

Colorado Water

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

OCTOBER 1998

Dick MacRavey, Executive Director of the Colorado Water Congress, speaks to an informal gathering of the CWC Water Education Committee at the COLORADO WATER WORKSHOP held in Gunnison July 29-31, 1998.

SEE WORKSHOP SUMMARY ON PAGE 15.

ALSO IN THIS ISSUE:

*Nature of Residential Water Use and Effectiveness of Conservation Programs.
See page 5.*



**Colorado
State
University**

WATER ITEMS AND ISSUES . . .

THE PERFECT HOOK -- Editorial by Robert C. Ward	3
RESEARCH OPPORTUNITIES	4
RESEARCH	
<i>Nature of Residential Water Use and Effectiveness of Conservation Programs</i>	5
<i>Water Research Awards</i>	11
MEETING BRIEFS	
<i>COLORADO WATER WORKSHOP: Learning About Water by Studying the Efforts of Others</i>	15
<i>Living Legends of Western Water -- John R. Fetcher</i>	16
<i>Keynote Address -- Floyd Dominy, Former Commissioner, Bureau of Reclamation</i>	18
<i>Senate Bill 1: A Landmark Decision in Texas for Water Conservation -- J.E. "Buster" Brown</i>	21
<i>We Can Achieve a Better Future -- Dick MacRavey</i>	25
UNIVERSITY WATER NEWS	27
SEMINARS	29
PUBLICATIONS	31
WEB PATHS	32
WATER NEWS DIGEST	33
CALLS FOR PAPERS	38
MEETINGS	39
CALENDAR	40

COLORADO WATER

Vol. 15, No. 5

October 1998

Editor:

Shirley Miller

Writers:

J.B. Bryant

Veva McCaig

John Carillo

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

Published by the

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

Phone: 970/491-6308

FAX: 970/491-2293

E-mail: CWRRI@ColoState.EDU

Internet: <http://www.ColoState.EDU/Depts/CWRRI>

EDITORIAL



THE PERFECT HOOK

Editorial by Robert C. Ward

Colorado water conferences, of which there are many, are playing an increasingly important information exchange role in the evolution of water management in Colorado. As water managers incorporate new public concerns into their decision making, the need for information about these new dimensions of water management increases. Concerns about water quality, ecosystem health and water conservation, to name a few of the evolving dimensions of water management, do not come to water managers with uniform instructions from the public. They come, instead, with a diverse set of suggestions (demands) that must be carefully understood and evaluated before water decisions are made. Colorado water conferences provide an excellent opportunity for water managers, water users, the interested public, and, yes, faculty, to gain an understanding of evolving water issues before important decisions regarding water are finalized.

University researchers often perform water research that has major public policy implications. Unfortunately, the implications may not be fully appreciated by faculty and excellent opportunities to enhance the practical applications of water research results are lost. The many Colorado water conferences provide opportunities for university faculty and students to gain valuable insight into the nuances of how Colorado's water resources are managed and to describe water research findings to Colorado's water managers.

Over the years *Colorado Water*, as well as a number of other water newsletters, has summarized the discussions and knowledge gained at many of Colorado's water conferences. In so doing, *Colorado Water* has attempted to channel water research and education information from Colorado's higher education campuses to water managers, and conversely, channel the thinking of today's water managers regarding their research and education needs to higher education. The water conservation research findings of Jim Heaney and his colleagues at the University of Colorado, presented in this issue, represent water information flowing off campus, while the summary of the Colorado Water Workshop meeting represents water information flowing to campus. The goal is to enhance communication and understanding of water research and education within the water management community, while at the same time enhancing understanding of the problems being faced by water managers within the academic community. Images of this dialogue are regularly provided in *Colorado Water* through the pictures of higher education faculty talking to Colorado water managers.

With the movement in Colorado to place important water decisions on the ballot, there is a rapidly emerging need for the public to understand Colorado's water management system, including its research efforts, in much more detail than currently exists. All of us in Colorado's water management community, both water managers and those who specialize in water education and research, must examine how our information can be distributed and understood by wider audiences.

I want to encourage all water organizations in Colorado, including faculty in higher education, to enhance the ways and means of getting knowledge and understanding of water issues to the public. The upcoming election, with ballot initiatives concerning confined animal feeding operations and groundwater pumping in the San Luis Valley, provides the perfect news 'hook' around which such efforts can be focused.

RESEARCH OPPORTUNITIES



AWWARF/EPA ANNOUNCE REQUESTS FOR PROPOSALS

The Microbial/Disinfection By-Product (M/DBP) Council, a partnership between the American Water Works Association Research Foundation (AWWARF) and the United States Environmental Protection Agency (USEPA), announces the selection of new research projects approved for funding in 1998. The objective of the M/DBP Council is to provide a vehicle for the selection and funding of research regarding the control of microbial contaminants in drinking water balanced against the by-products of disinfection.

Requests for proposals (RFPs) for these projects will be available on the AWWARF web site (<http://www.awwarf.com>) October 31. Proposals submitted in response to RFPs must be postmarked by February 1, 1999. Unless otherwise indicated, project proposals must include 25 percent of the total project budget as in-kind or cash contribution. In-kind contributions can be in the form of labor, laboratory services, or other support, and may come from utilities, consulting firms and universities. Contract awards for all projects will be determined by an AWWARF project advisory committee appointed for each project. Proposal evaluations will be based on responsiveness to the RFP, scientific and technical merit, and qualifications of the researchers.

Listed below are descriptions of the new projects and their maximum funding levels.

◆ **Study of Spontaneous Abortions and Disinfection By-Product (DBP) Exposures (RFP 2579).**

Determine if the results reported by the 1998 Waller et al. study can be replicated in other areas of the United States. Investigate whether exposure to THMs (especially BDCM), haloacetic acids species (HAAs), or other disinfection by-products (DBPs) may be associated with an increased risk of SAB. If feasible, other reproductive endpoints may be included in the study. (\$1,000,000 for first phase)

◆ **Infectious Disease Associated with Drinking Water from Surface Water Sources - Microbiological Water Quality Factors (RFP 2580).**

Assess the microbiological water quality of drinking water and evaluate pathogen occurrence risk factors in conjunction with the Centers for Disease Control and Prevention (CDC) epidemiology study. This study would include a population in a large community supplied by a public drinking water supply with a surface water source. (\$400,000)

◆ **Infectious Disease Associated with Drinking Water from Ground Water Sources - Microbiological Water Quality Factors (RFP 2581).**

Assess the microbiological water quality of drinking water and evaluate pathogen occurrence risk factors in conjunction with the Centers for Disease Control and Prevention (CDC) epidemiology study. This study would include a population in a large community supplied by a public drinking water supply with a groundwater source. (\$300,000)

◆ **Exposure Assessment on Existing Cancer Studies (RFP 2582).**

Improve DBP risk estimates with respect to specific classes of DBPs by improving the exposure assessment models of specific DBPs of health concern. (\$200,000)

RESEARCH



NATURE OF RESIDENTIAL WATER USE AND EFFECTIVENESS OF CONSERVATION PROGRAMS

by James P. Heaney, William DeOreo, Peter Mayer, Paul Lander, Jeff Harpring, Laurel Stadjuhar, Beorn Courtney, and Lynn Buhlig

An overview of research during the past four years on evaluating the nature of residential water use and the expected effectiveness of water conservation programs is presented. This research has been done jointly by faculty and students at the University of Colorado and staff members of Aquacraft, Inc. of Boulder, Colorado. The initial exploratory phase of this research was supported by the Colorado Water Resources Research Institute and the City of Boulder. Subsequent major funding for the national study was provided by the American Water Works Association Research Foundation and twelve participating cities including Boulder and Denver.

In the July 1998 issue of *Water Research News*, Michelsen, McGuckin, and Stumpf summarized the results of their effort to evaluate the effectiveness of residential price and nonprice programs. They used a "macro" approach and developed three estimating models. The Regional model compares water use patterns across cities. The Season Specific model is a variation of the Regional model that looks at water use behavior during specific seasons of the year. Finally, the City Specific model evaluates water use patterns in individual cities. In all cases, historical monthly water use data were utilized to do this analysis. Their results indicate that water price has a significant and negative impact on water use but that water demand is very price-inelastic. Thus, increasing water rates as a conservation measure will not cause a major decline in water use. Their results indicate that nonprice conservation programs can be effective but the results were mixed. Based on their monthly database, they concluded that outdoor water use does vary with monthly temperature, but not with monthly precipitation. A general conclusion of these authors is that:

A significant finding of this study is the overall lack of information available regarding the implementation of nonprice conservation programs and the lack of detail and consistency of water use information necessary to evaluate changes in demand. With improved information, combinations of programs, proven to be successful in reducing water-use levels in one city, could be applied to cities with similar characteristics in different regions of the United States.

◆ Overview of Our Urban Water Demand Studies

Beginning in 1993, Professor Heaney and a graduate student, Lynn Buhlig, began exploring the nature of urban water use and the possible effectiveness of water conservation. Using the City of Boulder as the case study and relying on aggregate monthly water use data for the entire city, we attempted to estimate the effectiveness of a variety of conservation practices that had been installed beginning in 1988. Data from 1971 through 1987 were used to describe the pre-conservation water use patterns. These data were compared to the post-conservation period of 1988 through 1994. A wide variety of conservation practices were installed by the City of Boulder including public education, a demonstration xeriscaping garden, increasing water rates, automation of the City's irrigation systems, and rebate programs for buffalo grass and soil moisture sensors. The results of this aggregate analysis using monthly data were disappointing. No statistically significant difference in the pre and post-conservation water use patterns could be discerned. This does not mean that the conservation practices were ineffective; rather, it means that the use of monthly data for the entire city probably disguises the impact of a small change in one component of water use. Based on this finding, we decided to move from doing statistical analysis of city-wide monthly water use data to evaluating individual houses. The problem was how to do detailed, non-intrusive measurements of household water use. The largest micro study that had been done was work by Brown and Caldwell (1984). This study sampled only a small number of houses and some of the metering was intrusive which may have affected the usage patterns.

Bill DeOreo, a consulting engineer in Boulder, solved the measurement problem by developing a computerized

sensing device that is attached to the water meter. It measures flow into the house at ten-second intervals. Signal processing software was developed to convert the ten-second flow signals to individual water using events. The initial evaluation of this technique was done in cooperation with the Water Conservation Office of the City of Boulder as part of Peter Mayer's 1995 MS thesis. The Heatherwood neighborhood near Boulder was the selected study area. The results were very encouraging.

After graduation, Peter Mayer joined Bill DeOreo at Aquacraft and they promoted the idea to cities across North America and to the American Water Works Association Research Foundation. As a result, a \$900,000 monitoring study was initiated. For each of 12 cities across North America, a sample of 1,000 houses was selected based on evaluation of local demographics and historical water use. A questionnaire was sent to each of these 1,000 houses. The average response rate was 46%. Based on the returned questionnaires, a sample of 100 houses was selected. Then, detailed monitoring was done on each of these houses during two 14-day periods, one warmer and one cooler. Data was successfully obtained from all but 12 of the 1,200 homes. About 28,000 complete days of water use data were collected including more than 1.9 million water-use events (toilet flushes, showers, clothes washer cycles, faucet usage, irrigation, etc.). Graduate students from the University of Colorado were employed to work on this project as part of their MS thesis research. This research project ended earlier this year and the results are now becoming available. A brief summary of findings to date is presented below. More detailed information about this entire effort can be found in a series of reports, papers, and theses, i.e., Buhlig (1995), Mayer (1995), DeOreo et al. (1996), DeOreo and Mayer (1996), Mayer et al. (1997), Courtney (1997), Harpring (1997), Stadjuhar (1997), or by contacting <http://www.aquacraft.com>.

◆ *Demographics of Study Participants*

The study group consists of a wide variety of single family homes. Study homes included mansions in gated communities and dilapidated one bedroom cabins. The landscapes ranged from lush turf grass and elegant xeriscape to horse pastures, hardscape to untamed weeds. The average household size in the study was 2.8 people and the median annual household income was between \$50,000 and \$60,000. Seventy-seven percent of survey respondents had completed at least some college and nearly 20 percent reported having either a Master's or higher degree. Nearly 92 percent of the surveyed homes were owner occupied and 8 percent were rental units. Of the study homes, 67.8 percent were

built before 1980, 23.5 percent were built between 1980 and 1992, and 4.2 percent were built since 1993 when new plumbing codes went into effect.

◆ *General Results*

The 12 study sites represent a diverse collection of single-family water use patterns. In each of the 12 cities, a sample of 1,000 houses was selected. One year of historical metered water use was obtained from billing records for each of the 12,000 houses. Annual water use and estimated indoor and outdoor water use for each city is shown in Table 1. Indoor water use is estimated by averaging water use during the non-irrigation season. The majority of residential water use in Boulder (57%) and Denver (60%) is for outdoor purposes, primarily lawn watering. While the variability in indoor water use for cities across North America is low, it is much higher for outdoor water use. The results of the detailed measurements of water use in 100 houses in each of the 12 cities are presented below.

◆ *Indoor Water Use*

Indoor water use patterns for Boulder and Denver are compared to indoor use in the other 10 cities in Table 2. These results are based on the four weeks of continuous measurements of household water use for 1,200 houses across North America. Toilets are the major use of water indoors comprising 26.7% of the total. Clothes washers (21.6%), showers (16.7%), faucets (15.7%), and leaks (13.7%) are the other major components of indoor water use. The distribution of indoor water use is quite stable across the major water use components. The main sources of variability are in minor uses and leaks. The average indoor water use rates per capita for Boulder and Denver are 64.9 and 69.2 gallons per capita per day, respectively. The 12 city average indoor water use is 69.7 gallons per capita per day. These results for indoor water use are somewhat higher than previous studies that estimated indoor water use at about 60 gpcd (Maddaus 1987). The major source of the difference is probably in how leaks are evaluated. It is difficult to separate leaks into indoor or outdoor. The value for leaks shown in Table 2 assumes that leaks are chargeable to indoor water use. If they were assigned to outdoor water use, then the average per capita indoor water use rate would decrease to about 60 gpcd. Indoor residential water use per capita is quite stable in the United States reflecting the fact that indoor water use is for relatively essential purposes.

Table 1. Annual indoor and outdoor water use for 1,000 houses in each of 12 cities

Study Site	1,000 gallons per house per year			%	
	Total	Indoor	Outdoor	Indoor	Outdoor
Boulder, CO	134.1	57.4	76.7	42.8%	57.2%
Denver, CO	159.9	64.4	95.5	40.3%	59.7%
Eugene, OR	107.9	63.9	44	59.2%	40.8%
Las Virgenes, CA	301.1	71.6	229.5	23.8%	76.2%
Lompoc, CA	103	62.9	40.1	61.1%	38.9%
Phoenix, AZ	172.4	71.2	101.2	41.3%	58.7%
San Diego, CA	150.1	55.8	94.3	37.2%	62.8%
Scottsdale/Tempe, AZ	184.9	61.9	123	33.5%	66.5%
Seattle, WA	80.1	49.5	30.6	61.8%	38.2%
Tampa, FL	98.9	53.9	45	54.5%	45.5%
Walnut, CA	208.8	75.3	133.5	36.1%	63.9%
Waterloo, ON	69.9	54.3	15.6	77.7%	22.3%
Average	147.6	61.8	85.8	41.9%	58.1%
Standard Deviation	64.80	8.00	58.98		
Coefficient of Variation	0.44	0.13	0.69		

Estimates are based on one year of monthly meter readings.

Indoor water use is estimated by averaging water use during the non-irrigation season.

Table 2. Summary of indoor water use for 12 cities in North America
All values in gallons per capita per day

User Category	Boulder Colorado	Denver Colorado	Other 10 cities	Average 12 cities	% of Indoor
Baths	1.4	1.6	1.1	1.2	1.7%
Clothes Washers	14.0	15.6	15.0	15.0	21.6%
Dish Washers	1.4	1.2	0.9	1.0	1.4%
Faucets	11.6	10.5	10.9	10.9	15.7%
Leaks*	3.4	5.8	10.5	9.5	13.7%
Showers	13.1	12.9	11.3	11.6	16.7%
Toilets	19.8	21.1	18.1	18.5	26.7%
Other Domestic	0.2	0.5	1.9	1.6	2.3%
INDOOR	64.9	69.2	69.7	69.3	100.0%

*Leaks are assumed to be indoor. They are actually a combination of indoor and outdoor leakage.

Indoor water use does not vary significantly over the year. Some daily variability occurs between weekdays and weekends. Peak usage occurs during the early morning

hours of 7 to 10 am. Most of this peak is due to toilet and shower use. Toilet flushing continues at a similar rate for the rest of the day and into the evening. On the other hand,

showers are taken primarily in the morning. Peak clothes washing activity occurs from 9 am to 1 pm. In general, water use in houses declines during the middle of the day since fewer people are at home. Use increases in the evening as people return home and prepare dinner, and then reaches its lowest level between midnight and 6 am when people are asleep. A general discussion of individual indoor water use components is presented below.

Toilet Flushing: Toilet flushing is the most regular and predictable of all of the indoor water uses with an average of 18.5 gpcd. Conservation options for toilets have focused on reducing the gallonage per flush from 4-5 gallons to 1.6 gallons which is mandated nationally in the plumbing codes beginning in 1993. An important concern with regard to lower volume per flush is that people would double or triple flush. Mayer et al. (1998) divided the NAREUS database into those houses that had only ultra-low flush (ULF)

toilets and those that didn't. The results, shown in Table 3, indicate the same number of flushes per day with the ULF houses using only 9.5 gpcd as compared to 19.5 gpcd for non-ULF houses, a major savings of 10 gpcd. The Boulder sample only contained 1.0% of houses that fell into the ULF category while Denver had 6.9% (Mayer et al. 1998). As people replace toilets around the country, the impact of using ULF toilets will become apparent. It is evident from Table 3 that double flushing is not a problem with ULF toilets.

The volume per flush can be reduced to 0.5 gallons using pressurized systems. This technology may gain more widespread use in the future. Dual flush toilets are employed in Australia wherein the user selects whether to use more or less flushing water depending upon the need.

Clothes Washing: Clothes washers use an average of 15.0 gpcd. The traditional Monday wash day has been replaced by a more uniform pattern of clothes washing which is done throughout the day with peaks in the morning and early afternoon. More efficient clothes washers are expected to reduce water use per load by about 25 percent. The timing on clothes washing could be affected by electric or water utility rates that provide time of day incentives and disincentives. For example, water users in Great Britain tend to wash clothes late at night to take advantage of lower electricity rates.

Showers and Baths: Showers (11.6 gpcd) are much more popular than baths (1.2 gpcd) for all 12 cities in the NAREUS study. For Boulder, Colorado, the morning shower is the predominant time for this activity. The other peak in showering occurs during the evening. Showers are taken on a daily basis in Boulder. Thus, no significant variability occurs from day to day. The main conservation option for showers is to use low-flow showerheads.

Table 3. Toilet use for ultra-low flow and non-ultra low flow toilets (Mayer et al. 1998).

Category	Houses	Mean per capita		
	% of total Number	Flushes/ houses	Gallons/ day	day
Ultra-low flow only	101	8.5%	5	9.5
Non ultra-low flow	1,087	91.5%	5.1	19.5
All	1,188	100.0%	5.1	18.6

Results to date indicate only limited reduction in water use since users did not set the older showerheads to the higher flow rates. Federal law mandates a maximum flow rate for showers of 2.5 gallons per minute (gpm). Results of the NAREUS study indicate that most people set their shower flow rate below this level. Thus, conservation savings may not be that significant (Mayer et al. 1998)

The results of the NAREUS study indicate that the average shower used 17.2 gallons and lasted for 8.2 minutes and the average flow rate was 2.1 gallons per minute (gpm). Most showers use between 5 and 20 gallons of water. This indicates that on average people shower at a flow rate below the 1992 plumbing code standard of 2.5 gpm. The LF shower homes used an average of 29.9 gpd and 11.3 gpcd for showering, while the non-LF shower homes used an average of 34.4 gpd and 13.4 gpcd. The net savings for the LF shower homes is therefore 2.1 gpcd. A more significant difference was observed in the mean daily per capita shower duration of the LF and non-LF shower homes. While the occupants of non-LF shower homes averaged 4.6 minutes per person per day of showering, occupants of the LF homes averaged 5.7 minutes per person per day. Nevertheless, the net difference in water use between the two groups is 2.1 gpcd.

Faucet Use: Faucet use includes drinking water, water for washing and rinsing dishes, flushing solids down the garbage disposal, shaving, and numerous other personal needs. Faucet use averages 10.9 gpcd. No breakdown among these uses is available although one can make educated guesses as to the amounts of water used for these purposes. Best estimates of actual drinking water use are in the range of 0.25 to 0.5 gallons per capita per day with a mean of 0.35 gallons per day (Cantor et al. 1987). Garbage disposals add about 1 gpcd to total indoor consumption (Karpiscak et al. 1990). Faucet use requires the highest water quality because it is the potable water source.

Dishwashers: Dishwashers are a relatively minor water use and newer dishwashers are being designed to conserve energy and water. Present per capita water use averages only 1.0 gpcd.

Water Use for Cooling: For some houses, and for many commercial and industrial establishments, water use for cooling is a significant part of the water budget. Swamp coolers are used in the more arid areas of the United States. Karpiscak et al. (1994) estimate that residential evaporative coolers use about 6 gpcd in Tuscon, Arizona. Because of the relatively small number of houses using coolers, the average usage is quite low, only 0.4 gpcd.

◆ *Outdoor Water Use*

Whereas indoor residential water use is very constant across the United States and does not vary seasonally, irrigation water use varies widely from little use to being the dominant water use. Also, it varies seasonally. The 12 cities in the NAREUS are not a representative sample of the United States with regard to climate types. Also, the amount of natural precipitation that occurred during the study periods can have a significant impact on the results. Nevertheless, the results certainly suggest the potential major impact of irrigation on average and peak water use.

Irrigation water use follows a definite pattern of high use rates in the morning and evening with low use rates during the day and late at night. Thus, these customers are following the common recommendations to not water during the middle of the day. Watering late at night is discouraged because of the noise from some types of sprinklers.

For the entire NAREUS study, outdoor water use averaged 85,800 gallons per house per year as was shown in Table 1, significantly more than the 61,800 gallons per house per year for indoor water use. Of course, these 12 cities do not

constitute a representative sample of all cities in North America. Nevertheless, the dominance of outdoor water use in the more arid western United States is apparent. In Boulder and Denver, outdoor water use averaged over the entire year exceeds indoor water use for the residential users. Thus, for residential areas in the more arid and warmer parts of the country, lawn watering is the largest single use on an annual average basis and is the dominant component of peak daily and hourly use during the summer months. In more arid areas, evapo-transpiration (E-T) requirements are much greater than natural rainfall. In warmer parts of the country, even those with abundant rainfall, e.g., Florida, irrigation water use rates are high because of the long growing season which includes some dry periods. Irrigation water use is a major input to the urban water budget during the growing season. A growing number of people are installing automatic sprinkling systems. These systems tend to use more water than manual systems (Mayer 1995). Also, the timers on these systems are seldom adjusted. Thus, lawn watering occurs even during rainy periods. Experience with soil moisture sensors to control sprinkling use has been mixed. Automatic sprinkling systems do offer the potential for more efficient use of water if they are properly calibrated and operated (Courtney 1997).

Peak hourly use in Boulder, Colorado occurs between 6 and 8 am and is caused predominantly by irrigation (Harring 1997). Indoor water use at 6 am is about 7.5 gallons per house while the total water use at the same time is about 41 gallons per house. Thus, irrigation constitutes over 80% of the peak hourly use. Options for reducing outdoor water use include using less water loving plants, applying water more efficiently, reducing the irrigated area, and using nonpotable water including stormwater runoff and treated wastewater (Courtney 1997). Sakrison (1996) projects a potential decrease of 35 % in the demand for irrigation water in King County, Washington if higher density urbanization occurs. For King County, the main way that water use is managed is by restrictions on outdoor water use for landscaping. A maximum permissible E-T is allotted that forces the property owner to reduce the amount of pervious area devoted to turf grass. Stormwater runoff to the pervious area can be used for an extra credit.

Lawn watering has increased in the United States as population migration occurs to warmer, more arid areas. Also, urban sprawl means much larger irrigable area per dwelling unit. Lawn watering needs are a dominant component of peak water use in urban areas. Reuse of treated wastewater and stormwater for lawn watering appears to be very attractive possibilities for more sustainable communities.

◆ Summary and Conclusions

The results of these process-oriented monitoring studies during the past four years provide a major improvement in our understanding of the nature of residential water use. For the 12 cities studied, indoor per capita water use averaged 69.3 gpcd with toilets, clothes washers, showers, faucets, and leaks being the largest indoor end use components. Cost-effective reduction in indoor use can be achieved by using low-flush toilets. This change is occurring nationwide due to the requirements of the national plumbing codes. Retrofitting showerheads is less effective since people do not operate showers at the higher flow rates anyway. Continuing improvements in household appliances are expected to significantly reduce indoor water use. Leaks are primarily the result of faulty toilet flapper valves and miscellaneous faucet and irrigation system leaks and can be repaired. Overall, for indoor water use, the picture is relatively optimistic in terms of reducing per capita water use. The current per capita use of about 65-70 gpcd should be reduced to 40-45 gpcd when existing conservation measures are used for all residential areas. This reduction saves not only on water supply costs but also on wastewater treatment costs since virtually all of the indoor water use must be collected and treated at the wastewater treatment plant.

While indoor water use is expected to decline as described above, the gains in reducing indoor water use may be offset by increases in outdoor water use. Outdoor water use exceeds indoor water use in more arid parts of the country. Also, outdoor water use constitutes the majority of the peak summer demand that taxes the capacity of urban water systems. The trend towards lower density housing increases the irrigable area per capita. Also, more people are installing automatic sprinkling systems. People vary widely in how they use water outdoors. This causes much uncertainty in estimating peak flow rates. A concerted effort is needed to devise more effective ways to reduce outdoor water use in urban areas. Intensive monitoring is needed to evaluate how irrigation water is actually used in urban areas. The possibility of reusing treated wastewater and stormwater for lawn watering should be given serious consideration, especially as the requirements for more stringent water treatment are imposed on cities. It is increasingly difficult to justify providing a very high level of treatment to all of the water brought into a city only to have the majority of it used to irrigate landscapes and flush toilets.

References

- Brown and Caldwell (1984) *Residential Water Conservation Programs - A Summary Report*. Report to US Dept. of Housing and Urban Development, Washington, DC.
- Buhlig, L. (1995) *Impact of the City of Boulder's Conservation Program on Aggregate Water Use*. MS Thesis, Dept. of Civil, Environmental, and Architectural Engineering, U. of Colorado, Boulder.
- Cantor, K.P., Hoover, R., Hartage, P. et al. (1987) Bladder cancer, drinking water source, and tap water consumption. *J. National Cancer Institute* 79(6): 1269-1279.
- Courtney, B.A. (1997) *An Integrated Approach to Urban Irrigation: The Role of Shading, Scheduling, and Directly Connected Imperviousness*. MS Thesis, Dept. of Civil, Environmental, and Architectural Engineering, U. of Colorado, Boulder.
- DeOreo, W., Heaney, J. and Mayer, P. (1996) Flow Trace Analysis to Assess Water Use. *Journal of the American Water Works Association*. Jan., p. 79-80.
- DeOreo, W.B. and P.W. Mayer. 1996. *Project Report: Measuring Actual Retrofit Savings and Conservation Effectiveness Using Flow Trace Analysis*. City of Boulder, Office of Water Conservation, Boulder, CO.
- Harpring, J. S. (1997) *Nature of Indoor Residential Water Use*. MS Thesis, Dept. of Civil, Environmental, and Architectural Engineering, U. of Colorado, Boulder, Colorado.
- Henze, M., Somlyódy, L. Schilling, W. and Tyson, J. (Eds.) (1997) Sustainable Sanitation. *Water Science and Technology*, Vol. 35, No. 9.
- Karpiscak, M.M., Brittain, R.G., and Foster, K.E. (1994) Desert House: A Demonstration/Experiment in Efficient Domestic Water and Energy Use. *Water Resources Bulletin*, Vol. 30, No. 2, p. 329-334.
- Law, I. (1997) Domestic Non-potable Reuse - Why Even Consider it? *Water*, May/June.
- Maddaus, W.O. (1987) *Water Conservation*. American Water Works Association. Denver, Colorado.
- Mayer (1995) *Residential Water Use and Conservation Effectiveness: A Process Approach*, Master's Thesis, University of Colorado.
- Mayer, P. W., De Oreo, W. B., Nelson, J. O., Opitz, E., and Allen, R. (1997) *North American Residential End Use Study Progress Report*. American Water Works Association Research Foundation, Denver, CO.
- Michelsen, A.M., McGuckin, J.T., and Stumpf, D.M. (1998) *Effectiveness of Residential Water Conservation Price and Nonprice Programs*. Water Research News. Colorado Water Resources Research Institute, Fort Collins, CO
- Sakrison, R.G. (1996) New Urbanism, Growth Management and the Effect on Metropolitan Water demands. *Proc. of Conserv 96*, ASCE, AWWA, and AWWA, Orlando, Florida, p. 19-26.
- Stadjuhar, L. (1997) *Outdoor Residential Water Use*, Master's Thesis, University of Colorado, Boulder, Colorado.

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. The list includes new projects and supplements to existing awards. The new projects are highlighted in bold type.

**COLORADO STATE UNIVERSITY
FORT COLLINS, CO 80523**

Title	PI	Dept	Sponsor
Climate & Land use Change on Ecosystem Dynamics... Spatial Integration of Regional Carbon Balance in Amazonia	Ellis,James	Natural Resource Ecology Lab	NSF-GEO-Geosciences
Water Usage of Cottonwoods	Denning,A Scott	Atmospheric Science	NASA-Goddard
San Miguel River Site Conservation Plan	Jacobi,William R	Bioagricultural Sci & Pest Mgmt	Denver Water
Synthetic Streamflow Generation & Forecasting Project, Phase III	Kettler,Stephan M	Fish & Wildlife Biology	The Nature Conservancy
Training & Education for Agricultural Chemicals & Groundwater	Salas,Jose D	Civil Engineering	DOE
Sentinel Fish Testing for WD Resistance	Waskom,Reagan M	Soil & Crop Sciences	CDA
Water Usage of Trees and Turf at ARDEC	Bergersen,Eric P	Coop Fish & Wildlife Research	CDWL
Whirling Disease in High Lakes	Jacobi,William R	Plant Path & Weed Science	City of Fort Collins
Aquatic Studies	Bergersen,Eric P	Coop Fish & Wildlife Research	CDWL
Whirling Disease PCR Development	Bergersen,Eric P	Coop Fish & Wildlife Research	CDWL
Measuring the Effects of Nonnative Brook Trout on Native Colorado River Cutthroat Trout Populations	Bergersen,Eric P	Coop Fish & Wildlife Research	CDW:
An Assessment of the Recreational Needs Within the Estes Valley Recreation & Park District	Fausch,Kurt D	Fish & Wildlife Biology	CDWL
Synthetic Streamflow Generation & Forecasting Project, Phase III	Rodriguez,Donald A	Nat Res Recreation & Tourism	EV Rec & Park District
Coping with Prolonged & Severe Drought in the Rio Grande River Basin	Salas,Jose D	Civil Engineering	DOE
Nutrient Supply Effects on Riparian Vegetation on the Green & Yampa Rivers	Frasier,W. Marshall	Agric & Resource Economics	NM State Univ.
Research on Stream & Riparian Contaminant Risk Assessment Methods for Monitoring Fish...	Binkley,Daniel E	Forest Sciences	DOI-USGS
Tamarisk Removal & Riparian Restoration Along Reaches of the Green River, CO.	Flickinger,Stephen A	Fish & Wildlife Biology	DOI-NBS
Coupled Solute Migration Through Clay Barrier Materials	Cooper,David Jonathan	Earth Resources	DOI
Dynamics of Whirling Disease on the Cache La Poudre River	Shackelford,Charles D	Civil Engineering	NSF - Engr. Grant
Processes Controlling Nitrogen Retention & Export in High Elevation Rocky Mountain Watersheds	Bergersen,Eric P	Coop Fish & Wildlife Research	Montana State Univ.
Improving Nexrad-Based Estimates of Precipitation Rates & Hydrometeor Classification	Baron,Jill	Natural Resource Ecology Lab	EPA-Environ. Ed.
Uncertainty & Risk Analysis Under Extreme Hydrologic Events	Rutledge,Steven A	Atmospheric Science	NSF-GEO-Geosciences
A Snow-Evolution Modeling-System for Weather, Climate, & Hydrologic Applications	Salas,Jose D	Civil Engineering	NSF - Engr. Grant
Snow Hydrology: The Parameterization of Sub-grid Processes Within a Physically Based Snow Energy and Mass Model	Pielke,Roger A	Atmospheric Science	NASA-Goddard
Impact of Clouds on Nitrogen Species & Ozone in the NARE Boundary Layer	Elder,Kevin J	Earth Resources	NASA-Goddard
Developing Tools to Predict Persistence of Extent & Reintroduced Native Cutthroat Trout Populations	Kreidenweis-Dandy, Sonia M	Cira	DOC-NOAA
	Fausch,Kurt D	Fish & Wildlife Biology	CDWL

Title	PI	Department	Sponsor*
Air-Sea Interaction Remote Sensing Processes	Vonderhaar,Thomas H	Cira	DOC-NOAA
Precision Farming to Protect Water Quality & Conserve Resources	Sommers, Lee E	Soil & Crop Sciences	USDA-ARS
McMurdo Dry Valleys: A Cold Desert Ecosystem	Wall,Diana H	Natural Resource Ecology Lab	Univ. of Alabama
Quantifying the Change in Greenhouse Gas Emissions Due to Natural Resource Conservation...	Paustian,Keith H	Natural Resource Ecology Lab	USDA-NRCS
Stochastic Analysis Modeling & Simulation (SAMS)	Salas,Jose D	Civil Engineering	DOI-USBR
Parameterizing Subgrid-Scale Snow-Cove Heterogeneities for Use in Regional & Global Climate..	Pielke,Roger A	Cira	DOC-NOAA
A Multisensor Satellite Study of Upper Tropospheric Water Vapor & Clouds	Stephens,Graeme L	Cira	DOC-NOAA
Long-Term Ecological Measurements in Loch Vale Watershed, Rocky Mtn. National Park	Baron,Jill	Natural Resource Ecology Lab	DOI-USGS
Watershed Research	Haas,Glenn E	Nat Res Recreation & Tourism	DOI-NBS
Platte River Hydraulic Model Study	Abt,Steven R	Civil Engineering	Love & Associates, Inc.
Wetland Management Field Support at Fort Drum, NY	Brozka,Robert J	Forest Sciences	DOD-ARMY
Effects of Winter & Spring Flows on Colorado Squawfish	Beyers,Daniel W	Fish & Wildlife Biology	DOI-USBR
Flaming Gorge Studies: Technical Integration & Synthesis	Bestgen,Kevin R	Fish & Wildlife Biology	DOI-USBR
Assessment of Drifting Larval Fishes in the Yampa & Green Rivers	Bestgen,Kevin R	Fish & Wildlife Biology	DOI-USBR
Initial Implementation of a Monitoring Programs for Evaluation of Restoration Activities	Bestgen,Kevin R	Fish & Wildlife Biology	DOI-USBR
Levee Removal & Floodplain Connectivity Evaluation in the Green River, Utah	Bestgen,Kevin R	Fish & Wildlife Biology	DOI-USBR
Duchesne River: Assessment & Refinement of Instream Flow Needs	Bestgen,Kevin R	Fish & Wildlife Biology	DOI-USBR
Assessment & Prediction of Effects of Selenium on Razorback Sucker	Beyers,Daniel W	Fish & Wildlife Biology	DOI-USBR
Yampa River Nonnative Fish Control: Northern Pike Spawning & Nursery Habitat Evaluation	Hawkins,John A	Fish & Wildlife Biology	DOI-USBR
Status of Flannelmouth & Bluehead Suckers & Roundtail Chub	Bestgen,Kevin R	Fish & Wildlife Biology	DOI-USBR
Canal Seepage Reduction Demonstration	Valliant,James C	Cooperative Extension	DOI-USBR
GOES Science Improvements	Vonderhaar,Thomas H	Cira	DOC-NOAA
Development of User-Friendly Graphical Interfaces for Ecological Simulation Models	Wall,Diana H	Natural Resource Ecology Lab	NM State University
Rivers/Trails/Conservation Act (RCTA) Technical Assistance (DURP)	Zuschlag,Nancy L	Cooperative Extension	DOI-NPS
Watershed Erosion Modeling for the Actinide Migration Studies — Rocky Flats	Julien,Pierre Y	Civil Engineering	Kaiser – Hill Company
Potential Consequences of Climate Change & Variability for the Rocky Mountain & Great Basin Region . .	Simmons,Carol L	Natural Resource Ecology Lab	DOI-USGS
Bureau of Land Management Montrose County Wetland Inventory & Assessment	Sanderson,John S	Fish & Wildlife Biology	DOI-BLM
Stochastic Analysis Modeling & Simulation (SAMS)	Salas,Jose D	Civil Engineering	DOI-USBR
Songbirds along the Rio Grande River	Knight,Richard L	Fish & Wildlife Biology	DOI-USBR
Snow Distribution & Runoff Forecasting, Kings River Basin, California	Elder,Kevin J	Earth Resources	DOD-ARMY-COE
Assessing the Impact of Remote Sensing Data on Cloudiness Predictions...	Stephens,Graeme L	Atmospheric Science	NASA

THE UNIVERSITY OF COLORADO
BOULDER, CO 80309

Title	PI	Department	Sponsor*
Littoral Sediment Transport Using Satellite Visible Infrared Imaging Radiometry	Syvitski, James	Geological Sciences	Raytheon Company
Effects of Climate Change in the Colorado Alpine Ecosystem Response to Altered Snowpack and Rainfall Regimes	Seastedt, Timothy	Geography	NSF
Deciphering the Ocean's Influence on East African Climate Using Multicentury Multivariate Coral Records	Cole, Julia	Geological Sciences	NSF
Development of the Relaxed Eddy Accumulation Technique and Stable Isotope Analysis for Studies of Ecosystem CO₂ Exchange...	Monson, Russell	Environ., Population & Organismic Biology	NSF
Validation Studies and Sensitivity Analysis for Retrievals of Snow Albedo and Snow-Covered Area from EOS AM-1 Instruments	Wick, Gary	Cooperative Inst. For Res. in Environmental Sciences (CIRES)	NASA
Passive Microwave Snow Cover Algorithm Inter-comparison and Validation	Armstrong, Richard	CIRES	NASA
Investigation of the Effects of Particle Ionization on the Earth's Middle Atmosphere and its Role in Global Change	Randall, Cora	Atmospheric & Space Physics	NASA
Radiocarbon, Ocean and Climate Change Over the Last Deglaciation	Hughen, Konrad	Geological Sciences	NSF
Drought in the Australian Outback: Milankovitch and Anthropogenic Forcing of the Australian Monsoon	Miller, Gifford	Geological Sciences	NSF
Climate Change of the Last 500 Years: Simulations vs. Data	Overpeck, Jonathan	Geological Sciences	NSF
Contemporary Variability, Future Changes and Human Dimensions of Snowpack Water Resources Over the Western U.S.	Serreze, Mark	Geography	NSF
Satellite Remote Sensing of Tropical Ice Clouds and Precipitation for GCM Verification	Evans, K. Franklin	Prog. In Atmos. & Oceanic Sci.	NASA
El Nino Prediction Using Hueristic Algorithms	Sahami, Kamran	Prog. In Atmos. & Oceanic Sci.	NASA
Investigating Downscaling Methods and Evaluating Climate Models for Use in Estimating Regional Water Resources in Mountainous Regions Under Changing Climatic Conditions	Frei, Allan	CIRES	NASA
Collaboration on the Development and Validation of the AMSR Snow Water Equivalent Algorithm	Armstrong, Richard	CIRES	NASA
Variations in GPS Time Series: A Study of Hydrological Loading Effects	Larson, Kristine	CIRES	NASA
Information Management of Hydrologic and Reservoir Data	Reitsma, Rene	Civil, Arch. & Environ. Engr.	DOI-USBR
Potential Effects of Global Climate Change on Western River Basins Study	Zagona, Edith	Civil, Arch. & Environ. Engr. CADSWES	DOI-USBR
Carbon Balance in Global Arid and Semiarid Lands	Wessman, Carol	CIRES	State of Colorado/CSU
McMurdo Dry Valley Long-Term Ecological Research	McKnight, Diane	Civil, Arch. & Environ. Engr.	Univ. of Alabama
Interannual Variations of Ozone and Their Relationship to Variations of Tropospheric Structure	Salby, Murry	Prog. In Atmos. & Oceanic Sci.	NSF
REU Supplement: Effects of Climate Change in the Colorado Alpine	Seastedt, Timothy	Environ., Population & Organismic Biology	NSF
Space Weather: Development of a Mid and High Latitude Ionospheric Storm-Time Correction Map	Fuller-Rowell, Timothy	CIRES	NSF

Title	PI	Department	Sponsor*
Understanding the Physical Basis of ENSO, ENSO Predictability, and the Relationship to Intraseasonal Variability Using a Hierarchy of Coupled Atmosphere-Ocean Models	Moore, Andrew	Prog. In Atmos. & Oceanic Sci.	NSF
Evaluation of Snow Water Equivalent Across Grassland Regions	Frei, Allan	CIRES	NASA
Potential Effects of Global Climate on the Maintenance of Biodiversity in Florida	Crumpacker, David W.	Environ., Population & Organismic Biology	EPA
Variable Ice-Sheet Discharge and Coastal Change in West Antarctica	Scambos, Theodore	CIRES	NASA
Sea Ice and Ocean Processes in Baffin Bay: A Study Using RADARSAT Data and Numerical Modeling	Steffen, Konrad	CIRES	NASA
Endangered Species/Limnology	Lewis, William	CIRES	DOI-USFWS

*FEDERAL SPONSORS: NOAA-National Oceanic & Atmospheric Admin., NSF-National Science Foundation, NRCS-Natural Resources Conservation Service, USFWS-US Fish & Wildlife Service, DOA-Department of the Army, USFS-US Forest Service, NPS-National Park Service, NASA-National Aeronautics & Space Administration, DOE-Department of Energy, NRC-Nuclear Regulatory Commission, USBR-US Bureau of Reclamation, NBS-National Biological Survey, COE-Corps of Engineers, DON-Department of the Navy, EPA-Environmental Protection Agency, USDA/ARS-Department of Agriculture, Agricultural Research Service. STATE SPONSORS: CDNR-Colorado Department of Natural Resources, NCWCD-Northern Colorado Water Conservancy District, CDWL-Colorado Division of Wildlife, CDA-Colorado Department of Agriculture.



WATER SUPPLY

Stream flows and SWSI values were higher for the northern portion of the state during August. Reports from those areas of the state also indicated that irrigation water supplies were generally adequate. Reports from the southwestern areas, especially the Durango region, indicate drier weather. Statewide, reservoir storage was at approximately 120% of normal as of the end of August.

The Surface Water Supply Index (SWSI) developed by the State Engineer's Office and the U.S.D.A. Natural Resources Conservation Service is used as an indicator of mountain-based water supply conditions in the major river basins of the state. It is based on stream flow, reservoir storage, and precipitation for the summer period (May through October). During the summer period stream flow is the primary component in all basins except the South Platte basin where reservoir storage is given the most weight. The following SWSI values were computed for each of the seven major basins for September 1, 1998 and reflect conditions during the month of August.

Basin	Sept. 1, 1998 SWSI Value	Change From Previous Mo.	Change From Previous Year
South Platte	3.4	+0.4	-0.6
Arkansas	1.3	+0.2	-1.6
Rio Grande	-0.1	+0.2	-2.7
Gunnison	-1.4	-1.9	-4.3
Colorado	3.2	+2.3	-0.1
Yampa/White	2.7	+0.3	-1.1
San Juan/Dolores	0.1	-1.0	-3.6

SCALE

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

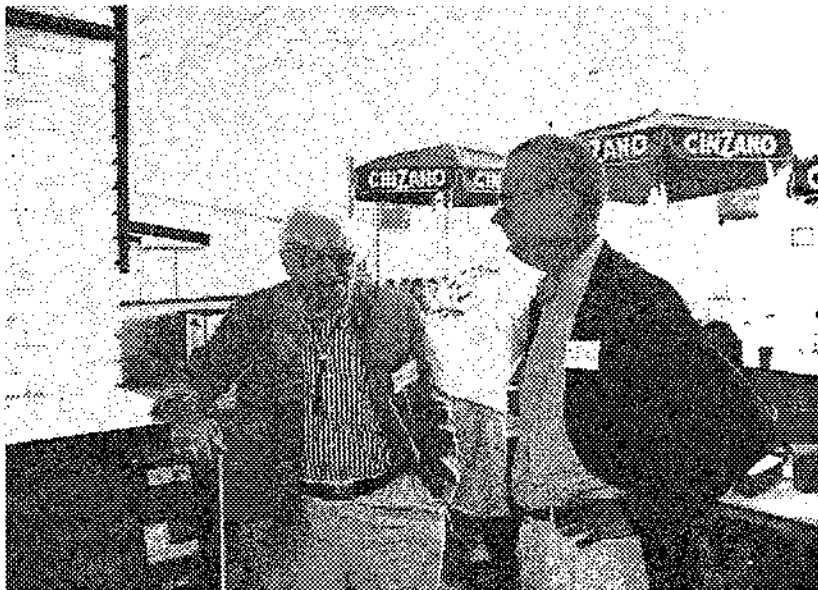
MEETING BRIEFS

THE COLORADO WATER WORKSHOP: LEARNING ABOUT WATER BY STUDYING THE EFFORTS OF OTHERS

The 1998 Colorado Water Workshop was held July 29-31 on the campus of Western State College in Gunnison. The meeting's theme, **World Water Lessons for a Changing West: On Management, Conservation, and Public Education**, provided attendees the opportunity to learn how others are approaching water problems around the world, across the United States, and across time. Texas Senator Buster Brown described Texas's efforts to address a number of emerging water management issues via Senate Bill 1. The lessons of Senate Bill 1, and there are many, are described in his talk on page 21.



Janice Sheftel, Colorado Water Conservation Board, with Jim Westcoat, Geography Department, University of Colorado



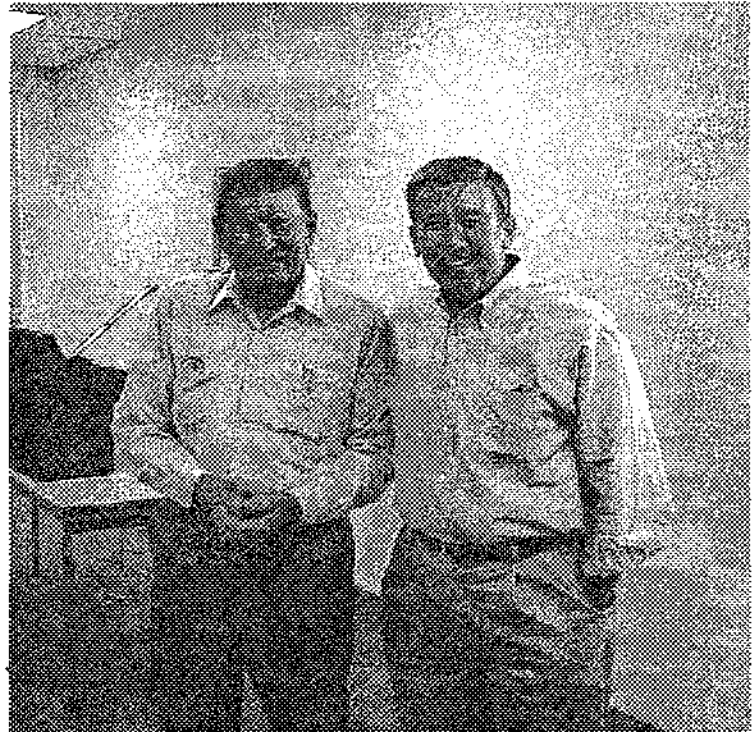
Floyd Dominy, Former USBR Commissioner, with Mark Smith, Professor of Economics, Colorado College.

While there are lessons to be learned from what others currently are doing, there are also lessons to be learned from history. Floyd Dominy, Former Bureau of Reclamation Commissioner, reviewed the issues facing water managers in the mid-1900s and commented upon the changes that have taken place since then. His remarks, and several questions and answers following his talk, are presented on page 18.

The Colorado Water Workshop 'Living Legend' for 1998 is John Fetcher, a rancher from the Elk River area north of Steamboat Springs. John's involvement with water development and management in the Steamboat area is truly legendary. He shares a lifetime of wisdom acquired in the business of Colorado water and other areas in his talk below.

After all the lessons provided at the Workshop, it was quite appropriate for Dick MacRavey, Executive Director of the Colorado Water Congress, to wrap up the three-day meeting with some conclusions on how we in Colorado will have to approach solving our water conflicts. The Colorado Water Congress was founded in 1958 to do what Dick describes on page 25.

Hopefully, the four talks presented in this issue of *COLORADO WATER* capture some of the excellent lessons presented at the Colorado Water Workshop in Gunnison.



John Fetcher being congratulated by Dan Merriman, Colorado Water Conservation Board.



"LIVING LEGENDS OF WESTERN WATER" Series

This Year's Special Guest: John R. Fetcher

I first thought that I would speak on a very serious subject, and then I said to myself, that would be much too solemn. So instead, I am going to tell you a little about my life and some of my experiences.

I graduated from Harvard with degrees in electrical engineering and business during the terrible depression of the '30s. I was fortunate, because one of my professors was a consultant for the Budd Company of Philadelphia, and they needed an engineer who had a speaking knowledge of French. The company was building stainless steel railway cars. They were also in the automobile body business. They needed an engineer who could be their liaison between Philadelphia and a French company that was also their licensee for the manufacture of stainless steel railway cars. I got the job because I spoke French, having lived in France as a boy with my family for three years.

I spent two exciting years in Paris and Europe. In 1936 the

company sent me over to Berlin during the Olympics. That was when Jesse Owens won two Olympic Gold Medals and Hitler wouldn't award them to him. I was there. As a matter of fact, I will never forget driving from downtown Berlin to the stadium. I heard the sirens behind my nice, green 1936 Plymouth. I said to myself, "I am an American. Who am I to get over for these Germans?" Guess who it was? Hermann Goehring, in an open sedan, with all those medals across his chest. I must say, I thought Germany was great! Then I met my parents in Copenhagen, and Dad straightened me out on Hitler.

Life in Paris for a 23-old young man was special. I had the new Plymouth, and in those days you could park on the Champs Elysees. Now they have to park on the sidewalk, there are so many cars. I got my love for skiing in the Alps. There is an expression in French, "faire le pont." It means "make the bridge." There are many religious holidays in France, and if a holiday occurred on a Thurs-

day, we would make the bridge to Monday. Often, we would take off in my Plymouth and drive down to the Alps to go skiing. Another thing that happened in Paris was a chance to learn to fly. There were three of us Americans who were so bored with the French two-hour lunch, we would drive out to the Villacouplay airport, and that is where I learned to fly. I remember my first soloing and then, later, flying over Versailles. I got my French flying license at that time and have never flown since.

We came back to the Budd Company in 1937, and I was put in charge of the manufacturing facilities. It was a big job. The war came, and we had to retool the entire plant from automobile bodies and railway cars into munitions. Our company was the first to make the bazooka, a rocket launcher that could be fired against tanks and which could penetrate 4 inches of armor. It was known as the infantryman's defense against the tank. We also made that terrible fragmentation bomb. And we even build a stainless steel cargo airplane. So, you can imagine the turmoil of converting a big company into war materials.

After the war, I met Clarissa, sister of a college roommate. We were married in '43, and if you can imagine, there was no gas for a honeymoon. After trying suburban life for a while, we thought that there might be a better way of life than 40 stoplights to work, the Beach Haven Yacht Club (I was a sailor), and the Merion Cricket Club, where I played tennis and squash racquets. So, I joined my brother and came out to visit Colorado. In seven days we saw seven ranches, and settled on one in the Elk River Valley. We moved to the place in October, 1949, Chris with three little boys. At that time, we didn't even know which end of a cow got up first.

We soon found out that the ranch wasn't going to pay the

bills, and we were up to our necks in mortgage payments. About that time, I got involved with two others to start the Storm Mountain ski area, thinking that there was more money in the people business than in cows, although I do prefer the cows. We opened the first chair lift in January, 1963. Five of us took turns operating the lift. We didn't even bother with a top attendant. We said, "If you don't get off, you'll come back down."

I will confess that as easterners, it was hard for us to understand that you couldn't make a hay crop if you didn't have irrigation. It is hard for easterners to understand that to this day.

We learned, of course, on the ranch and from irrigation, the importance of water. I will confess that as easterners, it was hard for us to understand that you couldn't make a hay crop if you didn't have irrigation. It is hard for easterners to understand that to this day. At that time, a group of us got together and formed the Upper Yampa Water Conservancy District. There was a demand for reservoirs to store spring runoff for

irrigation, particularly in the upper end of the valley where there is more land than there is flowing water for irrigation.

We built the Yamcolo Dam, which is on the headwaters of the Yampa River, with financial help from Colorado Ute Electric Company. They needed water for their thermal plants. We built Yamcolo in 1979. Stagecoach Reservoir followed, also built for irrigation and industrial use. It took us seven agreements, permits, and permissions to build Yamcolo; it took 71 permits, agreements and permissions to build Stagecoach eight years later. That goes to show you what has happened in terms of environmental concerns when you try to build a big project.

Here are a few precepts that kept me going and kept me alive: Get up before breakfast. Do it now. Drive fast only when you have to. Have a good and lasting marriage. If you think you are indispensable, don't retire. Be nice to people. Share a laugh with those you meet. Keep it short.



COLORADO WATER WORKSHOP KEYNOTE ADDRESS

by *Floyd Dominy*

Former Commissioner, U.S. Bureau of Reclamation

I almost didn't get here for this occasion, because right after I agreed, my bank called me and said the government had asked them to return my last retirement check. I asked if they gave a reason, and the bank said, "Yes. You're dead." After about 30 seconds of expletives, they knew I was alive. I sent in a notarized statement that I was alive, but still didn't get back on the payroll. I got a copy of the federal directory, found a telephone number and called. The answering service came on and said, "This is the Office of Emergency Management, Resurrection Branch. If you are calling from Heaven press one now; if you're calling from Hades press 2 now; if you are currently unassigned, please stay on the line for the next available placement officer."

During my 12 years of managing the Bureau of Reclamation, there was one thing that probably gave me more personal anguish than any other. The Colorado Storage Project Act of 1956 contained one little sentence that said, "None of the waters impounded behind Glen Canyon Dam will be allowed to enter Rainbow Bridge National Monument." That doesn't sound like very much, but actually it is pretty horrendous. Here is a 160-acre monument in the canyons at the foot of Navaho Mountain, and almost impossible to get to. How are we going to prevent the waters of Lake Powell from moving back into that 160-acre monument? The people who got that statement into the act had never been to Rainbow Bridge and none of the Congressmen had been there.

So, I became Commissioner April 1, 1959, and we had Glen Canyon Dam underway. We were not yet ready to pour the first bucket; we were still doing the preliminary work, but I knew that we needed to do something about that little line in the act. I called the construction engineer and arranged for us to get in there, look around, and decide what we should do. We rented horses and went in from Navaho Mountain, and spent four days in the canyon country. I took a lot of slides, and we came to the conclusion that we shouldn't do anything. It would require a dam at the mouth of Bridge Canyon below the national monument, another dam up above the monument, a couple of miles of tunnel to divert that water over into the canyon below Bridge canyon, and all this in almost inaccessible country. The scenic violence of doing that kind of construc-

tion – setting up diesel pumping plants and all the rest that would have to go with it – would be far worse than letting a little water back up under the bridge.

I went to Wayne Aspinall, Chairman of the Interior and Insular Affairs Committee, with my slides. I had Denver make a topographic model so I could take the water in and out and show that the water wouldn't do any harm whatever to the arch itself, and I said, "We have to amend this silly law." But Aspinall was adamant. "I am not going to open that up for amendment, because I don't know what else I might have to put up with." But I was adamant also. So, I went to the Appropriations Committee, with money appropriated to start the work to prevent waters from getting into the monument as the law required, and told them, "Don't give it to me. If you don't give me the money, I can't do the work, and the work shouldn't be done." So every year, from then until we finished the Glen Canyon Dam, the Appropriation Bill carried a little language that said, "...none of the money appropriated in this bill for the construction of Glen Canyon Dam power plant and transmission lines shall be used to construct any facility designed solely to prevent the waters of Lake Powell from entering Rainbow Bridge National Monument."

That amended the law, but a lot of people said you can't amend the law in an appropriation act. So, the Sierra Club took it to the courts, and Judge Ritter in Salt Lake City agreed that the law hadn't been amended and therefore you can't fill the reservoir above elevation 3600. That was appealed, and a smarter court overruled that decision. We don't have to keep the water out of Rainbow Bridge National Monument. I suspect that all of you who have been there went up by the water highway, which is the proper way to get there.

Thirty years ago next March Nixon had just been inaugurated. The American Water Works Association had an annual meeting scheduled in Washington, and they had a promise from the new Nixon White House that they would furnish a speaker who would describe the new look in Washington. At the last moment, they didn't get a speaker from the White House. Here they were, with 2,000 people expected at a big banquet and no speaker. They came to

Floyd Dominy and said, "You were dubbed by President Kennedy as the water boy of the nation, so you will have to bail us out and be our keynote speaker." I said I didn't know what the new Nixon White House would do and I wasn't even sure they would keep me on as Commissioner. So I told them to call the Secretary of the Interior and tell him that since he refused to be the speaker that I was agreeable, provided he told them how to introduce me. Secretary Hickel finally caved in, and said, "You may introduce him as the long-time Commissioner who will continue in office."

I had a captive audience who had come to hear about the new look in Washington from the Nixon White House, and who did they get? A man who had been there since Franklin Roosevelt on through Truman, Eisenhower, Kennedy and Johnson. I felt they had been shortchanged. And now look how you have been shortchanged. I am supposed to tell you about the future of Colorado water and I haven't paid any attention to or had any responsibility for or interest in Colorado water for 29 years. But the conference is about what we can learn from foreign experience, and I do have quite a little of that.

My first foreign experience was 1942, right after Pearl Harbor, when Nelson Rockefeller, Coordinator of Interamerican Affairs, asked me to go to Paraguay to try and influence the dictator there to stay with us during the war. We had already lost Argentina and Chile, who were allowing the Nazis to build submarine bases in their countries. I didn't know anything about Paraguay. I called the State Department and they said they had an expert on Paraguay. I went over and talked to him, and he said my biggest problem was that in the Chaco I would run into Guarani Indians. He said they were a pretty tough people, pretty hardnosed. I said, "How will I recognize a Guarani Indian from any other Indian?" He said, "It is very simple. The Guarani always walk single-file, never side-by-side." I said, "You are an expert - how many have you seen?" And he said, "One." So I have avoided experts ever since.

We can learn a lot from the Netherlands. In 1952 I was chief of the Irrigation Division and was invited there to visit with their people on some land reclamation projects.

They were taking holdings that had been subdivided from generation to generation, until the farms were so small and the drainage ditches so close together that they took up most of the land, and putting people on new lands that were coming into production from the Zuider Zee. We could learn a lot from the Netherlands about managing water, about keeping the ocean off your land, and that sort of thing.

I want to tell you about the Pa Mong project. In 1960, I was attending a large-dam conference in Rome when I got a telegram saying I should report to the American ambassador in Bangkok as soon as possible. I

went there, and he met me at the airport. He told me that in the afternoon there was a press conference set up with the Prime Ministers of Laos and Thailand at which our government, with me as the speaker, would promise to build the Pa Mong dam on the Mekong River, anchored in Laos and Thailand. The Mekong River is one of the ten biggest rivers in the world. It hadn't been studied; there was no geology, no hydrology, and no elevations established for the reservoir. I told him the Commissioner of Reclamation could not make such a statement. The most I could say was that we would start studies to find out whether that dam could be built and whether it should be built, from an economic point of view.

We did the studies for six long years, and I wish we could have put our money into the Pa Mong dam instead of dropping bombs on the rice paddies in Vietnam, Cambodia and Laos. The Pa Mong dam, less than 400 feet high, would have yielded 150 million acre-feet of water a year, one of the greatest hydroelectric and irrigation storage sites in the world. You could convert millions of acres of rice from a one-crop economy into a two-crop a year economy, and think how much better that would have been for that area than to bomb their rice paddies.

The State Department, with our government money, built a big project, a dam and an irrigation system to serve several hundred thousand acres of land in the Helman Valley in Afghanistan. They didn't consult the Bureau of Reclamation about the project, but turned it over to an American contractor on a cost-plus basis. After it was built, it wasn't working properly. The contractor hadn't paid any attention to the soils and hadn't provided for any drainage, and it

The Pa Mong dam, less than 400 feet high, would have yielded 150 million acre-feet of water a year, one of the greatest hydroelectric and irrigation storage sites in the world. You could convert millions of acres of rice from a one-crop economy into a two-crop a year economy, and think how much better that would have been for that area than to bomb their rice paddies.

was the Afghan government that told our State Department to ask the Bureau of Reclamation to come over and have a look at it. I had a team for years in the Helman Valley trying to straighten out that mess.

We could learn a lot from the Israelis about water management, including drip irrigation and how they co-mingle bad water with good to create five gallons of water instead of

one. They are doing some wonderful things with water under very adverse conditions.

We can learn a lot from Norway, Sweden and Switzerland about hydroelectricity. I am very envious that Norway and Sweden get all their energy from hydro — no acid rain and no smog-producing coal-fired plants. Yes, we could learn a lot from other people around the world.

SELECTIONS FROM QUESTION AND ANSWER SESSION

Q: You have probably read Mark Reisner's book, Cadillac Desert. Do you have any observations about that particular book?

A: Well, it exaggerates in many areas. Mark did come to my house, and I submitted to tape interviews for many hours. I gave him access to my files that had not yet been moved to the University of Wyoming. But it is perfectly obvious to anyone who reads it that he savaged Floyd Dominy at will. I think that is all the comment I have.

Q: With population growth and all the demands now, how would you like to see the Bureau operating?

A: There are so many changes in the federal legislation concerning the environment, endangered species, that it makes it impossible in my judgment to get an agreement on anything. I wonder what is going on in the wild blue yonder. I built two dams on a mountain farm ten years ago for trout ponds. They were immediately full of frogs, and now there are no frogs there. It drains right out of a national park. There is no agricultural land above those ponds, nothing but trees, bear, deer and raccoons, and yet that water somehow will not support frogs any longer. The trout still survive. I, for one, wonder why we need to save all the snail darters and other minor species because flora and fauna have been coming and going in this world of ours for millions of years. I don't know why we suddenly must stop all progress on irrigation development or hydroelectric development just to preserve some minor element in the fauna or flora field.

Q: What do you think of changes in the operation of Glen Canyon dam?

A: Had we built Marble Canyon dam we could have then continued to use Glen Canyon dam as a peaking source without the problem of fluctuating water through the Grand Canyon National Park. I am sympathetic with the fact that you need to maintain a fairly steady flow through the national park. It is interesting to note that with the 267 river miles of Colorado River, San Juan, and Escalante water that we flooded in Lake Powell, we have over 3 million visitors per year now. With the 265 river miles from Glen Canyon dam to Lake Mead, according to the Park Service, we can only support 20,000 per year.

Q: Knowing what you know today, what would you have done differently when you were Commissioner of Reclamation?

A: Stay there longer.

Q: The Sierra Club came out about a year ago with its "drain Lake Powell" scenario. I would like to hear your comments on this.

A: I can't believe that anyone in his right mind would make such a proposal seriously. Here is a region that, prior to the construction of Glen Canyon dam, had been visited in total by probably less than 1,000 people. Now, in addition to the pollution-free hydropower and all the economic benefits of 3 million visitors a year, I can't believe that anyone would want to convert it back to its original form.

Q: During your tenure as Commissioner of Reclamation, what were some of the important innovations from other parts of the world that the Bureau was able to draw upon and utilize in the American West?

A: One thing we got from abroad was a reinjectable grouting valve that was quite useful. We should have, but didn't, put more of our hydroelectric underground. The Swiss, Norwegians and Swedes have a good many of their hydroelectric plants under the mountain. I finally got one done here on the Gunnison. We should have done that on Fremont Canyon dam power plant, because we have had many rock scaling-problems there. We should have learned a lot more from Israel about saving water. The Europeans have successfully built many thin arch dams.





SENATE BILL 1: A LANDMARK DECISION IN TEXAS FOR WATER CONSERVATION

by Texas State Senator J.E. "Buster" Brown

It is so dry in Texas that the cows are giving evaporated milk, the fish are sweating, the Baptists have gone to sprinkling, and the last thing heard was a pine tree whistling for a dog.

I am glad I have a chance to talk with you about what we have done in Texas. I will give you a little background on the situation that caused the legislature to act on what was pretty historic for the State of Texas. In 1996 we went through a serious drought. In the 1997 legislative session, our Water Development Board made its report to the legislature on state water conditions and water plans for the state, which it is required to do annually. The report was presented in late 1996 after the immediate effect of the drought of '96, and we were coming into a session without a plan to do something about water.

The Lieutenant Governor called me in and laid out the history of attempts to prepare a water plan for Texas. Since 1955, the legislature had attempted four times to pass a water plan, and all four times the effort had failed. The report that we received from the Water Development Board talked not only about the drought of '96 and that it was about a \$3 billion loss to the agricultural interests, but that it was also a \$5 billion loss to the Texas economy. We had several cities, small cities but nonetheless important, that were within weeks of depleting their water supply and had no contingency plans.

The most startling fact was that when they looked at the population-growth projections for Texas, and the length of time that it takes to build a reservoir (a 20-year estimate), by the year 2040 Texas would double its population. By

the year 2010 the three major urban areas of Texas (San Antonio, Houston and Dallas-Fort Worth) would be 15 percent short of their daily water requirements if Texas continued with the same policies that it had in existence at the time. We had no choice but to try and do something about the water issue and about the water plan.

The most startling fact was that when they looked at the population-growth projections for Texas, and the length of time that it takes to build a reservoir (a 20-year estimate), by the year 2040 Texas would double its population. By the year 2010 the three major urban areas of Texas (San Antonio, Houston and Dallas-Fort Worth) would be 15 percent short of their daily water requirements if Texas continued with the same policies that it had in existence at the time. We had no choice but to try and do something about the water issue and about the water plan.

The Lieutenant Governor was quite honest with me, and said, "I don't really expect you to be able to pass a plan. This is probably a three-session process. Don't go into it with over-expectations, because you probably will not be able to get it done in a 140-day session." Recognizing that fact, we tried to do something different. We knew that four times before efforts had been made using the

traditional method — have agencies come up with a bill, file the bill, bring the parties together at a hearing, have comments — and then have it fall apart.

You probably know that Texas is a big state with diverse interests, geography and topography — it is very different from the Panhandle to East Texas, to South Texas, and the Big Bend area. Recognizing this, we tried something different. In the process of putting a bill together, agency personnel spent thousands of hours going through the prior legislation, looking at the problems, and looking at what needed to be addressed. They then identified the areas that were needed if a water plan if we were to do something

significant. Instead of drafting a bill and filing it, we identified 70 different groups that in the past had demonstrated an interest by coming to the Capitol and working on water issues. We tried to find those that had traditionally been battling each other and bring them to the Capitol at the same time in a mediation process. We let them go through the plan and identify their problems and fears that related to the different segments, and let them try to work together to find ways that would ease their concerns.

It was a long, tedious process, but we developed a bill, and after the bill was filed we allowed the same kind of input into the wording and the process. By the time we had our hearings, we had 450 amendments that we took up in the House and Senate. The bill went to conference, and after the conference committee worked out the differences, it passed the Senate unanimously and passed the House 144-4.

Instead of going through the bill, which made a lot of changes in the existing laws, I will talk about some of the new concepts that we implemented because they can apply anywhere. I mentioned earlier that the legislature had failed to act on prior water plans prepared by state agencies. Regardless of the reasons why, the fact remained that failure to act on water planning in 1997 was sure to bring about disaster for our state not only environmentally, but economically as well. The Water Development Board showed that if we had allowed that 15 percent shortage to take place, it would be an annual loss to the Texas economy in excess of \$40 billion per year. It was not a question of should we do it and will we do it, but how will we do it?

Senate Bill 1 capitalizes on newly found interest by changing the methods for developing a state water plan. Previously, all the state water plans had been prepared by a group of think-tank people sitting down in a room, coming up with the plan, and then presenting it at the local level, where it was rejected. Under Senate Bill 1, we concentrated on regional water planning, which is unique in the sense that Texas has not experienced that kind of planning before. Under Senate Bill 1 the state is divided into regions. The bill did not specify the number of regions, but left that to the agencies after they had looked at all the issues – water basins, water sources, tradition, geographics, population, and all the things that go into water planning.

The plan called for each region to do its own water plan. A regional water planning group appointed by the state agencies coordinates the plans. The regional plans must address water needs in the region for the next 50 years and

be submitted to the Texas Water Development Board by September 1, 2000. The board will review and approve the plans, working with the regions to resolve any interregional conflicts between the parties. The result will be a new water plan made up of all the regional plans.

This is the unique approach we used, because we recognized that if we tried to get 31 senators and 150 state representatives to agree to a specific plan that fit the entire state, we would fail. But we were able to convince them that if they allowed their local folks to come up with a plan and combined those plans into a single plan made up of 16 parts (one for each region), the bill could be passed. The change from a top-down process to one that works from the bottom up emphasizes local control and recognizes the resources that can be brought to bear on water problems while maximizing local and regional expertise.

As this process developed, it was not without some difficulty. As people came to the Capitol, they said almost unanimously, "We do not want the State of Texas or bureaucrats telling us how to manage our water at the local level. We want to do it ourselves." That was a clear message, so we said, "All right, we understand that. You will get a chance to make your own plans." We gave them the outline, appointed the group, started them on their way, and said the state would pay 75 percent of the cost involved and the other 25 percent would be paid locally.

The process is intended to bring into the water planning process local leaders who have not necessarily focused on water issues until now. This goal has been accomplished primarily through the establishment of the 16 regional planning groups. In some instances, we have had to remind folks that we are not going to build a levy on the lines that have been drawn for the regional boundaries and keep water from flowing from one part of Texas to another. The fears that people have are amazing – we have to remind them that the lines are simply for planning, not for implementation of plans and projects. I think they are convinced now that we are serious and that it is just for planning. In fact, several of the groups have joint meetings with regions next to them.

Texas has some unique water problems that are managed by the state. It has a border with Mexico where it has a serious water problem, and borders with New Mexico, Louisiana and Oklahoma. New Mexico and Mexico are very significant. I have asked the regional water groups in those areas to bring persons from Mexico and New Mexico into the planning process. We have no other way to do it

except through that process. In fact, I hosted a meeting with New Mexico legislators and state agency personnel and their Mexican counterparts about three weeks ago in Santa Fe to look at establishing a working relationship on some of these issues.

Drought contingency planning is something that was missing in Texas, and it was demonstrated in the 1996 drought. Several cities were almost out of water. One particular wood pulp plant in East Texas, to discharge its water through its permitting process, had to have a certain level in the stream. That stream had reached the level of flow that had about a week left, and they would have to shut down that plant – not because they didn't have adequate groundwater to draw from, but they didn't have the flows to discharge. The aquifer of a little town in East Texas, from which the Oasis Water Company draws its water, had reached a perilously low water level during the 1996 drought, partially because of the drought and partially because of the marketing of bottled water. The combination of those two things put that city in jeopardy.

Senate Bill 1 takes Texas out of the category of three Western states that did not have a drought management plan. The bill establishes the drought response and a monitoring committee comprising representatives of various state agencies. Drought will be treated like hurricanes, tornadoes, and other types of disasters. When drought conditions exist, this committee assesses and publicly reports drought and water supply conditions, advises the Governor on drought conditions, recommends specific provisions on drought response for inclusion in the state water plan, and ensures effective coordination among all state, local and federal agencies in drought response. The committee is getting a test right now, actually before it was ready, because little did we expect that we would be right back into the throes of a drought while we were putting together the various plans within Senate Bill 1. We had a report day before yesterday that the current drought already equals the 1996 drought. We have had 100 die in Texas because of the heat already, and the economic effect is at the \$4 billion loss stage.

The state water plan will include a statewide drought response plan comprising the drought response components of each of the regional plans. The regional planning groups can seek technical assistance from the state agencies. Additionally, Senate Bill 1 requires all wholesale and retail public water suppliers as well as irrigation districts to develop drought contingency plans which must be consistent with approved regional water plans. The theory is that every water supplier must develop a drought contingency

plan — if they apply for assistance from the state, or if they apply for a permit, they must demonstrate that they have a drought contingency plan in effect.

All these changes are necessary because Texas is prone to experience drought, and this is a statistic that we just received – Texas is more likely to have a six-month or year-long drought somewhere in the state than a near-normal to wet-weather spell for the same period. We have now grown to the point where drought conditions are estimated and predicted to be a part of our regular planning for Texas.

The TNRCC has developed a "watch list" whereby 200 water systems now are monitored daily as to both their water supply and the infrastructure. Diminishing water supplies or increased pressures on water supplies not only affect supply but also the infrastructure, as in the case of Fort Worth. Because of the increased demand and the dryness of the soil, the primary water main erupted in downtown Fort Worth and caused a huge loss of water. This came about mainly because of drought conditions.

We presently have water masters in South Texas along three of our rivers – the San Antonio, the Nueces and the Rio Grande. The water masters have historically been successful in getting some amount of water to most water right holders even in times of low flows. Now, water rights holders in other parts of the state are asking regulatory agencies and the legislature to look at considering water masters for their river basins to instantly and quickly be able to allocate water in times of need or emergency need as we have seen in Fort Worth. This is particularly true in the basins that are already over-appropriated, such as the Brazos River in Texas. Temporary water rights in some basins, primarily for road construction projects, have already been terminated in Texas because of the water shortage.

We have increased activity in precipitation enhancement – cloud-seeding projects that have occurred in the western half of the state. TNRCC just last week approved the weather modification program for a project covering nearly four million acres from Big Bend to Laredo, and the Edwards Aquifer Authority, which is the San Antonio supplier, has applied for a permit to conduct the same program over a nine-million acre area.

Finally, along the Rio Grande River, which borders Texas and Mexico, irrigation districts have been developing action plans on how to deliver water to municipalities during the drought. Conditions there are that the irrigators

have already been cut off. Water for irrigation purposes has been depleted and is no longer available, but the irrigation companies are utilizing their systems to bring water to the municipalities because the supply is that low.

Water conservation planning is another area that did not exist. We try to provide some incentives for water conservation, a necessary component in both regional water planning and drought contingency planning. Senate Bill 1 requires the development and implementation of a water conservation plan by every holder of a water right for 10,000 acre-feet or more for irrigation purposes, and every holder of a water right for 1,000 acre-feet or more for municipal, industrial, and other uses. These plans must be consistent with an approved water plan and must be developed with an opportunity for public input. Senate Bill 1 recognizes that water conservation is not only necessary for the success of water planning, but is often the least expensive source of new water or additional water supplies.

Senate Bill 1 amends Texas water law by recognizing that conserved water is a beneficial use under our definition of water. The intended purpose of this definition is to encourage large-scale conservation projects. Under our previous law, a water right holder might have been concerned that by reducing use through conservation methods, he would inadvertently abandon that water or lose the right to use that water. We will conserve water as a beneficial use under the definition that the water right holder now has the ability either to increase the effective amount of water that he can use through conservation measures or to market that portion of his water right that he has conserved.

Also, since the conserved water is a beneficial use, the user's conservation efforts protect the conserved amount of his right from cancellation due to abandonment or inactivity. The board goes on to define conserved water as that amount of water saved by a holder of a water right who practices techniques and technologies that would otherwise be irretrievably lost to all consumptive, beneficial uses arising from storage, transportation, distribution or application. This is an area where water users in rivers that had over-appropriated water use or water rights were very interested, because as is the case in most places, people who hold a lot of rights adhere to them very dearly. Under traditional Texas law, those who failed to utilize those water rights over a period of time would lose those rights. Our efforts were designed to try and help them both conserve water and use the water for other purposes.

We have also established a water bank, where portions of

water rights can be deposited and sold to others without losing the water right; and a water trust, where an unlimited percentage of water rights can be deposited or donated to the Texas Parks and Wildlife for environmental purposes. Those are two areas that were lacking because water rights holders were afraid to allow their water to be used for any other purpose for fear of losing it.

Another area where we were sorely lacking was water availability modeling for our river basins in Texas. Senate Bill 1 requires that each of the river basins in Texas will have a water availability model prepared by the state and made available to regional planners so that they can factually know what water supply is available, how much has been over-appropriated, and what they have to use. The models will be used to protect the amounts of water available to water rights holders, and are required to give an exact figure of what that river holds during a drought of record, when flows are at 75 percent of normal, and when flows are 50 percent of normal.

The Texas Lieutenant Governor and the Speaker have created an interim committee, because in this process we still were not able to come to the table with an agreement about what to do for future water sources. We do have in Texas a provision for interbasin transfer, but we were not able to get this kind of cooperation among the 70 different groups. Those people who have water in East Texas very vehemently said, "No one is coming to take our water" (even though they may have only 50 percent of it being used). My conclusion was that the bill was of such significance that we needed to get it passed, and we would set that issue aside and take it up during the next session.

Interbasin transfer is possible in Texas; the test is that detriment to the basin-of-origin cannot be greater than the benefits to the receiving basin, which is the court test that has been applied. The House was successful in adding a provision that any interbasin transfer of a water right moves that portion of the water right that is transferred to be the most genuine of all the rights within the river basin. We will change that in the next session, because interbasin transfers and new, innovative ways of moving water from one part of the state to another are an absolute necessity when you look down the road at how to alleviate suffering from the regional effects of drought.

All in all, I think that Texas, while it sometimes tries to be upfront and lead, was way behind the curve on our water planning. Senate Bill 1 gets us started with some innovative ways of looking at these issues.



WE CAN ACHIEVE A BETTER FUTURE

by Dick MacRavey, Executive Director
Colorado Water Congress

As the Colorado Water Workshop's last speaker, I would like to express the hope that the workshop's purpose, which is to learn, has been fulfilled. We are faced with incredibly complex issues in the state, the nation and the world that demand the very best from each of us. If I were a man of the cloth, my text today would be Chapter 29, Verse 18 of Proverbs: *Where there is no vision, the people perish.*

Before we proceed, I would like to read you a poem:

*One day through the primeval wood
A calf walked home, as good calves should;
But made a trail all bent askew,
A crooked trail, as calves all do.*

*Since then three hundred years have fled,
And I infer the calf is dead.
But still he left behind his trail,
And thereby hangs my tale.*

*The trail was taken up next day
By a lone dog that passed that way;
And then a wise bellwether sheep
Pursued the trail o'er hill and vale;
And drew the flocks behind him too,
As good bellweathers always do.*

*And from that day, o'er hill and glade
Through these old woods a path was made.
And many men wound in and out,
And dodged and turned and bent about,
And uttered words of righteous wrath
Because 'twas such a crooked path.*

But still they followed

*.... Do not laugh
The first migrations of that calf.
This forest path became a lane
That bent and turned and turned again.*

*This crooked land became a road
Where many a poor horse with his load
Toiled on beneath the burning sun
And traveled some three miles in one.*

*And thus a century and a half
They trod the footsteps of that calf.
The years passed on in swiftness fleet,
The road became a village street;
And this, before men were aware.
A city's crowded thoroughfare.
And soon the central street was this
Of a renowned metropolis;
And men two centuries and a half
Trod in the footsteps of that calf.*

*A hundred thousand men were led
By one calf near three centuries dead.
For men are prone to go it blind
Along the calf paths of the mind,*

I ask each of you to have an open mind — do not follow the mind path of the primeval calf. One of my professors in 1949 made the comment, "The more I see, the more I hear, the more I read, the less I know." In other words, the more we are exposed to, the more we realize there is to learn. Today, perhaps, this comment is even more relevant. We have the ability to make learning a lifelong adventure, if we so desire.

We need open, searching minds — we do not need to follow along the calf paths of the mind. We have, unfortunately, become embroiled in a "we" and "they" conflict regarding many issues. Perhaps, as Pogo put it so well: "We have met the enemy and it is us." I would like to offer some thoughts for your consideration, so we may leave a legacy that future generations will acclaim.

We must respect one another. Everyone's viewpoint and ideas should be respected. Differences are the starting point and the opportunity to act with patience, understanding and "give and take" to achieve solutions.

We must seek balance. Balance is necessary — pursuing an extreme course does not achieve balance. In 1943, when I was in junior high school, I learned about the word "ecology." In northern Arizona, mountain lions were killing off all the deer, and someone said, "Let's kill off the mountain lions." Since there were no longer enough natural predators, the deer were fruitful and multiplied. Soon it was discovered that there was not enough food for the deer, and they starved to death.

We must compromise when necessary. Compromise is not bad. The "Miracle at Philadelphia," as authored by Catherine Drinker Bowen, demonstrates the importance of compromises in writing our U.S. Constitution. This is very evident in the diary of James Madison. Would we have this great document if the founding fathers had not compromised?

We must visualize a better tomorrow. Chapter 29, Verse 18 of Proverbs is instructive — *Where there is no vision, the people perish.* I am confident that everyone here has ideas of how to achieve a better state, a better country and a better world. Visualize a better future — the status quo won't do it. He or she who stands still will only watch others rush by.

We must accept leadership responsibility. I equate leadership to the broadest meaning of politics as described by Elihu Root in a July 28, 1920 speech presenting a statue of Abraham Lincoln to the British people:

Politics is the practical exercise of the art of self-government, and somebody must attend to it if we are to have self-government; somebody must study it; and learn the art, and exercise patience and sympathy and skill to bring the multitude of opinions and wishes of self-governing people into such order that some prevailing opinion may be expressed and peaceably accepted. Otherwise, confusion will result either in dictatorship or anarchy. The principal ground of reproach against any American citizen should be that he is not a politician. Everyone ought to be, as Lincoln was.

I maintain that everyone has leadership abilities. Put your mind to it, and you will be a leader.

One hundred and six years ago, the mayor of Haverhill, Massachusetts, spoke at the funeral of the poet John Greenleaf Whittier. *Here may we be reminded, he said, that man is most honored, not by that which a city may do for him, but by that which he has done for the city.*

More than three plus generations later, our late President John F. Kennedy used a similar theme in his inaugural address. Let's substitute the word "Colorado" for the word "country" in the familiar phrase that still echoes from his message. Now, the mayor of Haverhill's simple statement becomes a challenge. A mere observation becomes a charge:

Your charge is to respect one another.

Your charge is to seek balance.

Your charge is to be willing to compromise when necessary.

Your charge is to have a vision for a better future.

Your charge is to be a leader.

Ask not what someone else can do for you, but what you can do for your fellow citizens.

With that in mind, we can achieve a better future.

UNIVERSITY WATER NEWS



COOPERATIVE EXTENSION ORGANIZES CONFINED ANIMAL FEEDING WORK GROUP

Cooperative Extension has organized a CSU Confined Animal Feeding WorkGroup comprised of representatives from county, regional, and state Extension offices. The multidisciplinary task force represents a wide spectrum of disciplines including economics, animal science, environmental sciences, political science, philosophy, community development and administration. The group has summarized current Colorado State University research regarding this issue and has communicated with a number of colleagues throughout the country who have already faced this development in their states or are continuing to work with policy makers regarding this issue. Cooperative Extension is

also developing a series of short fact sheets that cover the significant questions policy makers and citizens must ask to develop a response to these initiatives. Extension offers its available resources to provide assistance to producer groups, legislators, commissioners, corporate representatives and others. A listserv will be created and a phone tree implemented for immediate communication among the task force members regarding issues. Regular news will be shared through the task force whenever new information, a new policy or educational strategy is being implemented. Members of the CE Confined Animal Feeding Operations Task Force are:

CORE MEMBERS:

Lloyd Walker, Coordinator

State and Regional Staff

Mahdi Al-Kaisi
 Jessica Davis
 Mary McPhail Gray
 Mary Hartman
 Bob Jackson
 Sheila Knop
 Dennis Lamm
 Bernie Rollin
 Andy Seidl
 Ann Swinker
 Katherine Timm
 Jeff Tranel
 Reagan Waskom

Water Quality
 Soil Science
 Associate Director
 Communications
 Social Work
 Center for Rural Assistance
 Animal Science
 Philosophy/Ethics
 Agricultural & Resource Economics
 Animal Science
 Outreach Communications
 Agricultural Business Management
 Water Quality



County Staff:

Ron Ackerman	Southeast
Robbie Baird-LeValley	Northwest
Brad Gilmore	Northeast
Tom McBride	Front Range
Marvin Reynolds	Southwest

Identified Out-of-State Consultants

Leon Danielson	North Carolina
Barry Flinchbaugh	Kansas — Agricultural Economics
Bill Heffernan	Missouri — Rural Sociology
Paul Lasley	Iowa — Sociology
Pat Murphy	Kansas — Agricultural Engineering
Steve Smutko	North Carolina



For additional information about the Confined Animal Feeding Work Group contact Lloyd Walker at the Department of Chemical and Bioresource Engineering, Colorado State University, Fort Collins, CO 80523, Phone 970/491-6328 E-mail agengr@coop.ext.colostate.edu.

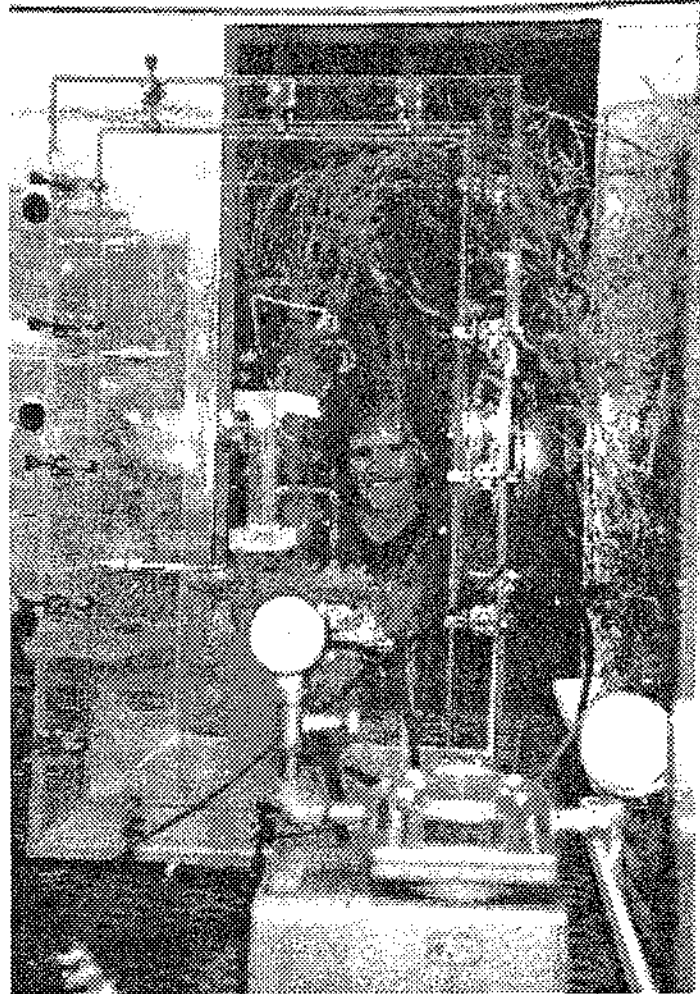
NEW FACULTY IN WATER

Elizabeth A.H. Pilon-Smits Department of Biology Colorado State University

Elizabeth A.H. Pilon-Smits is the newest faculty member of the Department of Biology at Colorado State University. A native of the Netherlands, Elizabeth received her Masters (biology) and Ph.D (evolutionary aspects of Crassulacean acid metabolism) at the University of Utrecht, the largest University in the Netherlands. With a Postdoctoral research fellowship awarded by the Dutch Organization for Scientific Research (NWO), Elizabeth investigated genetic engineering to improve plant drought resistance through the introduction of foreign sugar biosynthesis (fructan and trehalose).

From 1994-1998, Elizabeth was at the University of California at Berkeley, where she worked on two projects. One was a continuation of her drought resistance project, and the other was a new genetic engineering project on the phytoremediation of trace elements, especially selenium and cadmium. She created Indian mustard plants that accumulate up to three-fold more selenium, by over-expression of the key enzyme from the sulfur/selenium assimilation pathway, and manipulated the same plant species to accumulate up to three-fold more cadmium per plant by overproduction of metal-binding peptides. Elizabeth also did physiological studies in relation to selenium. One was a selenium volatilization study using Indian mustard plants, and another involved screening 20 aquatic plant species for their capacity to accumulate and volatilize selenium. Furthermore, she participated in a lab project exploring the use of constructed wetlands to clean up Se-contaminated wastewater. "At the Berkeley lab," said Elizabeth, "we constructed ten wetland cells in the Central Valley in California for the treatment of Se and salt-rich agricultural drainage water. There were ten cells, each with different plant species. The whole lab worked together in the construction and planting of these cells. The first results are promising, with about 70 percent of the Selenium removed by these cells."

Elizabeth plans to continue her research at Colorado State University. "Colorado is a good place to study phytoremediation (biological cleanup of pollution using plants) of selenium and heavy metals," she says, "because both selenium and heavy metals are present in the soil here and pose environmental problems and a potential threat to agriculture." She plans to study phytoremediation using a multi-disciplinary approach, both in the lab and in the field.



SEMINARS



UNIVERSITY OF COLORADO

The Natural Resources Law Center, University of Colorado School of Law

Presents

HOT TOPICS IN NATURAL RESOURCES

A Luncheon Program Series, Fall 1998

Tuesday, October 20, 1998

LARGE-SCALE HOG FARMING IN COLORADO: SOOEY OR SUE ME?

No longer just an eastern phenomenon, massive corporate hog farming operations have moved West, bringing an aroma of money and manure to many Colorado communities. Should Colorado follow the precedent of several other states and enact stringent new regulations to control the potential environmental impacts of these activities? **Brad Anderson**, Executive Vice President of the Colorado Cattle Feeders Association, and **Wayne Forman** of Brownstein Hyatt Farber & Strickland, PC, will provide differing viewpoints on the prospects of makin' bacon in Colorado.

Wednesday, December 2, 1998

ETHICAL ISSUES IN NATURAL RESOURCES REPRESENTATION

(CLE Ethics credit)

Given the passion and strong ideological conflicts often underlying natural resource conflicts, it is not uncommon for natural resource attorneys to find themselves in difficult ethical situations. **Kate Zimmerman**, solo practitioner and formerly an attorney with both the Land and Water Fund of the Rockies and the National Wildlife Federation, will utilize a series of hypotheticals to explore some of the ethical dilemmas associated with representing national environmental groups and other public interest organizations. **Leslie Kaas**, pro bono coordinator of the Land and Water Fund of the Rockies, will follow with a discussion of natural resource pro bono opportunities and obligations in the Rocky Mountain region.

All programs begin at noon at the offices of Holland & Hart (555 17th St., 32nd Floor) in Denver. Box lunches are provided. Each event offers one hour of CLE credit (applied for).



COLORADO STATE UNIVERSITY

INTERNATIONAL CONNECTIONS

12:15 pm to 1:00 pm, Tuesdays, Lory Student Center, Room 165

A Brown Bag Lecture Series - Free and Open to the Public

DATE	TOPIC	SPEAKER
Oct. 27	Are Pastoralism and Conservation Compatible: A Test Case Using Integrated Assessment in the Ngorongoro Area, Tanzania	Kathy Galvin, Asst. Professor Anthropology, CSU
Nov. 3	Future Prospects for Economic Recovery in Indonesia	Ramchand Oad, Assoc. Professor Chemical & Bioresource Engr., CSU
Nov. 17	Macedonian Agriculture: Building Trust	Sue Hine and Dawn Thilmany, Asst. Professors, Agric. & Resource Economics, CSU

Sponsored by International Education, Office of International Programs, 315 Aylesworth NE (491-6793), CSU.

NATURAL RESOURCE AND AGRICULTURAL ECONOMICS, CSU
FALL 1998 LUNCH TIME SEMINAR SERIES
Wednesdays, 12:10 to 1:00, 110 Animal Sciences Building (unless otherwise indicated)

DATE	TOPIC	SPEAKER
Oct. 14	Incorporating Stakeholder Preferences in Ecosystem Management: Results of a Survey	Debra Shields, U.S. Forest Service Eric Biltonen, CSU
Oct. 21	Economic Valuation of Ecosystem Services: A Case Study of the South Platte River	Paula Kent, CSU
Oct. 23 (Friday)	Measuring Recreation Benefits of Quality Improvements with Revealed and Stated Behavior Data	John Whitehead, East Carolina University
Oct. 28	Measuring Productivity Growth with Pollution	Bill Weber, Visiting Professor Southeast Missouri State University
Nov. 4	Ecosystem Valuation: A Landscape Perspective Using Stated Preferences	Jeff Lazo, Hagler Bailly, Boulder, CO
Nov. 11	Impacts of Captive Supplies & Marketing Agreements on Fed Cattle Prices: Results from an Experimental Market	Stephen Koontz, CSU
Nov. 18	Renewing Water Service Contracts of the Bureau of Reclamation: Comparing Economic and Environmental Conditions with the Original Contracts	Rob Davis, Bureau of Reclamation

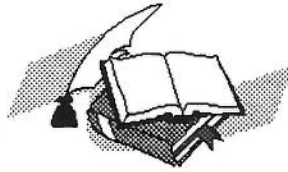
For additional information contact Dr. John Loomis, Phone 970/491-2485, E-mail jloomis@agsci.colostate.edu

DEPARTMENT OF EARTH RESOURCES, CSU

FALL 1998 SEMINAR SCHEDULE Unless otherwise indicated, all seminars are on Mondays and begin at 4:10 p.m. in Room 316 of the Natural Resources Building, with snacks at 4:00 pm (except where noted). For questions call 970/491-5661 or see updates on the departmental web page at <http://www.cnr.colostate.edu/ER/>

DATE	TOPIC	SPEAKER
Nov. 2	Predicting Future Water Usage in the U.S.	Tom Brown, Rocky Mountain Experiment Station, U.S. Forest Service
Nov. 9	Field Tracer Testing in Saturated, Fractured Tuff for the Yucca Mountain Project	Paul Reimus, Los Alamos Nat'l Lab.
Thursday Nov. 12, 7 pm	Creationism's Achilles Heel: the Geologic Record	Donald Wise, Franklin and Marshall College
Friday Nov. 13, 4:10 pm	Topographic Lineaments, Linemanship, and Other Lies	Donald Wise, Franklin and Marshall College
Nov. 16	Sedimentology and Meteoric Diagenesis of Holocene Carbonate Sand Islands, San Blas Archipelago, Panama	John Humphrey, Colorado School of Mines
Nov. 30	Ecological Importance of Hydrologic Regimes in Rocky Mountain Wetlands	David Cooper, Colorado State University

PUBLICATIONS



U.S. Geological Survey Publications

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 unless another source is provided.

Water Quality in the South Platte River Basin, Colorado, Nebraska, and Wyoming, 1992-95, by Kevin F. Dennehy, David W. Litke, Cathy M. Tate, Sharon L. Qi, Peter B. McMahon, Breton W. Bruce, Robert A. Kimbrough, and Janet S. Heiny. USGS Circular 1167.

Water Quality in the Rio Grande Valley, Colorado, New Mexico, and Texas, 1992-95, by Gary W. Levings, Denis F. Healy, Steven F. Richey, and Lisa F. Carter. USGS Circular 1162.

Pesticides in Surface Water in Agricultural and Urban Areas of the South Platte River Basin, from Denver, Colorado, to North Platte, Nebraska, 1993-94, by Robert A. Kimbrough and David W. Litke. Water-Resources Investigations Report 97-4230.

Ground Water and Surface Water — A Single Resource, by Thomas C. Winter, Judson W. Harvey, O. Lehn Franke, William M. Alley. 1998. USGS Circular 1139.

Relations of Main-Stem Reservoir Operations and Specific Conductance in the Lower Arkansas River, Southeastern Colorado, by Michael E. Lewis and Daniel L. Brendel. Water-Resources investigations Report 97-4239.

◆ National Water-Quality Assessment (NAWQA) Program

New USGS assessments of streams, rivers and groundwater in 20 major river basins describe:

- the occurrence and distribution of pesticides, nutrients, metals and industrial chemicals
- the condition of aquatic habitat
- the status of fish communities.

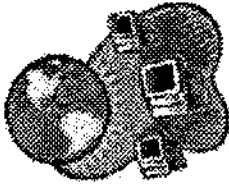
Each Assessment relates environmental conditions to the local effects of agricultural and urban land uses, point and nonpoint sources of contaminants, and natural geologic factors. Direct water-quality comparisons made among river basins put local conditions in a national context. *The information contained in these assessments is unavailable through any other source.*

RIVER BASIN ASSESSMENTS AVAILABLE NOW

Albemarle-Pamlico Drainage (Circular 1157)
 Apalachicola-Chattahoochee-Flint Rivers (Circular 1164)
 Central Columbia Plateau (Circular 1144)
 Central Nebraska Basins (Circular 1163)
 Connecticut, Housatonic and Thames Rivers (Circular 1155)
 Georgia-Florida Coastal Plain (Circular 1151)
 Hudson River (Circular 1165)
 Lower Susquehanna River (Circular 1168)
 Las Vegas Valley, Carson and Truckee Rivers (Circular 1170)
 Ozark Plateaus (Circular 1158)

Potomac River (Circular 1166)
 Red River of the North (Circular 1169)
Rio Grande Valley (Circular 1162)
 San Joaquin-Tulare Rivers (Circular 1159)
South Platte River (Circular 1167)
 Trinity River (Circular 1171)
 Upper Snake River (Circular 1160)
 Western Lake Michigan Drainage (Circular 1156)
White River (Circular 1150)
 Willamette River (Circular 1161)

Assessments in 39 additional river basins are ongoing, and a regional study of the High Plains Aquifer is planned. Request reports listed above or get information about NAWQA's additional water-quality assessments by contacting the NAWQA Program at 703/648-5716 or through email at nawqa_whq@usgs.gov. Visit the USGS home page at <http://water.usgs.gov> and click on NAWQA.



WEB PATHS

Description

American Water Works Association Research Foundation
Colorado River Water Users Association

The **National Small Flows Clearinghouse (NSFC)** now has two separate online discussion boards: one for dialogue about small community and onsite wastewater treatment issues, the other for discussions about onsite wastewater treatment demonstration and research projects.

Discussions about **small community drinking water issues** can be found on the **National Drinking Water Clearinghouse (NDWC)** site.

Training issues related to drinking water, wastewater treatment and solid waste can be discussed via the **National Environmental Training Center for Small Communities (NETCSC)** site.

VegSpec is a new web-based USDA program to help users select plants that solve conservation problems such as buffer strips, wetlands, rangelands, and other land restoration.

The **Arkansas River Basin Water Forum** provides year-round participation in Forum activities.

Inland Empire West RCD (CA) has developed children's materials to help teach about stormwater pollution and its effects.

For help with water issues go to the **League of Women Voters WaterWEB** for the names and numbers of local people actively involved in water protection in their community.

American Society of Agricultural Engineers provides latest advances in the science of on-site waste disposal. Proceedings of 8th Annual Symposium on Individual and Small Community Sewage Systems.

Backyard Conservation offers practices for homeowners and city residents to use in their yards including backyard pond, backyard wetland, composting, mulching, nutrient management, pest management, terracing, tree planting, water conservation and wildlife habitat.

EDF Chemical Scorecard includes full information for your community on the health effects of individual polluting chemicals, as well as instant rankings based on pollution loads and health hazards. Data include 17,000 manufacturing facilities covered by the Toxics Release Inventory for 2,000 counties and for every state. It provides users with maps locating manufacturing facilities in their communities and environmental release reports for specific facilities, zip codes, counties or states. SCORECARD's resources for the web page include organizational information provided to the National Environmental Projects Directory (NEPD), the People of Color (POC) Directory, and the Environmental Protection Agency's Toxics Release Inventory (TRI).

Website

<http://www.awwarf.com>
<http://crwua.mwd.dst.ca.us>

<http://www.nsfrc.wvu.edu>

<http://www.ndwc.wvu.edu>

<http://www.netc.wvu.edu>

<http://plants.usda.gov>

<http://www.uscolo.edu/arkriver/>

<http://www.iewrcd@earthlink.net>

http://www.lwv.org/drinking_water
select "LWV WaterWEB" from main menu

<http://asae.org>

<http://www.nhq.ners.usda.gov/CCS/BlkYrdHit.html>

<http://scorecard.org>
enter your zipcode in the "Find Your Community" box, hit "GO"

WATER NEWS DIGEST



by Jacklyn Bryant and Veva McCaig



DAM SAFETY

Looking for clues into the leaks at Horsetooth Dam

Engineers, looking for clues to why water seeped out of Horsetooth Dam at the rate of 900 gallons a minute to as much as 1200 gallons a minute this summer, are boring into a "suspicious layer of limestone under the dam. They are using video cameras and underwater SONAR scans to find the leaks at the northernmost of four dams that hold Horsetooth Reservoir. Engineers identified a stratum of limestone, about 150 feet below the top of the dam, that might be providing a pathway for the leak. The Bureau of Reclamation is boring holes into the layer at 12 sites around the north end of the reservoir, hoping to learn more about the limestone's possible role. The drilling is expected to be complete by early spring. Agency officials have said that there is no need for concern and that the area is comfortably within a "safety zone".

Fort Collins Coloradoan 9/1/1998



ENVIRONMENT

Trout population may be rebounding in the Animas River

While conducting a fish census study in the Animas River, Colorado Division of Wildlife officials have discovered that rainbow trout appear to be reproducing in the river better than ever before. The numbers of long, fat, healthy trout are looking good. A lack of young brown trout is causing some concern. Foremost in DOW officials' minds is whether the whirling disease outbreak in the Durango Fish Hatchery last year had any effect on fish in the Animas. Of the hundreds of fish caught from 32nd Street downstream to the U.S. Highway 550/160 High, none had shown clinical symptoms of whirling disease. Officials said a large number of young rainbows were found in the Animas - a sign that the fish are reproducing in the wild. The appearance of the naturally born rainbows is a good sign that the river, which has suffered from heavy metal pollution after years of mining, may be rebounding.

Durango Herald 9/10/1998



LEGISLATION

Nebraska makes changes/additions to water laws

As the 95th Nebraska Legislature drew to a close, LB 1161 brought some significant additions and changes to Nebraska's water-related laws. The bill survived substitutions, additions and the Governor's veto. Key water-related provisions of the bill include: providing cost-share dollars to install measuring devices on wells in the Republican River alluvium, changing the exemption from well permitting in the Ground Water Management and Protection Act for wells designed to pump under 50 gallons per minute, authorizing public water supply systems the ability to create and control well head protection areas, allowing natural resources districts to establish weather modification programs, and adopting the Geologists Registration Act.

A Livestock Waste Management Act is now state law, after passage of LB 1209. The bill, which evolved from three separate bills, substantially changes the way the Nebraska Department of Environmental Quality addresses livestock waste control facilities. It also modifies permits for dams that retain livestock waste as administered and checked by the Nebraska Department of Water Resources.

Water Current, Univ. of Nebraska Water Center, 6/98



LITIGATION

Water lawyers blast groups over threat of river lawsuit

Three leading water lawyers blasted a lawsuit threatened by the Forest Guardians that is aimed at bringing interstate river compacts under the control of federal environmental laws. Forest Guardians, a Santa Fe, N.M.-based environmental group, filed a notice of intent in May to sue various federal officials and the administrators of four interstate river compacts in the Southwest. No actual lawsuit has been filed since then. The group contends that the river compacts, approved by Congress early in the century, should now come under the guidance of the Endangered Species Act, the Clean Water Act, and the National Environmental Policy Act. They argue that the compacts violate every environmental law on the books. If the case proceeds, the water lawyers predict that it would bring efforts like the Endangered Fish Recovery Program to a screeching halt, as water users rise up to protect their share of the river. Lawyers also fear that the suit may open the door to interstate water marketing.

Grand Junction Daily Sentinel 8/28/1998



WATER DEVELOPMENT

It's farmers vs. ranchers in water dispute

A plan to increase the size of the only major reservoir in the La Plata River Basin, Red Mesa Reservoir, has pitted farmer against rancher as the two sides vie for what little water flows through the western part of the county. The enlargement, while helping to irrigate fields below the dam, could potentially take away water used for cattle above the reservoir. The plan has been proposed as an alternative to the stalled Animas-La Plata irrigation project intended to address the perennial shortage of water in that area. The Red Mesa ditch company wants to increase the size of the reservoir to 4,070 acre feet, enlarging the land served to 1,360 acres. It would also reserve 330 acre-feet for domestic water use. The plan calls for the expanded reservoir to be filled through La Plata River diversions throughout the winter months. Ranchers above the reservoir, who have historically used diversions to fill their water ditches for livestock use, object. They fear their stock water will be shut off with all of the depletions going toward storage. The ranchers filed a temporary injunction in 1996 to stop the changes. The project has been on hold since then. One of the problems, both sides agree, is that the law does not clearly spell out who has water rights during the winter. Ranchers would rather see a number of smaller storage facilities built along the La Plata River to accommodate water needs, rather than solely the Red Mesa Reservoir expansion.

Durango Herald 8/3/1998

Is Colorado water in danger?

Two ballot issues initiated by Stockman's Water and Saguache County rancher Gary Boyce are perceived as a threat to water in Colorado, not just the San Luis Valley. The ballot initiatives propose to put meters on a number of San Luis Valley wells and force the Rio Grande Water Conservation District to pay for water its members draw from under school trust lands. A grass-roots coalition calling itself Citizens for Colorado Water is gearing up for the threat. The citizens' group views the Stockman's initiatives as a defensive move against Rep. Lewis Entz's bill requiring a study of the valley's aquifer before any more water rights are granted. The coalition believes that if the ballot initiatives succeed, the Rio Grande Water Conservation District will go broke paying for water its farmers have used in the past; that the farmers won't be able to afford to pump water into the Closed Basin Project for Rio Grande Compact purposes to offset water they put on their own crops; and that Colorado will be in arrears in fulfilling its compact obligations. If the conservation district can't send water downstream to New Mexico, Texas and Mexico, farmers will have to curtail irrigating, possibly going out of business all together. This would leave the Closed Basin Project's canal empty creating a channel for Boyce and Stockman's water, if they get a water right. Originally Boyce had proposed pumping 100,000 acre-feet per year of water from beneath his Baca Ranch, but since then he has revised his proposal to 150,000 acre-feet per year. He would sell the water to the Front Range. What frustrates many coalition members is that if the initiatives make the November general election ballot, they only affect the San Luis Valley but the entire state will vote on them.

Pueblo Chieftain 9/8/1998

Babbitt proposes "Ultra-Lite" A-LP

In August, Interior Secretary Bruce Babbitt brought a third Animas-LaPlata proposal to Colorado. The newest and smallest of the A-LP plans proposes a single reservoir of 90,000 acre feet, costing approximately \$170 million, with all water use designated for

municipal and industrial uses. Annual draw from the Animas River would total 57,100-acre feet. The tribes would share 40,000 acre-feet per year and the rest would be divided between the San Juan Conservancy District in New Mexico and the Durango and Animas-LaPlata Conservancy Districts. With all irrigation and agricultural uses gone, the project proposes to establish a \$40 million fund for the tribes to acquire 13,000 acre-feet from willing sellers for farming. Up to \$20 million of this fund could be used to construct water delivery systems or pursue other economic enterprises. The project is supported by the Council on Environmental Quality and the EPA, but met with skepticism from tribal spokesmen, environmentalists and Sen. Nighthorse-Campbell. The decision on the project now rests with the Ute tribes.

Grand Junction Daily Sentinel 8/12/98, 8/13/98, 8/14/98, 8/16/98

Union Park loses yet another Front Range backer

The town council of Parker voted unanimously on Sept. 28 to end its participation in the Union Park project, handing yet another setback to the huge transmountain diversion and hydroelectric generating project. With Parker's withdrawal and Arapahoe County's previous stated intent to drop out, no elected government is involved. Only a handful of Front Range water and sanitation districts remain to carry on the fight. Unless the six-district consortium can entice another elected entity that could be a potential water or electrical user to assume the vacancies created by Parker and Arapahoe, the 900,000-acre-foot Union Park reservoir may be dead.

Gunnison Country Times 9/28/1998

Plan to double size of pipeline can proceed

A plan to double the size of the Ute Plateau Creek pipeline, serving Mesa County residents, can go forward in the wake of a federal agency's denial of two environmental groups' request to stop the progress. The replacement project involves exchanging an aging 24-inch concrete pipeline with a 48-inch PVC line along much of the same route the current pipe takes in Plateau Canyon. Doubling the size of the line would quadruple the water flow. The pipeline would serve a maximum of 200,000 people, a figure that closely matches Ute's 50-year population projection. The environmentalists both requested a stay and filed an appeal based on their belief that the BLM did not adequately study other alternatives. They have in the past argued that the increased pipeline could fuel unbridled development in the valley's prime farmland.

Grand Junction Daily Sentinel 8/28/1998



WATER QUALITY

Quality standards lowered for part of Alamosa River

Colorado's Water Quality Control Commission has decided to lower the water quality requirements for an upper section of the Alamosa River, but tighten them along other areas downstream. The EPA and the public health department had asked the agency to lower water quality standards because they were improperly classified. The commission decided to lower water quality standards above the defunct Summitville Mine but either maintain or tighten standards below the mine. Under the decision, levels of copper and aluminum allowed below the mine are more stringent.

Colorado Springs Gazette 7/31/1998, *Glenwood Post* 7/31/1998

Two farming regulation issues make Nov. ballot

Two initiatives dealing with regulation of the livestock industry, and hogs in particular, were ruled sufficient to make the Nov. 3 ballot. The two are the result of a stalemate in the Legislature this year over regulation of the burgeoning hog industry in eastern Colorado. If approved by voters, the first initiative, No. 112 proposed by the hog industry, would alter the state constitution making it illegal to regulate hog farms differently from more traditional livestock operations unless it can demonstrate that the species is a threat to the environment. The second initiative, No. 113 proposed by opponents to initiative No. 112, would require corporate hog farms that house 800,000 or more pounds of swine to meet certain established health and safety criteria. It would set up a permitting system to control odors and require soil monitoring of groundwater. If voters approve both issues, the one with the most votes takes effect.

Fort Collins Coloradoan 7/30/1998, *Grand Junction Daily Sentinel* 8/22/1998



WATER RIGHTS

Court upholds Chevron's water rights on Colorado River

Judge Thomas Ossala has upheld Chevron's water claim for potential oil shale development on the Western Slope. Boulder, Longmont, Ft. Collins and Greeley recently challenged Chevron; saying the conditional water right had been abandoned and that oil shale will not be economically developed in the foreseeable future. The oil company holds a set of three water rights, dating back to 1951, that total 251 cfs from the Colorado River. If this right were exercised, municipal supplies now taken from the Windy Gap Reservoir could be threatened. Using a 1990 provision of Colorado water law, Ossala ruled that although oil shale development is not viable at present, Chevron had pursued its claim appropriately.

Grand Junction Daily Sentinel 8/18/98

Gunnison district seeks tax hike to develop and protect water rights

The Upper Gunnison River Water Conservancy District has endorsed a plan that would double taxes collected by the district to finance legal battles with Front Range counties seeking to divert Gunnison Basin water. If voters approve the tax increase, the Gunnison River is one step closer to drying up as a source of water for the fast-growing Front Range. The board voted to put two issues on November's ballot, both aimed at generating money that the district can use to develop existing water rights as well as to fight off Front Range efforts to divert Gunnison River water. The district is hoping to show the water court that it is exercising "due diligence" in its efforts to use all of its water rights, which were conditionally allocated by the Bureau of Reclamation 37 years ago. If the court finds the district has not shown progress, district water rights could be revoked. If the progress is approved, the district would be closer to obtaining absolute rights to the water.

Denver Post 8/26/1998, Gunnison Country Times 9/1/1998



WATER SUPPLY

Douglas County OKs water rules

Developers in some areas of Douglas County will have to prove they have a 100-year water supply before they can build, under new water standards approved in August by Douglas County commissioners. The standards require developers not only to prove they have the legal right to the water, but also that they can actually deliver it and keep it flowing for 100 years. In some areas, builders would have to drill test wells. In limited areas where wells are drying up, developers have to come up with a renewable water supply. This plan will encourage efforts already under way by Douglas County and its neighbors to both develop long-range water supplies and to encourage water conservation.

Denver Post 8/13/98, 8/18/1998

City, feds swap ranch for lake

The U.S. Forest Service and city of Fort Collins have arranged a swap of forest land that will give the city more control over its water supply. The city is offering the federal government 520 acres of land known as the Rockwell Ranch in exchange for Joe Wright Reservoir. Fort Collins already operates the reservoir, one of the primary sources of drinking water for Fort Collins, but it does not own the land on which it is built. The Forest Service owns the land, and the city operates the reservoir through an easement that has to be renegotiated on a regular basis. The land swap means the city would be able to operate the reservoir on its own terms. In exchange, the city offered the Forest Service four plots of land within the Roosevelt National Forest. Forest service officials said the exchange would help preserve wild areas. The swap would be made official in the next 10 to 12 months.

Fort Collins Coloradoan 8/15/1998

Statistics Show Ogallala Aquifer Rebounding

The September 1998 issue of U.S. Water News reports that though the future of the Ogallala Aquifer looked bleak just five years ago, state water officials in Nebraska have reported a rebound in levels of the aquifer, as shown in the following water level statistics.

Upper Big Blue Natural Resources District

1998 average water levels are more than 4 feet higher than they were in 1961.

Center Platte Natural Resources District
Lower Republican natural Resources District

Average levels are up 5.27 feet from the benchmark year of 1982.
29 of 34 monitoring wells checked recently were higher than they were in 1981.

Nebraska water officials attribute the positive aquifer changes to a lack of understanding of the dynamics of the aquifer system. They say it indicates that water depletion is not necessarily inevitable, and that sustainability appears possible over the long haul. John Turnbull, general manager of the Upper Big Blue NRD, said the biggest factor toward sustainability is the use of irrigation as a supplement to rainfall, rather than rainfall as a supplement to irrigation. Aiding that cause is irrigation equipment that can be operated more efficiently and with less evaporation loss. Not everyone, however, is optimistic about the situation. Donald Green, who wrote "Land of the Underground Rain," said reports of increases in groundwater levels are temporary reversals on eventual depletion. Green is a history professor at Chadron State College.



MISCELLANEOUS

Front Range cities buying farmland

Westminster, Broomfield, Englewood, Littleton and Fort Collins now own farms or pasture land in eastern Colorado. The Metro Wastewater Reclamation District, which treats the wastewater of most of the metro area, owns and farms 52,000 acres in Adams County. All have purchased the land so they have a place to put biosolids, a byproduct of wastewater treatment. The cities and Metro District contract with farmers, who plant and harvest the crops, usually dryland wheat and corn, millet, alfalfa and other cattle fodder. As owners, the cities retain one-third of the crop while the farmer keeps two-thirds. Three main options are available for producers of biosolids: incineration, disposal in a landfill or apply it either for farming or land reclamation. The only drawback to use biosolids as fertilizer is public perception. Biosolids have been treated two or three times to kill pathogens. What is left is basically nitrogen, phosphorus and organic matter.

Boulder Daily Camera 8/3/1998

World water shortages to grow

Nearly half a billion people around the world face shortages of fresh water, and that number is expected to swell to 2.8 billion people by 2025 as the world population grows, says a report from The Johns Hopkins University School of Public Health. The report says, "To avoid catastrophe...it is important to act now" to reduce demand for fresh water by slowing population growth, conserving water, polluting less and managing supply and demand of water better." By 2025, one in every three of the world's projected 8 billion people will live in countries short of fresh water, the report said. Today, 31 countries, mostly in Africa and the Near East, face water stress or water scarcity. By 2025, population pressure will push 17 more countries, including India, onto the list. China, with a projected 2025 population of 1.5 billion, will not be far behind.

A country faces water stress when annual fresh water supplies drop below 1,700 cubic meters per person. Water-scarce countries have annual fresh water supplies of less than 1,000 cubic meters per person. Although much of the world is trying to meet a growing demand for fresh water, the situation is worst in developing countries where some 95 percent of the 80 million people added to the globe each year are born. Even in the United States, which has plenty of fresh water on a national basis, groundwater is being used at a rate 25 percent greater than its replenishment rate, the report said.

Fort Collins Coloradoan 8/27/98

Evidence of water found on moon

As much as 10 billion tons of water may be frozen near the moon's poles, according to data from a lunar spacecraft – water enough to build a moon village or to fuel rocket ships cruising even deeper into space. The chief scientist for the Lunar Prospector spacecraft now orbiting the moon says it found an abundance of hydrogen at both lunar poles, indicating from one billion tons of water to as high as 10 billion tons. That would be enough to build a colony on the moon's surface and to operate a rocket service station for journeys beyond. In addition to sustaining life in a moon village, water also can be used for rocket fuel by breaking it into its constituent chemicals – hydrogen and oxygen. Propellant for the space shuttle's main engines, for example, is hydrogen and oxygen.

Fort Collins Coloradoan 9/4/98

Shoreland volunteers make a difference

Minnesota's Shoreland Volunteer Program can boast impressive accomplishments over the last few years. These include sparking a \$100,000 shoreland revegetation demonstration and research project, increasing lake association membership by 200 percent, completing a comprehensive septic system survey and arranging for a co-op to mix fertilizers specially formulated for specific shoreland areas. The program, which was developed by the University of Minnesota Extension Service, is coordinated locally. It brings people with expertise in managing shoreland together with the people who want that expertise -- shoreland property owners. Over 250 volunteers have participated in the program in 18 Minnesota counties in the past three years. The program gives property owners the tools to make a difference in the quality of their lakes and rivers. Volunteers complete a one-day training workshop, planned by a local committee that includes members from local government, Extension, state agencies and nearby lake associations. Each workshop is tailored to accommodate local needs, but all workshops include basic information on limnology, aquatic vegetation, on-site wastewater treatment, communication and what is expected of volunteers. The program is still relatively new, and will continue to evolve as it is adopted and adapted across the state. A guidebook that describes the program is available from the University of Minnesota Water Resources Center at 612/625-2282.

Minnegram, Minnesota Water Resources Center, June 1998

CALLS FOR PAPERS

INTERNATIONAL CONFERENCE ON THE CHALLENGES FACING IRRIGATION AND DRAINAGE IN THE NEW MILLENNIUM, Sponsored by U.S. Committee on Irrigation and Drainage, Colorado State University, Fort Collins, Colorado -- **June 20-24, 1999**. Professionals involved in water resources, agriculture and environmental issues are invited to submit abstracts of papers proposed for the conference. The call for papers and the abstract form are available on the USCID web site -- www.uscid.org/~uscid, or Phone 303/628-5430, FAX 303/628-5431, E-mail: stephens@uscid.org. The abstract deadline is January 1, 1999.

FOURTH USA/CIS JOINT CONFERENCE ON ENVIRONMENTAL HYDROLOGY AND HYDROGEOLOGY, Sponsored by American Institute of Hydrology (AIH), San Francisco -- California, **November 7-10, 1999**. The conference is a continuation of joint meetings on the problems and solutions of mutual interest in environmental hydrology and hydrogeology in the USA and CIS (formerly USSR) organized by AIH in cooperation with major governmental agencies, scientific institutions and private organizations. The abstract deadline is February 28, 1999. Contact: AIH, Phone 651/484-8169, FAX 651/484-8357, E-mail AIHydro@aol.com, Website aihydro.org.

MEETINGS

**SECOND ANNUAL STUDENT WATER SYMPOSIUM -
Rooms 230 and 224-226, Lory Student Center
Colorado State University -- November 3-6, 1998**

The symposium will provide a showcase of the diversity of water studies at CSU ... undergraduate and graduate student presentations will span the water-related disciplines of the university.

SPECIAL FEATURE

Dr. C.E. Cushing, Keynote Speaker
"The Living Stream"
7pm, Tuesday, November 3, 1998
Cherokee Park Room, Lory Student Center

This is a 40-minute, slide-illustrated talk that summarizes the ecology of stream ecosystems, beginning with the physical and chemical setting and then bringing in the various energy sources and the functional groups of aquatic insects. It ends

with a summary of how all of these things interact at one spot in a stream and then how they interact along the entire stream continuum.

CLOSING RECEPTION
Thursday Evening, November 5, 1998
Room 230, Lory Student Center

See the website <http://lamar.colostate.edu/~watersym/> or send an E-mail to watersym@lamar.colostate.edu.

NOT IN MY WATERSHED!

**Changes In Water and Land use in the South Platte Basin — The 9th Annual South Platte Forum
October 28-29, 1998 — Raintree Plaza Conference Center, Longmont, Colorado**

Keynote Speakers:

Justice Gregg J. Hobbs, Jr. **Ed Quillen**, Denver Post Columnist
Special Geographical Presentation

Dr. William Riebsame, University of Colorado, Author of Atlas of the New West

Instream Flows...Coming Soon to a River Near You

Moderator: Dan Merriman, Colorado Water Conservation Board

Fred Anderson	Former Colorado Senator	<i>Colorado's Instream Flow Law: A History of Legislation</i>
Melinda Kassen	Colorado Trout Unlimited	<i>Colorado's Instream Flow Program: A Future Perspective</i>
Patty Wells	Denver Water	<i>Issues in the Implementation of the Instream Flow Program</i>

The Miracle of Fishes and Flows

Moderator: Jay Skinner, Colorado Division of Wildlife

Don Ament	Colorado State Senator	Title TBA
Jay Stafford	Colorado Division of Wildlife	<i>Managing Native Fish for the Future</i>
Dale Strickland	Western EcoSystems Technology, Inc.	<i>Platte River Endangered Species Partnership</i>

Models, Maps and Modems

Moderator: Kevin Dennehy, U.S. Geological Survey

Luis Garcia	Colorado State University	<i>South Platte Mapping and Analysis Program (SPMAP)</i>
Donald Schrupp	GIS Department, Colorado Division of Wildlife	<i>Using GIS in Environmental Science and Assessment</i>
Tony Selle	GIS Department, U.S. EPA	Title TBA

Days of Swine, Bovine, and Roses

Moderator: Mahdi Al-Kaisi, Colorado State University

Tom Haren	Colorado Cattle Feeders	<i>The Future of the Livestock Business in Colorado Myth, Perceptions, and Reality</i>
Derald Lang	Colorado Water Quality Control Commission	<i>Confined Animal Feeding Operations Control Regulations in Colorado</i>
3 rd Speaker	TBA	

The ABCs of TMDLs

Moderator: Russ Clayshulte, Denver Regional Council of Governments

Sarah Johnson	Colorado Water Quality Control Division	<i>The Total Maximum Daily Load Process</i>
Ray Christiansen	Colorado Farm Bureau	<i>Agriculture and TMDLs</i>
Robert Wiygul	EarthJustice Legal Defense Fund	<i>TMDLs From the Conservation Perspective: Getting from Point A to Non-Point B</i>

Can't We All Just Get Along

Moderator: Gene Schleiger, Northern Colorado Water Conservancy District

Alan Covich	Colorado State University	Title TBA
Rob Sakata	Sakata Farms	Title TBA
Hubert Farbes, Jr.	Brownstein, Hyatt, Farber and Strickland	Title TBA

To request information about the conference, contact: Laurie Schmidt, Colorado Water Resources Research Institute, 410N University Services Center, Fort Collins, CO 80523-2018, Phone: 970/226-0533 FAX: 970/491-2293 — E-mail: lschmidt@lamar.colostate.edu.

CALENDAR

- Oct. 22-23 WATER CHALLENGES ON THE LOWER RIO GRANDE, Las Cruces, NM. See the New Mexico WRI home page at <http://wri.nmsu.edu>
- Oct. 23-24 FIRST ANNUAL CONFERENCE, ENVIRONMENTAL PROTECTION & GROWTH MANAGEMENT IN THE WEST, University of Denver, Denver, CO. Contact: The Rocky Mountain Land Use Institute, 7150 Montview Blvd., Ste 122, Denver, CO, 80220, Phone 303/871-6239.
- Oct. 28-31 CONFERENCE ON SHARED RIVERS, River Basin Management to Meet Competing Needs, Park City, UT.
Contact: Larry D. Stephens, Phone 303/628-5430, FAX 303/628-5431, E-mail: stephens@uscid.org.
- Nov. 10-13 18TH INTERNATIONAL SYMPOSIUM, NORTH AMERICAN LAKE MANAGEMENT SOCIETY (NALMS), Cooperative Lake and Watershed Management: Linking Communities, Industry and Government, Banff, Alberta, Canada. Registration information can be found at the NALMS web site <http://www.biology.ualberta.ca/alms/1998/htm>.
- Nov. 15-19 34th ANNUAL CONFERENCE ON WATER RESOURCES 7 SYMPOSIUM ON APPLICATIONS OF WATER USE INFORMATION, Point Clear, AL. Contact American Water Resources Assoc., Phone 703/904-1225, FAX 703/904-1228, E-mail awrahq@aol.com

1999

- Jan. 28-29, 1999 COLORADO WATER CONGRESS ANNUAL CONVENTION, Holiday Inn, Northglenn, CO. For information contact the Colorado Water Congress, 1390 Logan, #312, Denver, CO 80203, Phone 303/837-0812, FAX 303/837-1607.
- March 10-13, 1999 BENCHMARKING IRRIGATION SYSTEM PERFORMANCE USING WATER MEASUREMENT AND WATER BALANCES, San Luis Obispo, CA. Contact Larry D. Stephens, USCID, Phone 303/628-5430, FAX 303/628-5431, E-mail stephens@uscid.org. The USCID web page can be found at www.uscid.org/~uscid.
- April 10-14, 1999 7TH MULTIDISCIPLINARY CONFERENCE ON SINKHOLES AND THE ENGINEERING AND ENVIRONMENTAL IMPACTS OF KARST, Harrisburg/Hershey, PA. Contact Gayle Herring, P.E. LaMoreaux & Assoc., Inc., Phone 423/483-7483, FAX 423/483-7639, E-mail pelaor@usit.net. Web page: www.uakron.edu/geology/karstwaters/7th.html
- June 2-5, 1999 FIFTH BENCHMARK WORKSHOP ON NUMERICAL ANALYSIS OF DAMS, Denver, CO. For information contact Pasquale Palumbo, Technical Secretariat, Via Pastrengo, 9, 24068 Seriate (BG), Italy. Phone 39-35-307-111, FAX 39-35-302-999, E-mail ppalumbo@ismes.it. See the U.S. Committee on Large Dams web page at www.uscold.org/~uscold.
- June 20-24, 1999 INTERNATIONAL CONFERENCE ON THE CHALLENGES FACING IRRIGATION AND DRAINAGE IN THE NEW MILLENNIUM, Sponsored by U.S. Committee on Irrigation and Drainage, Colorado State University, Fort Collins, CO. See the USCID web site — www.uscid.org/~uscid, or Phone 303/628-5430, FAX 303/628-5431, E-mail: stephens@uscid.org.
- July 7-9, 1999 WATERPOWER '99 — Hydro's Future: Technology, Markets and Policy Las Vegas, Nevada. Contact Liz Sigler at Phone 800/548-ASCE, ext. 6078 or 703/295-6078, FAX 703/295-6144, or E-mail lsigler@asce.org.
Waterpower home page: www.waterpower.org.

Colorado Water Resources Research Institute
Colorado State University

Bulk Rate
U.S. Postage
PAID
Fort Collins, CO