

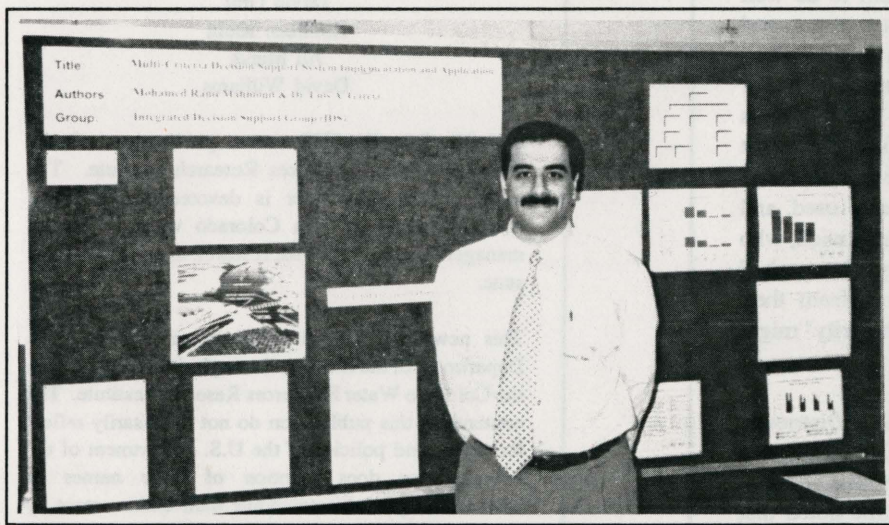
# Colorado Water

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

## WATER ITEMS AND ISSUES . . .

June 1995

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**Mohamed Rami Mahmoud, from CSU's Integrated Decision Support Group, was awarded Best Ph.D. Student Poster Presentation at the 1995 Hydrology Days (SEE PAGE 18).**

## CALL FOR PAPERS

Papers are now being accepted for upcoming issues of the **SMALL FLOWS JOURNAL**. For more information about the journal, manuscript submission guidelines, and deadlines, contact Cathleen Falvey at 1-800-624-8301, ext. 526, or mail to Editor, *The Small Flows Journal*, National Small Flows Clearinghouse, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064



## TALKING THE TALK!

by Robert C. Ward, Director

Colorado citizens are concerned about a number of water issues. Faculty in Colorado's higher education system confront these same issues in their teaching and research. Included in this edition of *COLORADO WATER* are four discussions by faculty and students that reflect the nature of their investigations into the latest water management developments.

I'd like to share with you my perspective of each article --

How much water does it take to cause significant movement of cobble and gravel bed material in the Colorado River (a factor to consider in habitat maintenance)? John Pitlick and Mark Van Steeter were fortunate enough to be conducting their CWRRI project in the Colorado River during the summer of 1993, a period of above average runoff. Their review of historical data, combined with 1993 field observations, provides insight into the nature of stream bottom and bank changes under different flow patterns. Given the concern for endangered species in the Colorado River, such understanding is important.

Larry Quinn reviews a vexing situation facing water quality managers in Colorado -- How do you measure Colorado's water quality and inform citizens of the successes and/or weaknesses in our state's water quality management program? This question has faced water quality managers for many years and is not easy to answer. Larry is tackling this problem as part of his Ph.D studies.

"Ecological integrity," "ecosystem management," "integrated watershed management" -- terms that do not seem to be well defined in the minds of many Colorado water users and managers -- appear with increasing frequency in federal water resource management plans. What do such terms imply for Colorado's water management system? A group of faculty has examined what the term "ecological integrity" might mean if it were applied to Colorado. This discussion should help alert *COLORADO WATER* readers to the concepts, terms used, and potential implications to water management. Alan Covich, who chaired the CWRRI-funded effort, and the faculty who worked with him are to be commended for interpreting, from their collective perspective, what the term "ecological integrity" might mean to Colorado water users/managers.

In the 1994 Supreme Court decision, Public Utility District of Jefferson County vs. State of Washington Department of Ecology, Justice O'Connor elaborated on relationships between water quantity and water quality management. She noted that distinctions between the two are "artificial." Bob Hiller, who teaches an environmental law course at Colorado State University, examined the decision with his students this past academic year. In this article, he shares his view of the potential implications to water management in Colorado.

Each of the above topics (habitat, monitoring, ecological goals, and institutional arrangements) will be discussed extensively by

Colorado water users and managers as Congress debates reauthorization of the Endangered Species Act, Clean Water Act, Safe Drinking Water Act and the Farm Bill.

Hopefully, the discussions contained herein will provide additional insights of these issues. I know I've gained new insights and understandings of the topics as I have worked with the authors to develop the above articles.

These four articles, while dealing with complex subjects, are presented in ways that articulate understanding. They try to avoid jargon and explain the issues/findings. The authors are faculty/students seeking knowledge and understanding in the best traditions of Colorado's higher education system. It is the goal of *COLORADO WATER* to share as many of these "talks" with you as possible.

### COLORADO WATER

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Robert C. Ward, Director



## **WATER RESEARCH**

### **ENDANGERED FISH HABITAT IN THE COLORADO RIVER**

(Condensed from Completion Report No. 188)

by

**John Pitlick and Mark Van Steeter**

**Department of Geography**

**University of Colorado**

Four species of fish in the upper Colorado River currently are listed as endangered -- the bonytail chub, the humpback chub, the Colorado squawfish and the razorback sucker. The latter two species were once plentiful in the reaches of the Colorado River near Grand Junction, Colorado. Several factors appear to have contributed to the decline of these fish, including competition with non-native species, deterioration in water quality, and a loss of habitat due to river channelization and flow regulation. This research focused on the issue of habitat loss in a 32-mile reach of the Colorado River near Grand Junction, Colorado.

Biologists have suggested that backwaters are an important habitat for these endangered fish, and that these habitats have been lost over time because of changes in the flow regime of the river. The U.S. Fish and Wildlife Service has recommended that more water be released from upstream reservoirs to improve in-channel habitat and enhance the recovery of these fish. It has not been known, however, exactly how high these flows should be or how long they should last. This research was undertaken to determine the extent of historical changes in riverine habitat and to better understand the processes of habitat formation. Researchers used aerial photographs, discharge records, and field studies to evaluate the significance of historical changes in flow regime and the effects of more recent flow events.

**Aerial Photographs**--Changes in the morphology of the river channel within the study reaches were analyzed using aerial photographs from 1937, 1954, 1968 and 1986. Outlines of specific features such as channel banks, islands, emergent bars and side channels were digitized on the photographs using a computer-aided design system (ACAD). From the ACAD system, the files were exported to ARC INFO, a vector-based Geographic Information System (GIS), where the areas of the main channel, islands and side channels were calculated and changes compared over time.

**Discharge Records**--Streamflow data were obtained from Water Supply Papers of the U.S. Geological Survey (USGS) and from a commercially available CD-ROM and software package

*Researchers used aerial photographs, discharge records, and field studies to evaluate the significance of historical changes in flow regime and the effects of more recent flow events.*

that contains peak- and daily-flow data from the USGS WATSTORE files. These data were used to quantify changes in flow regime due to reservoir regulation and water withdrawals. The analysis focuses on flow regime changes that occurred after 1930.

**Field Studies**--Field measurements were made at four sites in spring and summer 1993; with three sites chosen to study changes in backwater habitats and the fourth chosen to evaluate thresholds for bed-material transport. The backwater study sites were all formed by a lateral bar or island that forced flow down a side channel, all much smaller than the main channel. Field work consisted of repeated topographic surveys to determine the extent of erosion and deposition in the side channels. The site chosen for studying bed-material transport is located in a single-thread alluvial reach of the Colorado River near Fruita.

#### **SUMMARY**

**Aerial Photographs**--Comparing photographs from 1937 and 1986, there was a negligible (+ 1 percent) change in the area of the main channel, a 20 percent decrease in the area of islands, and an 18 percent decrease in the area of side channels and backwaters. The researchers noted, however, that in comparing the 1937 and 1986 photographs the overall trends were clearly influenced by channel changes (e.g., widening) associated with record floods in 1983 and 1984. Comparing photographs from 1954 and 1968, there was a 12 percent decrease in the area of the main channel, a 16 percent decrease in the area of islands, and a 27 percent decrease in the area of side channels and backwaters. These results are considered more indicative of what to expect during an extended period of low to moderate annual peak discharge.

**Discharge Records**--A preliminary analysis of peak flow data from several gaging stations in the region indicates that the annual peak discharge of the Colorado River has decreased by 19 percent in the last 30 years. This decrease follows the period of time when most of the major reservoirs in the upper basin were constructed. Peak flows on unregulated tributary streams



have remained stationary over the last 60 years. The researchers noted that peak flows on the Colorado River perhaps were anomalously high in the early 1900s. Other researchers also have questioned estimates of peak discharge made early in the century on streams elsewhere in Colorado that may have reflected higher precipitation and rainfall. In any event, it was not until the middle of this century that water development in the upper basin began to have much of an effect on streamflows of the upper Colorado River, and thus the analysis focuses on the changes in flow regime that occurred after 1930. In addition, investigators found that compared to peak discharges, transbasin diversions have probably had much less of an effect on peak flows than reservoirs. For example, in May 1993, exports through the Alva B. Adams tunnel amounted to less than 3 percent of the discharge at Cameo.

**Field Studies** conducted in the 15- and 18-mile reach during snowmelt runoff in 1993 reveal relatively minor changes in channel morphology even though the 1993 peak flow was the

highest in almost a decade. Field measurements at the 3 backwater study sites indicate that a few feet of fine sediment (silt) were scoured from the mouths of the side channels and there was some movement of coarse bed material in side channels and in the main channel. Modeling the flow in the single-thread reach indicated the threshold for transport of cobble bed material occurs at a discharge of about 20,000 cfs. This discharge is three times the mean annual flow. Significant motion of bed material, corresponding to a shear stress of twice the critical shear stress, occurs at a discharge of about 41,000 cubic feet per second. This discharge is equivalent to a five-year flood. The results of field studies and flow modeling indicate that above-average flows are required to remove appreciable amounts of silt from side channels and to initiate widespread motion of cobble and gravel substrates.

*Completion Report No. 188 is available from the Cooperative Extension Resource Center at Colorado State University. See page 16, PUBLICATIONS, for address and phone.*

## DEVELOPMENT AND USE OF ENVIRONMENTAL INDICATORS IN WATER QUALITY MANAGEMENT

by

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### Water Quality Management

Although the term "water quality management" (WQM) is widely used, there is no true consensus about its precise meaning. In the most basic sense, WQM assumes that regulatory agencies manage water resources for maximum *integrated water use benefit* under broad but definitive definitions of use requirements (human, ecological, cultural, etc.). Until very recently, water resources development has dictated the "water agenda" of the U.S. and WQM has followed behind. The current situation is somewhat in flux.

Further confusing the situation, the technocratic nature of U.S. WQM also has insulated the public from direct influences on the process and has disconnected it somewhat from its "part" in both the problems and the solutions. This lack in the public arena regarding WQM processes has contributed to a growing legislative stalemate regarding the future direction of the WQM process.

The purpose of this discussion is to review the nature of water quality management and its use of indicators to define goals and track accountability.

### Water Quality Goals and Objectives

Prior to the 1970s, the U.S. WQM programs were driven almost exclusively by public health concerns. Although the protection of public health (mainly through the development of sanitary

sewage collection and treatment systems) remained a viable goal, some well-publicized water quality disasters in the 1960s led to a widespread sentiment that the nation's water quality was deteriorating. This culminated in the passage of the Federal Water Pollution Control Act Amendments of 1972 (original Act in 1948). The Act has been amended several times since then (now referred to as the Clean Water Act), but the basic framework for WQM has remained fairly intact.

A major driving force for the 1972 Act was the national intent to set and work toward definitive clean water goals. The stated objective of the Act was to "restore and maintain the chemical, physical and biological integrity of the Nation's waters." Due both to the Act's timing and the aspirations of the main legislative players, many of its goals were more politically than scientifically based. Although some of the original goals (i.e., fishable and swimmable waters by 1983 and "no discharge" of pollutants by 1995) were not met in the planned timeframe, the **process** of setting national goals and working toward implementation objectives to meet these goals remains viable.

WQM under the Clean Water Act (CWA) is the **process** of developing water quality criteria for various beneficial uses of water, setting ambient and discharge water quality standards, diagnosing problems in specific watersheds through monitoring programs, assessing potential remedies to meet the beneficial uses assigned to the watershed (including use attainability studies), and the development of phased implementation plans to set a course for recovery.



## Environmental Indicators

The U.S. WQM process, as defined above, was successfully implemented over the years following the 1972 amendments, and the process led to significant water quality improvement in the nation's waters through the implementation of point source controls. However, in the 1980s it became apparent that water quality improvement had stagnated, mainly due to nonpoint source pollution. It also became apparent that the WQM process required an **expanded focus** to handle issues such as multi-media pollution, pollution prevention, watershed management planning and implementation, and other issues and strategies. Regulatory agencies were increasingly called to task to define the "results" of their actions and the potential benefits and costs, both for legislative bodies and the general public.

Defining progress has been a very difficult task. The issue of "water quality" involves a broad spectrum of political, economic, sociological and ecological perspectives that were not integrated easily into the WQM process. The U.S. Environmental Protection Agency (EPA) and the state regulatory programs have sought to develop "environmental indicators" to blend these components into a water quality platform that can be communicated easily to the public. Since the late 1980s, **comparative risk** has been emerging as the communication medium of choice for these indicators.

The potential use of environmental indicators is not new in WQM. There have been efforts to develop water quality indicators (WQI) for decades, but only recently has this received significant attention. At the federal level, one reason is the legislative/public mandate for performance-based regulatory programs, as represented by the **Government Performance and Results Act of 1993 (GPRA)**. To define "performance" in the area of WQM programs, methods were needed to report to the public and integrate it in water quality goal-setting and risk evaluation. Water Quality Indicators (WQI) are being proposed by the EPA which are designed to measure water quality under ambient conditions and identify how well the regulating and regulated communities perform. Water Quality Indicators (WQI) are tools to communicate statistical, scientific and technical

*The issue of "water quality" involves a broad spectrum of political, economic, sociological and ecological perspectives .... The U.S. Environmental Protection Agency (EPA) and the state regulatory programs have sought to develop "environmental indicators" to blend these components into a water quality platform that can easily be communicated to the public. Since the late 1980s, comparative risk has been emerging as the communication medium of choice for these indicators.*

**WATER QUALITY INDICATORS (WQI) are tools used to communicate and make accessible statistical, scientific and technical information about water quality conditions and trends to a variety of stakeholders. Descriptive WQI summarize sets of individual measurements and are scientifically derived. Aggregated and policy-oriented WQI go beyond descriptive indicators and attempt to display performance measures, costs and benefits, comparative risk and other information to guide policies and decision-making.**

information about water quality conditions and trends to a variety of stakeholders. **Descriptive WQI** summarize sets of individual measurements and are scientifically derived. **Aggregated and policy-oriented WQI** go beyond descriptive indicators and attempt to display performance measures, costs and benefits, comparative risk and other information to guide policies and decision-making.

The U.S. has embarked on a **National Goals Project** which

will set definitive goals and timetables for all media including water. Indicator development is progressing concurrently with the development of goals to provide benchmarks for strategic planning efforts. This effort also integrates into the international effort to define an Agenda 21 Action Plan for the U.S. relative to the international goal of sustainable development. (United Nations Conference on Environment and Development, 1992).

## Historical Context

### *Activities Prior to 1965*

The first Federal Water Pollution Control Act, passed in 1948, designated the states as the lead agencies in WQM with assistance from the U.S. Public Health Service. The Act provided the first federal funds for water pollution control and began subsidies for the construction of sewage treatment works. While the management of water resources to **maximize beneficial uses of water** was the driving force for the first half of the 20th century, the WPCA made WQM an adjunct to the prime focus on supplying water. The fundamental water quality concerns were public health of potable water supplies and the maintenance of a quality sufficient for its intended use. Ecological integrity concerns were few and usually focused on parks and preserves or areas of intense tourist activity (protected

for the economic benefits). States and local health agencies led the effort to protect water quality. As expected, there was a wide disparity in how water quality was protected and managed in different parts of the country.

### *WPCA Amendments of 1965*

For the most part, early water pollution control activities were not backed up by enforceable mandates or standards. The continuing deterioration of water quality in the U.S.,



coupled with the wide variance of local program activities for WQM, caused the federal government to pass the 1965 Amendments to the WPCA. These established the federal Water Pollution Control Administration and began the U.S. history of a more centralized and federal approach to WQM.

#### *WPCA Amendments of 1972*

In 1970, the federal government's environmental role was vested in the new Environmental Protection Agency (EPA). That year, the first Earth Day mobilized significant public support for stronger environmental action. Congress, inspired by the political mood, passed the Water Pollution Control Act Amendments of 1972 with the objective to "restore and maintain the chemical, physical and biological integrity of the Nation's waters." Some see this mandate as setting a target for the return of complete ecosystem integrity both by repairing impaired waters and by protecting those waters that had escaped impairment. Any local or regional wiggle room was eliminated, since the federal ambient and discharge standards became minimums on a nationwide basis. State programs could become only more stringent than national standards.

#### *Amendments Since 1972*

The WPCA was further amended in 1977 and 1987. The 1987 amendments targeted nonpoint source (NPS) pollution and the phase-out of federal grants for wastewater treatment facilities. The Act has been up for reauthorization since 1992, but efforts have been stalemated for a variety of political, technical, economic and other reasons which will be described in later sections. Much of the current stalemate can be traced to a lack of fiscal and technical accountability in the WQM process.

#### *Goals and Objectives of the Clean Water Act*

##### *Background Issues Driving the Act*

The CWA WQM programs are rigorous, consistent and effective as measured by most common yardsticks of performance. There was a perceived need to unify the national approaches for WQM both to prevent regional differences for environmental reasons and to prevent the migration of industry and jobs to areas minimizing environmental standards. Although the law was ambitious, the **basic informational tools of the Act were weak**. The gaps included: benchmarks against which to measure progress; integrated monitoring to determine the sources and effects of water-quality impairment; and communication of these problems to dischargers, other stakeholders and the general public. In addition, the lack of EPA cabinet status and Congressional committee power structures helped to maintain a disjointed implementation strategy for the various water quality activities enumerated in the Act.

The CWA goals and objectives were widely viewed as unattainable soon after passage. Many felt that setting extremely high or even unattainable goals was necessary to promote creativity and inventiveness in addressing water quality

problems. There was an ongoing effort during this time to develop WQI as a means to measure progress in meeting these (or newer) water quality goals and objectives. However, the history of the WQM programs over the first two decades has shown that both **political concerns** and dealing with environmental "hot spot" issues has set the WQM agenda.

#### *No Discharge of Pollutants*

The goal of "no discharge of pollutants by 1985" started considerable debate over definition of "no discharge" and whether it was technically feasible, cost-effective, or desirable. Many environmentalists felt that setting **ambitious goals** would foster innovation and creativity. These goals have been carried forward, as no one will come to grips with more realistic goals and objectives in an increasingly polarized legislative process. This idealism goes to the core of the CWA -- that costs and benefits should not be weighed in WQM decision-making. This basic premise is now being questioned.

#### *Fishable and Swimmable*

Fishable is shorthand for the "protection and propagation of fish, shellfish and wildlife," and the legislative history of the 1972 Act indicates that **biological integrity** means a balanced, indigenous population of fish and wildlife. About one-third of the surface waters in the U.S. still fail to meet this objective, mostly because of nonpoint source pollution (1992 305 (b) Report). This goal drives most water quality standards, as criteria for aquatic life generally are more stringent than those for swimming, irrigation, or potable water supply. The importance of this measure is further illustrated in the move toward measures of **ecological integrity** and/or ecological health of water which go beyond the standard and historical measures of water quality.

#### *Measuring Environmental Status and Results*

Formalizing environmental indicators and utilizing them as informational tracking tools in environmental programs took a diminished role from the mid-'70s to the late '80s. Regulatory agencies had a full agenda dealing with legislative mandates and the immense new environmental programs. A major driving force was "**crisis management**," such as the response to the Love Canal hazardous waste situation and the ever-changing political priorities that followed such occurrences. In addition, there was little enthusiasm in legislative or regulatory bodies for "accountability" of environmental activities. There was great difficulty in developing quantifiable indicators that could be used at a variety of levels, and there was minimal political or regulatory will to move forward in this area.

#### *Water Quality Improvement*

Water quality monitoring efforts are conducted by a myriad of federal, state, regional and local agencies with little coordination. Even the best monitoring efforts vary in frequency, methods, quality, and a host of other ways. A further



complication is that these factors have varied significantly during these two decades. In many agencies, measurement of water quality progress has focused on regulatory measures rather than environmental improvement (NPDES permits issued, samples taken, enforcement actions undertaken, annual budgets, etc.). This relates to a syndrome defined as "What gets measured, gets done." This inability to document progress has contributed to polarization of political discourse and the call for reduced EPA funding and/or increased oversight on many WQM programs. It has also contributed to growing public confusion. At the same time that public environmental awareness seems to be rising, there is growing pressure for result-oriented agency performance in the government. Environmental agencies see reduced budgets and a lack of public support at the same time that all polls show stronger support for the environment. The lack of definable benchmarks of performance lies at the root of this dichotomy.

### Water Quality Monitoring Programs

The Intergovernmental Task Force on Monitoring Water Quality produced a September 1994 draft strategy for improving water quality monitoring in the US. This strategy contained 13 key elements and associated recommendations, mainly dealing with coordination, consistency, and factors to consider in monitoring design. The use of indicators was specifically mentioned in the first key element as follows:

Goal Oriented Monitoring - Design water-quality-monitoring programs to explicitly measure progress in meeting goals for aquatic resources using **environmental indicators**. These goals include public health, ecosystem, and economic indicators. Monitoring for specific jointly agreed-upon indicators must measure progress toward meeting identified water-quality goals.

### Tracking WQM Performance

#### *NPDES Permits*

Administration of programs to reduce or eliminate pollutant discharges falls under the NPDES discharge permit programs of the EPA and/or delegated states. These programs include NPDES permits, pretreatment and sludge programs, and aggressive enforcement of the program requirements. NPDES permits were expanded in 1987 to include a variety of storm-water sources of pollutants. NPDES dischargers are required to report regularly on the quality of their discharges based on NPDES effluent limitations. In addition, state and EPA monitoring of compliance is both random and targeted to potential violations.

#### *Ambient Monitoring*

It will be necessary to use some form of ambient water quality data to measure WQM progress, but it is unclear how institutional overlaps and gaps can be addressed. Perhaps the strategy produced by the Intergovernmental Task Force on

Monitoring Water Quality will provide a focus for improvement. However, there seems to be little legislative inclination to combine and/or eliminate the federal efforts.

### *305(b) Reports*

Section 305(b) of the CWA requires EPA and the states to report progress in meeting the fishable and swimmable goals of the Act biennially. EPA measures national progress by summarizing **attainment of state water quality standards**. Water quality standards consist of designated beneficial uses, numeric and narrative criteria sufficient to protect each use, and an antidegradation statement. This process is expanding in importance in conjunction with the new focus on cost-effectiveness of the regulatory programs.

EPA (with major input and assistance from the states) assesses support of the following beneficial uses: *Aquatic Life Support, Fish Consumption, Shellfish Harvesting, Drinking Water Supply, Primary Contact Recreation - Swimming, Secondary Contact Recreation, and Agriculture*. The levels-of-use support are categorized as: Fully Supporting, Threatened, Partially Supporting, Not Supporting, and Non-Attainable (natural condition or human activity that cannot be reversed without widespread economic and social impacts from a Use Attainability Study). For waterbodies with more than one designated use, EPA consolidates the individual-use support information into a single overall-use support designation.

The states and EPA lack the resources to report on 100 percent of the surface waters in the U.S. Assessed waters are a subset of the total, and the reported results suffer because the ratio of pristine waters and impaired waters of the unassessed portion is an unknown number for any survey. In 1992, assessed waters included:

Percent	Water Source
18	rivers and streams
46	lakes, ponds and reservoirs
74	estuaries
6	ocean coastal waters
99	Great Lakes shoreline
4	wetlands

### *Council on Environmental Quality*

The Council on Environmental Quality (CEQ) is required by the National Environmental Policy Act (NEPA) to annually report the status of environmental conditions to the nation. CEQ has tried to expand this general effort with periodic reports about environmental trends.

### *Public Involvement*

Although the CWA provides for public involvement in a wide variety of WQM activities, the public generally has not been fully aware of the program outputs and performance. (The use of citizen suits by a small subset of very active citizens is one



exception to this rule.) In a sense, the public has remained on the outside and observed the process of regulators with some detachment. This, coupled with a growing disillusionment in governmental efficiency, has caused the general public to question the effectiveness of the WQM programs. There is a need for easily understood WQI (both physical and management) relative to water quality that can be used by a

wide variety of stakeholders and that the general public can grasp. There has been significant work related to economic indicators over the past few decades and they have been fully integrated into the public consciousness. A similar set of environmental indicators would provide a much-needed vehicle to assess and report on the performance of WQM programs and "re-connect" the public to the process.

### Summary and Conclusions

The U.S. WQM process was successfully implemented over the years following the 1972 amendments, and this process led to significant water quality improvement. However, it has been very difficult to quantify the improvements in water quality conditions to a variety of stakeholders.

**Unfinished Business**, published by the EPA in 1987, compared the relative risks posed by 31 environmental problems within four broad categories of risk: 1) human cancer risk, 2) human non-cancer health risk, 3) ecological risk, and 4) welfare risk. Recent legislative and management initiatives designed to improve the performance and accountability of federal agencies have demonstrated the need for a variety of environmental indicators in the EPA. To define "performance" in WQM

programs, methods are needed to report to and integrate the public in water quality goal setting and risk evaluation. EPA proposes WQI that are designed to measure water quality under ambient conditions and the trends which identify how well regulating and regulated communities perform. The US has embarked on a **National Goals Project** which will set definitive goals and timetables for all media including water. Indicator development is progressing concurrently with the development of goals to provide benchmarks for strategic planning efforts. The full integration of indicators into decision-making requires combined economic/environmental indicators which would, by nature, be developed in conjunction with costs, benefits and risks.

## ECOLOGICAL INTEGRITY: AN INTERDISCIPLINARY PERSPECTIVE ON WATER RESOURCE MANAGEMENT IN COLORADO AND THE WEST

### Summary of Task Force Report

*Editor's Note: As part of the 1993-94 CWRRI research program, an interdisciplinary team of scientists was assembled to integrate developments and provide an expanded concept of "ecological integrity," especially as it relates to water management in the Rocky Mountain West. Task Force members were: Alan Covich (Leader), Kurt Fausch and William Clements, Fishery and Wildlife Biology, CSU; John Stednick, Earth Resources, CSU; Steve Abt, Civil Engineering, CSU; and John Wilkins-Wells, Sociology, CSU.*

### Legislative Framework

**The Clean Water Act** -- What does "ecological integrity" mean and how does it relate to the management of natural resources? The concept relates both to mandates of the federal Clean Water Act of 1972 and to current efforts to revise and reauthorize this law and other legislation. Listed as one of the purposes of the Clean Water Act reauthorization is: "To assure that water pollution control programs more comprehensively protect the ecological integrity of water bodies...through enhanced protection of the physical and biological components...". Responses to the Act have improved water quality since 1972, but much remains to be done to improve management of water resources at the watershed scale. Recent state assessments of water quality show 30 percent of rivers, 42 percent of lakes, and

32 percent of estuaries continue to be degraded. Much of the degradation is from sediments and nutrients from urban and farm runoff, combined sewer overflows and municipal sewage.

While some chemical pollutants still contribute to serious water quality problems, there have been technological advances in point source control under the NPDES program (National Point Discharge Elimination System) and control of nonpoint source pollution with BMPs (Best Management Practices). Water quality monitoring efforts have now broadened to include cumulative watershed effects. Needed to meet this new challenge is a comprehensive set of criteria and methodologies to accurately assess the water quality aspects of ecosystem functions and efforts to maintain and to restore the integrity of whole catchments.



### Lowest Ecological Integrity

Areas that are intensively managed but not self-sustaining. Organisms are incapable of maintaining ecosystem functions and lack capability for adaptation.

#### Examples:

Poorly managed irrigation canals, river sections downstream from improperly designed or poorly functioning sewage treatment plants or storage reservoirs where the natural seasonal variability of river flows is modified and native species are absent.

### Highest Ecological Integrity

Areas with minimal management and self-sustaining ecosystem processes.

#### Examples:

"Protected" areas such as those within existing national parks if sufficiently large and continuous to include the full range of natural processes that characterize regional ecosystems. Continuous, high-cost maintenance is not required. These areas provide a baseline for evaluating regional ecological integrity and natural variability of species.

### Definitions

"Ecology" and "integrity," according to Webster's New World Dictionary, 2nd ed., mean:

**Ecology:** *(1) the branch of biology that deals with the relations between living organisms and their environment or the complex of relations between a specific organism and its environment; and*

**Integrity:** when related to the environment, is defined as: *the quality or state of being complete, whole and unimpaired.*

By definition, then, the term "ecological integrity" should include the relationships and adjustments of living organisms in their natural environment to maintain a quality or state of being that is complete, whole and unimpaired. For its purposes, Task Force members defined "ecological integrity" as:

*...an ecosystem where interconnected elements of physical habitat, and the surficial processes that create and maintain them, are capable of supporting and maintaining the full range of biota adapted for the region. Both the physical processes and the biota are naturally variable in time and space. Settings with ecological integrity are resilient, self-correcting when subject to natural disturbance, and their inherent potential is realized without management support or intervention. The concept of an ecosystem being capable of sustaining the biota adapted for the ecoregion is central to this definition.*

Task Force members noted that there are no inherently "good" or "bad" ecosystems, and recognized that human influences on "natural" ecosystems may be extensive as well as intensive. They emphasized that management of natural resources can best be evaluated by comparisons among a wide range of ecosystems and over long time scales. They viewed ecosystems and

management options as being distributed along a continuum. Task Force members characterized ecosystems with high integrity by four attributes:

- inherent regional potential for sustained productivity is realized
- condition is stable
- capacity for self-repair
- require minimal external support

In contrast, aquatic ecosystems that lack integrity are often characterized by shifts to altogether different phases that require expensive management intervention to achieve continued goals such as fisheries production, recreation and clean drinking water.

### Measures of Ecological Integrity

Prior to the 1980s, early investigations measured the number of different species living in a habitat (species richness) and their relative abundances (species evenness) to monitor many types of environmental changes. An important shift occurred in the 1980s when ecologists began to focus on biotic interactions, especially among native species that are well adapted for the range of natural variability that characterizes regional ecosystem processes. Researchers defined an early, function-based concept of "biotic integrity" as the "capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition and functional organization comparable to that of the natural habitat of the region" (Karr and Dudley 1981). Biotic integrity emphasized how the presence of various organisms, particularly specific fishes and invertebrates, provided information about water quality and general functional relationships of different aquatic environments.



Recently, discussion has centered on how habitat quality and long-term diversity are related. Much of this discussion focuses on connections among different aquatic habitats so that lakes and rivers are managed with consideration for both upstream and downstream effects within natural drainage units (Covich 1993). Protection of native aquatic species requires maintenance of connections among riverine, stream, lake and wetland habitats that often extend beyond social and political boundaries such as county or state lines.

### The Rocky Mountain Perspective

Historic accounts of some large rivers, such as the South Platte, show that hydrology and riparian ecosystems have changed dramatically in the last 150 years. Detailed descriptions of the Platte and the early effects of water diversion and irrigation provide a basis for historical comparison of seasonal and interannual variations in flow. For example, before 1900 the South Platte River basin in Colorado was hydrologically variable and inhabited by a walleye or sauger which was so abundant that it was caught with seines and dynamite and hauled by wagon loads to restaurants in Denver (Behnke, pers. comm.). U.S. Fish Commission records indicate that this species was extinct in the basin by 1900 (Wiltzius 1985). It would be of great value to us now as a recreational fishery.

Recent research in Colorado and other regions has begun to reveal that aquatic organisms have evolved life-history patterns that take advantage of the complex interconnectedness of habitat elements. Many aquatic invertebrates disperse downstream by drifting with stream flow as part of their life history. Adult fishes, ranging from small minnows in Great Plains streams (Winston et al. 1993) to the large Colorado squawfish, migrate upstream tens to hundreds of kilometers to spawn, with a downstream drift of juveniles to facilitate dispersal to rearing areas that are often in temporary floodplain or backwater habitats. This high incidence of movement across habitat boundaries indicates that interconnectedness is a key issue in ecological integrity.

### Assessing Ecological Integrity

**Physical Attributes** -- Specific physical measures can be used to assess the natural sensitivity of a watershed, its present hydrologic condition, and the hydrological implications of proposed management changes. Only three components are needed as initial criteria to assess watershed condition: water runoff patterns, sediment production and routing, and riparian condition. These components are recognized as important controls on fish habitats, water quality, channel stability, macroinvertebrate habitats, and eventually beneficial uses of the waters.

**Biological Attributes** -- The use of biological communities to measure biological integrity of stream ecosystems has several advantages over routine chemical analysis of water quality and should be included in any assessment of ecological integrity. Stream biota integrate changes in exposure conditions over time

scales of many months and years (depending on the species) and therefore provide a relatively continuous monitor of water quality. An important finding from earlier research (Woodwell 1962; Likens et al. 1978; Schindler et al. 1985; Wallace et al. 1986) is that indirect effects are often more significant than direct effects. For example, reduced prey abundance had a greater effect on lake trout populations than direct toxicological effects of reduced pH (Schindler et al., 1985).

**Social Attributes** -- Integration of social and natural components is one measure of the degree to which the natural ecosystem can be maintained over any extended period of time. Natural resource management units, whether small-scale irrigation systems, rangeland conservation areas, urban-fringe greenbelts or large river basins, have an economic, social and political dimension that is central to their functioning as ecologically integrated systems. These social systems must create local capacity for public involvement, education processes and conflict mitigation. Social equity must be acknowledged when gauging the most desirable state of equilibrium needed for ecological integrity. Social and economic costs associated with restoration, maintenance and possible regulatory measures should not be unfairly borne by particular segments of the community. An essential element is an economic assessment of alternative management scenarios and a risk-assessment analysis that evaluates long-term costs and benefits to the biota and social systems.

### Recommended Indicators for Ecological Integrity

Members of the task force believe that land and water stewardship should be broadened. In an idealized setting, ecological integrity can best be achieved by:

- maintaining natural flows of water, nutrients, and energy;
- maintaining the watershed function (both physical and biological) by maintaining the watershed structure;
- working at the landscape level on a watershed basis and, if appropriate, ignoring socio-political boundaries that do not coincide with ecological boundaries;
- working with local organizations and local government to overcome social or political fragmentation of natural ecological boundaries;
- recognizing stakeholders on a watershed basis and allowing them to participate in the decision-making process;
- subscribing to long-term monitoring with physical and biological comparisons among relatively undisturbed settings to establish baselines for broader regional comparisons;
- developing protocols to identify restoration needs, while recognizing and maintaining properly functioning systems; and



■ acknowledging variability in physical and biological processes and maintaining flexibility in assessing departures.

Task Force members emphasized a need to learn more about aquatic ecosystems in the Rocky Mountains and Great Plains. They reviewed studies in other regions and suggested several priorities for Colorado.

### Areas of Future Study

Fish -- Perhaps wide fluctuations in fish species richness and abundance are the norm, rather than an aberration as might be assumed. Although some fish populations in Colorado rivers have been extensively sampled, such as those in reaches of the Yampa and in trout streams statewide, little is known of the distribution in many environments, especially on the eastern plains. Relatively little is known about what they eat, where and when they spawn, and other aspects of their biology.

Sediment -- Inputs and transport rates from undisturbed or unmanaged watersheds are not known for all ecosystem types in Colorado.

Riparian Vegetation -- Type and condition of riparian vegetation are unknown for many Colorado ecosystems, especially those with hydrologic modification.

Social Organization -- More study of local management units is needed to identify attributes of successful cooperation and working partnerships. Contrasts among regional organizations in terms of conflict avoidance and resolution will provide insights for better integration of ecological processes in management decisions at the local level.

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- Woodwell (1962). Effects of ionizing radiation on terrestrial ecosystems. *Science* 138:572-577.

### 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

- Arkansas River Basin Research Study**, John D. Stednick, Earth Resources. Sponsor: Colorado Division of Wildlife (CDOW).
- Arkansas Darter Recovery: Defining Habitat Requirements and the Spatial Dynamics of Population...**, Kurt D. Fausch, Fishery and Wildlife Biology. Sponsor: CDOW.
- Economic Benefits of Urban Stream Restoration**, John B. Loomis, Agricultural and Resource Economics. Sponsor: California Department of Water Resources.
- Assessment of Bank Stabilization Effectiveness**, Chester C. Watson, Civil Engineering. Sponsor: YMMU01 Muddy Creek Task Force.
- Soda Butte Creek and the McLaren Tailings, Montana**, Stephen A. Flickinger, Fishery and Wildlife Biology. Sponsor: National Biological Survey (NBS).
- \*Geomorphology of the Little Snake River**, Ellen E. Wohl, Earth Resources. Sponsor: National Park Service (NPS).
- Land and Water Use Model for Applications in the Rio Grande Basin**, Robert G. Woodmansee, Natural Resource Ecology Lab. (NREL), Sponsor: U.S. Geological Survey (USGS).
- \*Methodologies for Design of Soil Covers for Waste Disposal Sites**, Steve Abt, Civil Engineering. Sponsor: Nuclear Regulatory Commission.
- Revision and Update of 1992 Report and Bibliography on "Impacts of Electrofishing on Fish"**, Robert T. Muth, Fishery and Wildlife Biology. Sponsor: Bureau of Reclamation (USBR).
- \*Interdisciplinary Approaches to Identification and Mitigation of NPS Water Quality Impacts**, John D. Stednick, Earth Resources. Sponsor: University of Wyoming.



- \*Flaming Gorge Studies: Technical Integration and Synthesis, Robert T. Muth, Fishery and Wildlife Biology. Sponsor: USBR.
- \*Biosphere-Atmosphere Interactions -- A Study of the Energy, Water and Carbon Cycles, David A. Randall. Sponsor: NASA-Goddard.
- \*Effects of Electrofishing Fields on Juvenile Humpback Chub and Developing Eggs..., Robert T. Muth, Fishery and Wildlife Biology. Sponsor: USBR.
- \*The Natural Resources Workstation -- Wetland Capabilities, Luis Garcia, Chem. and Bioresource Engineering. Sponsor: USBR.
- \*Effects of Recreational Trail Use on Biodiversity, Richard L. Knight, Fishery and Wildlife Biology. Sponsor: City of Boulder.
- \*TOGA/COARE Atmospheric Budget Studies, Richard H. Johnson, CIRA Administrative Unit. Sponsor: NOAA.
- Developing Incidence Functions for Colorado River Cutthroat Trout..., Kurt D. Fausch, Fishery and Wildlife Biology. Sponsor: USDA/USFS/Rocky Mountain Forest and Range Experiment Station.
- \*Individual-Base Model: Colorado Squawfish, Kevin R. Bestgen, Fishery and Wildlife Biology. Sponsor: NPS.
- \*Climate Change in the Colorado Rocky Mountains..., Roger A. Pielke, Atmospheric Science. Sponsor: NPS.
- \*Comparative Ecosystem Dynamics in Riparian Zones Along Regulated and Unregulated Rivers, David J. Cooper, Fishery and Wildlife Biology. Sponsor: NPS.
- Field Demonstration of Infiltration Controls for Landfills, Thomas Hakonson, Fishery and Wildlife Biology. Sponsor: DOD/Navy.
- \*Projecting Climate and Vegetation Change for the Central Grasslands..., Roger A. Pielke, Atmospheric Science. Sponsor: NPS.
- Density Estimation of Freshwater Shrimp Using Distance Sampling, Alan P. Covich, Fishery and Wildlife Biology. Sponsor: USDA/USFS.
- \*Razorback Sucker Larvae in Canyonlands National Park, Utah, Robert T. Muth, Fishery and Wildlife Biology. Sponsor: NPS.
- \*Fish Composition of the Yampa and Little Snake Rivers, John A. Hawkins, Fishery and Wildlife Biology. Sponsor: NPS.
- \*Projecting Effect of Global Change on Vegetation in Park Landscapes..., Dennis Ojima, NREL. Sponsor: NPS.

University of Colorado, Boulder, CO 80309

- South Platte Water Rights Management System -- Maintenance Phase, Jacquelyn Sullivan, Civil Engineering. Sponsor: State of Colorado.
- \*Conceptual Planning for Integrated Analyses (Integral) of Water Resource Systems and Power Operations, Edith Zagana, Civil Engineering. Sponsor: Tennessee Valley Authority.
- \*Dynamics of Subglacier Water Routing and Characterization of the Basal Hydraulic System, Mark Meier, Institute of Arctic and Alpine Research (IAAR). Sponsor: National Science Foundation (NSF).
- \*Laurentide Ice Sheet Instability: Heinrich Events in Labrador Sea, and Rapid Climate Change, John Andrews, IAAR. Sponsor: NSF.
- Assessment of Variations in the Snow Accumulation Rate in Northern Greenland, James White, IAAR. Sponsor: NSF.
- Hydrologic Impacts of Variations in the Albedo of Seasonal Snow, Ann Nolin, CIRES. Sponsor: NSF.
- Theoretical and Experimental Studies of Hydrological Properties of Rock Fractures During Active Deformation, Shemi Ge, CIRES. Sponsor: Department of Energy.

\*Supplement to existing award.

## 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 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 May 1, 1995 and reflect conditions during the month of April.

Basin	May 1, 1995 SWSI Value	Change From Previous Mo.	Change From Previous Yr.
South Platte	+0.8	+0.9	-1.9
Arkansas	+3.2	+1.3	+2.9
Rio Grande	+3.4	+0.2	+1.7
Gunnison	+3.6	+0.7	+3.5
Colorado	+2.6	+1.1	+2.6
Yampa/White	-0.4	+0.3	+1.1
San Juan/Dolores	+2.4	-0.2	+2.7

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



## **FEATURES**

### **U.S. SUPREME COURT ADDRESSES THE INTEGRATION OF WATER RIGHTS AND WATER QUALITY: NIGHTMARE OR DREAM COME TRUE?**

by

**Robert Hiller, J.D.**

*Assistant Professor, Department of Chemical and Bioresource Engineering  
Colorado State University*

On May 31, 1994 the U. S. Supreme Court decided the case entitled, "Public Utility District of Jefferson County vs. the Washington State Department of Ecology." For the first time, the U.S. Supreme Court has addressed a case which squarely encounters the potential conflicts between water quality control regulation at the state and federal level and state water rights laws in the Western United States. For over 20 years many observers and commentators have predicted the eventual confrontation between these potentially competing uses of Western waters. However, few would have predicted that the U.S. Supreme Court would squarely tackle such an issue as presented in this case.

#### **SUMMARY**

The U.S. Supreme Court held that the State of Washington was entitled to object to the construction of a federally licensed power project within its state because such projects do not comply with the state's water quality control regulations, including a requirement that the project provide minimum streamflows in a stream segment that would be adversely affected by the construction of the project. The Supreme Court decided that the state's ability to refuse to certify the project was in compliance with state water quality laws contemplated by the Federal Water Quality Control Act, and the state's authority to require minimum streamflows was allowable even in the face of the Federal Power Act licensing requirements for hydroelectric dams and state water quantity allocation laws which would not have required the minimum streamflows required by the State of Washington.

#### **FACTS**

The facts and background of the case are as follows: The petitioner before the U.S. Supreme Court, the Public Utility District of Jefferson County, was a city and local utility proposing to construct a hydrologic project located on the Dosewallips River just outside the Olympic National Park on federally owned lands within the Olympic National Forest. The project would divert water from a 1.2-mile reach of the river, run the water through turbines to generate electricity, and then return the water to the river below the 1.2 mile reach of the river (the bypass reach). Current flow on the bypass reach prior to the construction of the project was between 149-738 cubic feet-per-second (cfs). After construction of the project, estimated flow of the bypass reach would be reduced to 65-155

cfs. The stream segment in question would be subjected to diminished flows necessary to support two species of salmon.

The State of Washington refused to certify compliance with the state's water quality laws unless the project was required to maintain at least 100-200 cfs of flow in the bypass reach depending on the season. A state administrative appeals board denied the 401 certification condition requiring minimum streamflows and determined that it exceeded the authority of the State Department of Ecology and the state and federal water quality laws. The case proceeded to Superior Court, which upheld the minimum flow requirement. From there, the case was appealed to the Washington State Supreme Court which also upheld the minimum flow requirement. The Washington Supreme Court case was then heard by the U.S. Supreme Court in order to "resolve a conflict among state courts of last resort." In other words, the U.S. Supreme Court undertook this case in order to resolve potential conflicts that could arise in supreme courts in different states interpreting the same or similar issues.

#### **DISCUSSION OF THE CASE'S FINDINGS**

Justice O'Connor, writing for the majority, first summarized the most pertinent provisions of the federal and state water quality control laws which were applicable to this case. Those provisions are as follows:

EPA is entitled to establish minimum, technology-based effluent limitations. States subject to EPA's approval are entitled to establish water quality standards on various water stream segments located within the state. Water quality stream standards consist of designated uses as well as criteria for such waters based on those uses. The 1987 amendments to the Clean Water Act, in Section 303, require each state to adopt an antidegradation rule to help protect existing uses. Under federal water quality control laws, states may impose more stringent standards than the minimum standards established by federal law.

In this case, the State of Washington conducted an inventory and established five classes of water. The river in question received AA highest classification designation.

States have primary enforcement responsibility once they have control of the administration of water quality control at the state level. That includes the right to conduct 401 certifications to



determine whether federal projects will comply with state water quality standards. The 401 certification is required to set forth "any effluent limitation and other limitations" necessary to assure compliance with "applicable effluent limitations and other limitations."

Of special significance in this case and other 401 certifications is the fact that any such limitation becomes part of the federal license -- in this case, the federal power license for a hydroelectric project.

In order to understand the significance of the majority opinion, I think it is easiest to first look at the objections asserted by Justice Thomas writing for the dissenting minority. Justice Thomas would have rejected the minimum streamflow requirement that was incorporated in the Washington State 401 certification. His reasoning was that Section 401(d) provides a certification to assure that any applicant for a federal license and permit must comply with applicable effluent limitations and with any other appropriate requirement of state law. In his opinion, conditions of the certification must relate to a discharge, and since minimum flow requirements do not relate to a discharge it is an inappropriate requirement to be included in a 401 certification.

Justice Thomas, writing for the dissent, also believed that the majority gave too much deference to EPA regulations. The EPA promulgated regulations at 40 CFR 121.2(a)(3)(1993). Those regulations stated that a 401 certification shall contain "a statement that there is a reasonable assurance that the activity will be conducted in a manner that will not violate applicable water quality standards." Justice Thomas emphasized EPA's wording regarding water quality standards and asserted that a water quality standard sets forth a designated use. You cannot, in his opinion, enforce a water quality use without corresponding water quality criteria. In Justice Thomas's opinion, minimum streamflows are not criteria and therefore not appropriate for inclusion in a 401 certification.

Justice O'Connor, writing for the majority, addressed each of Thomas's assertions and went even further in setting forth her view of how water quality standards and water rights are integrated.

Justice O'Connor emphasized the wording in Section 401(d), which states that any applicant for a federal license must comply with applicable state water quality laws. In her opinion, once a project has a discharge, then additional conditions and limitations on the activity as a whole are permissible. She further relied on the EPA regulations cited above and EPA's use

*Perhaps in the most startling portion of the majority opinion, the Supreme Court addressed the interrelationship between water quality and water quantity...Justice O'Connor, writing for the majority, said: "This is an artificial distinction."*

of the word "activity" instead of the word "discharge" as being especially significant.

She also looked to Section 301 and pointed out that it does not refer to discharges. It provides that "in order to carry out the objective" of the Clean Water Act, states must impose "any more stringent limitation including those necessary to meet water quality standards established pursuant to state law." Justice O'Connor stated that although she wouldn't speculate on what other state laws might be

included within the 401(d) reference to "any other appropriate requirement of state law," she was sure that, as a minimum, state water quality standards under 303 are "appropriate requirements under state law."

Having concluded that a water quality standard is an appropriate state law under Section 401(d), O'Connor then turned to the question of whether a minimum streamflow condition is the kind of limitation that is appropriately included. Justice O'Connor then tackled the sometimes perplexing interrelationship between water quality uses and water quality criteria. Justice O'Connor stated that if you can't achieve the designated use, then you don't meet the water quality standard even if the numerical criteria for that designated use are being met. In other words, water quality criteria are guidelines indicating whether or not you are meeting a designated water quality standard. However, if you have not achieved the use for that standard, you still have not complied with the minimum requirements of the Clean Water Act. In her view, 401 requires that an activity be consistent both with the use designations and the water quality criteria. Justice O'Connor relied on EPA regulations which provide that compliance with water quality criteria will generally result in achieving the designated uses. However, she interpreted criteria as a convenient method of enforcement that cannot be expected to achieve uses in all rivers in a state within a given class. Therefore, she rejected the petitioner's allegation that they need only comply with water quality criteria. Petitioners argued that since minimum streamflows are not a criteria, but instead are a mechanism for achieving a designated use, they were an inappropriate requirement under state law.

Perhaps in the most startling portion of the majority opinion, the Supreme Court addressed the interrelationship between water quality and water quantity. Specifically, the petitioners had asserted that the Clean Water Act is only concerned with water quality and does not allow the regulation of water quantity. Justice O'Connor, writing for the majority, said: "This is an artificial distinction. In many cases, water quantity is closely related to water quality; a sufficient lowering of water quantity in a body of water could destroy all of its designated uses, be it for drinking water, recreation, navigation or as here, as a fishery."



She went on to cite references in the Clean Water Act that provide that pollution can constitute man-made or man-induced alterations, and that pursuant to Section 304 pollution may result in changes in movement, flow or circulation of the navigable waters of the United States. However, the petitioners had countered, making an allegation frequently heard by owners of water rights that Section 101(g) of the Clean Water Act contains the following provision:

"The authority of each state to allocate quantities of water within its jurisdiction shall not be superseded or impaired."

For decades water rights owners have asserted this statutory language as a theory for the proposition that various restrictions and limitations in the Clean Water Act cannot compel the use or application of water rights under state law in a manner inconsistent with those water rights granted under state law. Justice O'Connor tackled this allegation head-on by stating that the above-cited section, along with related sections, does not limit the scope of water pollution controls that may be imposed on users who have obtained, pursuant to state law, a (water rights) allocation.

*...it now is apparent that the Supreme Court has rejected the hopes of some that a barrier between water quality control regulations and water rights administration under state law could be constructed and maintained.*

Clearly, the arguments of the petitioners did not escape the majority. Justice O'Connor stated that the language referred to in 101(g) quoted above gives states authority to allocate water rights. She went on to say, "Therefore we find it peculiar that petitioners argue that it prevents a state from regulating streamflow." What Justice O'Connor seems to be saying here is that the authority to impose 401 certification limitations including minimum streamflows derives not from a conflict between federal and state authority, but directly from the state's authority to administer its own water quality controls. She apparently is posturing the conflict as not a federal-state conflict but as the right of a state to set limitations on its water quality control laws versus the right of a state to allocate water rights under state law.

### SUMMARY AND CONCLUSION

The Supreme Court clearly established that states have the right to impose limitations on projects seeking federal licenses to operate within their states. Those limitations can include minimum streamflows even though they contradict or contravene requirements under existing state water allocation laws. However, for the 401 certification requirement to be triggered, a project must seek a federal license such as a hydroelectric license under the Federal Power Act or a 404 permit under the Corps of Engineers Dredge and Fill Permit Program. It is likely that 401 certifications would also apply to federal special use permits, some of which are currently being renewed for reservoir and dam projects being located on federal lands. In each of those cases, state water quality authority will be asked to review the project's proposed activity and determine whether it will be consistent with state water quality control laws.

Not all states will seek to impose the stringent requirements that were sought by the State of Washington in this case. However, all states are required to have antidegradation rules, and it is possible that EPA could scrutinize the application of a state degradation rule in the future with this case in mind. That is to say that EPA could start to examine more carefully situations where certain stream segments do not meet state water quality stream standards because of fluctuations of streamflow conditions because of the use and application of water rights under state law. It is also possible that EPA, in reviewing the states' water quality programs every three years, could put

pressure on states that are not actively enforcing their antidegradation rule in such context to do so by requiring minimum streamflows or other conditions that might adversely affect the use of water rights issued pursuant to state law.

EPA is also becoming more active in pursuing the requirement that states inventory and designate certain stream segments that do not meet water quality stream standards because of the presence of conventional or toxic pollutants. EPA also has authority to compel states to establish total daily maximum loading requirements because of the presence of conventional pollutants on certain stream segments that fail to meet water quality stream standards. It is possible, as part of the establishment of total daily maximum loading requirements, that EPA might seek state-imposed minimum streamflow conditions or minimum flow releases from existing dam and reservoir projects in order to implement the total daily maximum loading requirements on that stream segment.

In any case, it now is apparent that the Supreme Court has rejected the hopes of some that a barrier between water quality control regulations and water rights administration under state law could be constructed and maintained. It is also obvious that the consequences of this case are far-reaching, as evidenced by the fact that legislative efforts are underway to amend the Clean Water Act in order to overcome the potential water rights impact that this decision could have in the future.



## **WATER PUBLICATIONS, DATABASES, VIDEOS**

### **NEW CWRRI REPORTS**

*CWRRI Reports are available from the Cooperative Extension Resource Center, General Services Building, Colorado State University, Fort Collins, CO 80523. Phone 970/491-6198; FAX 970/491-2961.*

**Proceedings: Workshop on Computer Applications in Water Management**, L. Ahuja, J. Leppert and K. Rojas, eds. Information Series No. 79. Available from Great Plains Agricultural Council. Call L. Ahuja at 970/490-8315.

In 1992 the Great Plains Agricultural Council's Executive Committee approved the formation of a Task Force on Computer Applications in Water Management. The Task Force was formed at the recommendation of the GPAC's Water Committee. The Task Force was organized in the spring of 1993 to plan and conduct a workshop that would provide a forum for model developers and users to discuss successes and failures of computer-based tools in water management. Task Force members formulated the purpose of the workshop as a meeting to familiarize state and local mid-level 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. The workshop was organized around applications of: **Information Technology, River Basin Scale Models, Watershed Scale Models, and Field Scale Models.**

### **USGS REPORTS**

*Contact the U.S. Geological Survey, Earth Science Information Center, Open-File Reports Section, Box 25286, Mail Stop 517, Denver Federal Center, Denver, CO 80225 or call 303/236-7476.*

**Water Quality of Storm Runoff and Comparison of Procedures for Estimating Storm-runoff Loads, Volume, Event-mean Concentrations, and the Mean Load for a Storm for Selected Properties and Constituents for Colorado Springs, Southeastern Colorado, 1992**, by Paul von Guerard and William B. Weiss. U.S. Geological Survey Water-Resources Investigations Report 94-4194.

The U.S. Environmental Protection Agency requires that municipalities that have a population of 100,000 or greater obtain National Pollutant Discharge Elimination System permits to characterize the quality of their storm runoff. This report presents the results of a study in the City of Colorado Springs to characterize the water quality of storm runoff and to compare procedures for the estimation of storm-runoff loads, volume, and event-mean concentrations for selected constituents. The study was conducted by the U.S. Geological Survey in cooperation with the Colorado Springs City Engineering Division.

**Regional Aquifer-System Analysis Program of the U.S. Geological Survey, 1978-1992**, by Ren Jen Sun and Richard H. Johnston. U.S. Geological Survey Circular 1099.

The major groundwater systems of the United States have been investigated by the U.S. Geological Survey (USGS) through its Regional Aquifer-System Analysis (RASA) Program. During the first 15 years of the program (1978-92), 25 regional aquifer systems, including the most heavily pumped aquifers in the Nation, were intensively studied. As of mid-1992, 18 of the regional aquifer studies are completed or nearly so; 7 of the regional aquifer studies are ongoing, and compilation of a national groundwater atlas is in progress. This report summarizes the status of each RASA study and briefly describes the hydrology of the 25 regional aquifer systems.

### **POSITIONS AVAILABLE**

The Missouri Division of Personnel announces recruitment for:

**Hydrologist I**  
Salary: \$2,044-2,711

**Hydrologist II**  
Salary: \$2,304-3,076

**Hydrologist III**  
Salary: \$2,498-3,346

**Hydrologist IV**  
Salary: \$2,825-3,811

These positions exist with the Department of Natural Resources, Cole and Phelps County, Missouri. However, the register established from this examination may be used to fill future vacancies without further examination as they occur in other areas of the State. Applications may be filed until further notice.

For job description and application contact:

Missouri Division of Personnel  
Truman State Office Building  
P.O. Box 388  
Jefferson City, MO 65102

Phone: 314/751-4162



## AGREEMENTS WRITTEN WITH WATER: PROSPECTS FOR INTEGRATED WATERSHED MANAGEMENT IN THE CACHE LA POUDE BASIN

*by David Graf and David Williams*

On April 26th, the Colorado State University chapter of the American Water Resources Association (AWRA) hosted a panel discussion entitled "Agreements Written With Water: Prospects for Integrated Watershed Management in the Cache la Poudre Basin." Participants included Wendy Rudnick, attorney with the CU Natural Resources Law Center, Doug Robotham, Assistant Director of Water Policy for the Department of Natural Resources, Eric Wilkinson, General Manager of the Northern Colorado Water Conservancy District, Kathleen Klein from the Colorado Water Resources Research Institute, and Skip Underwood, Supervisor of the Arapaho-Roosevelt National Forest. The participants represented both the larger management issues and operational issues specific to the Poudre River Basin. The discussion was moderated by CWRRI Director Robert Ward.

The purpose of the discussion was to examine the panacea dubbed "integrated watershed management" and see how it could apply, if it doesn't already, to current management activities in the basin. The impetus for the discussion came from a desire to learn about competing issues of resource allocation in the basin; specifically, how historic uses of water can be reconciled with increasing instream flow demand for recreation and habitat. It was also important to contrast top-down versus bottom-up management approaches to see what seems to work, what approach seems most appropriate for which scale, and what might work for the Poudre basin.

Panel moderator Robert Ward reminded the audience of the strong history of water resource use in the Poudre River Basin, hearkening back to the historic showdown in a schoolhouse in Greeley in the early 1860s, out of which the backbone of the prior appropriation doctrine, "first in time, first in right" was born.

The panel began with Wendy Rudnick, who contrasted centralized and grass roots approaches to watershed planning in the State of Oregon, where watershed planning activities are subject to county and state approval, with that of the Henry's Fork in Idaho where the process has been bottom-up and informally encouraged by the state. This latter approach is the tactic that the Colorado Department of Natural Resources

employs, using technical advisory assistance or conference participation as its main means of help. Watershed forums in various basins throughout the state have been initiated without formal aid or central bureaucratic mechanisms.

The discussion then shifted to the operations of both the U.S. Forest Service and the Northern Colorado Water Conservancy District. The USFS is constrained in its ability to employ creative water management strategies by the National Forest Management Act (requiring forest plans) and the Federal Land Policy Management Act (dictating procedures for issuing special use permits), both of which were passed after the last round of use permits was issued for waters privately owned on public land. This led to lengthy negotiations between the USFS and private owners, who use water originating on USFS land, for the re-issuance of 5 of over 100 lease permits coming to term in the near future. The need to find a strategy which streamlines the permitting process and integrates new mandates with prior uses was emphasized.

Eric Wilkinson presented a historic look at water management in the region and argued that integrated watershed management, meaning an acknowledgement of competing, multiple uses, has always been a part of water resource planning in the Poudre. Each time, solutions have been found to seemingly

insurmountable problems. He then described both the Colorado-Big Thompson (C-BT) completed in 1935 and the Poudre Project, in preliminary design, as examples.

In summary, discussion participants all emphasized the need for multiple use management. By involving multiple perspectives in a negotiating process, there naturally would emerge different styles of management, and different ideas of what the optimal solution might look like. A significant portion of the question period was spent addressing the negotiation process, and how groups not holding rights to water may acquire 'standing'. The prospects for integrated management in the Poudre River Basin seem to hinge on how various stakeholders can organize to articulate a common objective. A fundamental truth that seemed to emerge was that without strong leadership or a specific problem requiring attention, the prospects are limited, and the status quo was likely to continue.

### Colorado State University's Student Chapter of the American Water Resources Association

The Colorado State University chapter of the American Water Resources Association (CSU AWRA) actively promotes water education on the CSU campus. The main goal of the organization is to provide a means to integrate the many water related disciplines through an annual speaker series, community involvement, regular meetings, and field trips. This spring, the weekly speaker series was co-hosted with the Department of Hydrological Sciences and Engineering and emphasized the diversity of water-related issues with both technical and non-technical talks from professional and academic settings. All CSU AWRA sponsored events are open to the public. For more information, contact David Graf at 491-5661.



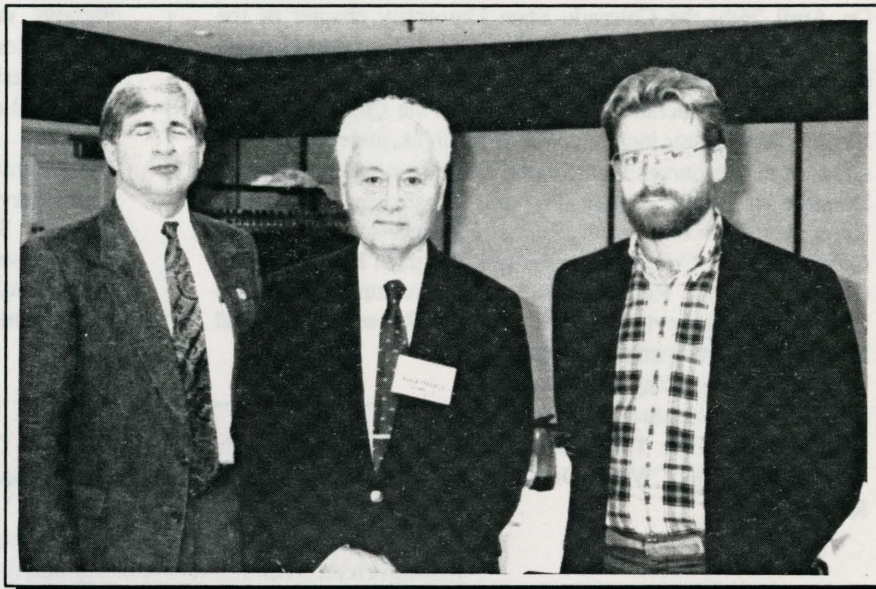
## 15th ANNUAL HYDROLOGY DAYS

by David Williams

On April 3 through April 7, the American Geophysical Union convened at Colorado State University to hold its fifth annual 'Hydrology Days' conference. Dedicated to Professor Emeritus Vujica Yevjevich of CSU's Civil Engineering Department, this year's Hydrology Days was an opportunity for professionals, academics, and students of hydrology to come together in an exchange of ideas, research, and results. Many of the presenters this year came from Colorado, but others came from as far away as Canada, Spain, Belgium, and Russia.

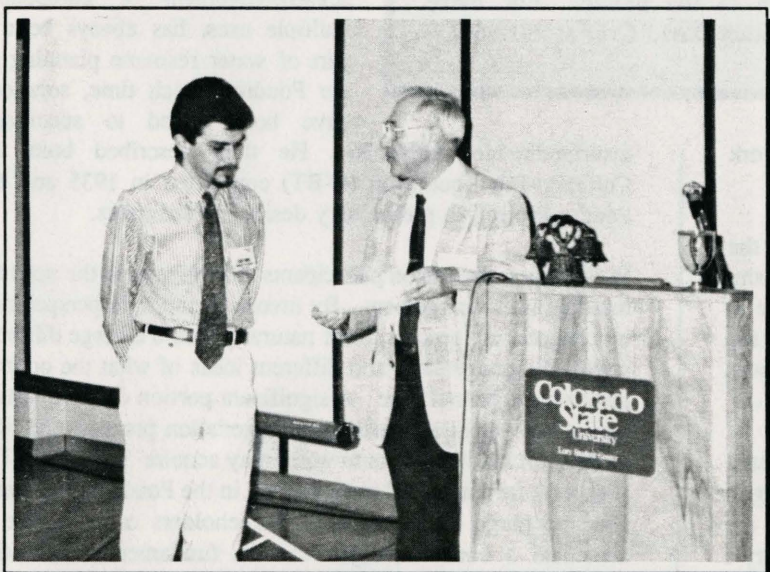
The first day of the five-day conference began with presentations of student papers. Two categories were presented -- M.S. and Ph.D. students. Papers presented included information on water-budgeting, water quality monitoring systems, information accountability, atmospheric processes, macropore flow, groundwater recharge, water diversion, process modeling, contaminant transport, flow prediction, and others.

Awards were given for the best presentation in each category. Sasa Tomic, of the University of Alabama in Tuscaloosa, was



*Professor Emeritus Vujica Yevjevich (center) with keynote speakers David Bowman, U.S. Fish and Wildlife Service (left) and Assistant Professor Mark Fiege*

awarded best M.S. student paper for his presentation entitled "Regional Low-Flow Frequency Analysis for Alabama Rivers." Germán Poveda from the University of Colorado was awarded best Ph.D. student paper for his presentation entitled "The Relationship Between ENSO and Hydrology of Columbia."



*Professor Hubert Morel-Seytoux, conference organizer, (right) presents Sasa Tomic with the award for Best Student Oral Presentation Award in the M.S. category.*

The second day of the conference marked the beginning of presentations by academic faculty and professionals in hydrology. That day's luncheon was treated to keynote speaker, Mark Fiege, Assistant Professor of History at Colorado State University. The title of his presentation was "Environmental History: Irrigation in the Snake River Valley." Fiege detailed the history of changes in habitat, hydrology, ecology, technology, and economy in the Snake River Valley caused by irrigation. He commented on the "hybrid landscape" created by irrigation and stressed the importance of historical perspectives, suggesting that humans cannot control all aspects of the environment -- they can only make changes to the landscape.

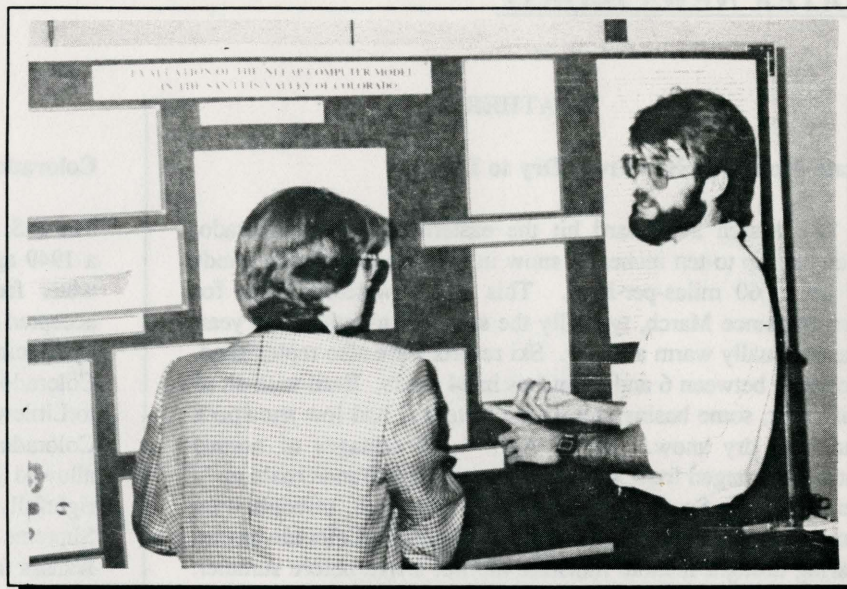
After lunch on the second day, M.S. and Ph.D. students and professionals presented posters and exhibits. These presentations documented research performed by the students and professionals. Topics included computer modeling, management, decision



support systems, hydraulic conductivity, and hydrology laboratory courses.

Awards were presented for the best student posters in the M.S. and Ph.D. categories. Sharika Senarath, from Colorado State University, was awarded best student poster presentation in the M.S. category for her poster entitled "GCM Land and Surface Hydrology Parameterizations -- Incorporating a Stochastic Surface Interception Capacity Function." In the Ph.D. category, Mohamed Rami Mahmoud, from Colorado State University, was awarded best student poster presentation for his poster entitled, "Multi-Criteria Decision Support System Implementation and Application."

Another highlight of the conference was the keynote address on Wednesday by David Bowman, South Platte River Coordinator for the U.S. Fish and Wildlife Service. Bowman expressed that hydrology must be joined with ecology when considering ecosystem management, approaching hydrology from the perspective of ecology. He backed his assertions with statistics, indicating that since the 1930s over 75 percent of wetland and channel habitat for wildlife in the South Platte River has been



*Kevin Lee, M.S. student at CSU, discusses his poster presentation, "Evaluation of the NLEAP Model in the San Luis Valley of Colorado," with a conference participant.*

destroyed, causing the South Platte to have nine listed endangered species and thirteen candidate species for listing. Bowman concluded by saying that peak flows have been the greatest factor in river health and habitat quality.

## **WATER EDUCATION**

### **PROJECT WET CURRICULUM AND ACTIVITY GUIDE**

Hopping in pillow slips that simulate caddisfly cases, students play a game of tag that illustrates how macroinvertebrate populations indicate water quality. Students imagine they are shrunk to the size of water molecules and take an incredible journey through the water cycle. Cub Scouts build rainsticks, an ancient instrument that imitates the sound of rain, and learn how diverse cultures celebrate water. High school seniors become CEOs and analyze relationships between economics and environmental quality.

What do caddisflies, water molecules, rainsticks, and CEOs have in common? They are all subjects in the newly released *Project WET Curriculum and Activity Guide*. The *Guide* was developed for teachers of grades Kindergarten through twelve and for nonschool educators such as: park naturalists, water resource managers, museum staff, and others.

Chris Bridges, sponsored by the Colorado Water Conservation Board, is Colorado's State Project Wet (Water Education for

Teachers) Coordinator. She will be utilizing the *Project WET Curriculum and Activity Guide* and other water-related materials in teacher training workshops taking place throughout the state. The *Guide* is co-sponsored by the Watercourse and WREEC (the Western Regional Environmental Education Council). Project WET is the third member of a family of environmental education programs including PLT (Project Learning Tree) and Project WILD. For more information about classroom ready teaching aids, publications, and training opportunities contact: Chris Bridges, Colorado Water Conservation Board, 1313 Sherman St., Room 721, Denver, Colorado 80203, (303) 866-3441.

Remember, these opportunities for training are open to teachers and other nonschool educators. The Colorado Water Conservation Board has developed, through the Division of Wildlife, SPLATTE (South Platte Learning and Teaching the Essentials) a curriculum specific to the South Platte River basin. Also in development is a curriculum on the Animas LaPlata.



## **WATER NEWS DIGEST**

### **WEATHER**

#### **State Moisture Goes From Dry to Deluge**

In late March a blizzard hit the eastern plains of Colorado, dropping up to ten inches of snow in places and bringing winds of up to 60 miles-per-hour. This was a welcome sight for farmers, since March, typically the snowiest month of the year, was unusually warm and dry. Ski resorts were also replenished, receiving between 6 and 16 inches in 24 hours. Even with all of this snow, some basins around the state still had low snowpack and very dry snow. As of April 1, percentages of normal snowpack ranged from 126 percent in the Rio Grande basin to 77 percent in the South Platte basin. In mid April, officials were worried about snowpack in the South Platte and Colorado basins, fearing drought if more moisture did not arrive before summer. They got it. In mid April, snowfalls started around the state, bringing the state average snowpack to 141 percent of normal with a high of 183 percent in the Arkansas basin and a low of 100 percent in the North Platte basin. Thoughts turned from drought to flood, with many officials recommending flood insurance. By mid May, the Arkansas and Gunnison basins were at 244 and 242 percent of normal snowpack, respectively, and some cities were preparing for the flood of the decade. Snow was still falling in parts of the state with Colorado Springs receiving as much as 3 inches in late May. As a matter of fact, while this is being written in Fort Collins it has been raining for two weeks. Who ever said water management is easy?

Colorado Springs *Gazette Telegraph* 3/27/95, 4/20/95, 5/3/90, 5/18/95; *Denver Post* 4/4/95, 5/3/95, 5/10/95, 5/11/95, 5/16/95; Fort Collins *Coloradoan* 3/31/95, 4/4/95, 4/15/95; Grand Junction *Daily Sentinel* 3/29/95, 4/3/95, 4/4/95, 5/2/95, 5/9/95, 5/17/95; Greeley *Tribune* 4/1/95, 4/4/95, 4/13/95, 4/15/95, 5/5/95, 5/16/95, 5/18/95; Montrose *Daily Press* 3/31/95, 4/5/95, 5/11/95, 5/18/95; Pueblo *Chieftain* 3/27/95, 3/29/95, 3/31/95, 4/15/95, 5/18/95, 5/19/95

### **WATER TRANSFER**

#### **Fort Collins-Kodak Water Transfer Completed**

The Colorado Division of Kodak and the City of Fort Collins have reached an agreement that transfers Kodak's ownership of North Poudre Irrigation Co. water to Fort Collins. In turn, Fort Collins has agreed to provide Kodak a firm annual supply through the city of Greeley of about 1,200 acre-feet. Under the agreement, Fort Collins gets more than 620 shares of North Poudre Irrigation Co. water, a continuation of accumulation of that company's water during the past 30 years. The shares are Colorado-Big Thompson water, representing about 2,000 acre-feet.

Fort Collins *Coloradoan* 4/14/95; Greeley *Tribune* 4/4/95

### **LITIGATION**

#### **Colorado Loses Battle Over Arkansas River**

The U.S. Supreme Court ruled on May 15 that Colorado violated a 1949 agreement with Kansas by taking more than its share of water from the Arkansas River. The justices unanimously accepted all four volumes of recommendations submitted to them by special master Arthur Littleworth. The decision could force Colorado to cap as many as 1,700 wells. The case now returns to Littleworth to determine the amount of damages to be paid by Colorado to Kansas. Kansas' principle claim was that Colorado allowed hundreds of wells to be drilled, draining water that rightfully belonged to Kansas. In Colorado's defense, the Supreme Court, agreeing with Littleworth's findings, ruled that Kansas failed to prove its claim that construction and use of the Trinidad dam and reservoir on the Purgatoire River near Trinidad have resulted in a material depletion of Arkansas River water for Kansas.

The Southeast Colorado Water Conservancy District will consider running a well-water replacement plan, using return flows from the Frying Pan-Arkansas Project, to solve problems wells have caused for Kansas and irrigation ditches in Colorado. Under the plan, the district would sell replacement water for large irrigation, commercial, and municipal wells west of John Martin Reservoir. The district also would collect accurate records of well pumping and buy other water to replace the water wells take from Kansas and in-state ditches. The plan would be administered by the district with money paid by well owners. Key provisions include:

- Elimination of the current rule allowing well owners to pump on Mondays, Tuesdays, and Wednesdays without replacement.
- Establishment of several sets of replacement percentages for well users.
- Irrigation ditch companies would give up their current first refusal rights to return flows from Frying Pan-Arkansas project water.
- The district will buy whatever water is needed to replace what the wells take from Kansas and irrigation ditches in Colorado.
- The replacement water that doesn't take the form of return flows would be released each day from storage reservoirs for use by irrigation ditches.
- Replacement water collected in the winter would be stored in each ditch's account.
- Ditches would sign over their return flow rights for five years while the plan is evaluated and adjusted. Participants would decide at the end of the five-year term if it should continue.

Colorado Springs *Gazette Telegraph* 5/16/95; *Denver Post* 5/16/95; Greeley *Tribune* 5/16/95; Montrose *Daily Press* 5/18/95; Pueblo *Chieftain* 4/21/95, 5/19/95, 5/21/95



## Baca Grande Sues AWDI Over Water

The Baca Grande Water and Sanitation District has filed suit against American Water Development Inc. in district water court in Saguache. The district wants to ensure that a 99-year lease entered into in 1972 with AWDI's predecessor will be preserved no matter what happens to AWDI. In the suit, filed in mid-April, the district has asked for a declaration that any water right owned by the Arizona-Colorado Land and Cattle Company (AZL) at the time the lease was executed in October, 1972, and subsequently owned by AWDI, be subject to first call by the district. It wants each water right to be subject to such a call, allowing the district to take the amount of water needed to satisfy its needs for its present or an increased service area. AWDI, saddled with a judgement of more than \$3 million including interest, is negotiating the sale of part of the ranch not in the subdivision. The lease provided the district up to 750 gallons per minute at a monthly rate of \$350 until the district bonds were retired, but no longer than 30 years from the first delivery of water to the district. At that time, the district was to pay AZL (now AWDI) by the acre-foot. The district maintains that the portion of the lease limiting the district's ability to procure water from other sources is void, because it is against public policy.

*Denver Post* 4/19/95; *Montrose Daily Press* 4/19/95; *Pueblo Chieftain* 4/16/95

## ENVIRONMENT

### BLM Checks Leaking Gases

Leaks of toxic hydrogen sulfide and methane gases near underground coal seams have been confirmed in several spots on the slopes southeast of Durango, and federal and local officials plan to set up checks of the area. U.S. Bureau of Land Management officials launched a sweep of the area after the Southern Ute Indian tribe investigated reports of leaking gas on its reservation in southwest Colorado. Some have suggested a possible connection between the rate of seeping gas and area gas production, while others have disputed a link. The Colorado portion of the San Juan Geological Basin, called the Ignacio-Blanco Field, is home to roughly 2,600 gas wells.

*Montrose Daily Press* 5/5/95

### Rep. McInnis Seeks Probe of Summitville Cleanup

Rep. Scott McInnis said in late April that he has requested a formal investigation into contracting costs for the cleanup at Summitville Gold Mine. The Summitville Consolidated Mining Co. operated the mine high in the San Juan mountains southwest of Del Norte until it declared bankruptcy in December 1992, leaving cleanup costs to taxpayers. The company used a cyanide-heap leaching method to extract gold from the ore. Cyanide and heavy metals leached into waterways in the area, and more than \$100 million has been spent to remedy the problem.

*Pueblo Chieftain* 4/18/95, 4/22/95

## Local Workers to Handle Leadville Cleanup

William Yellowtail, regional administrator of the U.S. Environmental Protection Agency, met with state and county officials in mid-April to discuss the Leadville cleanup project. At issue is the cleanup around hundreds of tailings piles, some a century old. Runoff from the piles carries lead and other heavy metals into the Arkansas River and has elevated lead levels throughout town. Under the federal Superfund law, the EPA, the state, and the mining company Asarco, declared a "principal responsible party," are required to conduct the cleanup together. The three signed a consent decree last May to guide the work. The consent decree requires EPA to be involved, but state and local crews will be allowed to conduct the cleanup. EPA says with cooperation they should be out of town in two to four years.

*Denver Post* 4/19/95; *Grand Junction Daily Sentinel* 4/19/95

## WATER PROJECTS

### Dominguez Project Backers Drop Water Rights Claim of 1971

The Dominguez Reservoir Corp. has abandoned its claims to 1971 water rights for Dominguez Reservoir held by the federal government. Instead, the Corporation will pursue a separate claim to the water filed in Montrose water court in 1988. The action by an attorney representing Dominguez was taken, because in recent settlement talks, various opponents agreed not to oppose the 1988 case in Montrose if the corporation would drop the 1971 case in Glenwood Springs. The 1971 rights have been a subject of controversy since the U.S. Bureau of Reclamation determined in 1984 that the project was not economically feasible. In 1987 the bureau assigned the rights to the Colorado River Conservation District. The district turned the rights back in January 1989, and four months later the bureau transferred the rights to the city of Grand Junction, which in turn gave them to the Dominguez Reservoir Corp. In the meantime, the Corporation filed its own claim in 1988.

*Grand Junction Daily Sentinel* 3/28/95, 4/20/95, 5/17/95

### Southern Water Supply Project on Schedule

The Southern Water Supply Project under construction by the Northern Colorado Water Conservancy District is on schedule and will deliver Windy Gap Project water to Broomfield early this summer. The project, started four years ago after Broomfield's water supply was deemed polluted, is set for completion in mid-June and will deliver water through a pipeline from Carter Lake southwest of Loveland to Broomfield. A supply line to the Louisville-Superior area will be complete in mid-1996 and to Fort Lupton and Hudson by the fall of 1996. Later this year, preliminary design of a line to Morgan County will begin, and completion of that part of the project is set for 1998.

*Greeley Tribune* 4/13/95



## AB Lateral Project Revived

A proposal to divert water from the Gunnison River to the Uncompahgre that failed to receive approval several years ago has been revived by supporters representing the Uncompahgre Valley Water Users Association (UVWUA). The project would divert water from the Gunnison River, through the existing Gunnison Tunnel just upstream of the Black Canyon of the Gunnison National Monument, and ship it to the Uncompahgre River. On its way the water would generate 40 megawatts of electricity. The plant is to be operated by the UVWUA and the revenues would be split with investors. Opposition concerns center around the lack of demand for extra power, citing the bankruptcy of the Colorado-Ute Electric Association due to an oversupply of power. Another concern is that the project would take too much water out of the Gunnison and put too much into the Uncompahgre. The Uncompahgre's usual bank stabilization problems might be worsened by adding more water to the river.

*Denver Post 5/8/95; Montrose Daily Press 4/5/95*

## CONSERVATION

### Conservation and Ranching Coexist at Nature Conservancy Operation

The historic Red Canyon Ranch near Lander, Wyoming represents the Nature Conservancy's attempt to show that ranching and conservation can coexist. While the conservancy and other groups often acquire ranchland to keep it open and out of the hands of developers, the land usually ends up in government hands or as a preserve. The conservancy decided to take a different approach in the case of the sprawling Red Canyon Ranch and run it as a working ranch and learning environment, complete with its own cattle. Besides showing ranches can be compatible with conservation, the ranch serves as a nonconfrontational learning area where ranchers and environmentalists can come together. Education programs range from high school field trips to a ranch internship with the University of Wyoming.

*Grand Junction Daily Sentinel 5/12/95*

## GROUNDWATER

### Some Water Wells Tainted in Lakewood

Residents in a small section of Lakewood were notified in late March of groundwater contamination, resulting from a solvent that leaked from underground tanks owned by the Federal Highway Administration. The contamination is being investigated by the highway administration and the Colorado Department of Health. Though the majority of residents within the contamination zone draw from municipal water supplies, the sample contained seven times the amount of the chemical allowed under standards for domestic use of groundwater.

*Denver Post 3/31/95; Grand Junction Daily Sentinel 4/1/95*

## WATER QUALITY

### Boulder Residents Win Toxic Water Lawsuit

On May 16, a jury awarded \$4.1 million to 105 residents of a neighborhood who alleged their groundwater was contaminated by 10 years of chemical pollution from a nearby circuit board manufacturing plant. The residents sued Centerline Circuits Inc., claiming that between 1968 and 1978 the firm dumped 3,500 gallons per day of industrial waste water contaminated with trichloroethane (TCE) and other industrial wastes into an aquifer feeding their wells. The award to residents of Boulder's Crestview neighborhood was divided into two parts. All 105 residents shared in \$3 million for a neighborhood cleanup and \$745,000 to annex Crestview to the city of Boulder's water and sewer services. Ten of the residents also shared in \$255,000 for medical monitoring and \$165,000 for loss of use and enjoyment of property. The remaining 95 residents still have outstanding claims concerning medical monitoring and loss of use and enjoyment against Centerline.

*Denver Post 5/17/95; Grand Junction Daily Sentinel 5/17/95*

### Colorado Springs Officials Defend Quality of Water

The Colorado Springs Water Department went on the offensive in late March to ease fears fueled by a network news report about its outdated treatment plant. The report, termed erroneous, came as a surprise to both city officials and the regional EPA office in Denver. Colorado Springs was singled out because it was cited in 1993 when about 22,000 people in Colorado Springs were getting water that was chlorinated but unfiltered during the summer. No health problems were reported, but the city was in violation of the federal requirement that water from surface sources had to be filtered by June 29, 1993. The city planned to beat the deadline by building a treatment plant at the mouth of Cheyenne Canyon but failed when residents objected to the location of the plant. The city switched all homes in the affected area to another, filtered source in October 1993 after the federal deadline.

*Colorado Springs Gazette Telegraph 3/31/95; Montrose Daily Press 3/31/95*

## WATER RATES

### Montrose City Council Approves Tap Fee Hike

Responding to concerns from homebuilders, the Montrose City Council gave final approval on May 18 to a revised hike in sewer and water connection fees. Instead of doubling tap fees, as was approved by the council two weeks ago, the council agreed to phase in the cost hike over three years, increasing tap fees by 33 1/3 percent each year. Monthly charges for city services are also expected to be raised in the future by the council to cover costs related to growth and capitol improvements.

*Montrose Daily Press 5/19/95*



## Rate Hike for Evans Supply Ditch Considered

The Greeley City Council has proposed rate increases of five percent for users of the Evans Supply Ditch. Proposed rates for the use of the ditch water are \$52.50 for the first acre to be irrigated, \$31.50 for the second acre, \$29.40 for the third, and \$21 on each additional acre. Those fees help pay for operations and maintenance of the ditch.

*Greeley Tribune 4/3/95*

## RECREATION

### Poudre River Trail Project gets \$100,000 GOCO Boost

The Poudre River Trail got a \$100,000 boost on April 13 when Greeley and Windsor received \$50,000 each from the Great Outdoors Colorado program to build more than a mile of the path. Greeley's grant will go toward continuing the path westward from Island Grove Park where a half-mile stretch already exists. Windsor's grant will help pay for a 0.9 mile portion of the trail following the river from the Larimer-Weld county line eastward, preserving access to the Frank Easement Ponds and a state DOW easement. The trail is a proposed 22-mile path that will connect Greeley and Windsor. Supporters hope it will eventually be linked to a trail built by Fort Collins.

*Greeley Tribune 4/14/95*

## WETLANDS

### Wetlands Moratorium is Declared

Citing a commitment to regulatory relief, the Agriculture Department declared a moratorium on designating new wetlands on farm property. The announcement is aimed at farmers who complain that some low-lying wet spots have been wrongfully called wetlands and off-limits to farming. Farmers who convert natural wetlands to cropland lose their eligibility for farm program benefits under swampbuster laws. Agriculture Secretary Dan Glickman said new delineations will be halted until Congress decides upon wetlands in the 1995 Farm Bill. The department also wants to review the results of a report on wetlands from the National Academy of Sciences.

*Montrose Daily Press 4/7/95*

### Prison Cleared of Wetlands Charge

The U.S. Army Corps of Engineers said that when a prison near Delta built its last series of sewage lagoons in the floodplain of Roubideau Creek, there were no violations of federal law. The corps determined that the lagoon was converted to agricultural use in 1963, before the Clean Water Act, requiring permits for work in waterways, became law. Other parts of the sewage system were not in a regulated wetland area.

*Grand Junction Daily Sentinel 4/3/95*

## WILDERNESS

### Wild-and-Scenic Status will not be Sought for Arkansas

Bureau of Land Management (BLM) officials did not seek wild-and-scenic status for the Arkansas River between Buena Vista and Canon City or for Beaver Creek, which flows through a remote area southwest of Colorado Springs, claiming that both streams can be protected without the designation. The Colorado Environmental Coalition opposes the decision. It claims the BLM used sloppy and unsupported rationales in choosing not to recommend the status for the river and creek and cites that the city of Colorado Springs has plans to build Elephant Rock Dam about two miles upstream from Buena Vista. Wild-and-scenic status may be granted only by Congress. First, however, a waterway must be studied and nominated for the status by BLM, the Forest Service, or the National Park Service. If BLM will not reconsider, the group's only recourse is federal court action.

*Colorado Springs Gazette Telegraph 5/1/95; Denver Post 5/2/95*

## PEOPLE

### CSU Professor Helps Ensure Mekong River's Future

When leaders from four countries in Southeast Asia signed a historic water treaty, George Radosevich was there, helping to ensure the river's future. Radosevich, a water law professor at Colorado State University, has worked for the past 15 years with the Mekong Working Group, established to negotiate an agreement for development of the river's natural resources. He has been the group's legal adviser for the past seven years. Representatives from Vietnam, Laos, Cambodia, and Thailand will sign the agreement, which will merge the four countries into one environmental community dedicated to the enrichment of life along the Mekong and the preservation of ecological integrity.

*Fort Collins Coloradoan 3/25/95*

### EPA Announces Awards

Since 1980 about 439 business, individuals, and agencies have been honored by the Environmental Protection Agency for contributions to environmental conservation. Among the Colorado winners this year are:

- Kate Jones of the Colorado Department of Natural Resources, who produces videos, brochures, and workbooks aimed at protecting wetlands.
- Jeff Keidel, of Buena Vista, credited with bringing together governmental agencies, miners, ranchers, and forest and river users into a community united by concerns for the Upper Arkansas River.
- Hester McNulty, a Boulder activist, who has worked for more than 20 years for water quality programs statewide.

*Grand Junction Daily Sentinel 4/19/95; Montrose Daily Press 4/19/95*



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## **CALLS FOR PAPERS**

### **ASCE North American Water and Environment Congress**

**June 22-28, 1996, Anaheim, CA.** To receive Call for Papers and program brochure, contact: Headquarters, American Society for Civil Engineers, Attn: Ms. Andrea Simon, Conference and Convention Department, 345 East 47th St., New York, NY 10017. FAX: 212/705-7975. Deadline: August 25, 1995.

### **Water Quality International '96**

**June 23-28, 1996, Singapore.** For abstract instructions contact: International Association on Water Quality (IAWQ), 1 Queen Anne's Gate, London SW1H 9BT, England. Tel: 44-171-222-3848; FAX 44-171-233-1197; Tlx 9188518 WATAD G. Presenters must pay registration fee and own expenses. Deadline: July 1, 1995.

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## **ANNOUNCEMENT AND CALL FOR PAPERS**

### **ENDANGERED SPECIES MANAGEMENT: PLANNING OUR FUTURE**

**The 6th Annual South Platte Basin Forum**

**October 25-26, 1995**

**The Ramkota Inn, Greeley, Colorado**

The South Platte Basin contains diverse ecological and social communities. The link binding these communities together is the South Platte River. Rapid growth has threatened ecological integrity and biological diversity, but legislation designed to protect diversity is perceived as a threat to social and economic prosperity in the basin. Can both communities be protected?

The 1995 South Platte Forum will address threatened, endangered, and state species of special concern in the South Platte Basin. Presentations will identify biological issues of concern, and keeping in mind the integrative framework developed in previous South Platte forums, investigate the political, economic and social implications of sensitive species management. How can protection and recovery of declining, threatened and endangered species be balanced with preserving historic ways of life and planning for inevitable growth? How has our use of water since settlement altered the ecological setting, and what is our vision for the ecology of the future? How will changes in Washington affect our ability to resolve endangered species issues?

You are invited to submit a one-page abstract to the organizing committee for a planned 15-minute presentation. Specific topics to be addressed at the conference include:

- State and federal endangered species legislation
- Current status of federally listed species and state species of special concern
- Habitat requirements of threatened and endangered species
- Threats to endangered species
- Implications of managing for recovery and preservation of sensitive species, with respect to
  - water conservation
  - economic development and regional growth
  - social responsibility and values
  - planning for future change

Abstracts are due by July 1, 1995. Authors whose papers are selected for presentation will be notified by August 1, 1995. The abstracts should be one page or shorter in length, and be submitted both in hard copy and Wordperfect or ASCII format on disk if possible. All submitted abstracts will be published in the conference proceedings.

#### **SUBMIT MATERIALS TO:**

Colorado Water Resources Research Institute  
410 University Services Center  
Colorado State University  
Fort Collins, CO 80523  
Attention: David Graf, Coordinator.  
Phone: 970/491-6308 FAX: 970/491-2293

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**INTERNATIONAL CONFERENCE ON EVAPOTRANSPIRATION AND IRRIGATION SCHEDULING  
IN CONJUNCTION WITH THE IRRIGATION ASSOCIATION EXPOSITION**

**November 3-6, 1996 -- San Antonio, Texas**

The conference will focus on reporting new technology, providing updates on existing technology, discussing techniques to apply a technology, and identifying and prioritizing future needs.

Obtain submittal forms and abstract instructions from:

Judy Brown  
American Society of Agricultural Engineers  
e-mail: brown@asae.org  
Phone: 616/428-6323  
FAX: 616/429-3852

Abstracts should emphasize the rationale, approach, results and significance to ET and/or irrigation scheduling. Author instructions for preparation of manuscripts in camera-ready form will be provided upon acceptance of the abstract. Papers will be limited to six (6) pages. Manuscripts will be reviewed by the Proceedings Committee. Published proceedings of the conference symposium papers will be distributed at the conference. All senior authors will be required to pay an advance registration fee: *Total proceedings cost/number of*

*papers (approximately \$75.80). This publication fee will be collected at the time of paper submission in its final version. This amount will be deducted later from final registration fees. Page charges of \$50 per page will be assessed for papers over six pages.*

Deadline for abstract: July 1, 1995

Send paper proposal forms to:

Walter C. Bausch  
USDA-ARS  
AERC-CSU Foothills Campus  
Colorado State University  
Fort Collins, CO 80523  
Phone: 970/491-8264 FAX: 970/491-8247  
INTERNET: walter@lily.aerc.colostate.edu  
(proposals not accepted by e-mail)

For information about the International Irrigation Exposition contact: Claude Phene, Co-chair, Phone 209/298-0201, FAX 209/298-8068; or Sharon McKnight, Phone 616/428-6333, FAX 616/429-3852.

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**CONFERENCE ON TAILINGS AND MINE WASTE '96**

**January 16-19, 1996  
Colorado State University  
Fort Collins, Colorado**

This event provides a forum for members of the mining community, engineers and scientists serving the mining industry, regulatory groups, and other interest groups concerned with environmental issues related to tailings and mine waste management. The conference has proven to be an exciting place for attendees to present ideas, learn of new developments, make contacts in their professional fields, and discuss problems of mutual interest. Issues of **mining, milling, environmental geotechnics, mining engineering, tailings management, geohydrology, geochemistry** and other related topics will be covered in focused sessions.

Authors are invited to submit a short one-page abstract by June 30, 1995.

To submit an abstract or for information contact:

Linda Hinshaw  
Department of Civil Engineering  
Colorado State University  
Fort Collins, CO 80523  
Phone: 970/491-6081  
FAX: 970/491-7727

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**WEFTEC '96**
**The WATER ENVIRONMENT FEDERATION's 69th Annual Conference and Exposition**

October 5-9, 1996, Dallas, TX. Abstracts should be a minimum of four and a maximum of six double-spaced pages including narrative, bibliographic material, graphs, sketches and tables. Abstracts exceeding six pages will be returned. Clearly but briefly define objectives, status, what was done, what was found, what conclusions were drawn, and what findings mean to the environmental engineering and operations community.

For abstract form and full instructions contact: Water Environment Federation, Attn: Conference Program, 601 Wythe Street, Alexandria, VA 22314-1994. Phone: 1/800/666-0206. Deadline: December 18, 1995. FAX submissions not accepted. Conference participants do not receive complimentary registrations.

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**MEETINGS**

**FALL SPECIALTY SEMINAR  
EVAPOTRANSPIRATION AND IRRIGATION EFFICIENCY FOR USE IN WATER TRANSFERS**

The American Consulting Engineers Council will sponsor a seminar on Evapotranspiration and Irrigation Efficiency for use in Water Transfers. This seminar will be held October 10-11, 1995 at the Arvada Center for the Arts and Humanities.

Featured speakers will be:

Judge Robert Behrman, Former Water Court Judge, Division One

Dr. Marvin Jensen, Senior Author and Private Consultant

Dr. Richard Allen, Professor, Biological and Irrigation Engineering, Utah State University

Dr. James Wright, Soil Scientist, Soil and Water Management Resources Unit, USDA/ARS

Dr. Terry Podmore, Professor, Chemical and Bioresource Engineering, Colorado State University

Dr. Harold Duke, USDA Agricultural Research Service, Fort Collins, and

Dr. Luis Garcia, Assistant Professor, Chemical and Bioresource Engineering, Colorado State University

Besides Judge Behrman, Bill Paddock, Water Attorney for Carlson, Hammond and Paddock, will speak at one of the luncheons. Both will speak on what the Water Court looks for when an expert witness presents new technology.

For those interested in evapotranspiration technology, irrigation efficiency research, research on irrigation methods and soil/water/plant relationships, you do not want to miss this seminar. For engineers or attorneys, this seminar will qualify for Professional Development Hours (PDH) accreditation. Continuing Legal Education (CLE) accreditation is pending.

For more information, contact ACEC/CO at 303/832-2200.

**The Endangered West  
August 2-4, 1995**

**20th Annual Colorado  
Water Workshop  
Western State College  
Gunnison, Colorado**

Can the West's finite water resources support a growing population, irrigated agriculture and endangered species? Should farms be sacrificed to provide water for other uses? How could the undeveloped waters of the Colorado River fit into the equation? Join the search for solutions this summer in beautiful Gunnison Valley.

Contact: Lucy High or Jill Corbett  
970/943-7156



**1995 SUMMER FIELD TOUR sponsored by the  
HIGH ALTITUDE REVEGETATION COMMITTEE  
July 27-28, 1995**

All interested people are invited. This year's tour will begin at the Eisenhower Tunnel and end in the Steamboat Springs area. No pre-registration, no registration fee, and everyone (spouses, friends and children) welcome. Be prepared to travel in your own vehicle. On Thursday, July 27, meet in the parking lot for westbound I-70 traffic at the west portal of the Eisenhower Tunnel at 8:45 a.m. It is important to be on time. There will be a charge of about \$10 per adult collected for an evening barbecue in Steamboat Springs.

In sequence, you will see:

- very old species test plots at the West Portal of the Eisenhower Tunnel
- DOT test plots on the large cut and fill slopes of I-70
- the Henderson tailing revegetation test plots discussed at the last HAR Conference
- the Wolford Mountain Reservoir/Recreation Project north of Kremmling
- traditional social hour and BBQ in Steamboat Springs followed by discussion of native vs. non-native plants in reclamation
- the Osage and McGregor Abandoned Mined Land Projects west of Steamboat Springs
- Seneca II Coal Mine reclamation
- 20-Mile Coal Mine reclamation

For additional information and complete schedule contact: **Larry Brown at 303/674-9813; Gary Thor at 970/491-7296; Chuck Jackson at 303/643-5836; or Ben Northcutt, 800/455-4322 or 970/879-3010.**

## CALENDAR

### 1995

- May 23-25** WORKSHOP ON COMPUTER APPLICATIONS IN WATER MANAGEMENT, Fort Collins, CO. Contact L.R. Ahuja, USDA-ARS, Phone 970/490-8300; fax 970/490-8310.
- June 6-8** GREAT PLAINS AGRICULTURAL COUNCIL 1995 ANNUAL MEETING: AGRICULTURAL/NATURAL RESOURCE POLICIES AND THE GREAT PLAINS, Albuquerque, NM. Contact: Helen F. McHugh, Program Chair, 970/491-6449, hfmchugh@lamar.colostate.edu.
- June 7-10** THE 5TH INTERNATIONAL SYMPOSIUM ON SOCIETY AND RESOURCE MANAGEMENT, Fort Collins, CO. Contact: Jennifer Pate, Phone 970/491-2077; FAX 970/491-2255.
- June 7-11** SOCIETY FOR CONSERVATION BIOLOGY, Fort Collins, CO. Contact: Rick Knight, Dept. of Fishery & Wildlife Biology, Colorado State Univ., Fort Collins, CO 80523, Phone 970/491-6714.
- June 9-11** 1ST CONFERENCE, ASSOCIATION FOR THE STUDY OF LITERATURE AND ENVIRONMENT, Fort Collins, CO. Contact: Office of Conference Services, Colorado State University, Phone 970/491-6222 or e-mail at asleconf@vines.colostate.edu.
- June 12** 2ND ANNUAL ENVIRONMENTAL WORKFORCE SYMPOSIUM, Seattle, WA. Contact: Environmental Careers Organization, Phone: 206/625-1750.
- June 18-20** 7TH INTERNATIONAL SYMPOSIUM ON AGRICULTURAL AND FOOD PROCESSING WASTES, Chicago, IL. Contact: ASAE Meetings Dept., Phone 616/429-0300; FAX 616/429-3852.
- June 25-28** AUTOMATING TO IMPROVE WATER QUALITY, Minneapolis, MN. For information call 1-703-684-2400, ext. 7221.
- June 25-28** WATER RESOURCES & ENVIRONMENTAL HAZARDS: EMPHASIS ON HYDROLOGIC & CULTURAL INSIGHT IN THE PACIFIC RIM, Honolulu, Oahu, HI. Contact American Water Resources Association, Phone 703/904-1225; FAX 703/904-1228.



- June 27-28     **HAZARDOUS MATERIALS AND WASTE WORKSHOP**, Denver, CO. Contact: National Environmental Health Association, Phone 303/756-9090.
- July 2-14     **INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS**, Boulder, CO. Contact IUGG XXI General Assembly, c/o American Geophysical Union, Phone 202/462-6900, FAX 202/328-0566, e-mail iugg\_xxiga@kosmos.agu.org.
- July 24     **FUNDAMENTALS OF COLORADO ENVIRONMENTAL LAW COMPLIANCE**, Denver, CO. Phone: 301/921-2345, FAX 301/921-0373.
- Aug 1-4     **WHOSE THIRST IS FIRST? A NEW PARADIGM FOR WATER MANAGEMENT?** The Universities Council on Water Resources Annual Meeting, Portland, ME. Contact: Camille Hedden, Phone 618/536-7571, FAX 618/453-2671, email hedden@uwin.siu.edu.
- Sept. 6-8     **SYMPOSIUM ON THE SETTLEMENT OF INDIAN RESERVED WATER RIGHTS CLAIMS**, Portland, OR. Contact: Western States Water Council, Phone 801/561-5300; FAX 801/255-9642.
- Sept. 10-13     **1995 ANNUAL CONFERENCE, ROCKY MOUNTAIN SECTION OF THE AMERICAN WATER WORKS ASSOCIATION AND THE ROCKY MOUNTAIN WATER POLLUTION CONTROL ASSOCIATION**, Sheridan, WY. Contact: Al Kinter, 307/674-9833; or David Hill, 307/235-8213.
- Sept. 17-20     **ASDSO ANNUAL CONFERENCE**, Atlanta, GA. Association of State Dam Safety Officials. Contact: ASDSO, 450 Old East Vine St., 2nd Floor, Lexington, KY 40507. Phone 606/247-5140; FAX 606/323-1958.
- Sept. 18-20     **VERSATILITY OF WETLANDS IN THE AGRICULTURAL LANDSCAPE**, Tampa, FL. Contact American Water Resources Association, Phone 703/904-1225; FAX 703/904-1228.
- Oct. 21-25     **WATER ENVIRONMENT FEDERATION 68TH ANNUAL CONFERENCE & EXPOSITION**, Miami Beach, FL. Contact: Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314-1994. Phone 800/444-2933.
- Nov. 5-9     **1995 NATIONAL CONFERENCE OF THE AMERICAN WATER RESOURCES ASSOCIATION**, Houston, Texas and Reconvened Conference Nov. 10-12, 1995, Cancun, Mexico, General Chairperson, Bechtel, 3000 Post Oak, Houston, TX 77252-2166, Phone 713/235-4921.

### **C O U R S E S** Denver, Colorado

Contact: Government Institutes, Inc.  
Phone 301/921-2345

Electronic Bulletin Board: 301/921-2373 (N-8-1)  
E-Mail: glinfo@aol.com.

**July 25-26, 1995. ADVANCED ENVIRONMENTAL COMPLIANCE FOR FEDERAL FACILITIES.**

**July 27-28, 1995. EFFECTIVE STRATEGIES FOR NEPA COMPLIANCE.**

**Nov. 6, 1995. ASBESTOS - LEAD - PCB MANAGEMENT.**

**Nov. 7-8, 1995. THE BASICS OF ENVIRONMENTAL COMPLIANCE: Regulations & Practical Applications.**

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

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