson, Pate Engineers, Inc., 13408 Northwest Freeway, Suite 160, Houston, TX 77040.

For National Symposium on Advances in Model Use and Development in Water Resources, submit abstracts to: Theodore G. Cleveland, Symposium Chairperson, Dept. of Civil and Environmental Engr., University of Houston, Houston, TX 77204-4791.

For National Symposium on North American Water Resources, submit abstracts to: Jerry R. Rogers, Symposium Chairperson, Dept. of Civil and Environmental Engr., University of Houston, Houston, TX 77204-4791.

**COLORADO WATER CONGRESS
UPCOMING MEETINGS**

CWC 1994 SUMMER CONVENTION PROGRAM

August 25-26, 1994

The Westin Resort, Vail, Colorado 81657

COLORADO WATER LAW SEMINAR

September 29-30, 1994

Holiday Inn, Northglenn, Colorado

FOR INFORMATION CONTACT:

Colorado Water Congress
1390 Logan Street, #312
Denver, Colorado 80203

Phone: 303/837-0812

CALENDAR

- Sept. 9-10 1994 INDIAN WATER RIGHTS CONFERENCE, Stanford, CA. Contact: Ann Robinson, Stanford Law School, Stanford, CA, 94305. Phone 415/723-2575.
- Sept. 11-15 11TH ANNUAL CONFERENCE OF ASDSO (ASSOCIATION OF STATE DAM SAFETY OFFICIALS, INC.), Boston, MA. Contact ASDSO at Phone 606/257-5146.
- Sept. 22-23 1994 JOINT COLORADO CHAPTER-SWCS AND COLORADO SOCIETY FOR RANGE MANAGEMENT TOUR, La Junta, CO. Contact: Mike Kinser, Secretary/Treasurer, SRM, 0051 Ponderosa Drive, Glenwood Springs, CO 81601303/945-2341.
- Sept. 22-24 STREAMBANK PROTECTION AND RESTORATION CONFERENCE, Portland, OR. Contact: Oregon Water Resources Research Institute, Oregon State University, Strand Agriculture Hall Rm. 210, Corvallis, OR 97331-2208. Phone 503/737-4022; FAX 503/737-2735.
- Sept. 26-28 ROCKY MOUNTAIN GROUNDWATER CONFERENCE, Las Vegas, NV. Contact: Paul Seaber, Desert Research Institute, P.O. Box 19040, Las Vegas, NV 89132-0040. Phone 702/895-0487.
- Sept. 28-30 WATERSHEDS '94 EXPO, Bellevue, WA. Contact: Andrea Lindsay, EPA, 206/553-1896 or toll-free 1-800/424-4EPA.
- Oct. 15-19 WEFTEC '94 --WATER ENVIRONMENT FEDERATION 67TH ANNUAL CONFERENCE/EXPOSITION, Chicago, IL. Contact: WEFTEC '94 c/o Galaxy, P.O. Box 3918, Frederick MD 21705. FAX 301/694-5124.
- Oct. 19-21 GREAT PLAINS ANIMAL WASTE CONFERENCE ON CONFINED ANIMAL PRODUCTION AND WATER QUALITY, Denver, CO. Contact: Reagan Wascom, Department of Agronomy, Colorado State University, Fort Collins, CO 80523. Phone: 303/491-6103.
- Nov. 6-10 AWRA NATIONAL SYMPOSIUMS ON WATER QUALITY AND NATIONAL WATER QUALITY ASSESSMENT (NAWQA), Chicago, IL. Contact AWRA, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814-2192. Phone 301/493-8600; FAX 301/493-5844.

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