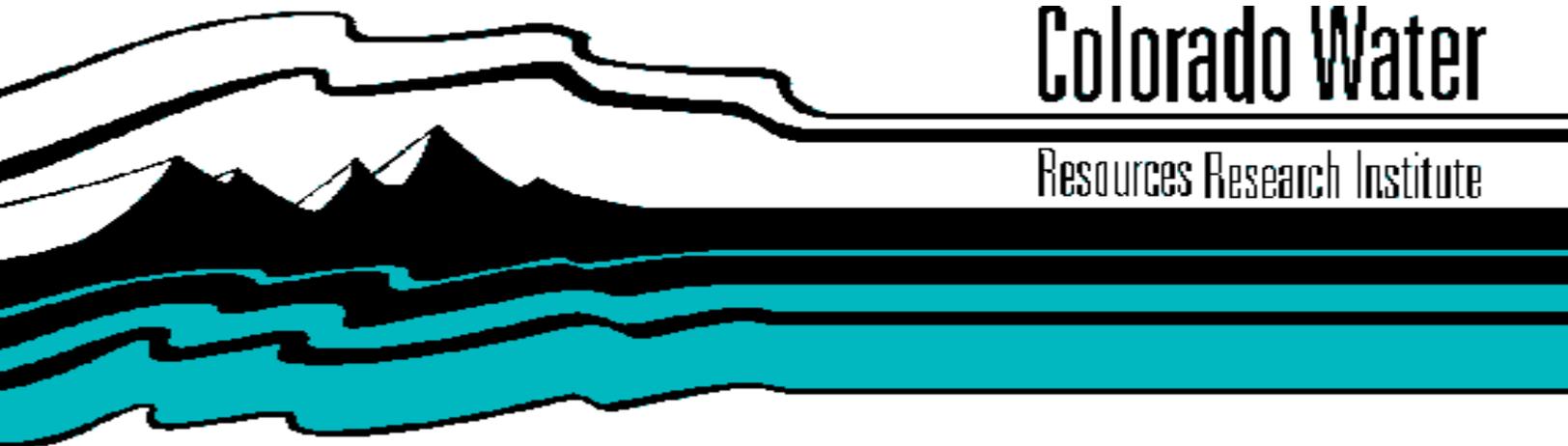


Arkansas River Basin Water Forum
“A River of Dreams and Realities”
Proceedings of the 1995 Arkansas River Basin Water Forum
January 17-18, 1995

A stylized graphic on the left side of the page. It features a black outline of a mountain range with several peaks. Below the mountains, a thick, wavy blue line represents a river. The entire graphic is set against a white background.

Colorado Water

Resources Research Institute

Information Series No. 82

Colorado
State
University

Arkansas River Basin Water Forum
“A River of Dreams and Realities”

Forum Planning Committee:

Jim Valliant, Chairman
Colorado State University Cooperative Extension

Robert Appel, Secretary
Southeast Colorado RC&D

Leon Bright
Arkansas Valley Audubon Society

Marie Del Toro
Colorado Springs
Utilities Department

Mike French
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Richard Hallock
Colorado State University Cooperative
Extension

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City of La Junta
Water Department

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ASARCO, Inc.

John McClave
Colorado State University Cooperative
Extension

Joe Mahaney
CF&I Steele

Tom Pointon
Agricultural Producer

Frank Sobolik
Colorado State University Cooperative
Extension

Charles L Thomson (dec.)
Southeastern Colorado Water Conservancy
District

Linda Thompson
Natural Resources Conservation Service

John Tonko
Colorado Division of Wildlife

Lloyd Walker
Colorado State University Cooperative
Extension

Jane Wustrow
Sangre de Cristo RC&D

January 17-19, 1995
University of Southern Colorado
Art/Music Building - Hoag Hall
Pueblo, Colorado

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Colorado Water Resources Research Institute
Colorado State University
Fort Collins, CO 80523
Robert C. Ward, Director

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**DEDICATED TO
CHARLES L. "TOMMY" THOMSON
1924-1994**

Charles L. "Tommy" Thomson was born and raised in Leadville, Colorado. He attended Colorado State University where he majored in Mechanical Engineering prior to enlisting in the Marine Corps early in World War II. He served in the Pacific Theater through the war, returned to civilian life for a few years and then re-enlisted in the Corps for service during the Korean Conflict. Tommy was medically retired in 1952 from injuries received in both tours of duty.

Mr. Thomson graduated from Southwestern Institute for Organizational Management in Dallas, Texas and served on the Faculty and Board of Advisors. He was a graduate of the Post Graduate School for Organizational Management at the University of Colorado and served on the Faculty and Board of Regents. He also served as Division Chairman for the Northwestern Division Board of Regents.

Tommy served as manager of the Salida Chamber of Commerce and General Manager of the Pueblo Chamber of Commerce. He was one of the first 34 Chamber Executives in the United States to be designated a "Certified Chamber Executive." On December 12, 1966, Mr. Thomson was appointed General Manager of the Southeastern Colorado Water Conservancy District and served in this position until the time of his death on October 22, 1994. The Conservancy District represents water users in nine counties in the Arkansas River Basin of Colorado. One of the many activities of the District is the sponsorship of the \$555 million Fryingpan-Arkansas Project.

Tommy served on many water-related committees, always promoting the Arkansas River Basin. Among his many duties, he served as President of the Colorado Water Congress and Colorado Water Advisory Committee. He was appointed to represent Colorado on the Arkansas River Basin Interstate Committee, which represents Arkansas, Oklahoma, Missouri, Kansas and Colorado on water resources matters, and was elected chairman in February, 1994. Tommy worked with the Arkansas Basin Development Association, and was elected President in 1994, the first person from Colorado to be elected to that office. He also served as Vice-President and was awarded an Honorary Life Membership for his service. He served as Chairman of the Board of Directors of the 50 State Water Resources Congress, the largest water association in the United States. He was three-time President of the Colorado River Water Users Association, and in 1993 Governor Roy Romer appointed him to the Colorado Water Conservation Board.

Among Mr. Thomson's many accolades were the coveted "Headgate Award," awarded in 1977 by the Four States Irrigation Council; the Wayne N. Aspinall "Water Leader of the Year Award" for 1983 given by the Colorado Water Congress; The U.S. Department of the Interior "Citizen Award" awarded in 1990; "Water Manager of the Year for 1992: as designated by the Office of the State Engineer and Division 2 Engineer; and the respected "Citizen of the Year for 1992" awarded by the Pueblo Chamber of Commerce. He was elected to "Who's Who in the West" in 1992 and 1993, "Who's Who Worldwide" in 1992 and "Who's Who Worldwide-1994/1995" Registry of Business Leaders. In 1994, Tommy received an award for outstanding service and leadership from the Arkansas Basin Development Association and the Arkansas River Basin Interstate Committee.

Tommy was involved in many city, area, state and regional activities, not limited to but including, Masons, Elks, Rotary, American Legion, Colorado State Fair, Colorado Highway Legislative Review Committee, Colorado Advisory Council for Small Business, Citizens Advisory Committee--School District 60, Southern Colorado Economic Development District and the Pueblo Development Foundation. He received many awards and much recognition for his service from the numerous organizations he served.

Mr. Thomson was program chairman for the Arkansas River Basin Water Forum at the time of his death. In one of Tommy's last letters he stated, "I am pleased to report that we now have all the necessary ingredients to make the 1995 Water Forum the most successful Conference-Symposium-Meeting-Forum ever held in the Arkansas River Basin in Colorado" Tommy worked up to the end on his beloved Arkansas River.

**Presentations on Tuesday
January 17, 1995**

Welcome

Milan Rewerts

Interim Director

Cooperative Extension, Colorado State University

It is my privilege to represent both Colorado State University and the University of Southern Colorado (and in his illness Dr. Bob Shirley) in offering some welcoming remarks this morning to this important forum. I am sure that President Al Yates, who is President of the CSU system as well as Colorado State University, would want me to say on his behalf welcome as well. So, welcome from Colorado State University, The University of Southern Colorado, and from Cooperative Extension in particular. That is the organization that I have the privilege of heading up, and we have some important connections with this forum that I will mention in a few minutes. We have something special in Colorado, I believe -- with Colorado State University, your land grant university; with the University of Southern Colorado, located in southeast Colorado; and of course with Fort Lewis College in the southwest part of the state.

This forum, with the theme, "A River of Dreams and Realities," is particularly fitting. Dreams and realities are appropriate for this river basin and all that it represents. It is true for decision makers and for all of us: to dream, but also face the realities as well. I am sure that the theme and what it represents was a challenge for the planning committee. I would like to acknowledge that committee and particularly its chair, Jim Valliant. Many of you know Jim, and if you don't, I am sure you will get to know him during the next two days. The planning committee including some 20 individuals from a broad variety of interests and perspectives. That in itself was undoubtedly a challenge, as those interests and perspectives came together to look at dreams and realities for the Arkansas River Basin and a forum related to that. That, to some extent I am sure, led to the array of speakers that will challenge you and offer various perspectives today and tomorrow. The speakers are indeed an impressive group of people.

This forum is about dialogue, debate and discussion about how people utilize water in the basin and how they work together to ensure its availability and its wisest use in all areas of eastern Colorado and beyond.

Cooperative Extension is integral to that and we are pleased and proud of that. Cooperative Extension is an integral part of Colorado State University in that it provides off-campus education to Colorado Citizens. It is part of a nationwide network through which county, state, and federal governments work with the private sector. Cooperative Extension's unbiased information is based on scientific research. It is information in which Coloradans can place their trust. Cooperative Extension brings research-based information and technology to the people of the state via its Extension faculty, both from county-based Extension specialists in the region and from specialists at the university related to the sciences in the departments there. Cooperative Extension is needs and issues-based. Therefore, our involvement in such a forum as this is not only appropriate but necessarily a part of our mission in serving the needs of Coloradans across the state. A couple of years ago we took a closer look at Colorado's needs and issues. We conducted a series of futures conferences across the state. We did that to listen to the needs and issues of customers, of you. This yielded a report that has five priorities in it. The report is available, and if you haven't seen it ask Jim or one of the Cooperative Extension folks and they can provide you a copy. I commend it to your reading.

There are two priorities out of those five that are particularly relevant to this forum: one is sustainable and profitable agriculture; the other is environmental and natural resource management. There were some key elements that you, the customers in the state, told us that we should consider as we do our work and research in Extension throughout the state. These included focusing on issues and providing a forum for discussion and debate. The whole area of public issues with us today, all the way from water issues to public land reform, needs forums for discussion and debate like you are having here focused on the Arkansas River Valley. We were told that most of the things that we need to deal with have interdisciplinary focuses and that we should use systems approaches to address them. We need to use technology appropriately. We were counseled to not allow technology to get in the way of people, but rather to apply technology appropriately in tech transfer and for distance education. Collaborating with other agencies and organizations is another important element, as is consideration of the changing and evolving environment. The concept of Best Management Practices (BMPs), and you'll hear more about those this week, is also a part.

From those priorities Cooperative Extension has identified some action issues that included enhancing water quality and conservation and integrated environmental and agricultural systems management. So, you can see why Cooperative

Extension is excited to be a part of this forum and heavily involved. We are proud to be one of the sponsoring organizations.

Finally, before I close, I want to acknowledge the hospitality of the University of Southern Colorado, a good partner in this state. They are an important unit in southeast Colorado to provide this kind of facility and support for these kinds of forums.

I wish you the best for a productive, challenging, and thought-provoking forum. I challenge you to look at the issues in new and innovative ways and consider the economic impacts of the issues, their social acceptability, and the environmental consequences. We are counseled constantly to consider those three elements: economic, social, and environmental issues. So I look forward to the forum's presentations and discussions. It looks like it will be enriching, challenging, probably a little frustrating, but most of all productive for the Arkansas River Valley.

Keynote Address

James Lochhead

Executive Director

Colorado Department of Natural Resources

It is a great pleasure to be here this morning. It is good to see those of you who are interested in the Arkansas River Basin talk, interact, and speak about the future of the basin and how you can be a part of that future.

I want begin by saying a couple of words about Tommy Thomson. I first met Tommy some 15 years ago when I was a lawyer in Glenwood Springs, dealing with a number of issues between the East Slope and the West Slope. Of course, Tommy was always a man of integrity and a man of honor, and it was a real privilege for me to know and work with him. His successor on the Water Conservation Board, as you know, is Alan Hamel of Pueblo, and it also will be a real pleasure for us to have Alan on the Water Conservation Board representing the Arkansas Basin. I know he will do an excellent job on the Water Conservation Board.

I also want to recognize the state employees that are here from the Division of Parks, the Division of Wildlife, and the Soil Conservation Board. It is important to recognize that the employees of state government attend these conferences because they want to hear and interact with people so that they can provide better service to you, and so that we can have programs that reflect the values of the people of the basin.

There are a lot of challenges in the Arkansas Basin. It is a basin of incredible complexity and diversity. Ultimately the people of this basin are tied to the river: how it runs, how it is allocated, the quality of the water, the quality of the habitat, and the quality of the recreational resource. I would encourage and challenge you in the course of this conference to take the information that you are going to receive and try and determine how you as a citizen, a state employee, a local business person, or a member of a private interest group can influence the direction of natural resources policy in this basin.

It is interesting for me to be part of a department that deals in all of the issues that you are going to hear about today. The Department of Natural Resources, through its various divisions, is involved in each of things that I am going to talk about and that you are going to hear about in this conference.

Let me talk about the basin as a whole from my perspective, having traveled through the basin and talked to a number of you about the issues that you face.

In Lake County:

- ◆ There is a lot of interest in economic development based on the history and the potential for tourism resources in the upper headwaters of the Arkansas.
- ◆ There are also some tremendous challenges in Lake County, in the Leadville area and farther down by Buena Vista, Salida, and Poncha Springs related to the fact that there is a tie economically to the ski economies and recreation economies of Summit and Eagle counties on the other side of the Divide. There is a real interest between the upper Arkansas and the interests of the Eagle River Basin to work together to deal with some of the social, economic and employee impacts of those issues.
- ◆ There is an issue related to water quality and the cleanup of mine discharges that you are going to hear about in the next two days. There is an EPA presence in the upper Arkansas headwater that the local community is not real happy about. We need to complete the cleanups so that there is not the stigma of Superfund that is clouding the other efforts toward economic development that are underway in the upper Arkansas Basin.
- ◆ We need to move forward with some of the voluntary programs toward abandoned mine cleanup that were halted because of liability concerns, so that we can continue on the path that we're on for improving water quality in the upper Arkansas Basin.
- ◆ The upper Arkansas has a lot of water that is managed through that area: transmountain water from the Frying Pan-Arkansas project and other projects that have impacts on the fisheries in Turquoise Lake and Twin Lakes, that have impacts on stream banks in the upper Arkansas, and that clearly affect both the fishing and the recreational resource in the upper Arkansas basin. We need to continue to work together to coordinate those operations in the most effective way possible.

Moving down to Chaffee County, Buena Vista, Salida, and Poncha Springs:

- ◆ There is a lot of interest and concern about growth and development of subdivisions and ranchettes in that area and the impacts of state land management and federal land management. Those communities are interested in working together on an expanded and jointly developed comprehensive planning process. It is very exciting for me to see those communities pull together in that effort.
- ◆ There is a tremendous resource in the Arkansas Headwaters Recreation Area, and also great potential for continuation of the constructive working relationship that we have among the Division of Parks the Division of Wildlife, the Bureau of Land Management and other agencies in how water resources are managed through that area. We have questions about whether that should be designated a national recreation area or not. I hope that in the course of this conference you'll have some very frank discussions about the pros and cons of that type of a designation and the future of the management of that area.

In Fremont County and the Canon City area:

- ◆ There is an updating of the 20-year economic development plan and an analysis of recreation as an element of that plan.
- ◆ There is concern about agricultural land preservation. There is a very active soil conservation district, the Fremont Soil Conservation District, that serves as a model for the way soil conservation districts can work with small agricultural interests. They are doing a lot of work with people who are moving in and buying small ranchettes, ten acres or less of land, and how that land can be managed.

Pueblo is obviously one of the major urban centers in Colorado and has a recreational resource, Pueblo Reservoir, that is the most visited state park in the state. As we have continued growth, development, and economic prosperity in the state, hopefully the city of Pueblo will be able to prosper as well and yet still retain the flavor and culture that is here in the Arkansas Basin, in southeast Colorado.

In Trinidad, we have challenges about maintaining recreational and wildlife pools in Trinidad Reservoir, and developing the Purgatoire River and the City of Trinidad as a recreational and economically sustainable place.

In the lower Arkansas basin we have a number of challenges about agriculture and the future of agriculture in the basin, in light of Kansas vs. Colorado. We have an ongoing initiative to put water into and helpfully develop a new state park at the Great Plains Reservoirs, and to be able to stabilize water levels in John Martin Reservoir and enhance the recreation and wildlife opportunities there. We want to do that in coordination and consultation with the agricultural community so we can do it in a way that is consistent with maintaining that economy.

Finally, overlaying the entire basin, on the horizon are a number of endangered species issues. We are dealing with those issues very comprehensively in the South Platte Basin and on the Colorado River, and I think it is only a matter of time before we have to start dealing with those issues in the Arkansas Basin as well.

How do we deal with all those issues? We have a multitude of agencies, we have municipalities, we have counties, we have state agencies, each of which has its own planning regions that don't necessarily correspond with county boundaries or with municipal boundaries. We have federal agencies that all have different missions from state agencies like the State Land Board, in terms of the management and use of their land. We have ditch companies, we have soil conservation districts, we have special districts. We have the Southeastern Water Conservancy District that spans a number of jurisdictions. All of these have various regulatory and/or taxing and revenue authorities. Therefore, aside from all the complexity of issues in the Arkansas basin that I have discussed, we have an incredible complexity of organizational structure of government, governmental agencies and interest groups that interact and try to deal with these issues. For me, one of the benefits of a conference like this is for us to have a conversation about how we as a society, how we as government, can try and figure out how this thing can work -- how we can manage these resources, how we can manage this government so it works both efficiently and responsibly.

There are a number of themes I have been concerned about and trying to work on in the Department of Natural Resources, that I think will move us toward in some positive directions to resolve these issues. One theme relates to information. We need to figure out ways to consolidate natural resource information among governmental agencies and make that information available at the local level. Be it water flow, be it flood plain information, be it wildlife habitat, be it geologic hazard, state government has a lot of technological resources and natural resource information. The federal government has similar information. We can consolidate that and have it on line through internet and other technologies to local governments, to private consultants, to ditch companies, to water managers, so that we are all operating on a common

information base. By doing so, I think that we will have a system that overall can work more efficiently.

The second theme is one of collaboration. We are trying to work to involve stake holders, the public, and local governments up front as equal partners in the decisions that are made by state and federal agencies as to how we manage our resources. Be it management of water through the Arkansas River for recreational uses, or collaborative public land management between state, federal, and local governments, I think that stakeholder involvement is a model that will help us move forward in doing things the right way.

A third theme is one of moving decisions to the right level of government. What that usually means is moving things down to the local level to the extent we possibly can, or at least involving combinations of levels in the government that relate to a particular issue in the most appropriate way. How do we deal with the issue of land use in Chaffee County, for example, and the issue of sprawl development or ranchette development? Those are local county and community land use decisions, but those decisions are impacted by decisions that the state and federal government make. We need to coordinate those so even though it is a primarily local decision, we can be sure that there is adequate communication between state and local government in that regard. How do we deal with the issues in the Kansas vs. Colorado case? Or endangered species issues that transcend the entire basin? Those, I believe, are primarily state decisions. We have a regulatory framework for how we administer water in the Arkansas Basin. We need to have the users, the people who use the resource at the table with us helping us make those decisions. We cannot sit in Denver and make those decisions for the Arkansas Basin. So we need to have that communication and action working in the right way.

The fourth theme is that we need to be more solution-oriented. We need to identify specific problems and figure out the right players to be at the table and then try and develop an approach to reach a resolution of that particular problem or set of problems. We then need to be aware of the interaction of those problems, but specifically we need to be orienting ourselves toward resolving problems and not developing rhetoric on a political or policy level between groups. At the same time we need to develop an overall vision about where we are going and how we are going to get there. When I say "we," I really am speaking of you the people in the Arkansas Basin. You need to think about what is the future of this basin economically, from a land use perspective, from a recreation perspective, from an agricultural perspective, from an aesthetic perspective. What is this basin going to be? What will it look like 50 to 100 years from now? How can the people of this basin work with other people in the State of Colorado so we can withstand economic boom and bust cycles, so that we can have an economy that is moving steadily forward, so that we can have an environment that we can be proud of to pass on to our children and grandchildren?

All of those themes, I think, are inherent in the development of the Governor's smart growth and development summit that will be held in Denver on January 25 and 26. I hope that those of you who have received invitations to the summit will be able to attend, because it is very important that we have good attendance at the summit from outside the Denver metro area. There are a lot of themes that we have worked on in addition to those I have mentioned here in the development of the summit.

First, it is a bottom-up process. We need to move decision making to the right level of government, usually the local government, and we want to be able to listen to local communities and to the people within those communities about what their visions are and what kinds of tools they want to be able to use help realize those visions.

Second, we are trying to do this through a theme of respect for private property rights. The Governor strongly believes that a top-down regulatory mechanism is not going to work politically or practically. It needs to come from the local level, it needs to be incentive-based, and it needs to respect private property.

Finally, I know there has been a lot of discussion about the summit and what its themes will be. The themes are really couched terms of developing a vision -- be it an economic future, be it a land use future, be it related to social or health care systems -- whatever that future is that is articulated and developed at the local level is what we want to come out of that summit. At the summit we have available a statewide poll to try and get a handle on the feelings of the people of the state about growth and development and where we are going as a state. We will have a number of breakout sessions that will be interactive to stimulate a discussion among the attendees. Those breakout sessions will be both on a statewide basis and a regional basis. We will have a number of papers that are presented to stimulate some discussions: one on land use tools that can be available on the local level; one on future economic development and opportunities; and another on housing that will be prepared by the housing industry. We hope that out of the statewide summit will come a number of regional summit conferences throughout the state. I believe that's where real work can be done. I encourage you in your discussions today to think about the possibilities of a regional conference, however that region might be defined, or

conferences in the Arkansas Basin about not just water or not just natural resources but the future of the Arkansas Basin and how you, as residents of this basin, can be directly involved in the shaping of that future.

There is also a parallel effort that will be ongoing, and Tom Kourlis will be talking about this, I understand, at lunch. It is related to the issue of sustainable agriculture and a sustainable agricultural economy. Agriculture is very important culturally, economically, and environmentally in this state. Therefore, we need to maintain a viable agricultural economy in the state. Tom Kourlis is going to be leading an effort that will look at the development of an overall strategy about how we go after that and I am sure he will talk about that in some detail at lunch.

Finally, let me talk about a couple of examples of where the Department of Natural Resources is going that will illustrate the themes that I talked about -- the way we want to operate and the way we want to interact at the local level with the people who live in this state. One relates to the Arkansas River Coordinating Committee. I am sure you are going to be hearing a lot of discussion over the next few days about the committee and the work that it is doing and where it is going. The committee, formed by executive order, involves county commissioners and representatives from throughout the basin. There's some 30 members. It is a big committee, but we wanted to be inclusive in how we created it.

The committee is focused on a number of tasks. One is to provide advice to the State Engineer regarding the administration of the river. It is an outreach effort to seek advice as to how the State Engineer should regulate water use, particularly from post compact depletion by wells, on an interstate basis under any ruling that might be forthcoming in Kansas v. Colorado.

The Committee will look at regulation on instate replacement and augmentation requirements, and how rules and regulations are developed and enforced. It is important, I think, to have communication not only in the formulation of those rules and regulations, but in making sure that when enforcement does occur, it is fair enforcement, and that it's done with open communication with the water users. There are some tough issues there.

We as a state may also have liability to the State of Kansas for past depletions, and if that order is made by the United States Supreme Court we as a state need to be in a position to decide how and in what form that compensation will occur. We need to coordinate that with the water users in the state and in this basin.

Finally, the committee is looking at the ongoing effort to develop the recreational and wildlife water resources in Trinidad, John Martin and Great Plains reservoirs, and how we can communicate and coordinate the efforts to acquire and move water into those facilities and enhance the water level in those facilities, with the enforcement and water acquisition activities that are going to be undertaken under the umbrella of the Kansas vs. Colorado case. It is our position we need to do this in the way that is least destructive to the agricultural economy in the Arkansas Basin and in a way that openly communicates to the water users in the basin. The committee has developed a work plan and three subcommittees have been formed: one dealing with recreation; one dealing with water augmentation; and one dealing with water acquisition.

There are also a number of state decisions that are already ongoing and have been made. The State Engineer, Hal Simpson, has promulgated rules and regulations requiring the metering of wells in the Arkansas Basin. At this point in time, there are some 800 wells that have not complied with the order, and the State Engineer is going to be moving forward with enforcement of those orders.

Another example of the way we are trying to work is in the Upper Arkansas Headwater Recreation Area (issues that we fondly refer to as "row vs. wade"), where we are looking at trying to balance flows for recreational use with the impacts on wildlife and the fishing and recreational economy in that area. We are currently undertaking a water needs assessment, and I think Bob Moore is going to talk about where we are in that needs assessment. From my perspective, there is good communication and a good working relationship among the agencies at the federal, state and local level in working through these issues. Clearly we have some tough tradeoffs in how water is managed through the system, but I think that the process that we have in place is the right one to get the right input to make those decisions.

In conclusion, it has been a pleasure for me to be here. I will be available to answer questions that you might have. Again, I encourage you to not just be a receptacle for information at this conference but to use the information, your thoughts and ideas to have some real conversations among both yourselves and the governmental people that are here about how you as a person, or how you as an organization, can help shape the future of this basin. Please realize that, as state government employees, we are here to listen and we are here to involve you as partners in the decisions that are made.

Arkansas Basin Water Programs

Dennis Montgomery
Hill & Robbins, P.C.

It's nice to see so many familiar faces in the audience. For those of you who read the program, there is a little bit of misrepresentation. Not only will David Robbins not present the program this morning, but the topic doesn't really describe what I intend to talk about. There are a wide variety of water programs in the Arkansas River Basin. For example, the Winter Water Storage Program is a program designed to improve the efficiency of water use in the Basin. And, there are other programs designed to control pollution. Many of the speakers who follow me will discuss the specifics of those programs. What I intend to do today is set a framework for discussion of those programs by explaining the Arkansas River Compact, the current lawsuit between Kansas and Colorado, and some of the implications of that lawsuit for future programs in the Arkansas River Basin.

The Arkansas River Compact was signed in December, 1948, by Commissioners appointed by Colorado and Kansas. It was ratified by the State Legislatures in early 1949, was approved by Congress, and became effective on May 31, 1949. The Compact has been in effect for 45 years now. There are two key facts about the Arkansas River Basin that help to understand the Compact.

First, most of the flow of the Arkansas River which passes Canon City is diverted in Colorado. The Arkansas River originates above Leadville. It flows down through a relatively narrow canyon to about Canon City, where the river comes out of the mountains into a relatively narrow valley. There is some irrigation in the Canon City area, although most of the irrigation in the Basin occurs below Pueblo. The flow at Canon City is sometimes viewed as an index of mountain runoff or snowmelt runoff in the Basin, and the native flow at Canon City over the past 80 or 90 years has averaged about 500,000 acre-feet per year. That has varied from year to year. It's probably been as high as 900,000 acre-feet, and as low as 220,000 acre feet. So it has varied by about a factor of four at Canon City.

There are no floods recorded at Canon City that are anything like the floods that have occurred at Pueblo, Las Animas, and the Stateline -- and that has an important bearing on water use in the Basin. Most of the flow that passes Canon City is usable and is diverted by ditches in Colorado. I have seen estimates that as high as 98 percent of the flow at Canon City is diverted and consumed in Colorado. I'm not sure about the consumed part, but the diverted part is certainly correct. That fact was important to the Colorado Commissioners who negotiated the Arkansas River Compact. They believed that Colorado had historically diverted the flow that came out of the mountains and was entitled to continue to divert that flow in the future. During the Compact negotiations, the Colorado Commissioners were unwilling to give Kansas any right based on a percentage or an index of flow at Canon City because Colorado had historically diverted the flow at Canon City.

The other fact that is helpful in understanding the Compact is that at the time the Compact was negotiated, the Stateline flow averaged about 280,000 acre-feet per year. The flow passing Garden City, which is below the diversion points of the ditches in Kansas, averaged about 170,000 acre-feet per year. If you compare Stateline flows and the flows at Garden City in the pre-Compact period, it is clear that there was a substantial amount of flow passing the diversion points of the Kansas ditches unused, either because it occurred at times that it wasn't usable for irrigation or it occurred in floods that were in excess of the diversion capacities of the Kansas ditches.

The Compact was negotiated following the construction of John Martin Reservoir, which the Federal Government had authorized in 1936. And the Compact was intended to allocate the benefits arising from the construction and operation of John Martin Reservoir. The Commissioners understood that John Martin would capture some of the unused flood flow passing Garden City and convert that into usable flow. They also understood that John Martin, by virtue of its location above the ditches in Colorado Water District 67 and Kansas, would regulate the supply of water for the ditches in District 67 and Kansas and provide water in a more timely manner.

After the Compact was signed, George Knapp, who was the Kansas Chief Engineer and chairman of the Kansas Commissioners, estimated that the flow at Garden City would be reduced by about 100,000 acre-feet per year. So whereas it had averaged 170,000 acre-feet per year prior to the Compact, he believed that operation of John Martin under the Compact would reduce the flow to about 70,000 acre feet. There were no engineering studies done to support his estimate; that was simply an estimate based on his judgment about how the Compact would operate. But, it is important to recognize

that even with the operation of John Martin Reservoir under the Compact, the Commissioners understood that there would still be some flow that went past Garden City unused. It would occur either at times when it wouldn't be usable in Colorado or Kansas or when there were floods that would exceed the diversion capacities of the ditches. And that was flow which would be available for future development in the basin.

After the Compact was signed, the Bureau of Reclamation proposed the development of an off-channel reservoir near the Colorado-Kansas Stateline. The inlet canal for the reservoir was to be located near Granada with a capacity of about 200 second feet. The Bureau estimated, based on diversions limited to 200 cfs, that there was about 48,000 acre-feet per year available for storage in an off-channel reservoir after the Compact became effective. Now some of that was flood flow and would not occur on an annual basis, but some of it was winter flow or flow that occurred at times when it was simply not usable in Colorado or Kansas because of rains or other factors. My point is that everyone recognized at the time the Compact was signed that there was a substantial amount of unused flow that would be available for future development.

In the time I have remaining, I cannot attempt to describe all of the provisions of the Arkansas River Compact. So I thought I would come at it by describing the Colorado Commissioners who negotiated the Compact and what their concerns were. Their concerns will help to understand the key provisions of the Compact.

The chairman of the Colorado Commissioners was Henry Vidal, a lawyer from Denver who was in his mid-seventies at the time the Compact negotiations took place. He was a Director of the Amity Mutual Irrigation Company, which is one of the major ditches below John Martin Dam in Water District 67. He had been one of the attorneys who represented Colorado in the litigation between Colorado and Kansas that began in 1928 and was completed in 1943. He had also represented the Arkansas Valley Ditch Association. He had 50 years of experience in the Arkansas River Valley and was extremely knowledgeable about the Basin. I think he viewed his role as representing Colorado Water District 67 and the ditches in Colorado below John Martin Reservoir.

The second Colorado Commissioner was Gail Ireland, who had been Attorney General for Colorado during the early 1940s when Colorado vs. Kansas was argued before the U.S. Supreme Court. He and his brother, Clarence, who had also been Attorney General for Colorado, later formed a law firm in Denver that still exists today, the firm of Ireland, Stapleton, Pascoe, and Pryor. Gail Ireland was still alive in 1985 when Kansas first asked for an investigation by the Arkansas River Compact Administration, and David Robbins and I interviewed him. He lived in an apartment overlooking Cheesman Park. He was in his early 90s and nearly blind, but his mind was still very sharp. He recalled the Compact negotiations and had some interesting comments about the Commissioners. He also recalled playing poker with Hans Kramer, the federal representative. Ireland viewed his role as representing state interests in the Compact negotiations.

The Arkansas River Compact was negotiated at the same time as the Upper Colorado River Compact. Clifford Stone was Director of the Colorado Water Conservation Board in the 1940s and Colorado's Commissioner to negotiate the Upper Colorado River Compact. There were matters of state policy that Judge Stone felt very strongly about, including the use of water imported into the Arkansas River Basin from the Colorado River Basin and the powers that would be granted to any commission or administration that was created by the Compact. The Upper Colorado Compact negotiations took place because the Bureau of Reclamation in the early '40s had done a study of possible projects in the Colorado River Basin and concluded that there were more potential projects that could be developed than there was water supply available to the Upper Basin states. So the Bureau recommended that the states of the Upper Colorado River Basin agree upon their individual shares of water apportioned to the Upper Basin under the Colorado River Compact. One of the projects the Bureau was investigating at that time was the Gunnison-Arkansas Project, which was a project to import water from the Colorado River Basin to the Arkansas River Basin. That project was eventually scaled back and became the Frying Pan-Arkansas Project.

The third Colorado Commissioner was Harry Mendenhall, a banker from Rocky Ford. He was neither a lawyer nor an engineer but was extremely knowledgeable about water matters and had a very practical understanding of the needs of farmers and irrigators in the Basin. He represented the interests of the ditches above John Martin Reservoir. They felt strongly that John Martin Reservoir had not been authorized solely for the benefit of ditches below the reservoir and in Kansas, and that the ditches above John Martin Reservoir were entitled to some of the benefits resulting from John Martin. Harry Mendenhall played a key role in negotiating agreements for operation of John Martin Reservoir. The Mendenhall-Leavitt agreements, which were negotiated during the Compact negotiations, formed the basis for Article V of the Compact. Harry Mendenhall worked out those agreements with William Leavitt, the President of the Garden City Company in Kansas, which was a major corporate owner of land and water rights in the Kansas. What the upper ditches

got from the Compact is that at times when there is water stored in John Martin Reservoir, the ditches above John Martin are free from calls by District 67 ditches. That allows ditches above John Martin to divert additional water at times there is water in storage in the reservoir. That is a key benefit to the upper ditches, although the Engineering Committee established by the Compact Commission was not able to agree upon operation studies to quantify the benefits of the Compact. The Engineering Committee began such studies but ran into a problem. The Committee was able to calculate the historical inflow at John Martin Reservoir and make assumptions about how that supply would be allocated to ditches in District 67 and to Kansas, but when the ditches in Colorado above John Martin insisted that they were entitled to make additional diversions, it threw the engineers for a loop because it required them to estimate how much those additional diversions would be and to what extent those diversions would reduce the supply into the reservoir.

The Mendenhall-Leavitt agreements worked well in practice during the late '40s, and the Engineering Committee simply never attempted to quantify the benefits of the Compact. I think the Colorado Commissioners went home believing that they had done better than they wanted anyone to know. Maybe the Kansas Commissioners felt the same way, I don't know. But I think the Colorado Commissioners clearly felt that this was a very advantageous compact from the standpoint of Colorado users. And one of the reasons was that releases from John Martin Reservoir for Kansas are measured at the Stateline.

Article V of the Compact allows both states to make demands for releases of water stored in the reservoir. If you look at the maximum rates of release of stored water, those work out to 60 percent for Colorado and 40 percent for Kansas. But the Kansas releases are satisfied by an equivalent in Stateline flow, which means that any flow at the Stateline is included in measuring the releases for Kansas. The Colorado Commissioners believed that in most circumstances there would be return flows from diversions by District 67 ditches that would make up a portion of the demands for releases by Kansas, so that when water was released from John Martin Reservoir, Colorado would actually get much more than 60 percent and Kansas would get much less than 40 percent of the water stored in John Martin.

So you might ask, Why would the Kansas Commissioners agree to a Compact which appeared to be based on the 60/40 split of water stored in John Martin if Kansas wasn't going to get 40 percent of the supply? I think the answer is that the Kansas Commissioners saw an advantage to Kansas from satisfying the Kansas releases by an equivalent in Stateline flow. The advantage to Kansas was that in dry periods releases from John Martin would have to be increased to make up whatever losses occurred between John Martin Dam and the Stateline. Therefore, in dry periods Kansas would be assured of getting its releases from John Martin at the Stateline. The Kansas Commissioners were less concerned about receiving 40 percent of the stored water in the wet periods so long as Kansas was guaranteed 40 percent of the stored water during dry periods. That, I think, is what the Kansas Commissioners believed, but as the Compact was implemented and as time went by and different people became involved in the operation of the Compact, some of the Kansas representatives began to feel that Kansas got a raw deal and that Kansas was entitled to 40 percent of the water stored in the reservoir. As a result, Kansas began demanding releases any time Colorado demanded a release so that Kansas would get 40 percent of the water stored in John Martin Reservoir. That's one factor that led to inefficiency in the operation of John Martin Reservoir.

The final Colorado Compact Commissioner was Charles Patterson, the chief engineer for the Colorado Water Conservation Board. You won't find his name among the Commissioners who signed the Compact. He resigned as a Compact Commissioner and as chief engineer for the Board before the Compact was signed. But he played a key role in the formation of the Compact. Charlie Patterson was probably as knowledgeable about the Arkansas River Basin as any engineer who has ever lived. He moved to Pueblo when he was 2 years old. He was educated at the University of Michigan and obtained a degree in engineering with an emphasis in groundwater in 1908. From then on, he spent almost his entire career in the Arkansas River Basin. He worked as an engineer for the Arkansas Valley Ditch Association. He was involved in the construction of several trans-mountain ditches that import water into the Arkansas River Basin. He served as an expert witness for Colorado in Colorado vs. Kansas. Patterson believed strongly that the decision by the U.S. Supreme Court in 1943 had said that Colorado was entitled to use the water supply it was using at that time. He recognized that John Martin Reservoir would be empty for long stretches of time because there were drought periods when there were no floods that would be captured in John Martin Reservoir. He believed strongly that Colorado should not in any way, shape, or form guarantee any delivery to Kansas because that would require curtailment of historic Colorado diversions during dry periods.

If you understand Patterson's view, I think you will have a better understanding of Article V because it doesn't guarantee Kansas deliveries or releases from storage during dry periods. When John Martin is empty, the river simply goes back to operation as though the reservoir had not been there.

I mentioned that the Commissioners understood that even with the Compact, there would be some unusable flow, and one of the key provisions of the Compact is Article IV-D. It addresses future development in the Basin and says that the Compact is not intended to impede or prevent future beneficial development of the Arkansas River Basin in Colorado or Kansas, provided, that the "waters of the Arkansas River" -- and that's a key term because "waters of the Arkansas River" is defined to exclude imported water -- shall not be materially depleted in usable flow or availability for use to the water users in Colorado and Kansas under the Compact. Each of those phrases is important in understanding what the Commissioners intended with respect to future development. During the current law suit, Kansas asserted that Article IV-D was intended to maintain the status quo with respect to existing diversions in Colorado and Kansas at the time the Compact negotiations took place. I don't think that's right, at least from my reading of the negotiations. I think what the Commissioners intended is that future development should not interfere with the water supply that would become available as a result of implementation of the Compact. They understood that if John Martin Reservoir captured some of the unused flood flow, there would be more water available for diversion in Colorado and Kansas. Whatever that supply was, that's what they didn't want future development to deplete. They recognized there would still be some unused flow that could be developed by both states. And for many years, development occurred in the Basin in both States without much complaint.

So let me jump to 1985, when Kansas requested an investigation by the Compact Administration of certain post-compact developments in Colorado. One of those was the operation of Trinidad Reservoir, which is a Federal dam and reservoir project on the Purgatoire River. The second was the operation of the Winter Water Storage Program. On the basis of a resolution that had been passed in 1951 by the Compact Administration, Kansas contended that an operating plan for the Winter Water Storage Program had to be approved by the Compact Administration. Colorado disagreed. Kansas also asserted that there were some depletions to usable Stateline flow occurring as a result of the Winter Water Storage Program. In 1983 Kansas hired an engineering firm to do an investigation of the Trinidad Project, the Winter Water Storage Program, and the cause of declines in Stateline flows. I'll give you my loose interpretation of the report. The engineering firm basically said, Well, if there are depletions from the Winter Water Storage Program, they are small. If the operation of Trinidad Reservoir has impacted Stateline flows, it's small. But post-compact well development in Colorado has been significant and has depleted Stateline flows and, if Kansas is going to file a lawsuit against Colorado, do it on the basis of post-compact well development. That's one we think we can prove.

The investigation by the Compact Administration did not proceed in the way Kansas wanted. In December 1985, Kansas filed a motion for leave to file a complaint with the United States Supreme Court. In July 1994, a Special Master appointed by the Supreme Court issued a report, and to give you a very brief summary, he recommends that the Court dismiss all of the claims by both States, with one exception. He recommends that the Supreme Court find that post-compact well pumping in Colorado has depleted usable Stateline flows. He didn't determine the amount of those depletions, but he made a number of rulings which will allow the states to quantify those depletions. If the Supreme Court affirms his report, he recommends that the case be remanded to him to quantify those depletions and to develop a remedy.

Both states have taken exceptions to rulings in the Master's report. The final briefs were filed two weeks ago. We anticipate that the U.S. Supreme Court will schedule the case for argument in late February or March of this year, and that we will have a decision by the end of June. Quite frankly, I think it is very unlikely that the Supreme Court will overturn the Master's finding that post-compact well pumping in Colorado has depleted usable Stateline flows. All of the expert witnesses who testified in the case conceded that there had been some depletions to Stateline flows as a result of post-compact pumping in Colorado.

What are the implications of the Master's report? Clearly, if the basic finding in his report is upheld, Colorado will have to develop a plan to prevent depletions to usable Stateline flows in the future from post-compact well pumping in Colorado. That means the Colorado State Engineer will have to prevent any post-compact well pumping unless those depletions are replaced. The good news is that the depletions to usable Stateline flows caused by post-compact well pumping in Colorado are relatively small as a percentage of the total amount of pumping.

There has been some discussion since the Master's report was issued that all well owners will have to do is replace depletions to usable Stateline flows caused by post-compact well pumping, and that they can continue to pump three days a week under existing rules and regulations. I want to throw some cold water on that notion and issue a word of caution. The very same evidence that showed that post-compact well pumping causes depletions to usable Stateline flows also showed that there were reductions in diversions by senior Colorado water rights as a result of well pumping. I don't think that it will be acceptable to senior Colorado ditches for well owners to propose a plan that simply replaces depletions to usable Stateline flows and does not address the impacts of pumping on senior Colorado ditches. There has also been

discussion about the possibility of State assistance in coming up with a water supply to replace depletions to usable Stateline flows in the future, or at least State assistance in financing the purchase of those water supplies. For there to be consensus on such assistance, I think the senior Colorado ditches are going to have to feel that their interests have been considered and adequately addressed.

Other implications of the Master's report that I foresee? -- I think there will be a reduction in the amount of well pumping in the Arkansas Valley in Colorado. I think that there is some marginal well pumping in the valley. When well owners have to pay to replace depletions, it will increase pumping costs, and some well owners will either decide not to pump or will pump less. On the other hand, I think well pumping is too important to many users to expect well pumping to stop entirely. If pumping is to continue, however, there will have to be a plan to replace the depletions to usable Stateline flows. We don't know what those depletions are yet. The Supreme Court has not approved a plan to replace those depletions. The Special Master hasn't even determined what the depletions to usable Stateline flow were in the past and hasn't determined how they will be calculated in the future.

Questions and Answers:

Q: What has happened to the flows that you said were not useable, 48,000 acre-feet a year?

A: There is still some unusable flow passing Garden City in high water years such as 1987, but much of that unusable flow is now being used by post-compact wells in both states. There was well development in Kansas, not just in Colorado. The well development in Kansas has significantly increased the river losses between the Stateline and Garden City. Today there is far less unused flow because it has been developed through the use of post-compact wells. Some of the pumping in Colorado depletes unused flows. But some of the pumping impacts occur at times when it is usable in Kansas, and that is the portion that Colorado well owners will have to replace in the future.

Q :... the amount of water that will have to be added at the Stateline will be relative small...What is the magnitude?

A: There have been articles in Kansas newspapers about future increases in flows in the Arkansas River as the result of the Special Master's report, but when you look at the evidence in the lawsuit, I think some of those articles are unrealistic. The depletions to usable Stateline flows over the period 1950-1985, calculated with the Kansas model, are about 330,000 acre-feet per year. That works out to about 10,000 acre-feet per year of depletions to usable Stateline flows. The average pumping in Colorado during that same period was about 150,000 acre-feet per year. So, you can see that as a percentage of total pumping, the depletions to usable Stateline flows are relatively small. The average flow at the Stateline over that period has been about 140,000 acre-feet per year. So, if Stateline flows were to increase by another 10,000 acre-feet per year, you are not going to get the kind of flow in the river that some of the articles in Kansas have been talking about, which suggest that the river will flow to Dodge City again. We are not talking about depletions of that magnitude at all.

Water Quality Programs in the Arkansas Basin

Gary Soldano

Colorado Department of Public Health & Environment

I would like to give you the gloss-over today on water quality programs as they specifically affect the Arkansas River Basin. A lot of your communities and industries are affected by these programs. Before we start, a good thing to do would be to think about a couple of questions. What is water quality, and why are we concerned about it? Those are two basic questions that people have tried to answer during the 30 years since the environmental programs have been around. A lot of times we receive conflicting answers and have ended up suing each other over the answers that we didn't like. I would like to go back 10 or 15 years and answer the second question first. Why are we concerned about water quality?

All of these photographs that you are going to see are 10 to 15 years old, and I want to say that a lot of these problems have been resolved or are on the way to being resolved. It is not my intent to point a finger at a particular part of the basin, but rather to point out the reasons why we are concerned about water quality.

This frame shows the Upper Arkansas where California Gulch enters the Arkansas River. You can see a striping pattern on the river. There is a plume of heavy metal pollution, commonly called "yellow boy", and you can see the drastic contrast between this area and the less polluted water coming down the Arkansas above California Gulch. At the time this slide was taken the plume extended and was visible almost all the way to Salida, which is over 60 river miles. This was obviously pollution from mine drainage, much of which was from an inactive mine. It is a definite water quality concern for us.



Upper Arkansas River where California Gulch enters the river.

We also have municipal sources of pollution, and our municipalities have invested in a lot of infrastructure to deal with it. Some of it is old, and sometimes it fails. On the Arkansas River near Pueblo, I dealt with the remains of a sewer line carrying about six million gallons a day of raw sewage to a treatment plant. In the river you could see what looked like cloudy water. It was a plume emanating from the end of the pipe underwater, where the sewage is entering the river. Downstream you saw the broken pieces of pipe. These were monuments to engineering of the '20s and '30s.

Domestic sewage entering our rivers and streams was something that was still occurring in the late 1970s and early 1980s. When I was a young engineer and went to work for the state health department, I was shocked during my first couple of weeks on the job. It was almost a daily occurrence that something like this happened or that there would be combined sewers overflowing during precipitation events, causing fairly gross pollution of the river.

There are also agricultural sources of pollution, such as dairies. Other than natural drainage to take wastewater off of the feed lots and the corrals, many had no runoff controls. The color of the runoff water indicates that is of very poor quality. This is another area of concern for water quality.

Another problem related to mining dealt with leaching of gold through the cyanide heap leach process. There was a pond that had 200 parts per million (ppm) of cyanide in it. It was also about to overflow its embankments. A few weeks after I looked at it, there was an inch-and-a-half rainstorm, and the banks of the pond broke. About 200,000 gallons of cyanide solution went into the creek, much to the dismay of the recreational summer-home community that is downstream on this creek. It was a very tense situation. Along with the Division of Wildlife (DOW), we took quite a few samples trying to detect cyanide downstream. Fortunately it appeared that there was enough dilution from the rainstorm to prevent any significant impact, like a fish kill or contamination of drinking water wells with cyanide.

There are unanticipated events that can affect water quality. It is poignant that I was in here yesterday trying to get comfortable with the equipment. I had this slide in my carousel, and I called home to find that I had been contacted about a train derailment that had occurred yesterday near CF&I's property here in Pueblo. A Burlington Northern train apparently derailed with a couple of tanker cars full of cattle feed in the form of a slurry. We are hoping there will not be a significant impact to the Arkansas River, because the flow entered CF&I's treatment system. Hopefully it will be treated before reaching the river. Ten to fifteen years ago we saw a lot of problems and we still have similar events occurring today, but we have made a lot of progress in those years. Hopefully this has been the primer for why we are concerned about water quality these days.

What is water quality? The answer will vary depending upon who you ask. If you are a farmer in Rocky Ford, you are not so concerned about ammonia, nitrogen, nitrate, or phosphorous in your irrigation water. Those are free fertilizers if they are in your irrigation water. If someone were going to do a project that would affect the amount of salt in your water, then you might be very concerned about it. If you were a rancher below the town of Cripple Creek, where flow through the wastewater treatment works tripled due to gambling, you would be concerned about your livestock drinking out of Cripple Creek. You would worry about the organisms they might be ingesting and the diseases for which they might be at risk. If you fish in the Upper Arkansas, you are obviously concerned about heavy metals. Opinions on acceptable water quality will vary widely, depending upon the water use you are talking about.

In 1972 the federal government passed the Water Pollution Control Act, defining nationally that all waters need to be fishable and swimmable, and that is another opinion on the definition of acceptable water quality. The Colorado legislature looked at the federal law and said, "That is all well and good, but we have streams in which no water runs during a substantial part of the year. We are not sure we want the federal government to apply that standard for water quality to our waters."

In 1973 the Colorado Legislature passed what is currently called the Colorado Water Quality Control Act, tying water quality to beneficial uses of water. These uses might be for drinking water, recreation, aquatic life and fishery resources, or agriculture. The legislation also provided for the creation of the Water Quality Control Commission and Division within the State Health Department. The Federal Water Pollution Control Act came to be known as the Clean Water Act and the Water Quality Act. The state act is the Water Quality Control Act, and it allows the Water Quality Control Commission and the Water Quality Control Division of the Colorado Department of Health and Environment to carry out most federal water quality programs.

I would be misleading you if I told you that this is where all authority over water quality resides in a nutshell. There are a lot of other federal and state agencies that get involved in water quality programs and have certain responsibilities and duties. At the federal level that includes EPA and, for dredge and fill permits, the Army Corps of Engineers. The Mined Land Reclamation Board and Division of Minerals and Geology are also involved. The State Engineer's Office, which primarily deals with water rights, has some responsibility in the area of water quality, relating to groundwater. The Oil and Gas Conservation Commission and the State Department of Agriculture also carry some responsibilities in the water quality arena.

What I would like to go over with you today are the programs carried out by the State Water Quality Control Commission and the Water Quality Control Division, which acts as staff to the Commission. The Commission is a nine-member body of citizens appointed from different areas of the state by the Governor. These are political appointments, and they generally are three-year terms. The Commission's directive under the Water Quality Control Act is to make the rules for water quality in Colorado. The Legislature recently revisited the act and made some changes, namely directing the formulation of coordinating agreements between the state agencies and the Water Quality Control Commission for how standards are applied in different water quality programs.

As for the Water Quality Control Division, the law gives us four primary elements to carry out water quality programs. The first element is to monitor water quality in the state's streams and groundwater, setting basic and site-specific standards for those waters. Those standards relate to the beneficial uses to which that water is put.

The stream standards, as they are called, are written as specific documents for each river basin in Colorado. The Arkansas Basin is divided into numerous segments, and the primary divisions are the Upper Arkansas, the Middle Arkansas and Fountain Creek, and the Lower Arkansas Basin. Each stream or tributary has the specific uses and standards for metals, nutrients, bacteria, or other criteria. Whatever scientifically relative standards are appropriate are then placed on each segment. Those are outlined in a document we call the Arkansas River Water Quality Standards Document.

From there we diverge and wear two hats. We have a regulatory program for point-source discharges and a voluntary program for non-point source discharges to state waters. The point-source discharge program is sometimes called by its acronyms, NPDES or CDPS (Colorado Discharge Permit System). It provides for discharge permits to be in effect for any discharge to the state's waters. These permits are written to prescribe the minimum water quality limits or the minimum treatment required to discharge wastewater back to state waters. That includes discharge from municipal and industrial wastewater treatment plants, and within the last five years we started issuing permits for discharge of stormwater from industrial operations in the state.

In the Arkansas basin we have about 150 municipal and industrial permits, allowing people to discharge to the Arkansas and its tributaries. We have about 400 permits for industrial stormwater discharges. The stormwater dischargers are not regulated as closely as municipal and industrial dischargers. The stormwater permits generally require best management practices to be in effect. I think that over the next day or two you will hear more about best management practices, so I will not dwell on that.

On the non-point source side we have projects including urban runoff, agricultural projects, and drainage from abandoned mines, and we have started to look at education as a key component in the non-point source water quality program. One of the projects that is going on in the Arkansas Basin, relating to non-point source discharges, is the Chalk Creek Project, which is the cleanup of abandoned mine drainage. We have a couple of sediment and erosion projects that relate to cattle grazing and agriculture. One of those is through the Sangre de Cristo Resource Conservation and Development Unit at Badger Creek in Fremont County, and it extends into Park County. The Patterson Hollow Project is an irrigation efficiency project conducted by the West Otero Soil Conservation District. Another project that is scheduled to get underway in Bent and Powers Counties will look at the efficiency of surge irrigation. Hopefully these projects will go far in educating the communities about simple methods for cleanup of non-point sources of pollution.

The other key element in the water quality programs in Colorado is our financial assistance program. We use public funds for water quality improvement projects. This is a flow of funds from several sources that we administer or are involved in. One of them is the Water Pollution Control Revolving Fund. This is federal money that comes through EPA and is a replacement for the EPA construction grant program, used in the past to build several municipal wastewater treatment facilities. Some of the larger plants that were built with EPA grant funds are at Leadville, Salida, and the Fremont Sanitation District wastewater treatment plant, which serves all of the prisons in eastern Fremont County as well as the communities at Cañon City and Florence. Pueblo and Colorado Springs have also used this program to build treatment plants. If I totaled it up, we have been involved with \$50 million to 75 million in projects under that program over the last 10 to 15 years.

We also have a small source of funds from the State Legislature to fund municipal wastewater treatment plants for small communities. We have about \$40 million in needs across the state, and the last two years have been good in the legislature for that program. We received \$2 million per year. That program provides partial grant assistance to small communities for municipal wastewater treatment projects. The population of those communities is generally under 5000. We also work with the other public funding agencies for water quality control projects. The Impact Assistance Fund and Community Development Block Grant program are primarily administered by the state Department of Local Affairs. When there is not enough funding from one source to help a small community with its project, we sometimes will package the funds together using multiple sources to help the community carry out the construction of a treatment plant. Section 319 of the Clean Water Act also funds some of these non-point source projects. These projects are packaged along with other funding through the Soil Conservation Service and local matching funds.

That is the gloss over on what the Water Quality Control Division does in the state and some of the projects that affect the Arkansas River Basin. Do we have time for any questions.

Questions and Answers:

Q: Untranscribable

A: I think the easiest way to explain that would be to say that we started out in 1972 with some really gross pollution problems for which people wanted solutions right away. The political process responded to that with hardcore regulatory programs that cracked down on communities and industries for wastewater treatment from point sources. In a lot of cases these were heavy-handed regulatory programs. After 10 years of that structure, feedback was coming back through the political process to Congress and the State Legislature, saying that this was not the best way to accomplish goals and get things done anymore.

When Congress revisited the Clean Water Act, which they have done several times since 1972, they decided to address non-point sources in a voluntary program. I believe it has been a very successful way to approach things. People in the agricultural community see themselves as stewards of the land, and they don't need a regulatory agency telling them how to do business and clean up water quality. In the voluntary program we have a cooperative effort between the agricultural community and the regulatory agencies, and that is an advantage of the voluntary program over the regulatory program.

Q: Untranscribable

A: On the non-point source side you are primarily looking at best management practices. When we review one of these projects, we try to look at how it will improve the current impact to the water resource and, if the water quality standard on that stream segment is not being met, how we can tailor the project to meet those standards.

Q: Untranscribable

A: That has been a sore thumb all over the state. Septic systems are regulated by minimum guidelines for their construction issued by the state Health Department. Each of the 63 counties in the state is then responsible for permitting and enforcing. This whole process was designed to address low-density development. Over the years we have ended up with high-density development operating with low-density septic system technology. We have a lot of places in the state where groundwater, some of which supplies drinking water wells, has been contaminated from septic system leach fields. The counties are working with us to rewrite the guidelines they use, attempting to do a better job of controlling high-density development where septic systems are being used. I don't have a good answer for you as to what is being done in specific places. I know in some places they are looking at small constructed wetlands systems. We are always open to new technologies. There may be some answers, but I think we are going to wrestle with that problem for a while.

Multi-Agency Water Needs Assessment

Bob Moore

Colorado State Director
U.S. Bureau of Land Management

You probably wonder why somebody from the Bureau of Land management is here to talk about water. After all, the Arkansas River is fully appropriated by private water-users and municipalities, and the BLM doesn't hold water rights that are large enough to make a difference anyway.

The reason I am here is interdependence. BLM believes that everyone at this conference is interested in achieving a healthy local economy, a high quality of life, and a sustainable social system for the Arkansas Valley. A healthy river and a healthy watershed are essential for reaching these goals. In our view, the land management agencies and the water users in this basin are dependent upon each other for fostering a healthy watershed, a healthy river, and a healthy economy, because none of us can accomplish these goals on our own.

The role of the land management agencies in the watershed creates this interdependency. BLM manages fourteen percent and the Forest Service manages twenty-seven percent of the land in the Upper Arkansas watershed. One of our goals for managing this forty-one percent total is to provide a constant, high-quality supply of water to the Arkansas River. These flows benefit natural resource values and water users who desire high quality water in a steady supply. You may have heard about some of the watershed improvement projects in which BLM is involved in places such as Texas Creek and Badger Creek. These and other projects like them are designed to decrease erosion and moderate stream flows by restoring riparian and upland vegetation communities.

The interdependence between water-users and BLM is also created by our role in the recreation economy in the Upper Arkansas River. BLM co-manages the Arkansas Headwaters Watershed Recreation Area, along with the Colorado Division of Parks and Outdoor Recreation. Components of this effort include: managing a permit system to insure fair business opportunities for recreational outfitters; acquiring land to provide better public access to the river for kayaking, rafting, and fishing; creating backcountry by-way routes to direct visitors to recreational opportunities throughout the watershed; and developing recreation sites to concentrate and limit the impacts of recreation on shorelines and vegetation. We have also requested flow augmentation from the Bureau of Reclamation since 1990 to extend the rafting season and to benefit fisheries. Augmented flow levels, timing, and quantities of water available have been coordinated between BLM, Division of Parks, Division of Wildlife, Bureau of Reclamation, Trout Unlimited, and the Southeast Colorado Water Conservancy District. The basis of this recreational economy is that visitors find outstanding conditions on the Arkansas River for rafting, Kayaking, and fishing. These conditions are dependent upon flows that are primarily determined by water-users in the lower watershed.

If BLM wants to increase public support for all these nonconsumptive uses, imposing our wants and desires on the water-users would be counterproductive. There are several facts that have led us to this conclusion. The BLM doesn't have a comprehensive understanding of this ecologically and legally complex river. The BLM doesn't control how water is allocated. The BLM has no interest in impacting water-dependent economic activity, such as irrigation, municipal use, and recreation use. Rather than imposing our will, BLM is seeking collaboration in water management. All stakeholders must be involved to discover water management options that protect water rights, support the farming and recreation economy, and adequately sustain the river's natural environment.

You might be asking yourself why BLM would pursue collaboration when it obviously requires an enormous amount of resources and effort. The reason for that is ecosystem management. Let me take a moment to de-mystify ecosystem management. I want to assure you that it is not just another jargon phrase for "Range Reform". It is also not a sly way for land management agencies to impose their will on private property owners. The essence of ecosystem management is building trust. Permanent improvements in the health of land and water cannot be achieved unless stakeholders understand and support actions to achieve that health. In addition, they must believe that those actions are in their personal interest.

Another Key element of ecosystem management is considering entire watersheds when identifying options for improving the health of land and water. I think this approach is easily understood by anyone who relies on the Arkansas

River. Actions anywhere in the watershed, such as grazing and mining, can affect the quality and quantity of water we all depend upon.

The third critical element is accurate and reliable information. It is impossible to identify effective options unless the stakeholders have accurate information about how the entire watershed functions, in terms of biology, hydrology, ecology, economics, and legal systems. For example, no one can identify options for managing the Arkansas River watershed without a complete understanding of the legal constraints that govern the exercise of water rights.

The commitment by land management agencies to pursue a collaborative ecosystem management approach for watersheds is evidenced by an effort called the “Colorado Ecosystem Partnership”. The Partnership consists of seven federal and seven Colorado state agencies who are working to facilitate and support community led efforts in managing watersheds. Private citizens, resource users, and scientists, are involved in work committees, set up by the partnership, and in community-led efforts supported by the Partnership. Examples of services performed by this Partnership include: providing financial and human resources to collaborative efforts in the start-up phase; sharing information and experience regarding which collaboration techniques appear to be most successful; and assistance to ecosystem projects in creating and assessing scientific, economic, and legal information. The Partnership has supported an impressive summary of ecosystem projects across the State. Several of these are focused on improving the health of rivers and streams, while supporting local economies. I encourage you to read the handout material that outlines ongoing efforts on the San Miguel, Yampa, and Colorado Rivers.

Many of you have heard about the “Arkansas River Water Needs Assessment,” in which the BLM is a key player. We view this process as an example of building trust and gathering accurate information for ecosystem management. A Memorandum of Understanding has created a partnership between the Colorado Department of Natural Resources, Bureau of Reclamation, the Forest Service, and BLM. The goal of this partnership is to provide Arkansas River stakeholders with a synthesis of scientific and legal information about the Upper Arkansas and its related reservoirs. Ultimately we hope this information can be used to discuss workable options for supporting a healthy river and a healthy economy. The main product of this partnership will be a documented report of the assessment effort.

Before I briefly outline the work and results we are striving for in the assessment, let me outline what the assessment is not. The assessment is not a decision document. It is only a data collection effort. We hope the data can be used as a foundation for future collaborative-decision making. The assessment is not an effort to quantify any type of instream-flow water rights, such as a federally reserved right for a potential wild and scenic river or a potential wilderness area. Our hope is that this study will identify river management options that are far more feasible for this river system. The assessment is not a unilateral closed door effort by government agencies to collect data and draw conclusions. Progress and data will be shared during the data gathering process with water-users, recreationists, and other resource-users to insure objectivity. The assessment does not examine natural resource values in a vacuum. Constraints on river management imposed by infrastructure, reservoir operations, and water rights are a major part of the analysis.

With this type of open process in mind, the interagency partnership has defined its area of investigation as the entire Upper Arkansas River, from Pueblo Reservoir to Turquoise and Twin Lakes. Studies are under way to understand how various streamflows and reservoir levels affect natural resource values. Examples of some of the questions we are trying to answer include: what is the relationship between various reservoir levels and the health of lake-trout in Turquoise Lake? What is the relationship between various flow levels and satisfaction with rafting and kayaking experiences on the river? What is the relationship between various flow levels and the health of plant communities that grow along the river? A Specific example of one of these studies is an effort to determine how much habitat is available for fish at different flow levels. Hydrologists determine what percentage of the streambed is inundated at different flow levels, and then fisheries biologists identify what percentage of the flooded habitat is usable for feeding and spawning.

Even though these are some good examples, I would like to briefly outline the complete list of natural resource values the interagency partnership is investigating.

- Fisheries: both cold and warm water species;
- Wildlife: shorebirds, waterfowl, raptors, sheep, and threatened and endangered species;
- Boating: access, navigation, and safety issues;

- Fishing: shoreline access fishing opportunities;
- Water quality: factors contributing to quality problems and impact of water quality on aquatic species.
- Vegetation: woody species and wildlife habitat; and
- Aesthetics: desirable shoreline conditions.

Simultaneously with these studies, constraints on the amount of water available to support natural resource values are being identified and studied as well. Some of these constraints are hydrologic, such as natural processes that are continually reshaping the Arkansas River channel and the average annual yield of imported and native water in the basin. Figure 1 illustrates the assessment process by relations study phases to time.

Many of the constraints we are studying are legal and institutional. For example, the interagency partnership acknowledges the impact of the court decision in *Colorado vs. Kansas*. Water management will become even tighter, and the court decision may eliminate some long-term management options for stakeholders in the basin. To gain a comprehensive and integrated view of these kinds of constraints, the assessment will analyze factors such as: historical operation patterns of reservoirs; long-term and short-term water contracts supplied by reservoirs; historical operating patterns of municipalities and their long term water supply goals; leases of water between municipalities and irrigators; cumulative effect of the numerous exchanges in the basin; and how irrigation needs effect water operations in the upper basin. As this phase of the assessment progresses, we plan to share our findings with an advisory group of water users. This group will help assure that our results are objective and that the interagency is aware of all the factors that need to be considered in river management options.

After all of these studies are complete, an evaluation phase will occur. The optimal and adequate flows for different resource values are sometimes in conflict. The evaluation will identify trade-offs between those values. For example, releasing additional flows from reservoirs for an extended rafting season may draw down reservoirs to unacceptable levels for water users or other recreationists. The ultimate goal of the resource values evaluation process is to specify possible flow regimes which would best satisfy and support all of the natural resource values.

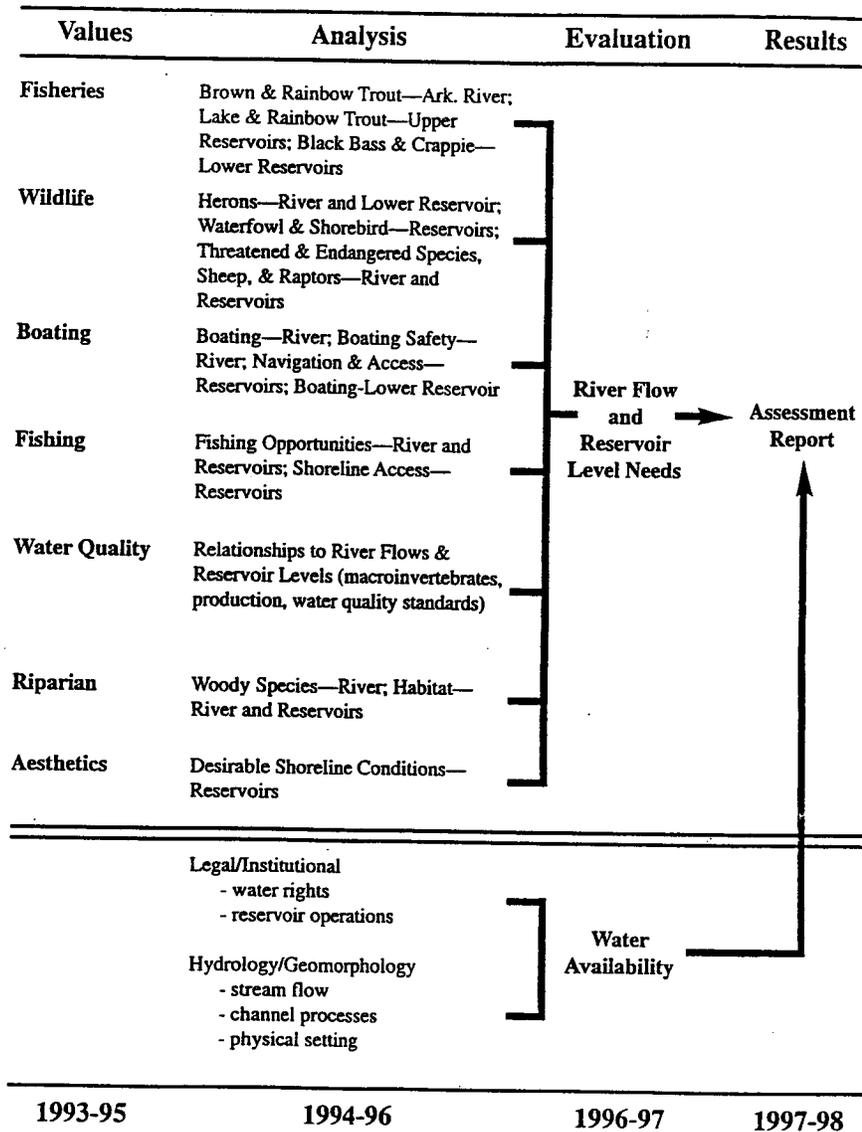
The evaluation of the legal and institutional constraints identifies where opportunities may lie to move the river closer to the ideal hydrograph without an adverse impact on water users. For example, movement of water from Twin Lakes and Turquoise Reservoirs to Pueblo Reservoir, can possibly be timed to benefit natural resources without impacting water users. Exchanges and alternate points of diversion may be identified that could benefit both natural resources and water users. The water users advisory group will be key in identifying options that merit further investigation. Options worthy of discussion by the larger group of Arkansas River stakeholders will be placed in a final report.

This assessment may sound like a large investment for uncertain results, however a very similar assessment demonstrates some of the results we hope to see. BLM has collaborated on a flow assessment of the Rio Chama, the largest tributary of the Rio Grande within New Mexico. The study reach was affected by upstream and downstream reservoirs operated by the Bureau of Reclamation and Corps of Engineers, similar to the situation on the Arkansas. The Rio Chama is also fully appropriated, meaning that river management options had a potential impact on water users. The Rio Chama also supports similar natural resource values, including extensive recreational boating and fishing. Finally, many of the players are similar to those we have along the Arkansas. The river supplies municipal water for Albuquerque and eight smaller municipalities. The river also supplies irrigation for 90,000 acres in the Middle Rio Grande Conservancy District.

In the short term, the Rio Chama assessment laid a foundation for releases from El Vado Reservoir to support natural resource values. The assessment provided a framework, allowing the city of Albuquerque to accommodate this practice, because the water could be recaptured at Albiquiu Reservoir downstream. In the long term, the assessment is bringing the major players to the table to develop an agreement regarding water management. Stakeholders feel more confident negotiating, because the assessment has provided a full understanding of several factors: trade-offs between satisfying the multiple water demands created by natural resource values and water users; constraints imposed by compacts, water rights, and agency legal obligations to address natural resource problems; and potential river management options, including options that no party had the resources to investigate alone. The Rio Chama assessment is helping all the stakeholders take off their blinders. The blinders are created by agency missions and appropriations, established ways of doing business, artificial jurisdictional boundaries, and misperceptions about the interest and flexibility of other stakeholders.

I hope we can also break down these barriers in the Arkansas River watershed and collaboratively find river management options that advance all of our interests. Maintaining our economy, quality of life, and a healthy river are the reasons for all of us to pursue that collaboration.

Fig. 1. Arkansas River Water Needs Assessment



Luncheon Address

Tom Kourlis
Commissioner
Colorado Department of Agriculture

We in agriculture have done such a good job of providing safe, healthy food, that we have been forgotten. We did such a good job in agriculture that we are taken for granted. That is one reason why I took this job. When we were asked to speak here in the Arkansas Valley, I asked myself a few questions. What is the importance of agriculture? What does it mean to the community of agriculture? It made me think broadly about something I said nine months ago: we are a success story and because of it we are own enemy. I think that is true in a lot of ways. Let me talk about some examples and some issues that make me bring that to belief.

Today 1.8 percent of the U.S. population is engaged in production agriculture, compared to 90 percent when we signed the Constitution for this country. There are 128 people dependent on every farmer for food and clothing. The United States is the world's largest exporter of food. In 1993, we exported \$42.5 billion worth of agriculture. That outran our agricultural imports for \$8 billion. For the past six years, the agricultural trade surplus has averaged \$7.4 billion. That surplus in foreign trade has been a significant factor in reducing our trade deficit. What has all that success cost the country?

The rhetoric that we are going to balance the federal budget by slashing farm subsidies is ridiculous. We hear constantly about the high cost of farm subsidies and welfare. In 1992, which is the latest data that I have, the United States Department of Agriculture's total budget was \$56 billion dollars. That is real money. That is a lot of money, but that is still a very small part of the whole federal budget. If I remember correctly it is between 2 and 5 percent of the national budget. People frequently think that it is all subsidies. Only 58 percent of that budget was spent on farm support programs and farm subsidies. Approximately half that money was spent on food stamps, school lunch programs, food programs for women and children, and a lot of other things. What did the farmer actually get out of that money? In 1992, farmers received \$9.7 billion in assistance from farm programs. Most of those were in loans, and most of those loans got paid back.

Now there is another budget, and the loans and guarantees were about 17 percent of the USDA's budget. Some people don't like the Conservation Reserve Program. Some people embrace it and endorse it as a wonderful program. I am delighted that they extended that program. I think that is important to extend that program for many reasons. We should wait and get an understanding of what is going to happen with GATT and NAFTA to really determine what we should do. We need that better information to make decisions more effectively.

Let me talk now generally about a farm program. I went to the University of Denver, and I had an economics teacher named Petijon. In the '60s Dr. Petijon was the economic advisor to Kennedy and Johnson. He talked to me a lot about the farm programs, and I was trying to make a decision. Do I go back in agriculture; do I go to Law School; or do I do something else? So I asked him the question one time after school, and he said, "Son, come with me." He was an arrogant kind of guy. On the first day of his class he walked in and said, "Let me tell you something. This is economics. Eighty-percent of you guys are dumbshits and will never understand how it works." He went on to say, "economics in the United States is capitalistic. Here is an example to help you understand this. All of you already paid your tuition to come to this school, so if you want your money's worth come and get it. If you don't want your money's worth, stay home. I'm not going to require that you go to class. I am not going to require that you take an exam. I don't care. You paid me, and if you want your money's worth, come and get it." So this man appealed to me. He talked straight. He told you the way he saw it. He wasn't necessarily polite, but it was something that I understood. Coming from the land, I understood that very straight forward conversation.

When I found out that he was part of the farm program in the '60s when they really developed and expanded it, I asked him about it. He said, "this not a farm program; this is a people subsidy. It helps us deal with poverty. That is why we are doing it. That is why the people of this country should pay for this program. We have made a decision that we want to take care of the less fortunate. This is the most cost effective way to do it."

I said, "I don't understand that. Wait a minute. The farmer is going to get the check." He said, "Well, yeah the farmer

is going to get the check, but if he gets the check he is going to overproduce. If he overproduces there will be an oversupply. If there is an oversupply in a capitalistic market that means the price will go down. If the price goes down, food will be provided to the public, to all the people, at a cheaper price.” If you have a certain poverty level and food decreases in price, we actually have who people make less money who are now above the poverty line. That means they will collect less food, money and other forms of compensation. From another point view, as Kennedy believed it, you get the rich to pay more for their food. You can't say that if you make more than a certain amount of money that you must shop at a more highly priced grocery store. That stuck in my head, and I think the purpose of farm programs is one thing that has been misunderstood about agriculture. Should we continue farm subsidies? I think that question is going to come up soon. What should farm subsidies be and how we structure them?

The thing that is really important, when it comes to farm programs, is to identify and understand what they contribute to the State of Colorado. I have some statistics for you. For every \$100 dollars of income of the average American, \$10 dollars goes to food. For every \$100 dollars the French make \$16 is spent on food. For the Japanese it is \$18 dollars. In Mexico it is \$32 dollars. In China it is \$48 dollars. I mentioned that we are our own worst enemy. This is because we have done such a good job. American agriculture has done a great job. Nobody eats cheaper than in this country.

Agriculture provides other things that are important, such as economics. From a state perspective, we are dealing with sustainable agriculture. A lot of people think that sustainable agriculture implies the ability to perpetually live off the land. I agree with that, but that is only part of sustainable. To me, sustainable agriculture is being able to live and provide from that land in perpetuity. That does not mean just environmentally. That means people also have to be able to make a living off that land perpetually. When you combine those two, then you have sustainable agriculture. If you divide them, then you do not. You cannot separate one from the other.

Why am I talking about farm programs and sustainable agriculture, and how does it relate to the Arkansas Valley? We are talking about a lot of the issues here, and some of the issues are the same ones that we are wrestling with in the state government. One issue is growth. I just drove from Denver this morning. I remember in the 1960s, when I was at the University of Denver we would play the Air Force Academy. When you left Denver, there was nothing. Then you saw some lights and turned into the Air Force Academy. Now you never leave the lights. We are saying it is important that we keep some open space and that we provide some other things that the people want. Agriculture provides that open space at no cost to the public.

A few years ago we approved Great Outdoors Colorado money for use on open space, wildlife, and recreation, and it is a good program. That money will be spent on GOCO programs, but agriculture provides wildlife and open space benefits while contributing to the local economy and the tax base. When we look at agriculture, it is important to take these benefits into account. As was mentioned yesterday, agriculture is one place you can “park” land. I didn't like the word “park,” but I am going to use it because it really stimulated some thought Agriculture is one place you can park a resource, and, if done appropriately, it will be there in perpetuity for our next generation or the generation after that. It will be there 100 years from now, and they can make land use decisions based on their needs. I don't know of another use that achieves that and still contributes economically. So that is the importance of agriculture in a broad sense.

Now, let me talk a little bit about the Arkansas Valley. The Arkansas Valley drainage has long been known as the state's premiere agricultural area. From the Continental Divide to the state line is the size of the Arkansas Valley. That is the southeast part of our state. It produces some of the state's finest cattle, grain, high-quality alfalfa, and vegetables. Its irrigated land has truly made it a garden spot in the state's industry. That has become a reality in the Arkansas Valley, because of water and the uses that many in this room have made of it. That has given us the opportunity to have agriculture to the extent that we do. When you wrestle with questions at this forum, as all of the good speakers that I have heard this morning have, you can say that you have done a good job. We have done a great job. We have given agriculture more diversity, a variety of crops, and more crops of the kind that people want. That is what the Arkansas Valley has provided. The market value of the region's agricultural production was \$578 million in 1992. I think that will go up, but we do not yet have those numbers for 1993. That is the equivalent of 14 percent of the states total agricultural sales, which is \$4.1 billion. I am talking about agricultural sales at the gate without further processing, and there are other residual benefits to that. The best analogy for the benefit of sales at the gate that I can make is in Greeley. If cattle were not fed in Greeley, then ConAgra wouldn't be there, because it is cheaper to transport processed food than live food. When you think about your Valley and develop your vision for it, consider the importance of agriculture. That is something that would be beneficial to you. If you keep your agricultural base as you expand vertically, then it gets better and more productive, and it provides you with all the things I mentioned earlier.

Where do we go from here? What is the challenge? Tommy Thomson, to whom this conference is dedicated, proved, that if you work together you can overcome major difficulties, major conflicts in water use. Today, if agriculture in the valley is to remain viable, farmers will need to work with all of the other water users and interests gathered here today to come up with new solutions and answers. As a matter of fact, I see some people from the Arkansas Valley who are working on the Colorado-Kansas lawsuit, and they are trying to come up with a proactive, least-cost, and beneficial way to resolve that lawsuit. Those kinds of activities are the best.

I have another analogy that I think Tommy Thomson understood way back before any of us even thought of it. The importance of sitting down with people and trying to come up with a good answer, is that you can come up with the most cost-effective answer. It is the best way to come up with a win-win scenario. Typically, people think, “oh you want a win-win? I am going to give away my farm and he gets what he wants, and that’s a win-win. That is not a win-win. That is a win-lose. I am not talking about the other way either. Take everything that he wants and cherishes, and and I give nothing, that is lose-win. I am talking about win-win. I think that Tommy Thomson understood win-win, understood the benefits of doing that.

It is more important today than it ever has been. As resources, specifically water, suffer more demand, we have to be more efficient at using it. We have to understand how we can use it effectively. The closer you have to call something, the better your answers have to be. I will give you an analogy for how we used to do it. I think that this is how government generally functioned for a number of years. We had one extreme position that would say, “We want it over here. This is what we think is right.” The other group said, “we want it over here.” Government basically said, “we will split it right here. Maybe not in the middle, but we will split it.” The expectations of the resource, however, were not as high, and our needs from that resource weren’t as high. Even if the decision wasn’t made in the best place, it was close enough. An axe-splitting deal worked when we were splitting logs, but we are now to the point that we are defining how splinters should go. That is why collaboration is important. That is why I am really pleased to see people of different interests and directions here, wrestling with the question of water.

In closing let me say again that to have sustainable agriculture you need a healthy resource and safe food, but you also need it to be profitable. If are not concerned about the viability of an industry, you will deal with the consequences of not being so. Maybe you will not have as much food as you want. If you do not consider all the benefits that it provides to your valley, you may find that you have to use tax dollars, Great Outdoors Colorado money, to give you open space, recreation, and wildlife habitat. So we have to split it, think about it, do it effectively, and balance it. That is what we have to do. I think that we can do that if we step forward in a proactive way and try to understand what the issues are. As the leaders that are here are getting involved and trying to get those answers, I think we can do it. So let’s say that in the Arkansas Valley, agriculture is very important. Water is critical to this state. The quality of it and our ability to appreciate and preserve it for others, affect all of our lives and our ability to make a living in this state.

Legislative Issues

Honorable Don Ament, Chairman
Colorado State Senator

Senate Committee on Agriculture, Natural Resources, and Energy

Good afternoon. I want to recognize a few people here, so as you think about public policy making in water you don't leave me alone here to defend all the water policy. We have from Senator Brown's office, I see, Dave. Is there anyone else from Senator Brown's office? Stand up. Judy's here too, good. And from Congressman McGinnis' office I just saw Steve, are you still here Steve or did you just say hello and leave? Good, Steve stuck with me. And Doris from Congressman Allard's office. Great, thank you. And don't forget, we still have former Representative Shoemaker in the room I see, and he knows a little something about water in agriculture as well.

Before I start this morning I'd like to know just for my own curiosity how many of you in this room are actual water owners who develop water and own water now. Can I see a show of hands. I really worry a lot about how many people really stay involved in water and water policy discussions and that's why I asked you that question. It's not that everybody isn't involved, but it's also important to know who actually owns the water.

I think I'm very fortunate myself to be a grandson of a water commissioner on the Western Slope and to have had the opportunity to travel around as he surveyed his ditches and headgates. As a youngster, I was able to follow him around as he made his rounds every day, and I learned a lot about water and water development and I got to see it with my own eyes. I also was privileged that my father happened to be associated with Thompson Pipe and Steel Company in Denver. I had a lot of opportunities, as he was a sales engineer earlier, to travel around with him and see people put water to beneficial use, see them develop modern-day practices, and see how people could actually make water stretch and also develop. And so I was really interested in seeing that as I grew up, and then as I looked at what was happening on my own family farm out northeast of Sterling, and how we developed water and put water to beneficial use, I was further amazed at what actually could happen with the proper use of water.

I guess what I want to tell you today is that I am very thankful that my forefathers, our forbearers, had the initiative, if you will, to go out and make something happen. Those people went out and invested their all in developing water. Many of you are aware of those kinds of things that happened in your own area, where people invested everything they had, even bonded their places to put water to beneficial use. I saw that on my parents' farm, my grandfathers farm, when they bonded their farm to develop a north Sterling irrigation district, defaulted on the bonds, and turned over again to start anew because they knew water was the future of their country. I watched how the Federal Government through the Bureau of Reclamation was part of tremendous projects -- projects that put water on the land, put water in communities, and developed water and stored it for that day when the rain didn't come and the snow didn't fall. I am alarmed now to see the new direction of the Bureau of Reclamation. I am curious to know if all the people who raised their hands in this room as water owners and people involved in water can tell me today that we don't need to develop any more water, that all we need to do is conserve and manage the water we do have better.

We have a very sound system that somebody put together ahead of us that we are enjoying now and I think as I talk through my remarks today I hope that we will have a discussion here on how we're looking to the future of water in Colorado and also our downstream states. I think what's going to dictate a lot of this is, of course, growth. We've already seen growth. I've seen a lot of growth in the State of Colorado since I've been in the Legislature. But I've also seen a major shift of the population. My Senate district, which is virtually everything in northeastern Colorado, lost 17,000 people in the last 10 years in that last census period; lost 17,000 people while the State of Colorado grew over 3 percent.

As we see this growth occurring and we get into discussion of higher and better use and moving water to the higher use, we also see some new problems. We've had some demands made, as you all very well know, by our downstream neighbor states. I suppose we'd have been okay through all of this if the water development pace had kept up with the growth, and of course I think that is where the problem arises.

We have new problems now, new influences, the new environmental awareness if you will, and environmental communities now. I think the top 12 environmental organizations have over \$500 million and untold numbers of people that are involved in influencing public policy. That's all right. I am involved in environmental issues myself. I make my living on the land and I have to take care of that. But I'm very much concerned now that as we look at water development

and water issues, that certainly the environmental community is playing a new role, and it's not that middle-of-the-road role that I'm concerned about. It's when they get too far to the extreme and don't have the background that I think necessary to play a meaningful part in the policy decisions that will come forward. I have to tell you, more than once do I invite people that testify before the Senate Ag committee to tell me what their experience has been in water law and water development. Of course, you can imagine in some cases they are well qualified; in most cases it's a newfound concern, and I appreciate their concern, but with that concern has to come a responsible approach to understanding the total picture.

I think we are in what I refer to right now as the post-Two Forks era. Many of you followed this yourselves, as that big project went down and it didn't go down because the people of the State of Colorado wanted it to go down. It went down because a bureaucrat in Washington D.C. vetoed the process. And so what we're looking at now in that project failure is all kinds of initiatives going forward to develop water. Of course, probably the first big one you were aware of was AWDI. Another one from the Arkansas River area would have been the Ft. Lyon Canal. But I can list a lot more of them. It could be over on the Colorado River in a Shoshone proposed change with Public Service Company. It could be water augmentation switches on the South Platte. You see the whole controversy about moving Weld County agricultural water to Thornton. And so I think there are a lot of examples of where we have seen the results of not developing a major amount of water.

And so what are we going to see along those lines? Well, it's a sure cinch that the permitting process is going to continue to be very difficult because of a lot of federal regulations. You aren't going to see it any easier to permit a project now, unless we have some major changes, than you did in the Two Forks time. We are going to see all kinds of problems because it takes nearly 30 years to permit a project. And of course that costs a lot of money, there are a lot of unknowns and you may not succeed after you spend the money and go through all of that. So we're going to see a lot of difficulty permitting. That's because of a whole host of things: Endangered Species Act, Clean Water Act, and a whole lot of things that I'm sure you're all aware of.

We will continue to see basin rivalries. I think you understand already. We've had a number of bills, basin-of-origin kinds of legislation, that try to say, here's the manner in which you can transfer water out of one basin to another, and most of the time those have failed. I think you have to agree, though, that our Prior Appropriation law has stood the test of time and has probably really ruled over those basin rivalries, and probably rightly so.

Water speculators? How many of you know the people who are now in the business of trying to get involved in moving the water we do have around to the highest bidder and to what some refer to as the highest and best use? I think a few examples of that, again, were probably AWDI and Ft. Lyons, but we have a new one, and you will see that debated to some extent in the State Legislature -- it's Roan Creek. That is an issue that I want to briefly touch on with you so you understand the implications. There is a conditional water right on the Colorado River owned by Chevron and maybe another couple of companies. It was a conditional right to be used to develop oil shale, and some quick-thinking folks in the Las Vegas area thought maybe it would be a good idea that they would spend their capital and go up in that Roan Creek area north of DeBeque on the Colorado River, place a dam there, and build a dam and store the water and then let the water run down to them as they needed. They would pay some fee for that water. In fact their contention is that they want to change the export statute in the Colorado Revised Statutes to allow that to happen. After 30 years the water would revert back to Chevron and they would use that for oil shale development.

So, there are some very innovative ideas around on how you do water. In fact, you can't believe all of them. Some are using those old single hull oil tankers and bringing water down from the Columbia River. I'm telling you, when you're out of water, as many of you know, you will do anything to take care of that.

Now, one of the other issues that I think, because of the Two Forks and lack of development, will be the exploration and maybe the production of closed-aquifer water. I think you see that in the Denver Basin where even the State Land Board is involved in some controversy and some contention about how you mine the water out of a closed aquifer. So there will be continued discussions on how you do this, and in fact how long it takes to replenish that closed basin. You will see another whole host of ideas come forward on how we mine water from our groundwater closed basin.

What's happening here? In my view, our society is very complacent about agriculture, about the food chain, and about water. Consumers expect to have an abundance of food at an affordable price, and they expect quality water at a reasonable price the minute they turn on the tap. And I think we're finding now that there are no guarantees unless we plan for that to happen. And that's the part that worries me right now. We have to prepare for the future like our forefathers

prepared for us. The implications of not preparing for this will be things that you have seen here; the dry up of ag land, the disappearance of small rural communities, the increase in cost of the quality of life that we've all become accustomed to, and consequently I think we're going to need to do some things to remedy that.

Where are we right now? In my view, one of the things we have to look to is change in the Federal Government. I think the Federal Government right now has all of a sudden decided that they are a major stakeholder in this water business themselves. They want habitat, they want wildlife, they want aesthetics, they want to carry out the mandates of the Endangered Species Act. And I always ask the question myself, where were they when we were trying to develop water and put projects in place? Were they a partner with us? And I suggest many times not. So I think certainly they should be one of the players and they certainly are one of the stakeholders and one of those that needs to be part of the solution.

We have new out-of-state demands, and I'm sure that's the reason many of you are in this room today. We have out-of-state demands primarily because, I think, states downstream have taken for granted as well their water supply. They didn't realize, as the State of Colorado has done, how you regulate water use -- the priority system, the well water system and so on. And so I think they are a part of our problem and they need to be a part of our solution. I'm really concerned where they were when we were trying to develop water and trying to put projects in place. They were a major stakeholder and I'm not so sure they were a part of our solution either. Now, of course, they want to renegotiate what we're doing.

Well, you've noticed, I'm sure, the Governor now has identified growth and population shifts to the Front Range as a major issue he wants to deal with. What do you suppose that's going to do to our water system? I suggest that one of the first things you'll see is the pressure to shift agricultural water to urban use. And the thing that never ceases to amaze me is that the Denver Water Board (regardless of how you feel about the Denver Water Board) had the foresight, the political clout, and the money a long time ago to go forward and develop water. So the City of Denver isn't too worried about all this. But the City of Denver that has that clout, and has that power, now has changed their whole focus, and their focus now is similar to the Bureau of Reclamation. They want to just manage water better and be more efficient about the way it is used. Those are very good things for them to do, but that is not the answer at the bottom line.

We are going to have to take a look, I think, at how we are going to handle this pressure, and one of those ways I think we ought to deal with regulatory reform is at the Federal level. We have to bring a reasonableness to the Endangered Species Act, the Clean Water Act, and the permitting process. That's not going to be easy to do. And we don't want to throw all of those things aside. But I think when we're doing things in Colorado to protect the pallet sturgeon in Missouri, when we're doing things in Colorado to look at a whooping crane in the central Platte, I think we need to talk about the implications of that. When we're taking water away from private water owners, from people that have developed a property right, when we're taking water away from them because the Forest Service supported by the US Fish and Wildlife says we're going to send this kind of water out of the South Platte River or out of the Arkansas or out of the Colorado or down the Rio Grande, when we're going to take a look at those kinds of things we're going to have to do some real tough comparison and a real tough balancing act. Because a lot of these rivers are made good out of the use and reuse, the filling of the sponge if you will, the return flow back to the basin or the recharge of the aquifer. Those are the things that make these rivers work. When you start pipelining that water out, we have to look at whether we are tearing down a system that we just have started to really make work well. And so I think these discussions and the implications these things have on small communities and agriculture will have to be looked at.

Quite honestly, this is the time to look at these things, with a major shift in the Washington scene. I think politically this is the time to see if we can't bring some reasonableness to some of those laws and let people know how they work. I just am appalled at the fact that in four or five of those communities I mentioned up in the northern part of the state, where the Forest Service is just blackmailing them to give them water or give them money, and they support that with the Endangered Species Act. And I'm really concerned about that -- that is just extortion at the first level. So those are going to be some of the things I think we need to do as we look for the balance at the Federal Government level. If the people of the United States really think it's important to use water for the endangered species, then they ought to help pay for it (with an environmental tax).

More importantly, what we have to do here is understand that we need to reach some cooperative solutions between the East Slope and the West Slope, the north and the south, that benefits everybody. I am one who believes that the solution to the Arkansas River problem, the solution to the South Platte, is more water, simply more water. If that's what we want to do, if we want to have all these projects, if we want to have water for recreation, if we want to have water for parks, if we want to have the kind of thing we all hoped we could have, and that's a beautiful, colorful Colorado, we must

have more water. It's very simple. We cannot continue -- just like I asked you, do you think you can sit in this room today and tell me this is all the water we'll ever need to develop, that all we have to do is conserve and manage it better? I can't say that, and if you can say that I would be glad to carry some of your ideas forward in the Colorado General Assembly and the public policy arena. But I don't think we can say that. No more could our forefathers have said that in the 1900s, and so I think we have to look to that future and we need to develop that water. And it's unconscionable for me to think the western slopers would say they would rather send that water to California than to the eastern slope of the State of Colorado.

I think people have to realize, again, that we all are stakeholders in this state's welfare, and those people on the Western Slope, north and south, east and west, wherever we want to take a look, benefit from a strong Colorado economy. We benefit by things that happen on the West Slope, but so do they benefit from things that happen on the East Slope. We can talk about it if you want in terms of school finance, in terms of highways, in terms of higher education, or in terms of tourism. I don't care wherever you want to look, keeping the entire State of Colorado healthy is something we all ought to be concerned about, and we need to keep everyone aware of that as we suggest some ways that we could cooperatively work together on some water development issues.

And so I would hope, in conclusion, that as we take a look at some of these things that we will explore some ideas about some storage that we would build for the Western Slope to assure them of water. I would hope that we would take a look at some cooperative solutions that would allow us to transport some more water on to this side. And most importantly, I would hope that we go forward and remind ourselves of the foresight of our founding fathers when they developed the system of water law and distribution that we live with today. I guess when I say something like that I have to remember Tommy Thomson, who invited me to speak and be a part of learning a whole lot about Colorado water law, especially down in the southeastern point. I want to remember that we should carry forward some of those ideas about how we can provide for the future of our children and for the children after that and keep the people of Colorado, and some parts of the nation, enjoying a world of food a'plenty, water a'plenty, and something we want to pass on as our legacy to those that follow after us.

Questions and Answers:

A: The question was about county powers, 1041 powers, and whether those powers should be used to halt and stop in its tracks water projects. My reply to that is that I carried a basin-of-origin bill that would allow, under certain circumstances, for you to transfer water from basins if you paid the price and met the criteria and so on. The counties really came after us on that issue because they thought it took away from their local planning and zoning, as you probably are aware. And so I tried to accommodate, reach a middle ground if you will, and say Hey, we understand there are impacts when we do water projects in your county. But there are also some benefits, and I tried to hit that middle ground by inviting all the water experts of counties, put everybody around a table and see if we could hit that median. How much should you pay for these rights to avoid from being stopped stone cold? And I guess I would have to tell you it was unsuccessful. You know, it is a balance. I like to keep zoning and planning and things like that, land use decisions, as close to the local level as possible. At the same time, I think there has to be some reasonableness with that, and so you try to hit a balance there and quite honestly, for one, I don't think we can continue to just be able to blanketly stop all water development with county powers.

Recreation Management

Steve Reese
Park Manager

Arkansas Headwaters Recreation Area

I am Steve of the "Steve and Mike Show." I appreciate the opportunity to be in front of a group like this. I think this is one of the most important things we can do. First, I'll give you some background on the recreation area. The Arkansas Headwaters Recreation Area was created in October of 1989 and it's a pretty slick operation, if I do say so myself. It's obviously new, just a little bit over five years old. Except at times, since I've been here throughout its duration, it seems as though it's several lifetimes. It's unique too. Today I stand here representing Colorado State Parks, who I work for, and the Bureau of Land Management, who I work with. Dave, would you stand up? That's my partner. Now sit down. Today, together as partners, Colorado State Parks and the Bureau of Land Management manage this new thing called the Arkansas Headwaters Recreation Area.

To give a little bit of background just to make sure everyone knows what it is, I preface this by saying the Arkansas Head Waters Recreation Area is what we're all calling the Upper Arkansas from Leadville down towards Pueblo. The Arkansas River (and we all know this) is recognized as a premiere recreation river in the United States. It is one of Colorado's outstanding natural resources and it's located right smack in the center of the state. Reaching from Leadville to Pueblo, the Arkansas Headwaters Recreation Area is a little bit longer than 148 miles. It has international, national, and statewide recognition for outstanding boating -- whitewater boating opportunities -- and is very well known for its outstanding fishing opportunities as well. Sightseeing is extremely popular for the river flows through the Sangre de Cristos and the Collegiate ranges; it lies in the bottom of the Royal Gorge; and it flows beside highways 24, 285 and 50 throughout its length which are primary tourism routes in Colorado. The recreation area is a two to three hour drive away from about two to three million people on the Front Range. The Upper River passes through four counties, six cities, and several smaller Colorado communities. Sixty percent of the river through this region flows through private lands; thirty percent runs through that belonging to the Bureau of Land Management; and ten percent flows through lands belonging to the Forest Service, municipalities, and the State of Colorado and other agencies.

We talk about land ownership; well, we all know water ownership is equally as important here. Every drop of this water in the Arkansas River belongs to someone, and it's on its way somewhere on some given schedule. On the Arkansas, whitewater boating has increased by an average of 18 percent a year from 1982 through today. There is more whitewater boating on the Arkansas River than on any other river in the United States. There is more whitewater boating on this river than on all other Colorado rivers combined. Just this last year there were 287,000 folks who had a really great time boating on the Arkansas. Water is a magnet for everybody. Hunting, hiking, fishing, sightseeing, camping, picnicking, gold panning -- all these uses are increasing. Again, just this last summer there was a total in excess of 475,000 folks that recreated on the Arkansas, and since 1990 that's an increase of over 64 percent. It's obvious that tourism and recreation have become leading industries in Colorado. Peak to peak, the recreation area consists of outstanding resources and recreation opportunities that have a very strong regional impact. It's estimated that the total statewide economic impacts of Arkansas Headwaters Recreation Area use are in excess of \$50 million annually.

Because of all this, recreation management and resource protection are critical issues, and working in partnership with communities, land owners, and all the many user groups is just absolutely essential. It is also essential to work with water users. That seems so obvious -- standing up here saying that today -- but just think back. Demand is removing our traditional barriers. As I said, it is a new recreation area, and prior to 1989 there was no recreation area and no management plan.

As was seen, recreational growth was occurring, and is occurring, at an extremely rapid pace. Landowners were concerned with increasing trespass. Private boaters were concerned with the burgeoning numbers of commercial boaters. Fishermen were concerned with any boaters. Flows were being altered in those days on various and sometimes arbitrary days. Local business were pleased with area visitors, but everybody was concerned with resource protection and the impacts this increasing use was creating. If there was a question, who did you ask? Was the answer, if you got one, the same in Canon City as it was up in Buena Vista? So, it was obvious that this increasing use had to have some guidance and control. Facilities needed to be developed, river access needed to be obtained, and issues facing the entire river corridor needed to be addressed.

The management plan we're working with today was developed with a 22-member advisory committee. These were people local in the valley, grassroots people, and their concerns created what we're working with today. It wasn't easy. It took several years and special state legislation which gave state parks the authority to manage recreation on the surface of this river, but this effort resulted in today's recreation area and the unique management approach, a cooperative management agreement. Again, this is a partnership between the Bureau of Land Management and Colorado State Parks.

Our roles have been defined and our missions have been agreed to. State Parks primarily has the responsibility for recreation in the river corridor. The Bureau of Land Management has responsibility for other multiple use activities which you would normally expect the BLM to be working with, and we both support each other, almost every step of the way. In addition, fortunately, the management plan also called for a seven-member citizen task force, and this is part of our recreation area's management team. This task force represents anglers, private boaters, environmental concerns, commercial boaters, land owners and cattlemen, the Upper Arkansas Council of Governments, and water users. These people on the citizen task force contribute a tremendous amount of their own time. They are our eyes and ears, and they keep our feet firmly anchored in reality. It would be very difficult to do what we're doing without them.

Recreation in the area is almost entirely funded by user fees. Except for outfitters and their guests, which pay one percent of the gross receipts taken in by commercial outfitters, you and I would pay \$1 per person, or you could purchase an annual parks pass good in any state park in Colorado. This is required in all of our developed sites. Since we have been in existence, again just a little over five years, we have operated in the black every year with these user fees. There is no question that by working together both agencies have been able to accomplish far more together than either one could ever even have considered doing on its own.

Some of the things that have happened: We have completed several land acquisitions which have provided important river access opportunities. Facilities providing services for fishermen, boaters, picnickers, sightseers and many other have been completed. These include restrooms, change areas, boat ramps, tables and grills, handicapped fishing trails, parking areas, internal roadways and necessary parking. Watchable wildlife areas have been constructed. Both resource studies and user surveys providing necessary, and I want to underline useful, information have been conducted and others are underway. One of those in particular is the one Bob Moore mentioned with the water needs assessment. Environmental education and safety programs are being developed and presented throughout the river corridor. Management issues are also being dealt with. Law enforcement programs have been implemented dealing with use issues. Carrying capacities for whitewater boating use have been established, and rationing of outfitted use is underway on the river. We just compiled this last year's use figures for the Arkansas, and for the first time we will be rationing in the Royal Gorge this coming summer.

This spring we will be opening a brand new recreation site just above Salida, a place called Stone Bridge, and a new campground at Five Points just above Canon City. We are working with Colorado's Department of Transportation to develop better and safer highway access to recreation sites. Two are complete with new accel, decel, and turn lanes, and three more will be under construction this coming winter in '95 and '96. In 1992 we began a stage of development utilizing lottery funds and budgeted at \$400,000 a year for a period of 5 years, or a total of \$2 million. BLM has budgeted additional funds throughout this time period. And just this month, you may have seen in the newspapers, Go Colorado has provided \$485,000 to the recreation area, allowing us to speed up our development program. It's obvious there is a lot happening on the river.

With all this in mind, we're looking for ways to do things better. We want to improve. We want to become more efficient and more productive. We want to provide better visitor services and resource protection. We want to be able to respond to changing demands in a well-balanced manner. This spring State Parks and BLM staff will work together out of the same office building in Salida for the first time. Up to this point, we've had one office in Salida and one office in Canyon City. I'm sure there are many other ways in which we can improve as well. Maybe we need to extend the partnership to include the Forest Service or other agencies within the Valley.

Bob mentioned the possibility of his concept of an NRA. That is being discussed in the area, and I think one of the things that's important to note for all of us is that with an NRA you use those initials to identify a concept, but what really is possible with that is we can develop it from the ground up -- what's important to us, what makes things work better, how we can improve, how we can become more efficient and productive -- we define locally and from the ground up what that NRA could be. That's a real important point to mention and to remember. And throughout all of this, it is essential to keep a sense of perspective, to stay in touch continually with our neighbors, our communities, and all the many people who have

an interest in the river and in the recreation area. Progress, good progress, the kind of progress we want, will no longer occur unless everyone who has an interest is involved. The Arkansas Headwaters Recreation Area began that way and it is important that it remain that way. The partnerships and working relationships formed over the last five years have been the basis of the recreation area's success. Continued hard work to maintain existing and develop new partnerships and understandings will be the basis of the areas ability to succeed in the future. Forums like this are just exactly what we need to do to be able to communicate and recognize what is important to each other. Thank you for letting us be part of this forum.

Recreation Management

Mike French

Park Manager, Lake Pueblo State Park
Colorado Department of Parks & Outdoor Recreation

I know a lot of people put a lot of time and energy into this forum and I hope you are enjoying it. During one of our forum planning meetings I was reminded that a lot of people really don't know a lot about Pueblo Reservoir or Lake Pueblo State Park, so I thought it would be appropriate if I gave you a short visual tour of the facilities that we have and the recreational opportunities that we offer at the park.

Shortly after the devastating flood of 1921 farmers and urban leaders began talking of improving water supplies and flood control. Various engineering studies of potential sites for dams and levies began in the late 1920s and continued through the 1930s. Finally, after much talk and debate in Congress, Congress approved the Frying Pan-Arkansas Project in 1962. As a result of the Frying Pan-Arkansas project, Pueblo dam was built and completed in 1975. Built by the United States Department of the Interior's Bureau of Reclamation, the dam is a combination earth and concrete structure over 2 miles long and 250 feet high. Created primarily to provide supplemental irrigation water to approximately 300,000 acres of agricultural land in the lower Arkansas Valley, the reservoir also provides flood control, water for municipal and industrial use, recreation use, and conservation of fish and wildlife. The reservoir is over 9 miles long with 60 miles of shoreline, and when full has 4,646 surface acres and stores almost 300,000 acre-feet of water.

Taking advantage of the recreational opportunities provided by the reservoir, the Colorado Department of Natural Resources entered into a management agreement with the Bureau of Reclamation for the purpose of managing and developing the reservoir and associated 17,000 acres of land for recreation and wildlife purposes. Management of the area is shared between the Division of Parks and the Division of Wildlife. Originally designated as Pueblo State Recreation Area by the Division of Parks, its name was changed a few years ago to Lake Pueblo State Park. The Park encompasses 4,512 acres of federal land, 4,533 acres of state land, and the 4,646 surface-acre reservoir, for a total of 13,691 acres available for public use.

With an annual visitation of 1.5 million visitors per year, Lake Pueblo State Park has become one of the top attractions in Colorado. The Park provides visitors with three campgrounds featuring 400 camp-sites. The visitor is provided with paved roads, a paved camp pad, electrical hookups, a shade shelter with a grill and a table at each site, flush restrooms, showers, laundry facilities, water hookups, RV dump stations, and play structures. A group campground which can accommodate up to 17 camping units is also available. 375 picnic sites provide day-use visitors with the table and grill as well as access to the many recreation opportunities which are available. The Park has 1800 paved day parking spaces, as well as 27 miles of paved road and 16 miles of paved, non-motorized trail which provides a connection from the reservoir to the trail system within the City of Pueblo.

Three entrances provide visitor access to the park and the park facilities: one access from the north by way of Highway 50; the other two from the south by way of Highway 96. The park provides the visitor with a developed swim beach located in the Rock Canyon area below the dam, and offers the visitor a nine-acre swim area with five acres of grass, sandy beaches, a covered deck and first aid station, restrooms, showers, tables, volleyball, food concession, a water slide, bumper boats, paddle boats, and a variety of playground equipment. The park offers four covered group shelters which offer large groups a facility with restrooms, electricity, tables, grills, volleyball, and play equipment.

Boating visitors to Lake Pueblo gain access to the reservoir by using one of two boat ramps located on the north and south side of the reservoir. Each ramp provides boaters six lanes for launching and retrieval of their boats. A combination park office and visitor center provides for administration functions and offers an 85-seat auditorium for large groups and park programs. A display area within the visitor center features displays and information relating to the park and the reservoir. Lake Pueblo features several private concessions operated under contractual agreements with the Division of Parks which provide additional services to park visitors. Two full-service marinas located on the north and south sides of the reservoir provide a total of 660 mooring slips to boaters. They also provide miscellaneous supplies, gasoline, boat repairs, boat rentals, and dry-storage facilities. The water slide and food concession located at the Rock Canyon swim beach are also park private concessions. The park also features a tour boat concession which provides park visitors guided tours of the reservoir and is very popular.

As one of the largest bodies of water along with Front Range, Lake Pueblo's 1.5 million visitors come to the area primarily to take advantage of the water-based recreation opportunities the area offers. Everything from sail boating to para-sailing, jet skiing to water skiing, pleasure boating to wind surfing -- all are available at the park. In addition to the boating opportunities, the reservoir provides the visitor with other recreation activities such as fishing, trails, swimming and camping.

Unfortunately, when you have the number of visitors that we have at Lake Pueblo, problems are bound to happen. That's not to say that all of the problems are caused by people. Mother Nature never fails to provide some excitement. However, hopefully through the hard work of the Park staff and more importantly through educational programs designed to help visitors learn more about the area and the environment, an understanding and appreciation will be fostered that will help preserve and provide the same opportunities for the future. And with that, that's briefly what we have at the park to offer to you.

Yak Tunnel Clean-up

David Suhr
Manager

Yak Tunnel Project Unit Environmental Manager, ASARCO

My topic is the Yak Tunnel primarily, but first I would like to give you an idea of the location of California Gulch. It is along the southern boundary of Leadville, and the Yak Tunnel is located within California Gulch. This clean-up project actually came about in three stages. First, we built a surge pond to pick up any surges that might occur out of the tunnel. The second stage was a water treatment plant which removed 99.99 percent of the minerals in the water. In the third stage, to control the flows to the water treatment plant, we built a flow-through bulkhead within the tunnel. Prior to that we had to rehabilitate the tunnel almost all the way in.

The tunnel was first built, or first started, in 1889 by a fellow named A. A. Blow. In 1893, about four years later, the Sherman Silver Act was repealed, and it had a devastating effect on the silver industry. About a year later, another group got together and formed the Yak Tunnel Mining and Milling Company. Its president was a fellow named James Grant, who incidentally was also the first Democratic Governor of Colorado. In 1895 work resumed, and the idea of the tunnel was basically threefold. The first idea was to provide water drainage for the mining area. The second idea was for exploration of the new areas underground. The third purpose was for ore hauling. Currently the tunnel is about four miles long, but it was originally planned to go through and under the Mosquito Range into Park County. As you might expect, most of the mining activity in the area occurred during the first during the First and Second World Wars. There was a mill located at the mouth of the Yak Tunnel. Here we are 100 years after the Yak Tunnel's history began, and we are faced with the clean-up of a tunnel that once was hailed by the *Denver Times* as the "Most Magnificent Mining Enterprise in the World." The construction of the bulkhead in the tunnel was intended to maintain a constant flow to the water treatment plant and prevent any surges. If the water treatment plant went down for any reason, we could shut off the flows at the bulkhead, repair anything in the water treatment plant, and store the water temporarily in the tunnel itself.

It is 100 years old this year. Looking inside the tunnel, you can see the water was not of the best quality, and there is a pipe along the side used to supply water to the mill, which is located near the mouth of the tunnel. The first thing we had to do was divert the water around the portal interests so we could construct a sound portal. We used sandbags and a pump behind them to pump to the water around our work area. In the process of rebuilding the portal entrance, we had to go under a road. The road started to slough, so we eventually had to tear it out completely and divert the traffic around it. As we went into the portal we used a backhoe to dig out some of the loose material. As we went in we backtailed behind us before we got into the actual tunnel construction, thereby rebuilding the road. As we got in there, we noticed that the back, or the roof as you might call it, had caved in. Water was working its way out of the tunnel, but not as readily as it should have been. Where the ground was really bad, we drove railing in ahead of us to protect the workers from any rocks that might fall from the back.

When we were partially in, we switched from wood sets to steel sets. They worked just about as well as the wood, but normally we use wood in underground mine supports. These are old sets that were put in several years ago. They are arched sets, and they were bent right on the spot. I had a forge there that bent them. You can see the previous water level in the tunnel, and there is some sludge we had to go through that was like really thick soup. You could actually walk through it, and we gave the state and the federal agency an opportunity and go upstream with us a couple times. It was not a pleasant job, because it was pretty messy. Once we got into the good ground we were looking for a limestone deposit deposited years ago. The ground conditions improved substantially, so we were looking for a spot to put the actual bulkhead. We ordered this submarine-type door about 36-inches in diameter, and it was placed in the bulkhead itself. It was cemented in. We also put timber and piping through the bulkhead. Some of the other pipes, the smaller pipes, are actually grout pipes, and we could use them to pipe grout or cement in after we had the bulkhead constructed.

The end of that submarine type-door and project is down at the water treatment plant. The door is upstream, so we will shut that whenever we decide to test the bulkhead for leaks. The lower pipes will have control valves that we can control from the water treatment plant, and they are installed right now. Ultimately, the water will go down to this plant where it is treated. It goes through thickeners, and the heavy part or the sludge is removed. If for some reason the turbidity or the other particles in the water do not meet the standards, there are gauges here that will indicate the water quality, and if it is not of substantial quality it will divert back into the surge pond that we previously constructed. Otherwise it will go

directly back into California Gulch. Everything here is controlled by a computer, and in case the computer goes down, it can be controlled manually.

Incidentally this project was totally funded by ASRCO and NEWMONT Mining Company.

Questions and Answers:

Q: Where does the sludge go?

A: Sludge goes up to East Helena to a smelter.

Q: How do you clean the water?

A: Primarily bring the pH up to 10.5, add a polymer and it settles in one of two thickeners. Once it has settled in the thickener, then it either is pumped to a filter press and dried, or part of it is recycled to thicken it.

Water Management And U.S.B.R. Policies

Jack Garner
Area Manager
Bureau of Reclamation

Today I would like to talk to you about what is happening to the Bureau of Reclamation -- where we have been and where we are going in the future. Reclamation was established in 1902 as a civil works and construction agency. Our original mission or vision at that time was to develop the water resources in the arid west, so as to promote settlement and economic development of the region. Reclamation did a good job. We build hundreds of projects with notable dams like Hoover, Glen Canyon, Grand Coulee, Shasta, and right here in our back yard Pueblo Reservoir, Twin Lakes, Turquoise Lake, and go over on the other side of the mountain to Ruedi Reservoir.

With all these dams and the infrastructure that goes with them, Reclamation is the largest wholesale supplier of water in the United States and the sixth largest generator of power. We manage 45 percent of the surface water in the Western United States. That all took place as a result of being a civil works and construction agency.

Back in mid-1980s, Reclamation began to realize that there were no more big water projects to develop. There are a couple of reasons for that. One of the primary ones is economics. We have hundreds, if not thousands of projects still on the books that have not been built, because they are not economically feasible. In addition to that, because of the environmental issues, it became increasingly difficult to get authority and money for constructing water projects and dams. Needless to say, the days of the Federal Government building large water projects and major dams are over. It has taken since the mid '80s up to the last 3 years for the Bureau of Reclamation to realize that is what has happened. We had to take a hard look at where do we go from here since we are no longer constructing these facilities. The answer is to concentrate on managing the facility and resources we have.

Joe Hall, our previous Deputy Commissioner, described it very well when he compared changing the direction of the Bureau of Reclamation to trying to change the direction of a large aircraft carrier. You can change the direction of a speedboat in a matter of seconds, but it takes a long time to change the direction of a large aircraft carrier. Reclamation has been changing direction since the mid '80s, and amazingly enough in the last couple of years, I have seen progress toward Reclamation becoming a water management agency. In order to change Reclamation direction from construction to a water management agency, one of the first things done was to reorganize (downsizing). We have done a considerable amount of downsizing. I think that every agency that is represented here -- I have talked to BLM, Forest Service, Division of Wildlife (DOW) -- everybody is going through downsizing. In Reclamation, we had a total of about 7500 employees westwide. In the last couple of years, we have reduced that by 1347 employees, which is a substantial amount. In my office alone, we have a total of about 120 employees, and by the next year we will have lost about 32 of that 120 employees. This is not the typical operation, where all of the people in the field are the ones that lose their jobs. I will be able to replace about one-third of the 32 that I am going to lose. Most of the 1,347 will come out of our Regional Office, Denver office and Washington Office, which is a little bit different than what usually happens. Normally, they keep their people, and we end up with nobody in the field. The problem is, with the 32 that I am losing or have lost, a lot of them are the institutional knowledge of this area -- Bob Jesse, Tom Gibbens, Roger Weideman -- I am sure that a number of you know those names. Those are the people who have the historic knowledge. You can replace that vacancy, but you cannot replace that knowledge.

Another organizational change area is the concept of the Area Office. As an Area Manager, what this means is the Commissioner has delegated more authority to us. I didn't believe it when the Commissioner said he was going to do this, but it has actually happened. A good example of what we have ended up with is the Ruedi contracting. Water contracting in Reclamation, is one of the more complicated processes. In the contracting process, we first develop a basis for negotiation, which is reviewed by the Region, Denver, and Washington. Many months later the approved basis comes back, and begin negotiations. When negotiations are complete, we would forward the contract to the Region, Denver, and Washington, and they would have to approve it. Commissioner Beard said, "We don't need all that stuff. If you, as the Area Manager, think it is a good contract, then you sign it," and delegated the authority to the Area Manager to do so. That is refreshing; by empowering the people in the field, you feel a lot more responsible for what you do.

We have eliminated a lot of levels of management in Reclamation. When I came into this position a little over 3 ½

years ago, I had 7 division chiefs and about that many branch chiefs. Today I have 3 division chiefs and no branch chiefs. We no longer have a head of the Pueblo office. It is handled as a self-managed team. We have six extremely competent employees, each with different expertise. They all report to me. This is a new concept, and they are doing an excellent job.

The other significant thing that has happened is the shift in our program priorities. Everybody is well aware of the fact that the Western United States is now the most urbanized portion of the country and is experiencing the most rapid growth. From the comments today about the growth of the Front Range -- you can see what the problem is. We have competing interests for water. This was demonstrated in the discussion on recreation use. Look at the issues among the rafters, the fishermen and the flatwater boaters. Look at the tremendous impact that the rafting industry has created in the Buena Vista and Salida area -- Steve Reese said there are some 280,000 whitewater rafters on the Arkansas River, which makes it the number one rafted river in the United States. That is incredible. Nobody 10 years ago would have thought that even possible.

Reclamation is moving from a construction agency to a water management agency. When we were a construction agency we put a low priority on our resource management responsibility -- recreation or wildlife, etc. Today as a water resource management agency, we have to look at where water is delivered. Whether it is being delivered in compliance with law, contract or permit; how we are reimbursed for its use; and what environmental impacts this use has. The bottom line is that there is not enough water and the days of the large transmountain diversion projects are over. That is fairly obvious when you see what happened to Homestake II and when you look at storage, either on-stream or off-stream storage. Look at the debate that is going on for Elephant Rock. The Federal Government is not going to come in and build major Federal facilities not now or any time on the near future.

As a Federal agency, we have to be responsive to public values, public opinion, and the public means. The public is telling us they want more recreation, fish and wildlife. I think the noon speaker brought up a excellent point. The agricultural community has done such a good job that it is almost to their detriment. People now want more activities to go along with what agriculture has made available to them. Their values have changed. Reclamation did not decide in the mid-1980s that we wanted to get out of the dam building business. The public and Congress told us that we were going to get out of the dam building business. Our funding is gradually decreasing. Funding for operation of our facilities is decreasing or staying level for the next few years. It was not Reclamation's decision to get out of the dam building business.

One of Commissioner Beard's highest priorities from a water management standpoint is water conservation. I have heard various references to water conservation in the speeches today. The fact is there is no new water coming in to the Valley, so we have to figure out what to do with the water we have. Reclamation came out with a set of draft guidelines for water conservation last week. There is a 90-day review period on those draft water conservation guidelines. It is not our intent to tell you how to do water conservation. Instead, we are trying to get you to come up with creative ways to do water conservation. Water conservation may not be the answer to the problem, but it is one of the answers to the problem. It is best for everyone, whether you are an agricultural user, or municipality to take a hard look at those guidelines for water conservation. The reason the guidelines were drafted is because the Reclamation Reform Act of 1982 requires us to have water conservation plans for all of our customers that benefit from Reclamation project water. What the Commissioner is trying to do is make those as flexible as possible. What he sees and what we have seen in the past, when we put together regulations that try to tell you how to do things, somehow we get bogged down in all the legal hassles. You spend more money on lawyers and we spend more money on paperwork, and we don't accomplish what we originally wanted to accomplish, which is balance of the resource and a better use of the resource. Reclamation is interested in the improvement and better management of water supplies. It is imperative to all of us to take a hard look at water conservation.

For all of you agricultural users out there, I know that the Reclamation Reform Act is a thorn in your side. It is a thorn in our side, and we are trying our best to figure out how we can accomplish some of these things without regulations. I feel that our best possibility is to work together. You have heard from virtually every speaker that what is important in this valley is partnership and cooperation. I see Reclamation turning the corner from a construction, hard-driving, dam-building agency, to a partner in water management. We are not abandoning the agricultural interests; we are just broadening the field of people that we are listening to.

Questions and Answers

Q: How do you manage the siltation, to keep Pueblo from becoming a mud flat?

A: My office has responsibility for the Frying Pan-Arkansas Projects, in addition to the Leadville mine drainage tunnel. You heard the previous speaker describe the siltation problems associated with the Yak and the Leadville tunnels, and how this mine drainage has been coming down the Arkansas for years and ending up in Pueblo Reservoir. Cleaning up and stabilizing the upstream mine areas is a step in the right direction towards cutting down on the siltation within the terminal reservoir, which in this case is Pueblo.

Q: Will the conservation plans fall under the compliance?

A: The draft guidelines (and I remind you that these are draft guidelines) have been modified and they are more flexible. One controversial item still in them is NEPA (National Environmental Policy Act) compliance. I don't see that as being that much of a problem in the Arkansas. I think that we need to take a look at the NEPA process and work with the water districts, and municipalities to see how we are going to apply it in the individual cases.

Q: Is there a hidden agenda in the Water Conservation Guidelines?

A: The Water Conservation Guidelines are not designed for the Federal Government to take water from agriculture and give it to fish. They are designed to take the limited amount of water that we have and identify the best use for that water, how we can utilize it and stretch it the furthest. It is the responsibility of water districts, on the ditch users, and the municipalities, to figure out what the best use is. I don't see water conservation from a regulation standpoint, but I do see it generating thinking of how we can better conserve our water.

State-of-the-Art Waste and Wastewater Treatment

Jon Northrop
Chief Executive Officer
Bion Technologies, Inc.

When I was invited to speak here today I wasn't quite sure how I would fit in or how Bion would fit in. Having listened to the speakers here today, I see that we are a good fit. We are a very small company, and we work on wastewater treatment and solid waste treatment, as it is borne in wastewater. We are fundamentally focused on agriculture and industries that are related to agriculture -- primarily food processing. We have technology that can be used for municipal wastewater treatment, but it has not been used that way yet. When it is it will be for small rural communities rather than for large cities, because it is fairly land intensive. We are providing a win-win scenario. We offer our clients systems that cost less and perform better than most of the conventional systems available, and that is a win for the client. In terms of cleaning wastewater, we offer systems that clean up very well and that create additional wetland and habitat areas. To regulatory agencies and people concerned with the environment, this too is a win. So in many ways we are assisting in the viability of the agricultural industry.

Let's move on to who we are and what are we doing. Our company was founded in 1989, and we are involved in innovative biological treatment of wastewater. The two principals in the company are myself and my brother, Jerry, who is a mad scientist. He has a Ph.D. in biophysics, and he developed the technology. We patented what we were working with, and we have been moving forward ever since 1989. I will show you some examples of the systems that we are dealing with, so you can see what we are talking about. Then I will wrap up why I think our technology or some similar to ours is a very appropriate thing to be considered in the Arkansas Valley.

Our systems offer a number of advantages. They are economical, and I mean economical. We can install a system typically for 10 to 40 percent of the cost of a more conventional system. They are also economical in the sense that the operation of the system typically costs 20 to 30 percent of what the operation of a more standard system would be. Finally, they are much faster to install and get operational. They are effective and we have yet to find a situation where we can not meet the set guidelines. In fact, we have put systems in a couple of locations where we are solving a problem that nobody else has yet been able to solve.

They are environmental systems in several factors. First, we in fact clean up the waste stream, so it can be reused or discharged to the environment under appropriate controls. Second, we create wetlands-like areas in most of our systems that are natural attractions for birds and animals. Third, the habitat area around the system is a very environmentally pleasing area.

We started our first project in 1991, and today we have 22 projects on line. We have about 16 people on the payroll, and they are spread across the country. We have two out in the state of Washington, and a number in New York. We have a number in Florida, and some in North Carolina. We are fairly well spread out, but our corporate headquarters is in Denver. We do not yet have any wastewater projects in Colorado, but that is on the drawing board for this calendar year.

Let me show you an example of how our technology differs from more standard technology. There is a large, advanced wastewater treatment plant in the town of Amherst, New York, serving a city of about 110,000 people. It occupies 64 acres, and it takes 80 people to run it. It was built in the late 1970s for 125 million dollars, and it is a good plant. In terms of size it is in the top five plants in the nation, processing about 25 million gallons a day, and it is consistently performs in the top one or two percent nationally. Our alternative can be seen in a system on a dairy farm in south central Florida. It is not treating 23 million gallons a day. In fact, it treats about 150 thousand gallons a day, so it is dramatically smaller in terms of the volume. The organic load processed in this system, however, is fully 20 percent of the load that goes through the bigger plant, processing 23 million gallons a day. If we were to expand this facility to treat the 23 millions gallons and the organic load that is carried in the municipal stream, the system would end up occupying approximately 100 acres. It would take 10 people to operate it, and it would cost about 12 or 13 million dollars to build. The performance, I am sure, would be every bit as good as that large plant that cost 125 million to build.

Let's go on and look some examples of what we are doing. We work with a light industry plant that is treating wastewater from a citrus processing plant in south Florida. The plant was facing a permit renewal crisis. They were

looking at about a million dollars to replace their wastewater treatment system with a more conventional one. We put this system in for about \$300,000, and it provides tertiary treatment. The waste stream goes through a preliminary screening, into a bioreactor bacteriological treatment zone, and finally to an ecoreactor area, which in effect is a large, intensely managed wetland area. Then the water is collected in a perimeter ditch for potential discharge through a permitted source or permitted point. The area surrounding the bioreactor is divided into a number of rectangles, and that is the ecoreactor. It is divided into 24 individual cells, and we process the water in various manners between and among those cells to accomplish the treatment objectives. We inject a substantial amount of air in the bioreactor area to introduce bacterial growth and to start the process.

This system is handling about 300,000 to 400,000 gallons a day, and the BOD load runs at about five-thousand parts per million. We use extensive aeration, and the water is then moved on into the ecoreactor system. There is a substantial variety of vegetation present in the ecoreactor. It is not seeded, and we do not try to conform it to a particular plant species by area. Instead we encourage as much diversity as possible to get maximum treatment performance. One of the interesting features about this facility is that it is a magnet for birds. There is a flock of birds that arrives on most mornings at about 7:30 or 8:00, and some say there are as many as 4,000 birds. Many of the people in the plant now take their coffee break to stand out in back and watch the bird life. They really like it, and we are pleased that the system has added that enjoyment to their situation.

The performance period is from March to May of 1994. We don't report during the summer, because the plant is shut down when the juice season ends in May. It resumes in October, so we have data through the tail end of the last juice season. It shows the percentage of reduction for a number of variables: BOD, 99.6; total suspended solids, 97.8; total nitrogen, 92; total phosphorous, 81. That is the performance we have seen from this system. This system is a zero discharge plan. It currently has a NPDES discharge permit, but when the permit comes up for renewal in July it will be canceled. Additionally, we are working with the company now to extend the system to handle all of the stormwater runoff from the site as well.

Let's look at another application, also in the citrus industry. We deal with another plant about seven miles from the first one we saw. They too were facing a permit crisis and had to replace their plant. They were looking at a cost of 2 million to 2.5 million dollars to do it. We got involved and installed a system on waste ground. There was an old gravel pit in the middle of a citrus grove, and we put the system in there. It cost them less than \$450,000. It processes between half-a-million to 1 million gallons a day, and the waste stream is very concentrated, carrying up to 40,000 parts per million of BOD. It is almost thick enough to cut with a knife. The water comes into the bioreactor area, and then it moves through cells three, four, five, six and seven, which are the ecoreactor cells. It goes into a final cell, which is a waste storage cell. In the bioreactor of this particular system, we have 140 horsepower of aeration. The water then moves, as I said, into the ecoreactor cells. The vegetation here is substantially different from the prior system. That is partly because of what was already growing there and partly because this system processes close to a million gallons a day. It has only has roughly 20 acres of space, so it is a very intense system. The other, processing 300,000 gallons a day, had 77 acres available for the system. So space changes the way the system operates, therefore it changes the plant life in the system.

The system water is finally disposed of by piping it to an area where they have planted new groves, and they use the water from the system to irrigate those groves. The water is piped from the plant to the system; it is processed through the system; and then it is piped back to the land surrounding the plant. They have about 80 acres that they used to use for wastewater disposal. They simply sprayed it out on the ground, and it subsequently killed all of the vegetation. You can imagine spraying water with 40,000 parts per million of BOD. It is going to wipe out the vegetation, and it is going to stink. So they had 80 acres of ground on which they just sprayed water repeatedly, and it was a disaster. The neighbors were complaining about the odor. With the new system cleaning their wastewater, they have replanted that 80 acres with citrus trees, and that will bring a very significant profit gain for them. Once those trees begin producing, they will net approximately \$3,000 a year per acre, so the system will be paid for two years after they start harvesting a crop. That is part of the economic benefit. The system itself is also a bird refuge. It is full of cranes, herons, ducks, grebes, alligators and the other kinds of wildlife you would expect.

The processing results we got from this system near the end of the processing season showed the BOD and TSS at 98 and 98 are about the same. The nitrogen and the phosphorus removal percentages, however, are lower, with eighty percent removal on the nitrogen and only 52 percent on phosphorus. That is by design. They are using this water to irrigate the young trees, and they wanted to have more phosphorous and nitrogen in the water to stimulate the growth of the trees to reduce the requirement for fertilization. We designed and built the system so as to leave a fair amount of that material in

the water for use on the plants.

Let's go to a different application: a surface water runoff system in which we are primarily trying to remove phosphorous as a nutrient. It is at a large dairy, again in the south central Florida area. This one happens to be in Okeechobee. The water from this dairy only has to travel about five miles to reach Lake Okeechobee, and from there it goes through the Everglades agricultural area, which is a huge problem in terms of phosphorous removal. Just as big sugar interests have been accused of killing the Everglades, the big dairy farms north of Lake Okeechobee have been accused of killing the lake. This is one of those farms, and it was releasing phosphorous to the environment at unacceptable levels. It has an area of 190 acres, and the actual dairy barn sits approximately in the middle of that. When there is heavy rain, as there is quite often in south central Florida, the runoff from this whole area is collected in one ditch and leaves the farm through that ditch. If any of you have read dairy magazines in the last three or four years, you may have read about the deadly ditch on Dry Lake Dairy Number 2 in Florida. That is the ditch.

The problem was that the phosphorous levels in that ditch were running at 17 to 20 parts per million, but the state required them to be at 1.2 in order to protect the lake. The situation had escalated to the point where the state said, "any more violations and we will fine you \$10,000 a day." A dairy farm can not afford that, particularly when there is water running in the ditch only 40 to 70 days of the year. We built a system that occupies about eight acres of his pasturage, however, it opened twelve acres that he previously had to fence off, providing a gain in land usability.

As the water enters the bioreactor, the system adds a small amount of chemical to help the process work. The reason for that is that we cannot establish a steady state bacterial population, because the system only has water going through it 40 to 70 days of the year. The bioreactor will dry up in the meantime. It can literally go from being dry one day to processing 10 million gallons of water the next. We had to add something to help the phosphorous removal process. We use a small amount of dilute ferrous sulfate. Ferrous sulfate is in the vitamin pills that many of us take every morning, and it is not a hazardous material. We are putting in what are effectively very minute quantities to accomplish the processing.

Water then flows through the ecoreactor area with some recycle back to the bioreactor, and leaves through the seasonal outfall ditch. The farm harvests this crop about twice a year and feeds it to his cows. Further down in the ecoreactor the grasses are shorter, and there is a wider variety of vegetation growing. He harvests this once a year and removes it to feed to the cattle. It runs about 25 to 28 percent protein, but hay harvested from irrigated, fertilized fields in Florida typically runs around 8 percent protein. So the farmer is delighted to get a protein rich food supplement as a spinoff from this system. The cost to install the system was about \$150,000, and it costs about \$20,000 per year to operate. Before we installed that system, the state of Florida had funded a demonstration project on the farm. They built a pure chemical precipitation system to clean the water, and it did a beautiful job. It created drinking water and produced absolutely outstanding water. Unfortunately they then told the farmer to buy the system and run it. The cost was \$1.2 million to buy it, and \$200,000 a year to run it. Furthermore, it produced a sludge that had to be disposed of at a hazardous waste site. The dairy farm could not afford it, and that was when we got involved. Recall the numbers. Our system costs about \$150,000 to buy and about \$20,000 per year to operate, so it is a substantial improvement for the farmer.

One day my brother was on site, taking some water tests. One of the people from the South Florida Water Management District, the organization that monitors this site, happened to show up. He had just purchased four wine glasses for his fiance. I don't know if he ever told her what he did with them, and if he did, I don't know if they ever got married. One was filled with water randomly sampled upstream from the treatment system. Two were filled with water from intermediate stages of the process. One was filled with water leaving the system. The water coming out is fundamentally clear. It has a slight brownish cast, characteristic of water in south central Florida, because of the tannin that is present in the water.

The outfall pipe is where the water actually leaves the system, and there are crayfish and minnows living in this water. This water is of very high quality, and it is meeting the performance targets it has to meet. Recall that this system can go from being dry to processing 10 million gallons per day and back to being dry in a 3 or 4 day cycle. It is very difficult to handle that fluctuation in a normal manner, however, on a treatment basis weighted by time, the total phosphorous levels before and after in milligrams per liter are 11 and 1.05, respectively. The standard the state has is that the rolling 12-month average has to be 1.2 or less. The system has been running two and a half years, and 1.05 milligrams per liter is the level where we are performing. So we are consistently meeting that target.

The dairy man has said, "you guys saved my farm. If you had not done this, I would have gone out of business, because there was no other alternative. I could not afford the fines or the solution the state was recommending." In addition, he and one of his brothers, who helps run this and another dairy farm, were at a situation with the regulatory people in which they were enemies. Today they socialize, their families socialize, and it is a nice feeling to see that coming from a system like this. We not only solved his problem, but we have healed a person-to-person kind of rift.

This is a different kind of approach, and it is the last of the systems I will talk about. Obviously I could run through a bunch more. This one is different, because it is in the north. The system is about 40 miles south of Rochester, New York, so it is a cold weather system. The dairy farm is currently milking 1200 animals. It is a free stall system, with the cows are in the barn or the milk parlor, but they are never in the pasture. When he can, he will add two more barns so that the total milking capacity will be 2400 cows. The system we built can handle the full 2400 animals. Another feature that makes the system different is that it produces a saleable product. The ones that I have already mentioned and most of the systems that we had worked on until we built this one, were solving regulatory problems. Somebody had to meet a standard for a regulatory group or had a permit coming up for renewal, and they had to upgrade their old system or install a new system. With this one the system actually creates a product.

Here is how it works. The barns and the milk parlor are flushed with recycle water. There are sloped floors so that all the manure is washed out into the collection pit. From there it goes into a bioreactor for initial processing and through a series of cells in the ecoreactor. Then the water is pumped back and reused, making his a zero discharge system. He occasionally will take some high intensity water out of the bioreactor to give a field a jump start. He farms about 2000 acres on this farm, and he will use that water to get a crop started quickly. Other than that all the water is contained in the system.

The flushing process starts down a lane cleaning out all of the droppings from a day or a half day. As the water flows out the back into the system it is carrying a tremendous load. Some people have said that it looks like thin cream of wheat that somebody died brown, and that is about what it is. The system is in the north, and last winter was brutal in that part of New York State. There was one period of about three weeks during which the temperature never rose above zero. For them, that is a tough winter, and they had a lot of snow. The system performed beautifully the whole time.

The process creates what looks like dirt, but let me describe it for you. Today's dairy cow, at least on this farm, weighs about 1400 pounds. It produces about 60 to 80 pounds of milk a day, and it also produces 120 pounds of semi-liquid waste. All of that waste is moved into the system by water, and the processing in the system is done by water. The 1,200 cows at that dairy, therefore, produce about 70 tons of manure a day. Our system converts that into 30 to 40 cubic yards of what we call bion-soil on a daily basis. You can't harvest it daily; you have to accumulate it, let the process work, let the bacterial action occur, recycle to enhance the nutrient loading in the material. but you can harvest it about twice a year. We go in with a bulldozer and push the material out of the cell and into piles. Once it is accumulated in the piles, we either sell it in bulk or sift and bag it. Since this material is certified by NOFA, the Northeastern Organic Farmers Association, it can be used by organic farmers on organic farms in the northeast part of the country. We have systems Florida producing a similar product, also certified for organic farm use. Citrus growers are interested, because organic fertilizers have been shown to enhance the performance of trees, increasing the yield and the sugar content of the fruit, and just the yield you get. It is good for home use in gardens, but I wouldn't recommend that anyone use it inside a house. We don't sterilize it, therefore it has manure gnats in it. Golf courses are looking at it for both new construction and top dressing on fairways. In Washington state it is being considered for land reclamation to sidedress roads where clear-cutting has occurred. There are all kinds of uses for this material, and it is very attractive.

We call it bion-soil, and it is all organic. In New York state we certify it as a 2-1-1 fertilizer. In Florida, because the systems run differently, we are actually going to certify it as 4-2-2 fertilizer. It has a full spectrum of the micro-nutrients necessary for plant growth, because the feed given to cattle in a high-intensity operation is a full-spectrum feed. Everything that is necessary is there, and cows do not capture it all. That makes the soil is a good blend.

One of the nice features of this system is that it is economical for the farmer. It not only solves a discharge and environmental problem but also produces income. Typically on a farm like this they spend anywhere from \$50,000 to \$100,000 a year to handle and dispose of manure. In this case, our system takes over the handling of the manure, so the farmer does not have to do that. We also create a marketable product and share the net revenue with the farmer. Once the system on this farm is finally debugged and running efficiently, the farm will go from spending about \$70,000 to handle manure to a net revenue of about \$40,000 a year from processed manure sales. That is an increase of over \$100,000 in the

profitability of the operation, attributable to the installation of this system.

This is a win-win situation. The client is clearly winning. The environment is also winning, because there is elimination of discharge and odor. The odor in the dairy is nearly gone because of the biology involved in the system. That feature has caused the hog industry to get interested in it, and we now have our first contract in North Carolina to install a system on a hog farm. If the odor problem can be solved, then they will really like the process.

That is a very quick look at Bion Environmental Technologies. I have shown you a sampling of the kinds of systems we are doing. We are not looking at municipal wastewater treatment for big cities, and we are not looking at treating hazardous or toxic waste from chemical plants or anything like that. Our focus is on the small municipal area, agriculture, farmers, and the industries that support them. That is where we think the attention needs to be focused. Because of the economics we can bring to bear, we think we can really help the farmer. We are trying to protect the environment, produce clean water, or restrict the discharge of polluted water, and we are creating wetland habitats. We are reducing the cost fairly dramatically and, in some cases, even creating a profit for the farmer. We think this is an important way for technology to be applied to wastewater, and we think it is important in a region like the Arkansas River Basin. We do not yet have any projects in Colorado, and I am not sure when we will. In the areas where we are working it is a good way to help establish environmentally responsible treatment that the farmer or the industry can afford. We think that it is an important move toward the future; critical for us, our children and our grandchildren. That's my story.

Questions and Answers

Q: What is the limit on the amount of wastewater this system could treat?

A: It could handle theoretically any size. There is a practical limitation on the land value surrounding cities as cities get bigger. We are looking at treatment facilities for 10,000 to 20,000 people, probably maximum size. There are some 10,000 or 15,000 plants like that in the country that need repair or replacement. We are trying to stay on the smaller side, partly because the land value is so high.

Q: Would it work near a river?

A: Certainly. It could work on the banks of a river. All we would have to do is line appropriate cells, if needed, so there is no migration.

Q: What is patented in this system? The bioreactor?

A: We have a number of patents. There is an overall patent on the process, and process patents are different than a patent on a wrist watch or calculator. With a process patent, we are patenting what it is that the process does and how we manage the process. We then have subsidiary patents under that. For example, in the bion-soil there is a patent application pending on the product produced by process, so it is that kind of patent protection that we have worked for.

Q: In what pathways are you moving nitrogen?

A: Primarily in plant growth, harvesting plant growth, or in the case where you are producing a soil-like product, you are binding it into the soil-like product so it can be sold and used as fertilizer.

Q: Untranscribable

A: Some, sure. In fact, in some systems we encourage that. It just depends on what the application is.

Q: What are some of the factors involved in design of the system in Colorado?

A: There are a number of factors because it is a natural system. In a cold climate it has to be bigger than in a warm climate, because in the winter the biological processes slow down. In a dry climate, you would clearly set it up to be as tightly controlled a recycle system as you could, so you clean the water and reuse it as opposed to disposing of it. In a dry climate you would try to hold the cell sizes down and keep as much sealing vegetation in as you could,

duckweed, for example, on any open water surfaces to try to retard evaporation. So you would change the system in the way you operate it for a more arid climate. We have one system running in the Yakima valley in Washington, and in that area they get about 12 inches of rainfall a year, so the climate is very similar to what it is here, and that system seems to be performing very well.

Q: What is the smallest size of an operation that this system would work on? (Rest of question inaudible)

A: So far, the economics say we don't want to take on a dairy farm with less than 280 to 300 head. The economics of the cost to construct, the cost to operate, say that is about the smallest we want to go to. We think we can get it down from that but we haven't succeeded yet, and we haven't tried it yet, quite frankly.

Q: The other question, have we considered tandem operation with a methane digester first and then one of our systems, so the methane digester could produce power or heat, or methane that could be sold, and then our system take over?

A: We have considered that. We haven't run one yet. When you run a methane digester you are left with a waste product and a waste stream that still needs treatment, so it would be logical that we could put the treatment system in to take care of that. The production of end product would drop, probably. The system wouldn't have to be as large, in all likelihood, so that could be done. We have one system where we have gone in tandem with a mechanical separator. The farmer separates mechanically and reuses the product he separates for bedding material, and we take the rest of the waste stream to treat it. There are lots of potential applications.

Demands on Municipal Water Managers

Gary Bostrom

Manager, Resources and Planning Division
Colorado Springs Water Department

This afternoon I would like to talk to you about our water resource planning efforts that the City of Colorado Springs has going on now. We are looking at how to meet the future water needs of the city. Before I do that, I would like to give you a brief overview of our system and some background information on Colorado Springs water.

Our developed water supplies are made up of local projects, transmountain projects, our Colorado Canal interests and our exchanges. Our local projects supply about 26,000 acre-feet per year. That is a small percentage of our total supply, so Colorado Springs has had to go great distances to develop its water supply, and primarily that has been through the development or acquisition of transmountain water projects where water is conveyed from the Western Slope to the Arkansas River Basin.

We also have water supplies that have yet to be developed. To put this in perspective, we currently use about 73,000 acre-feet per year, so our developed supplies are essentially double what our current demand is today. To give our water supply a geographic perspective, the green lines that you see on this map are our delivery systems, because we do collect our water primarily from the Western Slope or in the Arkansas River area. We need delivery systems to bring that water to the City of Colorado Springs. If you look to the left of the map, the heavy, grayish line is the Continental Divide.

We are very dependent on delivery systems, and that really is the challenge we face as we look to developing additional water or providing additional water to the city. How do we get additional water supply or delivery capacity for the city? And the challenge with delivery capacity is driven by growth. If you look at this map, it is a result of some work that we had consultants do for us to look at what kind of population growth the city might experience. If you look at the black line, that is the historical growth for the city through the '70s and '80s. The high, dotted line brackets the upper end of the possible growth for El Paso County, but it is representative of Colorado Springs as well. That represents an historical trend of what we have experienced in the past. The lower line represents what would happen if we have a major military cutback. That is essentially the loss of Fort Carson as a military installation in Colorado Springs.

You can see the effect of that. We not only lose population initially, but it takes a long time to recover from that occurrence.

If you look at the difference between those two lines -- the high growth and the military cutback -- by the year 2040 that difference is about the size of El Paso County today. So you can see that it makes a significant difference for us depending on what happens to Fort Carson. We have taken the high line and used it for water resource planning. We are risk-averse. We want to plan for the worst case, and this gives you a picture of where we are today and what we are looking at in the future. Currently we have about 320,000 people. By the year 2010 that could be, on the high side, as many as 445,000 people; and by 2040 we could have as many as 600,000 being served by our water system. Translated into water, that is currently 73,000 acre-feet, by the year 2010 about 106,000 acre-feet, and by the year 2040 about 140,000 acre-feet. So you can see, by 2040 we not only will have to address delivery issues, but additional water supply issues as well.

Our current delivery capacity is about 107,000 acre-feet per year. By the year 2010 we have to do something. We have to figure out a way to get more water to our customers if this growth does occur. I should also point out that because it is so difficult to build water projects that whatever we do to meet that 2010 date, we would make sure that it is large enough for this planning effort and that we address the needs of the community through the year 2040. That is about 33,000 acre-feet, about a 30 mgd system.

From this, we have developed a mission statement. Our mission is to develop a water resource plan addressing our community's potential water needs through the year 2040, and again, that is about a 30 mgd system (mgd = 1 million gallons per day). To do that, we have set up a planning process that we are calling our water resource plan. It is essentially an integrated resource plan (IRP). Some of you may be familiar with IRP. IRP is where you look at the full spectrum of alternatives -- supply side alternatives, demand side alternatives such as conservation, public process where you try to

include the public in the decision making process. Those are all elements of what we are doing in this process that I hope to describe to you today.

Some of the studies that we have done to date -- we started in 1989 with a raw water delivery study, the study that identified Elephant Rock as a potential dam site and a need that we would have for a western delivery system from Buena Vista to Colorado Springs. We have looked at the Williams Creek Reservoir site southeast of Fountain, Colorado that essentially would be used in all of our alternatives. We have looked at raising and enlarging Pueblo Dam. We have looked at the Fry-Ark operations -- How can the Frying Pan-Arkansas Project be operated in a way where we could possibly use some of that existing storage?

We have looked at our population forecast. I have shared some of those numbers with you. We have tried to evaluate how our customers use water so we can better identify conservation alternatives. We have gone back and looked at more Fry-Ark studies. We have modeled the Fry-Ark system, because there seems to be a potential in using existing storage instead of building new storage on the Arkansas. We have looked at water reclamation. Water reclamation is where you take wastewater effluent and treat it to a level where you bring it back into the potable water system.

It has taken us long enough that we have updated some original studies. We are looking at water conservation alternatives. Whatever we do will include water conservation. I appreciate the plug from Jack Garner on the award that we received last year. We are proud of that, and we believe that we have an excellent water conservation program in Colorado Springs, but there is always more that can be done. We are looking at local system improvements and how we can improve our existing system; development of groundwater; extending our existing nonpotable water system that takes wastewater and conveys it to irrigation customers; and we have also done some socio-economic, regulatory and environmental screening studies. I have some results of that I would like to share with you later on.

Just to give you a feel of what has been done, this overhead reflects what we did in 1989. The blue lines indicate existing delivery systems. The red lines indicate proposed delivery systems. Alternative A is an alternative with Elephant Rock Reservoir and a western delivery system. Alternative B comes up from Pueblo Reservoir. We even looked at Alternative C, and that is where we would enlarge Lake Meredith and have an easterly delivery system coming to the city.

Here are some results that we have just completed out of our MODSIM work and looking at minimum levels of storage that we need to make these systems work. This is still somewhat preliminary, but I thought it would be good to share it with you today. If we run water down Fountain Creek and we have an exchange into Pueblo Reservoir and there is a delivery system coming out of Pueblo Reservoir, we need a minimum of 5,000 acre-feet to make that work. That is a relatively small number compared to some of the numbers we have talked about in the past. If we have a western delivery system or we use Elephant Rock Reservoir, the storage requirement varies from 11,000 to 18,000 acre-feet. That does not include dead storage or other storage elements that might be required. But that gives you a feel for what we are looking for, and because they are in this range, they are of this magnitude, we believe that there may be opportunities to contract with the Bureau of Reclamation and the Southeastern Colorado Water Conservancy District to use some existing storage in the Fry-Ark project.

Here are some numbers from that same study about the Fry-Ark project. This graph shows how much storage is in Twin Lakes, Turquoise, and in Pueblo Reservoir and the maximum storage required. There are daily simulations from 1966 through 1990 of the project and we looked at how much storage was necessary to make the project work. It required out of the entire project about 260,000 acre-feet. There is a total of 352,000 acre-feet available, and so the minimum amount of storage that was available was about 92,000 acre-feet. There is lots of storage out there. In Pueblo alone there is about 58,000 acre-feet. One major assumption on this analysis is that we were not able to factor in East Slope storage water rights. For those of you who know about the Fry-Ark Project, that is a big component of the project, but if you take that aside this is how much storage is in the project just to operate with West Slope water. It gives you an idea how the system may be operated in a different way or storage that might be available at certain times.

Just to go to the other end of the water resource spectrum, I would like to quickly show you what a water reclamation system looks like. This is where we take wastewater, treat it, and put it back into our potable system. For those of you who understand water rights issues, we would recapture our transmountain effluent. Instead of making it go through an Arkansas River exchange, we would divert it out of Fountain Creek, near Fountain Colorado, and pump it into a water reclamation plant. This is a high-tech water treatment plant that has microfiltration, reverse osmosis, as well as many other processes. From that, we would store the water in Williams Creek Reservoir where people could recreate and then the

water would be piped to a conventional water treatment plant and then into our distribution system. In the future, for peaking purposes, we would build another reservoir, Jimmy Camp Creek Reservoir, east of Colorado Springs that would allow us to peak more with this particular system.

In addition to these technical studies, I would like to quickly show you some results of socio-economic work that we have done. We had focus groups that some of you attended and were involved in at Buena Vista, Salida, Pueblo, and in Colorado Springs. Based on those focus groups, we identified issues that concerned people and then did telephone surveys. We did about 500 telephone surveys in those communities. This is what we had heard, and I am contrasting Buena Vista and Colorado Springs. You notice the numbers do not add up to 100, and that is because it only shows those people who would approve or disapprove and not the indifference. So, the difference of the addition of these and the 100 are those people who were indifferent. You can see with Elephant Rock in the Buena Vista area that generally people disapprove of that project. They don't like the thought of a reservoir just upstream. At the same time, there are about 16 percent that said they would approve it, which was surprising to us. In the Colorado Springs area, 60 percent approved it but 30 percent disapproved it, and that was interesting to see -- that 30 percent of our customers, at least based on this sample, would disapprove of an Elephant Rock reservoir system.

Mount Princeton is essentially the same system as Elephant Rock without the large reservoir. With Mount Princeton you can see there are less disapprovals in the Buena Vista area and more approvals in Colorado Springs. With Pueblo Reservoir you can see, as you get away from Buena Vista and it is not in their backyard, so to speak, there is more approval -- 60 percent approval, 14 percent disapproval; Colorado Springs 55 percent approval and 32 percent disapproval, which is interesting that 32 percent would disapprove of this particular alternative.

Then, with water reclamation there is a clear signal that Buena Vista says: Colorado Springs, you can treat your own wastewater and use that before you tap the Arkansas, with 92 percent approval of that and 2 percent disapproval. But in Colorado Springs 70 percent of this sample approved of wastewater reclamation, which is very interesting as well.

As we consider what this water resource plan might look like, we are going to look at short-term strategies; because the longer we can defer these major projects that are in the \$300 million to \$500 million range, it is in everyone's best interest. We are looking at conservation, groundwater, non-potable system extensions, a Fountain Creek intake to better utilize our local water supplies, making improvements to the Homestake pipeline and Blue River pipelines, and a transfer system to move water around locally for better utilization.

Also, we are going to look at the selection of a major delivery system from the Arkansas and opportunities to contract for storage from the Fry-Ark Project and something that will have to be resolved as resolution of the Elephant Rock water rights filings.

So far, I have talked about the technical work that we have done. For a couple of minutes, I would like to focus on the public process side of it. That is equally as important. That is where we do all the technical work and we go out into our community and other communities and say, "What do you think? We want your input." Actually, this forum is one form of public input; being able to share with you what we are doing and to hear back from you about this process. Where we are at in this process is that we have completed our technical studies. We are in January, 1995 where we are preparing a draft water resource plan. This draft water resource plan will stay draft while we go through this public process, because we can't finalize it until we get all the public comment and until we hear from everyone. We are going through an internal review process with our own staff, the people who operate water treatment plants and distribution systems and watersheds, and asking them what they think, because they are the ones who operate these systems and probably have some better understanding of the system than we do.

We are also planning on holding workshops for staff and other general city folks that are affected by this. In February we will prepare for an extended public process that I will describe in a minute. We will meet with affected regulatory agencies, and all these major alternatives have some federal agency that is a player. To date we have met with many of them, and the feedback that I am getting is that they are all pleased with the process that we are following, and we want to keep them apprised as to what we are up to and what we are doing. We will look at opportunities for joint ventures. We will also consider having a citizens' group to help us address community values issues -- values such as allowing water to flow through the local tributaries of Colorado Springs, conservation levels, rates, growth issues, and those types of things -- we will work with a citizens' group. Then, we are also planning on briefing our Congressional staffs. Several of our Congressional representatives, over the years, have asked us about this process and we feel it is important to try and get out

and brief their staffs so that they understand where we are at in this process as well.

Then, March 1 is a very important date, because for those of you who follow Colorado Springs issues, that is the date when Fort Carson preliminary findings will come out on base the reduction effort. If Fort Carson is on that list, a lot of the work that we would expect to do after March 1 we will not do. It is hard to go out into our community and talk about growth-related issues when our community is going to be trying to figure out how we deal with losing the state's largest employer in our own back yard. But, with that said, if we assess that the effects on Fort Carson are not that great we will continue to go through this process where we will work with our council closely, we will brief the media to let them know what we are doing, and then we will try to really get out in the community and talk to homeowner groups and have symposia sponsored if possible, meet with civic groups, and we will do that not only in our community but in Pueblo, in Buena Vista, and along the Arkansas River. We plan on holding open houses in all of our city's neighborhood centers and also, again, away from Colorado Springs to hear what people think about these various alternatives. As we hear from people, we hope to capture everything that they say so that the decision makers, whether they are people on my team or whether it is city council, understand all the concerns that are related to any particular alternative.

Then, in June and July, if we finish this process by May (but when you go into this kind of public process it may take you two years to go through it), we are committed to taking however much time we need to get through a public process in a responsible manner. Assuming no major setbacks, we would hope this summer to take the public information, along with our technical work, and blend them together and integrate the two areas and come up with a water resource plan. We would brief our council on it and then go back and work on it probably some more, and hopefully in August we would present that plan to our city council. So, that is the public process aspect of it.

With this process, if any of you would like to follow what we are doing, I would encourage you to give me your name and address. I would like to include you on our mailing list. We will be glad to keep you posted on this whole process as we go through it. I have another request I would like to make of this group, and that is, if you are aware of groups along the Arkansas River that should hear this presentation as we go into the public process, I would like you to let me know of these groups. We want to make sure that people who are affected by our plans have an opportunity to hear about it and to comment on it.

Questions and Answers:

Q: What percentage of your water is used for irrigation?

A: About 40 percent of our water is used for irrigation. We are developing ways to recapture some of that water and be able to reuse it locally through a subsurface irrigation return flow program.

Q: Untranscribable

A: The yield numbers, I believe, are generally at the point of diversion, so they would reduce some as far as going to the tap. A lot of our systems are in pipe closed systems, but we would have some evaporative losses. As far as our consumptive use is concerned (this was years ago), it is about 43 percent, but that is irrigation included. If you subtract a certain amount of irrigation that we are able to reuse, it is less than that.

Q: Untranscribable

A: That is a good question. Right now we're holding it relatively constant, but as we apply the effects of conservation those will come down. Those of you who are familiar with the 1991 Federal Energy Act, it required that all toilets and showerheads be low-flow, so if you go to your local lumberyard all you can buy now are low-flow fixtures. So, those numbers will come down as far as use in 2010, 2040. We don't have those yet, but we are working on it. Over time, those numbers will come down, and then we will look at additional levels of conservation and even pull those down more. We are in the process of doing some of that now.

Q: Untranscribable

A: I think we filed back in 1989 based on actions by the BLM considering designating the Arkansas River as wild and scenic. We felt to preserve this as an option, as one of the alternatives, we had to file a water right to preserve that

particular option. I would guess that as we go through the public process and hear what people have to say and as we look at it technically, we will be in a position to evaluate the need for that particular filing for that reservoir.

Q: Untranscribable

A: First, the Homestake II water yield is 22,000 acre-feet divided between two cities: Aurora and Colorado Springs, 11,000 acre-feet per city. That is still an important asset for the City of Colorado Springs, and whatever we do in this process we need to recognize that those future supplies need the flexibility to be brought into the system. I know Jack Garner said that we may no longer see transmountain projects, but I hope that we still may be successful in the future in that development.

The second question is the effects on Fort Carson if it doesn't close. What do we expect our usage to be in about ten years. We have excess water. For those of you who are familiar with our sales, we sold about 45,000 acre-feet last year to farmers and irrigators in the Arkansas Valley. We think we can continue to do that, as long as we meet our primary goal of providing water to our customers.

Q: Untranscribable

A: It really depends on which alternative is most cost-effective. Williams Creek is generally associated with reclamation, and on a per acre-foot basis that is the most expensive. From a permitting aspect you don't have as many permits, so, there are offsetting issues. Elephant Rock is probably the next most expensive alternative in terms of building that reservoir and a pipeline system, and the least expensive, it seems like right now, is coming up from Pueblo Reservoir and using existing storage space, which isn't surprising. If you can contract for storage space and not build it, you automatically get some cost savings there.

Q: Untranscribable

A: Given the assumptions that went into that model, that is the findings. That is daily modeling from '66 to '90, and again, East Slope storage rights were not included because we couldn't figure out how to do it. I guess what that is saying is there is excess storage space in average and dry years, and in the wet years, the one in ten years when the East Slope rights kick in, there isn't storage, most likely. But if you have some ways to handle that with a contract, it seems like you still have a basis for figuring out a way to use that. In those extremely wet years, there is not the demand for the water, so there are other ways that you could address that.

Shifting Paradigms

Steve Glazer
High Country Citizens' Alliance

Good evening ladies and gentlemen. When Jeff Keidel invited me here tonight to talk about the public trust doctrine, I was flattered. I must preface my remarks with the disclaimer that I not a lawyer and I only have a layman's interest in this subject--admittedly a very interested layman.

The public trust doctrine involves the protection of public values. Our societal values are constantly changing. I refer to these changing values as a shifting paradigm. A paradigm being a model of how things are done or ordered. Since the turn of the century, our priorities had been to protect our individual, business and corporate interest's first, and our community and environmental interests second. I suggest that the current paradigm is a reversal of these priorities. Citizens of Colorado and the nation today are most concerned about our communities and environment. This new way of thinking started over 20 years ago with the passage of the Clean Water Act, one of the most comprehensive pieces of legislation ever passed by Congress. It was closely followed by a litany of environmental legislation intended to create a framework and mechanisms to protect our environment-its integrity and diversity. Even with this mandate, we still have not been able to protect water quality and are seeing a decline of the populations of most native aquatic species in all our river basins.

The recent challenge to the momentum of this effort, in the form of anti-regulation furor and takings rhetoric, I suspect, its an effort to resist the shifting paradigm. This is happening because of the reluctance of our institutions to change. The status quo has phenomenal inertia. Congress and our legislature are controlled by special interests that are determined to maintain the status quo. The public values paradigm, though, is gaining recognition of its new priorities form judicial and administrative government. The public trust, as public values doctrine, and strike down legislation that interferes with public interest goals.

There are several reasons for the current interest in understanding the public trust doctrine. Among them are that the doctrine was drawn into appropriative water law in California by the Mono Lake Case that, after 15 years, was finalized in September of last year. And the High Country Citizens' Alliance attempted to assert public values in Colorado water law in the Union Park Cases decided by the State Supreme Court in February of this year. Also, an effort is underway to put an initiative on the 1996 ballot that would amend the Colorado Constitution to require a strong public trust doctrine that would protect and defend the public's interest from marrow definitions of water as private property. I will discuss these events, but first, some background.

The origin of the public trust doctrine is found in Roman law as was incorporated into English common law following the Magna Carta. Quoting Institutes of Justinian 2.1.1, dated 533 AD, "By the law of nature these things are common to mankind-- the air running water, the sea and consequently, the shores of the sea." This historic concept led to a US Supreme Court decision in Martin v Waddell in which Chief Justice Taney wrote in 1842, "When the Revolution took place, the people of each state became the holders of the absolute right to all their waters and the soils under them for the own common use." The Court, in 1891 added, "The government is guardian for the people over the public lands. The obligations of the government oblige it to see that the law is carried out, and that none of the public domain in wasted or disposed of to a party not entitled to it." And the landmark Illinois v Illinois Central R.R.Co. (1892) decision moved the public trust doctrine from the national level to the level of the states. The Supreme Court said "The doctrine is founded upon the necessity of preserving for the public the use of..waters form private interruption and encroachment...and control by the state, for purposes of trust, can never be lost." When Colorado adopted the prior appropriation system it provided for usufructury rights that are grants by which the state conveys use to those who wish to use the waters held in trust by the state for the public. The significance that the Colorado Constitution retained the ownership of water to the people has faded over the years as laws and court decisions asserted private use rights. This has led to the state not preventing private uses from impairing public trust interests in water and underlying lands.

The three traditional public trust uses are navigation, fishing and commerce. If fishing is protected by the trust it follows that the fish themselves are a trust asset and since fish require aquatic vegetation and macroinvertebrates for sustenance, then the need to maintain the biological, physical and chemical integrity of our streams should require that the trust protect the stream quality, bed, banks and riparian wetlands as well. In 1983, in National Audubon Society v Superior

Court of Albany, the California Supreme Court said “to administer the appropriative water rights system without consideration of the public trust doctrine may cause unnecessary and unjustified harm to the trust interests. The continuing power of the state, as administrator of the public trust, extends to the *revocation* of previously granted rights or the enforcement of the trust against lands long thought free of the trust...” This case does not preclude non-environmental uses of our waters but requires them to be balanced, and can be used to set a standard or review for administrative actions to prevent environmentally harmful activities. Protection of the uses of water has since been explained to include recreation, habitat protection and aquaculture. Most harmful uses are usually unintended and unwitting. Once identified, though, the public trust obligation is to correct these mistakes.

The Mono Lake Case was brought against Los Angeles because a transbasin diversion of 95,000 AF per year was destroying the ecosystem of the basin of origin. Los Angeles had been diverting this water for over fifty years which was 25 percent of its total water supply when the court ordered a stop to the diversion and environmental studies conducted. That was in 1989. In September of 1994 the court confirmed its preliminary order saying that LA could not resume its diversion until Mono Lake reattains its historic levels and future diversions cannot reduce the lake level.

The Colorado courts, on the other hand, have spurned recognition of the public trust doctrine. In the Union Parks Case, High County Citizens’ Alliance attempted to avoid the public trust by focusing on public values. We asked the water court, when evaluating a water right application, to examine and evaluate what the public’s interest is in that resource before they allow it to be appropriated to private use. Our attorneys focused on the constitutional recital that, prior to appropriation to beneficial uses, the water is dedicated to the use of the people of the state. In February, the Supreme Court rejected our cross appeal, saying “...the good of the public is the province of the General Assembly and the electorate. Conceptually, the public interest theory is in conflict with the doctrine of prior appropriation because water court cannot, in the absence of statutory authority, deny a legitimate appropriation based on public policy...We reject the...invitation to create a complex system of common law to balance competing public interests.” As you might assume, this is not the interpretation we were hoping for.

The citizen initiative titled Public Rights in Water is an attempt to reintroduce a dual, equal and conjunctive system of private and public ownership and uses of water. The current imbalance favoring private use is the result of the cumulative effect of numerous court rulings defining appropriated water as private property. In People v Emmert (1979) the Colorado Supreme Court said that Article XVI, Section 5 of the Constitution only retained public ownership of water to preserve the historic appropriation system, specifically rejecting the public trust. As a result of Emmert, once appropriated, water became the property of the appropriator not to be interfered with by the public. As more and more water is appropriated we are reaching the limit of the resource, exhausting its supply and impairing its quality. Because of the ever increasing and competing demands for water, it is time we start confining the definition of beneficial use. The legislature has defined and prioritized uses but has not defined what is *not* beneficial, such as overuse. Incorporating a strong public trust doctrine into Colorado water law will require that water cannot be appropriated to uses that would conflict with public values. If we want to continue to pursue our goals of finding a new balance between public and private uses in Colorado, the court suggests we seek redress from the electorate. And that would have to be in the form of a ballot initiative. There is one embodiment of the public trust doctrine in Colorado water law.

In 1973, responding to the new environmental awareness sweeping the country, the legislature created the Instream Flow Program as an attempt to protect the natural environment to a reasonable degree. The program stated out by only providing minimum flows needed to sustain a single trout species. But through agency rule-making procedures, we have been able to expand the definition of beneficial use of endangered fish including warm water species. Appropriations are now being made in a manner to reproduce more natural hydrographs destroyed by impoundments. The public trust doctrine depends on a strong and well defended instream flow program.

The research you are dedicated to is critical in order to show a strong relationship between cause and effect. You need to help identify impairments to our streams so they can be corrected. Good science is our best tool to putting an end to the abuses our most precious natural resource is being subject to. A strong emphasis needs to focus on the importance of wetlands and how badly they have been neglected. We also need lots of data from you to justify a frontal attack on the causes of non point source pollution. Then, hopefully, a discussion on the subject of integration water and land use planning and management can receive the attention it deserves.

Proposed Initiative on “Public Rights in Water II”

The title as designated and fixed by the Board is as follows:

AN AMENDMENT TO THE COLORADO CONSTITUTION CONCERNING THE PUBLIC’S INTERESTS IN THE STATE WATERS, AND, IN CONNECTION THEREWITH, REQUIRING THE STATE TO ADOPT AND DEFEND A STRONG PUBLIC TRUST DOCTRINE WITH RESPECT TO THE WATERS IN COLORADO WITHOUT DENYING THE RIGHTS OF THE USES OF WATER BY THE MANNER OF APPROPRIATION; REQUIRING THE STATE TO DEFEND THE PUBLIC’S OWNERSHIP INTEREST IN STATE WATERS; PERMITTING THE OWNERSHIP OF WATER RIGHTS TO BE DECREED TO THE PUBLIC AND DEDICATED TO THE BENEFIT OF A PARTICULAR WATER SYSTEM WITHOUT HINDRANCE FROM A STATE OR OTHER GOVERNMENTAL BODY; REQUIRING THE COLORADO WATER CONSERVATION BOARD OR ANY GOVERNMENTAL SUBDIVISION WITH A SIMILAR PURPOSE AND FUNCTION ACCEPT AND PROTECT THE PUBLIC’S OWNERSHIP OF DECREE WATER INTERESTS FROM TRANSFER; REQUIRING THE STATE TO DEFEND DEDICATIONS OF DECREED WATER INTERESTS AS A MATTER OF THE STATE’S PUBLIC TRUST IN WATERS; REQUIRING THE APPROVAL OF A MAJORITY OF A DISTRICT’S ELECTORS VOTING ON THE ISSUE BEFORE CHANGING THE BOUNDARIES OF OR ELIMINATION A WATER CONSERVANCY OR WATER CONSERVATION DISTRICT; AND REQUIRING THAT ALL DIRECTORIES OF A WATER CONSERVANCY OR WATER CONSERVATION DISTRICT BE ELECTED IN A SIMILAR MANNER AS BOARD MEMBERS OF SPECIAL DISTRICTS.

Be it enacted by the people of the State of Colorado that Section 5 or Article XVI of the Constitution of the State of Colorado is amended to read:

Article XVI Section 5. Water of Streams Public Property.

(1) The water of every natural stream, not heretofore appropriated, within the state of Colorado, is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the state, subject to appropriation as hereinafter provided.

(2) THAT ON AND AFTER JANUARY 1, 1997, THE STATE OF COLORADO ADOPT AND DEFEND A STRONG PUBLIC TRUST DOCTRINE REGARDING THE PUBLIC’S RIGHTS AND OWNERSHIP IN AND OF THE WATERS IN COLORADO; AND THAT THE PUBLIC FURTHER REQUIRES THAT THE STATE OF COLORADO PROTECT AND DEFEND THE PUBLIC’S INTERESTS IN WATERS FROM UNWARRANTED OR OTHERWISE NARROW DEFINITIONS OF ITS WATERS AS PRIVATE PROPERTY; BUT, HOWEVER, THAT THE RIGHTS OF THE USES OF WATERS BY THE MANNER OF APPROPRIATION NOT BE HEREINUNDER DENIED.

QUALIFIED ELECTORS OF THAT DISTRICT’S VOTERS WHO ACTUALLY

(3) ADDITIONALLY, ANY CHANGE IN THE BOUNDARIES OF A WATER CONSERVANCY DISTRICT OR A WATER CONSERVATION DISTRICT, OR ANY PROPOSAL REGARDING THE CONTINUED EXISTENCE OF A WATER CONSERVANCY DISTRICT OR A WATER CONSERVATION DISTRICT, MUST RECEIVE THE APPROVAL OF THE MAJORITY OF THE STATUTORILY CAST BALLOTS AT AN ELECTION REGARDING SUCH ISSUES.

(4) ADDITIONALLY, ALL DIRECTORS OF WATER CONSERVANCY DISTRICTS AND WATER CONSERVATION DISTRICTS SHALL BE ELECTED TO THOSE DIRECTORSHIPS IN A MANNER SIMILAR TO THE ELECTION OF DIRECTORSHIPS FOR OTHER COLORADO SPECIAL DISTRICTS. WATER CONSERVANCY DISTRICTS AND WATER CONSERVATION DISTRICTS SHALL INCLUDE THOSE POLITICAL SUBDIVISIONS OF SUBSTANTIALLY SIMILAR PURPOSE AND FUNCTION OF EITHER TYPE OF DISTRICT WHICH MAY BE CREATED EITHER STATUTORILY OR CONSTITUTIONALLY HEREAFTER.

(5) ADDITIONALLY, ANY OWNERSHIP IN THE RIGHTS OF USE OF WATERS MAY BE DECREED TO THE PUBLIC WITH THE UNDERSTANDING THAT SUCH DECREE WATER USE RIGHT SHALL BE DEDICATED TO THE BENEFIT OF ANY STREAM OR WATERCOURSE OR TO ANY LENTIC WATER BODY FOR THE BENEFIT AND USE OF THAT SYSTEM WITHOUT HINDRANCE FROM A STATE OF COLORADO OR OTHER

GOVERNMENTAL BODY. IT IS FURTHER PROVIDED HERE THAT THE COLORADO WATER CONSERVATION BOARD, OR ANY GOVERNMENTAL SUBDIVISION OF A SUBSTANTIALLY SIMILAR PURPOSE AND FUNCTION WHICH MAY BE CREATED EITHER STATUTORILY OR CONSTITUTIONALLY HEREAFTER, MUST ACCEPT AND PROTECT SAID PUBLIC OWNERSHIP AND DEDICATIONS FROM WATER TRANSFER FROM THE PUBLIC'S OWNERSHIP, OR FROM THE TRANSFER FROM THE WATER SYSTEM TO WHICH THAT DECREE WAS DEDICATED. IT IS SPECIFICALLY ENACTED HERE THAT ANY AND ALL DEDICATIONS OF DECREED WATERS TO THE USES OF STREAMS AND WATERS AND LAKES SHALL BE DEFENDED BY COLORADO GOVERNMENT AS AN ELEMENT IN THE MATTER OF COLORADO'S PUBLIC TRUSTS IN WATERS.

RICHARD G. HAMILTON
164 WEST LANE
P.O. BOX F
SHAWNEE, CO 80475-000F

JEANNE W. ENGLERT
1840 CENTAUR VILLAGE DR.
LAFAYETTE, CO 80026
303-665-2582

**Presentations on Wednesday,
January 18, 1995**

Water Purchases -- Changes in Place and Type of Use

Doug Kemper
Manager, Water Resource Division
City of Aurora

The title of my talk today is "Water Purchases: Changes in Type and Place of Use." I will be giving some background on Aurora's system; discuss what Aurora considers when we are developing new water supplies; spend a little time on the Rocky Ford transfer and our revegetation project; and then conclude with some comments on our future direction.

The City of Aurora is located east of Denver. Its current population is about a quarter of a million. Our planning area is about 200 square miles. We currently treat about 45,000 acre-feet of water per year. Our growth rate is forecast to continue at a little less than 2 percent.

About 5 years ago, we revised our policies for water supply and acquisition. About the time the Two Forks permit was denied, the city withdrew from its Collegiate Range Project in the Gunnison Basin, and were also deeply involved in litigation over the permit denial for Homestake II in the Eagle River Basin. These events really forced us to reevaluate how we were approaching our water supply and development.

The most significant policy change was that we will focus on an incremental approach to water supply development targeted at bringing on-line 10,000 acre-feet per decade of new water supplies. That matches fairly well with the 2 percent growth rate.

When looking at developing new water supplies, the options really fall into 3 categories.

One is to develop water supplies that are not currently allocated to a given use. An example of this would be to develop a flood water right. With the proposed Two Forks Project, a good portion of the yield would originate from wet year flows on the South Platte River. What is needed for this type of project is a large storage bucket to capture the high flows that come fairly infrequently. Another example of developing unallocated flows is to develop water supplies in a basin where there is excess water in most years. One approach is to go to the West Slope and develop water supply projects. The Frying Pan Arkansas-Project would be an example..

A second category of commonly used approaches to water supply development is to make more efficient use of existing supplies and systems. Water conservation is in this category. Aurora has a very aggressive conservation program. We have one full-time staff person and a part-time staff person that work exclusively with water conservation.

Another approach in the category of making more efficient use of existing supplies is recycling. Water not historically a part of the stream system can often be legally reused. This would include water imported from another basin and transferred agricultural water rights. That type of water can be directly reused, but in the United States that really is not a practice -- where a direct connection is made between the wastewater treatment plant and drinking water supply systems purposes. At our Sand Creek Reclamation Facility, Aurora has been directly recycling a portion of its wastewater for irrigation uses for almost 25 years.

The more typical way that we recycle water is through exchange programs where either sewer return flows or lawn return flows are exchanged back upstream to a point of diversion. Colorado Springs has pursued that approach. Pueblo is in water court this week with that approach. Aurora has also operated exchanges for many years.

A third area where more efficient use of existing supplies is being studied is through a group of Metro area water suppliers known as the Front Range Forum. The Colorado Water Conservation Board has a \$450,000 study that is examining how can we best work together. In essence, a lot of that study is focusing on Denver system spills. Denver's collection system typically spills water in a normal year, and a lot of the discussion is focusing on that as well as effluent reuse and more creative things with the agricultural community like the interruptible supply contracts, etc.

The third category of approaches to water supply and development is reallocation of existing supplies, and this is typically the purchase of agricultural water rights. About three quarters of Aurora's current supply system has been

developed through the purchase and transfer of agricultural water rights, mostly in the South Platte Basin. Delays associated with both Two Forks and Homestake II resulted in the decision to complete two agricultural water purchases in the lower Arkansas Basin.

One of the purchases involved the Colorado Canal that is located in Crowley County about 50 miles east of Pueblo. Colorado Springs had initially acquired just over half of the shares in the ditch company and Aurora followed with an acquisition of a quarter of it. We ended up retiring about 11,000 acres as a result of this transfer. Colorado Springs did about double that. The yield to Aurora from that transfer was about 8,000 acre-feet, making it one of our largest agricultural transfers; the largest, next to Rocky Ford.

The Rocky Ford transfer took place in the mid '80s as well. We entered into an agreement with a group of private investors to purchase 58 percent of the shares in the ditch that were historically used to irrigate 4,100 acres. The transfer decree that was ultimately granted was unusual in a couple of respects.

There were requirements to develop a computer program and to hire a water commissioner to administer the decree. The decree that ultimately was entered required monitoring about 20 different items on a daily basis. This was one of the most complicated transfer decrees that had gone through in the basin, and the concern was that we needed more in the way of administration. For that purpose, we provided a water commissioner for a period of five years, a computer and a computer program.

Another unusual aspect of the decree was revegetation requirement. For the first time that I am aware, the East Otero Soil Conservation District became involved in a transfer proceeding. Their concern was: if water was moved off the land would there become a blowing dust and weed problem? Revegetation requirements were for the first time required in both the Colorado Canal and Rocky Ford transfer decrees. It is now part of the statutes. In 1992, the Legislature passed a bill requiring that all agricultural transfers must consider revegetation provisions.

The city's revegetation program is located near Rocky Ford. Revegetation is divided into three steps. The first step is to plant a cover crop, typically corn or milo. We shear that off at 12 to 18 inches. The purpose of the cover crop is threefold: to provide a firm, relatively weed-free seed bed for the grass to germinate; to provide some physical shelter from winds, and to provide mulch to reduce soil evaporation.

Before any seed went into the seed box, there was a tremendous amount of research that went into the program. A number of different entities spent roughly a quarter of a million dollars over five years studying the best species to use, when to irrigate, how much to irrigate, and what methods of weed control would work best. The seed mixes that were selected were Side-Oats Grams, Blue Grama, Alkali Sacaton, Switchgrass, Western Wheatgrass, and Yellow Blue stem.

Weed competition; particularly Koshi, Bindweed and annual grasses; is a constant battle. The first year, because the grass is in a fairly delicate condition, we usually control weeds through mowing. Although we may apply some pre-emergent herbicide early for broadleaf weed control, and sometimes very late in the season as well; mowing is the primary method of weed control. Each field, typically, gets two mowings per year.

In the second and third years, we can be more aggressive with chemical weed control. The usual method of application is with ground rigs, although we have used aerial spraying on occasion.

The goal of the revegetation program is to establish a permanent ground cover on all fields that will survive through drought conditions. It typically takes 3 to 5 years from the time a field is planted until the grass matures to a point where it can be considered established.

Our transfer decree provides that the amount of water Aurora can move is dependent upon the number of acres that are established to a permanent ground cover. The water court has appointed an independent panel that is required to inspect and evaluate the current status of the fields. This panel has determined that just over half of the acreage is presently established.

A major issue for Aurora is the long-term use and management of the land. We have found that proper management of the land should involve cattle grazing. Our observations have been that cattle grazing serves as an additional method of weed control and is enhancing the vigor of the grass. The presence of cattle on rangeland has recently received some

negative publicity, primarily from the standpoint of overgrazing. In contrast, we have an advanced grazing management program that matches animal numbers to the land. We use an approach of high animal numbers grazing the fields for a short duration type. We typically have a central watering area with fields that radiate out from that. We use a lot of fencing and move the cattle frequently.

The city has invested about \$5 million on the Rocky Ford ditch and the Colorado Canal revegetation program that covers a total of about 15,000 acres. Our approach from the beginning was to go in, get the job done, and get it done correctly. We are pleased with the progress of the revegetation program. The success of any revegetation program is dependent upon a lot of different people doing the right things, but Gerry Knapp and Paul Flack have really been an asset to our program.

In terms of where we can go from here, a couple of things are important. One is that when we get into an agricultural transfer, the typical reaction of all the parties is very defensive. The primary goal is to maintain historic conditions considering a number of factors: unit consumptive uses, crop water availability, and irrigation return flow patterns. I think historically we really have not done the job that we need to do in resolving conflicts on these issues. The better approach is to use interest-based negotiations -- where the focus is on mutual interests as opposed to entrenched positions and discovering options for mutual gain. Roger Fisher of the Harvard Negotiation Project has written an excellent book on this called Getting to Yes, and I would encourage you to review it.

The other important thing is information management. For those who have not had a chance to see the South Platte Management Program, I would encourage you to contact the State Engineer's office to set up a demonstration. The water users initiated this program about five years ago. The Water Conservation Board has contributed a little over a third of a million dollars toward this program. This program, for the first time, really opens the process of access to critical information: location of water rights, stream flow conditions, etc. When I first started in the business, we were all very closed in terms of providing information and letting each other know what we were doing, things are changing.

I would like to mention that we have been considering establishing an information communication system for the Arkansas Basin. For those that are interested in participating in this effort, please contact me. I would love to have your participation. I think that the more we know about each other's systems, the better off we all are.

Questions and Answers:

Q: When did you start diverting this water?

A: It was about two years ago. That water is exchanged to the Otero Pump Station at Twin Lakes. We are just over the 50 percent mark on the revegetation program on the Rocky Ford side, so that amounts to about 4,000 acre-feet that we are currently exchanging.

What we tried to do from the beginning was to minimize the impact of our exchange on the river. As an example, we entered into an agreement with Pueblo five years ago where we trade them water that we would normally divert from the Rocky Ford transfer with other transmountain water that they have. We really have been trying to minimize any type of impacts that exchanges have had on the river. I understand that there was a report on one of the local news stations last week that contained a considerable amount of misinformation about our exchanges. They did not contact Aurora to my knowledge. This is one of the reasons I feel it is important for us to try to be as open as we can with our operations. Frankly, the more you understand about our operations, the happier I am.

Q: What is Aurora doing with its conservation program?

A: We have several different elements. First, every year we do a children's water festival. This past year we had 500 to 600 children, and we are shooting for close to 1,000 this year. So we do a lot of education work and its a really fun thing for the kids to do. It gets them out of their school for a day to come and learn a little bit about water. We think that education component is extremely important. We have a very aggressive leak detection program using high tech equipment monitoring for leaks. We have a lawn permit program that limits the amount of blue grass that can be installed on individual properties. We have a full-time conservation office, and our main goal is to keep the per capita demand where it is right now, which is about 170 gallons per capita per day. In the last 10 years, we have been

successful at doing just that.

Q: What is the economic impact on the area of drying up the farmland and what are the considerations as to whether the city should continue to own the revegetated land?

A: According to the Special Masters Report, there are about 320,000 acres under irrigation in the lower Arkansas Valley. Our transfers have removed about 15,000 acres of land from irrigation or just under 5 percent of the total.

One of the commonly cited economic impact is on the local tax base. Land that is irrigated is taxed at a different rate than land that is not irrigated. There are a couple things to remember that offset that, in my opinion. In the example of the Colorado Canal, the acquisition of that water brought about \$20 million into the local economy. It was about five years ago that a study was completed to determine whether the people who had sold the water were moving out of Crowley County. The results showed that the people were staying, which likely means the money was also staying.

The other thing was the revegetation program. We spent \$5 million on the program, nearly all of it was spent in the locally. This I think has gone to offset the economic impact of the water sales. One of the first challenges we had, from the city's standpoint, was to get the city's purchasing and contracts procedures to work for farming 150 miles from the city limits. From the beginning, we had to get an exemption from our standard procedures to be able to spend the money locally, to hire local irrigation, to hire local weed control help, seed drillers, etc. We felt that it was important that we use local resources.

In terms of acquisition of land, we rarely do it if there is any way at to avoid it. My knowledge of the city's history is that there were only two times when we ended up doing that. One was the Rocky Ford transfer. We acquired 4,100 acres of land. The reason was the investors that brought us the water were originally supposed to do the revegetation program. They did not. We negotiated to take over the program, and as part of that they were going to reimburse us for our costs from the sale of the land. Rather than do that, they let the land go into tax sale. In order for us to protect our interests, we required them to pay the back taxes and turn the land over to us.

When we acquired that land, it was taken off the tax base because municipalities do not pay local taxes. We negotiated with the county to pay \$10,000 per year, with an annual escalator for a period of 20 years, to help offset that tax impact. It was not something we were required by law to do, but we did it anyway.

The court retained jurisdiction in the transfer decree until 20 years after the revegetation is complete. Any decision to sell the land will be subject to concerns that the ground cover be properly maintained.

Water Facts and Figures: Quantity and Quality

Doug Cain

Subdistrict Chief, U.S. Geological Survey
Pueblo, Colorado

What I am going to try to do is give you a broad overview of the big picture of water and water quality within the Arkansas Basin. I am going to try to answer several questions, questions about quantity, quality, and try to give you some short answers. Then, at the end, I thought I would do something a little bit different. Looking out at this group there are a lot of people I see that probably know more about water in the basin and water quality than I do, so I have a little quiz. I have seven different questions, and those of you who are real water buffalos should know the answers to all of these. There are some easy ones and some hard ones, and hopefully we will have some fun with that at the end of my talk.

The first thing I want to talk about is quantity. How much water is there in the basin, and where does it come from? I guess the reality in most basins is that water only comes from one place, and that is out of the sky. In this basin we have another place where we get a little bit of water, and that is from transmountain imports. When I was preparing for this talk, I had never really done this calculation before; it is fairly easy to do though. That is, about how much water falls on the basin in a year? About 20 million acre-feet. It is a huge amount of water, and it is a lot more that most of us think about having available in the basin. I work with water all the time, but I can't think very easily about 20 million acre-feet of water. We never see that much around here all in one place or at one time. I tried to give some other ideas about how much that is. I want you to think about this a little bit. If there were 25,000 cubic feet per second falling on the basin, that would accrue 20 million acre-feet a year. But I thought about it and said, "Gee, I don't think I have ever seen 25,000 cfs." I lived in Pueblo at the time of the 1965 flood, but I actually didn't get out to see the flow. I know some of you probably have seen this much water, but I haven't, not all one place. I have seen maybe 8,000 or 10,000.

But another way to think about that is within the Arkansas Basin in Colorado there are about 25,000 square miles, so if you want to think about averaging the amount of precipitation that we get over the whole basin and throughout the year (clearly it doesn't fall that way), that's about one cubic foot per second coming out of the sky on every square mile of the basin continuously for a year. That is basically where we get most of our water. It comes out of the sky, and that is about how much there is. That is maybe a different way to think about how much there is. I guess the short answer to how much is there that I would give, based on those numbers, is there is more than you think, but as we all know, there still isn't enough for all the needs that we have in the basin.

Another place that water comes from, as I said, is from transmountain imports, bringing water primarily from the Colorado River basin into the Arkansas basin. That varies a lot both from year-to-year, and it has varied in time as we have been able to bring more transmountain water over, but it is something on the order of 75,000 to 200,000 acre-feet per year. Some of that water comes into the basin and then leaves the basin like the water that Doug Kemper talked about, some of the Homestake water that Aurora uses. The other thing that is interesting about this water, and some of this may have been discussed yesterday, is that this water can be used and reused until it is completely gone, in contrast to other water in the basin, that can only be used once and then has to be returned back to the stream. On an annual average basis that amounts to about 100 to 300 cubic feet per second of water coming in from the Colorado River Basin. I guess as you think about 20 million acre-feet, one of the realities is that most of that water gets evaporated and never reaches the streams. To give you an idea of how much water is actually in the river, something that is interesting to note is that the greatest average annual flow in the Arkansas occurs at Avondale. It doesn't occur at places upstream from that, primarily because even though there is irrigation upstream from Avondale, at Avondale, which is just east of Pueblo, we get the flow of Fountain Creek and some of the return flow from CF&I and the City of Pueblo. That's the point where most of the time there is more water in the river than there is at any other place in the basin.

The other thing to note is that at Avondale, where there is more water than at any other place, on an annual average basis you see about 650,000 acre-feet of water at that point, which is a whole lot different than the 20 million that I talked about. It is another indication that most of that 20 million falls on the land, and it never reaches streams, as most of it is evaporated up into the atmosphere. You can see that there is some water, an important amount of water, contributed from both Fountain and the Purgatory which are the major tributaries in the basin. But in comparison to the main stem, there is not a huge amount of water that comes down those on an average annual basis.

One of the major issues in the Arkansas River Compact lawsuit, which I understand you heard about yesterday, is groundwater pumpage. I just wanted to give you a rough idea about how much groundwater there is in the basin. What I'm talking about is groundwater that is in the top 200 feet of the alluvium, and alluvium is just sand and gravel deposits. One thing I should say is that almost all of the water here is considered tributary groundwater, so it is connected to streams. This water may be there, but is not water you can just go out and develop. You have to go through a legal process to develop this. This is just to give you an idea how much groundwater there is within this basin. It is a fairly larger amount. It is about 13 million acre-feet, and it is distributed in these major areas: what we would call the Leadville Basin (1,900,000 acre-feet), the Salida/Buena Vista Basin (3,800,000 acre-feet), and the Wet Mountain Valley (4,500,000 acre-feet). Within the lower Arkansas, the water that is the primary subject in the Compact lawsuit is a fairly small portion of this total 13 million -- it is about 2 million acre-feet, more or less. Also, there are about 450,000 acre-feet in the Black Squirrel Basin and 160,000 acre-feet in the alluvial aquifer along Fountain Creek. I should say that I'm just trying to give the big picture. I have rounded a lot of these off or they are numbers that are just estimated, but all of these numbers have been published in various places in the literature. There is a lot of groundwater in the basin. More than we normally think about. There is about 13 million acre-feet; that is about two-thirds the amount of water that falls on the basin in a given year.

One of the things I thought I should talk about is how variable is the amount of water that we have. If you haven't heard Frank Malenski say this before, you can ask him to tell it to you today. He has told me a lot of times that the river doesn't run on averages; the river runs every day, and every day it is different. That is one of the reasons we have difficulty in using the water within the basin, is because it is really variable. That starts with variations in how much precipitation falls on the basin. It ranges from a little less than 10 inches per year to over 40 inches per year -- 40 inches per year along the mountains, especially the Sawatch Range and the Sangre de Cristos, down to less than 10 inches per year at a place that is the subject of our first question on the quiz at the end of the talk. There is also a lot of variation in precipitation from year to year. Within a given site from a high year to a low year we might see three times as much rain and snowfall at a site from a low year to a high year -- maybe four times. Typically, we might see at some sites in the basin a low year being around six inches per year and a high year being somewhere around 20 or 25 inches per year. There is a huge amount of variation, and that drives how much variation there is in streamflow.

The other thing that all of us probably know but may not have thought about a lot, is that there is more variation in rainfall than there is in snowfall, both in size of storms and in how much precipitation we get from rainfall in a given year. Snow is a little bit more predictable, although not a huge amount.

Within the river there is a lot of variation. Annual variation means how much variation there is from a low year to a high year. One thing that is important to note about this is that at Granite, Wellsville, Pueblo and Avondale, most of the flow in the stream is from snowfall and not so much from rainfall. At those sites we see about the same amount of variation from a high year to a low year (about 3 to 4 times) as we do in the precipitation in the rain or the snowfall. As you get further downstream, down to Las Animas and Coolidge and some of the streams that are more plains streams like the Fountain and the Purgatory, there is a lot more variation from low year to a high year (about 10 to 50 times) than there is at the streams where the flow is almost all from snowmelt.

The other type of variation is daily variation. That is the variation that you might see in one of these streams in a pretty normal year from the highest flow to the lowest flow. These are big numbers, and you can see at the plains streams like Fountain Creek, which is really subject to flooding, that we get a huge amount of variation between the low flow and the high flow (about 600 times). I want to make a point, too, that where I'm talking about Fountain Creek and Purgatory I'm talking about their flows at the mouth, so Fountain at Pueblo and Purgatory near Las Animas. Huge amounts of variation there. That is one of the problems we have in using water, because generally for the use that we have for the water we would like to have much more stable flows than occur naturally.

The other question I said I would try to answer is "Where does it go?" Most of that 20 million acre-feet, as I said, simply evaporates. It never reaches stream channels so it is not water that we can put to use. But of the water that we can use, "Where does it go?" Agriculture uses about 90 percent of that water to irrigate about 400,000 acres. We heard a number earlier today of about 320,000 irrigated acres, and that's acres that are irrigated downstream from Pueblo. The 400,000 acres includes total irrigated acres within the basin including the upper basin and along Fountain Creek and some other places. Interesting to note that when we drive through the basin I always get the impression that there is a lot of irrigated land, and 400,000 acres is a lot. But it really is only about two percent of the total land area within the Arkansas basin. I think you get a lot better appreciation for how much irrigated land there is when you fly over the basin. It turns

out that the roads and the towns are all right along the river and that is where the irrigation is, so that is why we feel there is a lot of irrigation in the basin. There is a lot, but compared to the total land area it is not a huge amount.

Cities and industry use about five percent of what is left of that 20 million after a lot of it evaporates, and that is to supply about 650,000 thousand people that live within the basin, and the rest flows into Kansas. I showed a number earlier of flow at Coolidge, kind of an average annual flow, I think of about 150,000 acre-feet. That is where the rest of it goes. That is my discussion of quantity, where it comes from, where it goes. You hydrologists in the audience might recognize what I just did as a kind of a crude water budget.

I always talk about quantity before I talk about quality because quantity affects quality a lot. I am not going to go into any great technical detail on quality, but just talk about how good and bad it is and where is the best and where is the worst water. There is some outstanding water quality within the basin. Most of it occurs in mountain streams, and especially in streams that are not affected by mine drainage or mining. These would be high mountain streams, especially in the Sawatch range, Sangre de Cristo range, and along the Front Range. Within the mainstem of the Arkansas River -- and when I am talking about best and worst here, one of the questions you always have to talk about when you are talking about water quality is the quality for what use -- the primary uses of water that are affected by quality in the basin are for agricultural use, for municipal use, for drinking, for instream uses like fishing (there is also recreational use, but it is not affected as much by quality). In the mainstem of the Arkansas river the best quality is probably from Granite, or really from where Lake creek comes into the mainstem of the Arkansas near Twin Lakes down to about Canon City.

If we want to talk about the worst quality, there are three places that may give you an idea about some of the problems we have with quality in the basin. The Arkansas River mainstem and some of the tributaries upstream from Granite and in the Leadville area are probably where we have some of the worst-quality water in the basin. As one of the talks yesterday discussed, that situation is improving as we are trying to do some remediation of some of those past activities. Even though I said that some of the best water quality in the mainstem of the Arkansas River occurs downstream from Granite, we still see some effects downstream from Granite from the mine drainage problems in the Leadville area.

Some of the other "worsts," and the reasons for the worsts. The reason for the poor water quality in the upper basin is really from the metals and acid that comes in from the Leadville area. Two other worst areas that I will mention is the Arkansas River basically downstream from La Junta, or more accurately downstream from the headgate of the Fort Lyon Canal. There are a lot of salts in the river in that area, and a main part of that is because water is used and reused by agriculture. A lot of the time much of water in the river at that point downstream from the Fort Lyon is irrigation return flow, water that has already been used once and discharged back to the river, so there are a lot of salts in the water.

A couple of things I might mention is that from the information we have on the mainstem of the river, even though there is a lot of agricultural activity, we haven't seen problems with nutrients -- nitrogen or phosphorous -- in that reach of the river that seem to be a major problem. Even though we haven't done a lot of sampling, we haven't seen much of a problem with pesticides in that part of the river. Another area where we have poor water quality is along Fountain Creek downstream from Colorado Springs, and for two reasons: (1) because the water is used and reused for agricultural purposes; and (2) there is a lot of municipal wastewater in that reach of the stream. The wastewater is treated to meet the standards that the state has set, but still there is degradation of water quality as a result of that wastewater.

Just a little summary of how man affects water quality, but certainly within the Arkansas basin there also are a lot of natural effects on water quality because of the geology and the climate that we have. These are the ways that man affects water quality in the basin:

Through mine drainage, especially in the upper basin.

Through use and reuse of water by agriculture that just concentrates the salts. Pure water gets transpired by the plants, but the salts are left behind.

Municipal wastewater, especially from the large cities in the basin, notably Colorado Springs and Pueblo.

Ok, we're down to the quiz. You true water buffaloes out there should be able to get all of these.

1. Where is the lowest average annual precipitation in the Arkansas Basin in Colorado?

- A: Buena Vista. Buena Vista has average annual precipitation of a little under 10 inches -- 9.6 or 9.7 inches per year.
2. Where was the largest instantaneous flow, a flow that had the largest amount of water that ever passed a single point that we've measured (so this probably would be only in the last hundred years)? When and where did it occur?
- A: It was during the 1965 flood on Rule Creek, near Toonerville. Anybody know where Toonerville is? Rule Creek is a tributary to the Arkansas River that enters the south side of John Martin Reservoir. The flow that was measured there indirectly was about 276,000 cubic feet per second.
3. What was the largest amount of precipitation that was measured during the 1965 floods anywhere in the basin?
- A: The Corps of Engineers, during a 14 hour period in June 1965, measured 15.5 inches of precipitation at a place about 20 miles southeast of Lamar. If you think about 15.5 inches of precipitation in that area, that is probably just slightly higher than the average annual precipitation that would occur, and that occurred in less than 14 hours.
4. Where is the area in the United States with the second highest number of days with thunderstorms?
- A: There is an area in Southeastern Colorado and Northeastern New Mexico that is second only to South Florida for the number of days that you'll have thunderstorms occur in a given year.
5. What river in the United States, on average, is four times saltier than the Colorado River as it enters Mexico?
- A: The Arkansas River near Coolidge, Kansas as it leaves Colorado and enters Kansas.
6. What was the total runoff in the 1965 flood?
- A: It was about 800,000 acre-feet of water. I would like you to think about that and compare that to the average annual flow at Avondale, which is about 650,000 acre-feet. Within less than a week during the 1965 flood there was more runoff than would pass the Avondale gauge in an average year. It is a huge amount of water, and most of that occurred in four or five days.
7. What is the largest flow recorded on the Arkansas River at Las Animas, and when was it recorded?
- A: There was a major flood that occurred on some tributaries in the lower Arkansas in 1955. There was about 26,000 cubic feet per second at the gauge at Las Animas. That is why I put it on here because it was a surprising one to me, that it wasn't 1965, 1921, 1942, 1957, some of the big years that we know of in the basin.

Augmentation and Supplemental Supply

David Harrison

Attorney

Moses, Wittemyer, Harrison and Woodruff

I promised Tommy Thomson that I would try to describe well augmentation in a balanced way for all three organizations that are currently working in the area. I represent one of those three, the Lower Arkansas Water Management Association (LAWMA), which has 500 wells, of which 400 are large capacity irrigation wells. Of the remaining 100 wells, 30 are municipal wells for the smaller towns and, interestingly enough, the other 70 are inactive wells. The Colorado Water Protective and Development Association (CWPDA) is another organization that has been active for quite some time. CWPDA has a membership of approximately 600 wells. This last year, the Arkansas Groundwater Users Association (AGUA) was formed and it has approximately 300 wells. One or more of these organizations may have some members that are municipal wells, and they are not included in the above totals. These organizations are voluntary membership, dues-based type organizations. Their purpose is to provide replacement plans to allow wells to continue pumping under the rules and regulations of the Arkansas River.

Hal Simpson, Colorado's State Engineer, says that under the rules and regulations you can pump 3 days out of 7, if yours is a pre-1972 well, for free basically. However, if you want to operate 7 days out of 7, and most well owners do, you have to be in a replacement plan (Rule 5). The purpose of these replacement plans is to put water back into the stream to make up for the depletion caused by these wells. The amount of depletion caused by the well is not everything the well pumps, because the well pumps water out of the ground, applies it to the field, some of it is burned up, and some of it runs back into the ground and makes its way back to the river. The depletion is the amount of reduced flow in the river as a result of the well pumping, and it is a combination of the consumptive use of that well water plus other losses that may occur to the groundwater before the remainder is returned to the stream.

In preparation for Kansas v. Colorado, Colorado identified 2,062 irrigation wells with a capacity greater than 100 gallons per minute. Of those, about 1,480 were above John Martin Reservoir, and the balance of about 580 were below John Martin Reservoir. If you add up the wells that are currently in the three large augmentation organizations, you get something around 1,300. So, 1,300 wells are in these replacement plans, and at least a couple thousand of them are on paper. I suspect that difference may be a large number of inactive wells that the owners simply are not interested in operating or paying to augment. I also suspect that there are a large number of those wells that simply are operating outside the administration. If that is the case, that is something that needs to be dealt with over time under strict administration.

Also in preparing for Kansas v. Colorado, Colorado developed numbers suggesting that on the average about 145,000 acre-feet of groundwater are pumped by the large-capacity irrigation wells. Kansas had a number of 165,000 acre-feet. I suspect that the real number is somewhat smaller than that. Under the rules and regulations, it is now necessary for all wells to either have a meter or be measured and tested to establish a power coefficient so that by use of power records it can be told how much they are pumping. All three organizations, CWPDA, AGUA, and LAWMA have been going through the process of measuring wells, testing them and establishing power factors if they do not have meters. LAWMA's preliminary information suggests that the power coefficients we have been using may have been somewhat understated, that the wells are actually more inefficient than we thought and that the real estimate of well pumping might be as low as 120,000 to 130,000 acre-feet within the whole valley.

Now the current situation is that each of these three organizations over the last year, and years prior to that in the case of CWPDA and LAWMA, have had replacement plans approved on an annual basis with the Division Engineer's office. These plans have put in some water rights designed to offset to some degree the amount of impact caused by those wells. We know that the standards for these plans is going to tighten up. This last year the target was to have these plans replace an amount of water equal to four-sevenths of the amount of depletion caused by those wells.

The purpose of these replacement plans up until recently has been strictly focused on taking care of injury to Colorado ditches. Given the Special Master's ruling in Kansas v. Colorado, we will now have to start taking care of the impact that occurs at the state line. The depletion that is caused to the flows at the state line, which would otherwise be usable to Kansas, will apparently have to be replaced. This past year a couple of thousand acre-feet of water from a couple of

augmentation groups were delivered to the State Engineer and made available for the purpose of delivering it to the state line to help offset the impact to Kansas. I think we are looking at a situation in which the replacement plans will have to deal in the future with both impact to Colorado ditches and replacement of depletions to usable flow at the state line. I think that all of the wells in the valley have both of those problems, in perhaps different proportions. You might notice that a well right at the state line can pump and will have virtually no impact on Colorado ditches in any direct fashion. It will, however, have a direct impact on the depletions to the usable flow at the state line. It might be said that well has to replace a lot of water to the state line, but a well way upstream above John Martin somewhere will be causing a depletion to the river, and that may mostly affect Colorado ditches and have less of an effect on the state line. Those generalities are probably true but, I believe, after looking at some of the early engineering, that it is pretty clear that all the wells are causing an impact on both the state line usable flow and on Colorado ditches. We are all in this together in that respect, although the numbers will be different for different wells.

The current situation is that there has been a lot of transmountain return flow in the river, transmountain return flow that is claimable and reusable by its owners but which has not been claimed fully and reused by those owners. That has helped to offset the situation at the state line. There is no legal agreement saying that can continue, but it is one of the realities that must be looked at.

LAWMA has had, in its replacement plan, what is called the Buffalo demonstration project, a series of wells that pumped straight into the Buffalo ditch to reduce the call of the Buffalo Ditch on other water rights and thereby help offset the impact of pumping. The Buffalo Ditch in particular came under a great deal of scrutiny in Kansas v. Colorado and it is clear that pumping has aggravated the depletion to state line usable flows. Consequently, this past summer that project was discontinued and is no longer part of the LAWMA replacement plan, nor will it ever be again. The replacement plans from here on out are going to have to deal with both Colorado ditches and state line impacts.

Now, where do we go from here? I would like to make a suggestion born out of experiences that my clients have had elsewhere in the state. In 1979 in the San Luis Valley there was a bloody trial, lasting nearly all summer, over rules and regulations to get at well pumping and compact-related issues. Major factions in the Valley went at it and ran up an outstanding legal bill. One of my clients, I am ashamed to say, is still in the process of paying off a bond issue it took out to pay off litigation expenses back in 1979.

It is common, I suppose, for a water lawyer to joke about legal fees. I know you know that is not a laughing matter. Litigation is terribly expensive, and it quite often is not productive. The outcome is not predictable, and it is often not very efficient in resolving the disputes that we are talking about. What concerns me greatly is that we might keep moving in a fractionated way -- three separate augmentation groups and three separate augmentation plans. And there are other augmentation plans being proposed. Individual users under some of the ditches happen to receive Fry-Ark Project water, and some of those users have a first right of refusal to use the return flow from that ditch's Fry-Ark water and they could use that in an augmentation plan. However, if there are more than three augmentation plans, people may get involved in each other's augmentation plans and in the State Engineer's rules and regulations and then we will have a blood bath in the water court in the Arkansas Valley.

It doesn't have to be like that. Perhaps there could be a single unified plan. The Arkansas River Coordinating Committee (ARCC) has been set up to bring people together to talk about these things and see if there can be some acceptable broad plan. One thing emerging out of the discussions in ARCC, and emerging out of other informal discussions, is that there be a single augmentation plan developed for the Arkansas valley that will take care of all well pumping honestly and fairly. Frank Milenski has told me several times that there are a lot of problems in his mind with what we may be proposing, but let's get it on the table and talk about it. We have a long way to go to get numbers developed, but are committed to putting them on the table.

There are some basic principles that we are going to have to follow. There is currently, temporarily, under the rules and regulations that are in place right now, a three-sevenths "freebie" that I am afraid is going to go away in time. Certainly the three-sevenths freebie does not apply to depletions to state line usable flows, assuming the Special Master's ruling is upheld in the Supreme Court. If the Special Master is correct, all depletions at the state line to useable flows are going to have to be replaced, and the four-sevenths rule doesn't make any sense in that context. It would be possible to just take care of state line flows now vis-a-vis the Kansas case, and just continue with the four sevenths. But what will the consequences be when full replacement has to be made to any injurious effect caused to Colorado ditches as well as full replacement to useable flows at the state line? Why not put all of the pieces together so that there can be some peace on the

river with respect to this problem. I therefore urge, even though it is not at the moment legally required, that the development of an augmentation plan address full replacement -- seven-sevenths replacement, not some fraction of it.

Such a plan ought to take advantage, to the greatest degree possible, of the presence of transmountain return flows in the system, despite some major limitations. One of those limitations is that Fry-Ark Project water is legally tied to the Southeastern Colorado Water Conservancy District and cannot be used outside the district or outside the state. (I.e., you cannot bring this water over from the West Slope and then ship it down to Kansas.) Part of the augmentation responsibility here is to take care of Colorado ditches, to take care of wells that are causing depletions, which wells are inside the district.

Secondly, these return flows are planned for long-term uses, principally for cities which own or are entitled to Fry-Ark water and own some of their own transmountain water. It has been made very clear that it is not likely that water will be available for permanent use for augmentation. On the other hand, it is likely that it will be available for quite some time and appropriate for augmentation during the interim. If deals can be arrived at among the municipalities, Southeastern Colorado Water Conservancy District and the well user groups, there will be a real benefit, in terms of the monetary return, for the temporary use of that transmountain water.

It is clear that some new water will have to be brought into this, perhaps through dry-up of existing irrigation or acquisition of existing irrigation. We do not yet have any agreement on how many acre-feet or how many dollars this will take. There are water rights for sale on the Arkansas at quite a range of prices. The water that is up high in the basin close to Pueblo Reservoir is quite valuable and is usable by the cities. Down below John Martin or even halfway toward John Martin, water cannot be brought back up to Pueblo Reservoir anymore. Prior transfers have taken up that opportunity, and it is very difficult to transfer any more water to municipalities from down river. The price of water on a permanent basis is quite a bit cheaper further down the river and that should be taken advantage of in putting together a plan for augmentation that will be as economical as possible.

Another mechanism may be helpful, perhaps in place of the transmountain water, on a temporary five or ten-year basis. A plan for the acquisition of the most inefficient irrigation throughout the valley could be set up by a market mechanism. The amount of historically irrigated acreage that has occurred on individual farmers' lands could be predetermined by the state using aerial photos. Bids for the sale of the irrigation rights on portions of that acreage would be solicited by some central entity. Each farm unit would be eligible to sell not more than some percentage of his irrigated area, say 20%. This way no simple farm unit would be shut down, and the dry-up would be spread more or less uniformly throughout the valley. Each farmer would have an incentive to dry-up only the most inefficient part of his operation. This way, there is a method of coming up with an efficient reallocation of water to take care of the problem that admittedly is caused by the pumps.

There are several potential problems with this proposal for a valley-wide plan. I talk about wanting to see a unified single plan, but things are not very unified in the Arkansas Valley. As far as I can see, they never have been. This valley has been fragmented for a long time. Fighting is a rich tradition. I know, however, that you can do better than that. It need not be something you are stuck with. If there is integrity and honesty on all sides, I think you can skip the litigation phase of this.

But, there are some principles that people are worried about. Some of the wells in the valley are thought to be more responsible for the problem, right now, than others. You may know that a significant group of wells have been permitted since 1972, generally close to the state line. Those have had a fairly direct impact on usable flows at the state line. I hear people in this part of the river saying, "Why should we be responsible to Kansas? Those pumpers down at the state line caused the problem." That is only partly true. Those wells have caused part of the problem and all of the other wells in the valley have caused part of the problem.

In addition, this is not just about state line impacts; it is about impacts on all of the wells. Even the pre-compact wells must have the limited amount of pre-compact pumping credit allocated to them. And those pre-compact wells are still very, very junior in the Arkansas priority system, and they have a responsibility to the ditches in Colorado also, under the rules and regulations. Post-1972 wells also have responsibility as some wells are the sole source of supply for irrigated land. Other wells are used conjunctively with water rights under a ditch and they don't pump as much. They are not as much of the problem.

The ARCC process is going on, albeit clumsily. It is difficult to talk about these things in that context, but it is

probably the best forum available at the moment. You can probably expect help from the State Engineer's office and the Colorado Water Conservation Board to put a plan together. The State may also be willing to provide long-term, low-interest financing to buy these water rights.

It appears that there are enough details in this plan to kill it before it is born. It is often said that the devil is in the details. In this case, however, the devil is the details. But, if there is a process of open and honest discussion, much will be gained. One of your heroes in the valley, Charles Biese, the great water lawyer that represented the Southeastern District for so long, often said, as a property lawyer, "Better certainty than justice." A little bit of that kind of practical thinking is necessary in developing this plan.

Water Administration in Colorado

Hal Simpson
State Engineer

Colorado Division of Water Resources

I would like to thank Jim Bryant and the late Tommy Thomson for putting this together. It is a fairly impressive agenda, and if you look at the exhibits in the outer area, quite educational and informative. It really gets at the objective of this conference, which is to educate and to open up dialogue on the various diverse issues facing this basin, which is facing a lot of changes as we move forward into the future. Tommy requested that I discuss water administration in Colorado, and not knowing my audience, I earlier assumed that most of you would be water buffalos. Then I got to thinking and talking to people and realized probably not, and looking at the back up here and seeing some of the students I thought I would change it and try to just talk about water administration and how do we do it and what are the tools we use to accomplish it.

What is water administration? In the simplest terms, it is enforcement of the Doctrine of Prior Appropriation. And another way of putting it is enforcing "first in time, first in right." Colorado's history is full of its development and use of water rights, and it has always been done in accordance with the Doctrine of Prior Appropriation. Water users are allowed to divert water when in priority in accordance with their adjudicated amounts and uses, and it is up to the staff of the State Engineer to enforce those decrees of the court. But how is priority achieved or established? The statutes make it very clear: it is based upon the date you first put your water to use and the date of adjudication. If you are the oldest water right in a stream system and you were in the first adjudication, you are going to be the number one water right on that system. Newer water rights are then put into lesser priority. The water courts assign priorities over time. Before there was a water court, there were district courts. Then in the 1969 Water Rights and Determination Act all the various district court decrees were brought together under the jurisdiction of one water court in each water division, and those are the decrees that my staff must enforce and administer.

However, in some cases old water rights didn't avail themselves to the first adjudication, and came into a second or supplemental adjudication. They do not maintain that priority based just upon use. They have to be junior to all the rights adjudicated in the prior adjudication, and that has created some major problems at times in the past as these older rights find out they're not as senior as they thought because the didn't come into the first original adjudication.

Water administration is simple if the supply exceeds the demand. It is then just a matter of monitoring use and recording the amount diverted, and putting together diversion records at the end of the irrigation season. Unfortunately in Colorado that isn't the case, because in most of our basins at some time during the year or at all times during the year the demand exceeds the supply, and that results in our water commissioners having to do a lot more day-to-day water rights administration. In other words, going to the junior water rights and curtailing their use to deliver water to the senior right down the stream who has placed a call.

In Colorado, as most of you are aware, our runoff is very cyclic. Two-thirds of the runoff occurs in about one-third of the year. In May and June it is wonderful, and there is usually no call except on certain systems. Our water commissioners try to allocate every drop in accordance with who is entitled to it. In some basins, there are surplus flows flowing out of state. But after the runoff season is over and we move into July and August, we start having calls placed by senior water rights, and as a result of those calls we have to then go to a very careful day-to-day and sometimes hour-to-hour water rights administration.

What is caused not only by our hydrologic runoff circumstances but by how the state was developed, also has an impact on where we are deemed to be over-appropriated (that's another term for where the supply is less than the demand). In the 1800's, we had direct flow water rights developed. As those took all available supply and calls were placed, the junior rights had to then go to constructing supplemental storage vessels. Along the Arkansas River, for instance, you have off-channel reservoirs that were then constructed to capture some of the peak and then store it and make it available later in the irrigation season. Those water rights have about late 1800 or early 1900 priorities.

As a result of trying to capture and use the runoff, particularly on the Eastern Slope (on the South Platte, the Arkansas, and the Rio Grande Basins), most of our basins are considered to be over-appropriated and some extremely over-appropriated. The Arkansas River Basin I view as our most over-appropriated basin. Because of the interstate compact

with Kansas, no uses after 1948 should be allowed if they deplete the useable state line flows. Only if John Martin reservoir is filling would it be deemed to be a period of no call, and that happens very rarely.

The next basin that is probably nearly as over-appropriated is the Rio Grande Basin, and this too has a compact which has a very stringent delivery obligation. Only if Elephant Butte Reservoir down near Texas spills do we deem that the Rio Grande is not on call, so those two basins are extremely over-appropriated and require considerable water rights administration.

The next basin that is in line would be the South Platte River Basin. It has calls in on the average that last about three months during the latter part of the irrigation season and early storage season. Some years, in dry years, it's longer, but that's the average and it gives us a lot of flexibility to do some things outside of the period of call. There are artificial recharge projects up on the Platte that take water at times of no call and recharge the alluvium to offset the effects of wells and things like that.

The Colorado River Basin is not quite as over-appropriated and we do get calls, but they're shorter in duration. We have a call from the large irrigation rights of Grand Junction that come on for a month or two in drier years. In a slightly above average year they may not call, but the rest of the time the Colorado River Basin, except for some of the tributaries, has surplus water. That is where we, as far as our inter-state compacts go, probably have around a million acre-feet of water that we are not using that we are entitled to pursue into the Colorado River compact.

What about groundwater administration? I haven't talked about it. It was not really administered as part of this priority system that goes back to the 1880's when the State Engineer's office was first established. It really came about as a result of the 1969 Water Rights Determination Act which directed the State Engineer to develop a scheme through rulemaking to bring wells into the priority system. Wells were directed in that act to submit for an original adjudication, the first time they were required to be adjudicated, by July 1, 1972. If they did, they were able to relate back to the date of construction and maybe gain some priority within the tabulation of water rights.

The State Engineer, Mr. Kuiper, promulgated rules and regulations in the Platte River Basin and the Arkansas River Basin at about the same time requiring a phase in of well curtailment, curtailing pumping one day a week in 1971 or 1972 and then gradually adding to it. Things changed in different basins, though. In the South Platte River Basin there was a large trial. The end result was wells within the South Platte River Basin were required to not pump unless they were in a plan for augmentation that replaced their depletions at a time of call.

In the Arkansas River Basin, we got to where there were three days of pumping and four days off and the rules were challenged. There was a trial down here, and the end result was different. The Colorado Supreme Court found that the State Engineer didn't prove that the three-day rule, as it was in effect, may have been insufficient and, therefore, additional curtailment wasn't necessary. That's where we are today: three days of pumping or, in the alternative if you want to pump seven days a week to better irrigate your crops, you must be in an approved replacement plan. This year our newly promulgated rules and regulations in the Arkansas Basin require that all well users report the amount of water pumped beginning with this year and continuing into the future. Those rules were challenged, but they were upheld by the water court and they are now the rules in effect in the Arkansas Basin. I anticipate additional rules in 1996 as we deal with the Interstate compact issue with Kansas. I'm sure Dennis Montgomery, in speaking to you yesterday, informed you of some of those possibilities.

How do we accomplish water administration? One word -- water commissioners. Those of you who know what a water commissioner does know what I mean, but to some of you who don't, what are they? They are the people out in the field. Usually their car or their home is their office, but they are out on the ditch banks and on the streams making those adjustments to the amount of water that can be diverted, recording water use, generating records of very important data on how much is diverted so that we can (1) better manage our resources, and (2) make sure that the party to which the water is entitled is getting it.

Probably Colorado has the most complex water administration program in the United States. In my discussions with other State Engineers throughout the west, no state can do what we do as far as trying to make sure water right owners get the water to which they are entitled. In a lot of states it's just an approximate allocation of use, but in Colorado, as you saw from Doug Cain, streamflow changes daily. It is not constant. There are diurnal effects that can be significant. During the snowmelt runoff in particular, it can fluctuate hundreds of cfs. So with that daily change or the change resulting from a

thunderstorm, of which we have a lot in the Arkansas Basin, the River is never constant. Even though the demand may be from, say the Fort Lyon Canal headgate, there may be times when we get a slug of water down and it's satisfied and then the call should shift to another right. And how we do that is through our water commissioners and through an evolving process.

Historically, if you look back in time the water commissioners didn't have the information to change the flow or the settings as much. They relied upon what they saw in the stream system. They recorded data in field books, handwritten field books that we still have and which are very important data in our offices. They generated records of call and to some degree tried to record irrigated acres. But the ability to adjust the river or the call as the river fluctuated, they didn't have the ability because they didn't have the communication system or the information system that we now have today. That improved as we moved from the horse to the automobile and they could drive to the headgate or drive to the gaging station and get an idea on the amount of flow and, therefore, do a better job.

Then we really made a giant step forward, I think, in about 1985. The Colorado Water Resources and Power Development Authority gave to the State Engineer a system we call the Satellite Monitoring System. It consists of 150 gaging stations and/or major canals equipped with data collection platforms that transmit real-time data or near real-time data. They collect data every fifteen minutes, then send a signal every four hours up to a satellite that's relayed back to our office in Denver. That is then fed through a computer system to come up with the streamflow or the amount of water being diverted by a canal. Our commissioners can access that data through a PC dialing into a special phone number in Denver, or if they don't have a PC, they can use Water Talk, as can members of the public. With a touchtone phone and the right phone number, which we gladly give out, it's a free system. You can call in, hit certain numbers and you can find out the flow at any gaging station where we have a data collection platform. A lot of people use that. Rafting people call in to determine what the flow is. Fly fishermen or trout fishermen may call before they drive to western Colorado to go fishing to determine what the streamflow is on their favorite trout stream. So, it has a lot of public benefit and we're using it a lot.

And then we have taken it a step further with the South Platte Water Rights Management System. It's a pilot project that Doug Kemper talked about earlier where we take the data from the Satellite Monitoring System plus information provided by water users, and in the South Platte we have a lot of large water users, Denver, Aurora, Englewood, that divert. A lot of that information can be transmitted directly by the user to a work station in Denver. The water commissioners on each district input data that they have either from going to the headgate or from the user-supplied information via their small, desktop computer or their laptop computer. You saw yesterday the water commissioner's tool kit that allows them to transmit the data to a central site. It is all interpreted and then made available to anybody through a PC into the workstation. They can monitor what Denver's diverting, what Aurora's diverting, what exchanges are taking place between, say transmountain effluent at the north end of Denver back up to intake at Denver or Aurora. Our commissioners can see what the river gain may be or river loss. It is graphed for them so they can see the hydrograph and they can set the river more accurately. If we get a half-inch storm on Denver that generates one heck of a peak, because of all of the impervious surfaces. They can now see that and adjust the headgates downstream so that the flush of water goes to the person who is entitled to it, the water right owner, and doesn't flow on by to somebody who is not entitled to it.

So, it has a lot of possibilities. We are hoping that we can finalize the project and show its benefits this year. It became operational late in 1994. It is my hope, then, to transfer that technology, which is transferable, to other parts of the state, and certainly the Arkansas River Basin should probably be the next basin where such technology is moved. It's just a case of getting the information into the right workstation and having the water commissioners equipped with appropriate tool boxes. And that's our goal for this year.

The role of the water commissioners certainly has changed. If you look back in time, they were basically water cops. They had the authority of a deputy sheriff, were deputized, had the authority to make arrests, and do whatever was necessary to enforce the decrees of the court. But it has changed over time, and now technicians have to interpret very complex water court decrees. As Doug Kemper indicated, the Rocky Ford decree required a special water commissioner just to monitor all the things required to make sure that change of use case can be properly administered so that other water right owners will not be injured.

The City of Thornton has a large change case moving through the court in Greeley. The decree, which is on appeal to the Colorado Supreme Court would require a water commissioner to monitor about 90 different things under that ditch system to assure compliance with the decree and prevent injury to other water users. We just don't have those kind of resources. Obviously we've asked the court in Greeley, as we did the court down here, to have the City of Thornton

assigned to us, or pay for, the cost of that additional water commissioner. They have appealed that to the Supreme Court and I don't know what the outcome will be. But, we don't have the resources to take on these types of administration of very complex decrees. The legislature is not likely to give us additional staff because of the crunch created by Amendment 1, and we are competing with prisons, education, and highways, to get and protect our budget. So, in some cases we have to ask for additional resources through the water court when these complex plans for augmentation or change cases come through.

In addition to those complex cases, there are a lot of other ones out there resulting from the adjudication of wells resulting from the 1969 Act. This requires that water commissioners become much more involved in well administration, accounting for return flows and use under plans for augmentation, and be very computer literate to monitor flows. Here on the Fountain Creek system we have two water commissioners that are both here. You may meet them outside later. But, it takes two commissioners just to monitor the complex decrees on the Fountain system and those of the City of Colorado Springs in tracking their trans-mountain return flows which they are entitled to reuse. It is a much more complicated role than it used to be, and as a result, the type of water commissioner we try to employ is a rare person. It has to be somebody that's competent technically, and very competent in the area of public relations and public service because they're dealing with a complex issue with a lot of questions from the people they administer, from the public that is moving here from out of state trying to find out why they can't have a well permit on this stream or why they can't build their little trout pond right next to a flowing trout stream so that they can have their little amenity with their lot. It requires a lot of extra effort, so that individual is fairly unique, and we have to go through a careful selection process to get the type of water commissioner that we would like to find. On top of that, the salaries are not as wonderful as you would think after laying out those duties. They are technician salaries within the state system, with starting salaries somewhere around \$1500 a month. So, its hard to recruit a starting water commissioner with those salaries and those duties, but we try and we do find, and have found, good people who are willing to take on those responsibilities.

In closing, I would say that water administration is an evolving process. It has a rich and interesting tradition. I would say in the future we're going to have to deal with change. We're going to have to do more with the same resources, and we're going to have to be able to apply new technology even more than we are now and new concepts if we're going to be able to stay on top of this very complex issue that we call water administration.

Questions and Answers:

Q: Did you say that wells adjudicated before the compact were not subject to administration?

A: No, I didn't say that. I didn't even deal with that very complex issue. The Supreme Court of the United States assigned the case on that issue in litigation between Kansas and Colorado to a Special Master. His report is before the Supreme Court for review. He found that post-compact wells and the effect of their pumping did deplete usable state line flow. He did not quantify it. But he did also find that pre-compact wells, those constructed before the compact, had a limited amount of water that they could pump. We had argued that they could pump based upon their priority and decree in times of shortage up to that amount. He capped it at 15,000 acre-feet per year for the entire basin. We showed, or tried to show, it's more like 40,00 acre-feet per year. We have appealed that issue to the US Supreme Court so that issue has not been decided, but we do expect the court to put some cap on pre-compact pumping. Let's say it is 30,000 acre-feet. Then we'll have to promulgate a rule. There are about 700 pre-compact wells out there, so somehow we're going to have to deal with that issue. Do we put a uniform amount on or do we do it based on priority of well? We have to think this through, but it isn't going to be unlimited pumping up here. Its going to be some number. If it's 15,000 its about 20-25 acre-feet per well. If its 30,000 its 50-acre feet per well. Most of them pump more than that, so we're going to have to find a way through a rule to limit the amount of pre-compact pumping. But the issue really hasn't been decided and we'll have to wait and see how that comes out.

Q: Based upon Doug Cain's discussion where he showed how much water is in storage in the upper 200 feet of the various alluvial aquifers, if a well is deeper than 200 feet is it non-tributary?

A: No. That is just, I think, Doug's estimate of the amount of near surface storage that may be available through conjunctive use. What determines whether or not a well is non-tributary is the formation it is pumping from and its connection to the surface stream, and that is usually just a few of the aquifers in the state -- those in the Denver Basin and those in certain designated groundwater basins. So depth wouldn't really affect whether its tributary or non-tributary.

Administration of Water in the Arkansas Basin, Colorado

Steve Witte
Division Engineer
Water Division II

Good morning, and thank you, Thelma. I have been asked to talk this morning on administration of water in the Arkansas basin in Colorado. I want to try to focus on administration in the valley, which extends from Freemont Pass on the west to the Colorado State line on the east and from Monument Hill on the north to Raton Pass on the south. It takes in a wide geographic area, and the administration requires an integration of all of the surface water rights on the main stem and tributaries throughout that area. It also requires a distinction between trans-mountain and native sources of water and an incorporation of groundwater and surface water in conjunctive administration. The Arkansas River is unique in that, among the various divisions in Colorado, it is required to allocate the available water supplies on a year-round basis.

I want to begin this morning by walking you through some of the significant surface water operation events that occur at various times throughout a typical year. I would like to start on a calendar year basis. On the first of January we are generally on a storage mode throughout the Arkansas basin. We are in the middle of the storage season at John Martin Reservoir. At John Martin Reservoir, we are in conservation storage from November 1st to about April 1st of each year. During this period all inflow to the reservoir is stored and distributed into individual accounts for later use by ditch companies in Colorado and Kansas.

On January first we are also in the middle of the Pueblo Reservoir winter storage program. That program extends from November 15th to March 15th of each year. For those of you who are not familiar, this is a program that was developed cooperatively among a number of ditch rights in the valley. It was later confirmed by court decree, changing the former operating practice of winter-time direct-flow irrigation, and water is now stored for release later in the year when farmers felt it would be more advantageous for them and more in keeping with the crop demand. This 1980 storage program is one of the legacies that Tommy Thompson and many of the water right owners who worked together over the years have left for us, and it has proved to be beneficial to the water users. Also on January first we are in storage at Trinidad Reservoir on the Purgatorie River, and this program operates under much of the same theory as the Pueblo program.

By March 15th of a given year, there is a distribution of the water accumulated under the Pueblo winter storage program, and that also marks the beginning of direct flow diversions by surface water rights, depending upon the availability of water supply and the respective priorities in the reach above John Martin Reservoir. Typically if streamflows are insufficient to meet demand at that time of the year, then ditch companies will call for a release of either their winter storage program water or carry-over prior-project water to supplement their needs at that time of year.

By April 1 we do a distribution of the conservation storage in John Martin into accounts. This account system came about through the 1980 operating resolution of the Arkansas River Compact Administration. Until this distribution into individual accounts, which in total makes the division of the water in conservation storage 60-percent for Colorado ditches and 40-percent for Kansas ditches, the water rights or ditches below John Martin are precluded from placing a priority call upstream of John Martin Reservoir.

By May 1 of a given year, the water stored in Pueblo Reservoir under the winter storage program of the previous year must be released to the river. Also by this time, any unused allocations of agricultural water made in a previous year under the Frying Pan-Arkansas Project are subject to cancellation and reallocation by the policy of the Southeastern Colorado Water Conservancy District, which is the sponsoring agency of the Frying Pan-Arkansas Project.

Normally, by May 15 of each year the Southeastern Colorado Water Conservancy District makes an allocation of the quantity of Frying Pan-Arkansas Project water that is determined to be available. According to the allocation principles of the District, 51 percent of the available supply is reserved for municipalities and domestic use. If that is not all sold, then the remaining water is subject to allocation for other purposes. In 1994 the municipalities were allocated 13,810 acre-feet, and irrigators were allocated about 37,800 acre-feet. Release of that water after allocation is subject to sale. The money has to be received by Southeastern before the water can be released.

That brings up to about June tenth of the given year. Normally that represents the peak of the snowmelt runoff. At

that point, a relatively junior priority may reliably expect to be entitled to receive water, and also at that time imports from the Colorado River basin are at their maximum. Hal has already explained to you how my staff monitors native flow on a daily basis throughout the tributaries and on the main-stem in relation to the demand or calls for water and relative to the priority of other rights that are calling for water at those times. The native supply is then distributed to the most senior rights first, ensuring that they are satisfied in accordance with their priority.

Reservoir releases of previously stored native water that may be in the river or transmountain water that is released to the stream system at those times is not subject to the same distribution on the basis of priority. That water is generally earmarked for specific delivery to its owners. There are often misunderstandings about the rights of storage appropriators or rights to divert water to storage. These are regulated on the basis of priority, just as the other direct flow rights that take the water and apply it to immediate use. Since storage rights are relatively junior, this peak of the runoff period generally represents their best opportunity to divert also. Beginning in late June and continuing through August, during the thunderstorm season, there are frequently sporadic events where there is a sufficient supply of water to satisfy junior water rights, including storage rights. The river call can swing wildly in terms of both priority and geographic location of the rights. This complicates the problem of distributing water strictly in accordance with priorities on a minute-by-minute basis.

Exchange opportunities can occur at any time. An exchange is an operation in which a water right or user may take water from the stream system and then replace a like quantity to the stream at another point, subject to that operation not causing injury to other water rights. Such proposed operations must be evaluated on a case-by-case basis.

That brings us up to about July 1. Although it doesn't fit neatly in to the category of administration or into the chronology that I am attempting to follow here, I want to interject a note about a cooperative flow program. The United States Bureau of Reclamation, the Colorado Department of Natural Resources, and water users supplement flows for rafting in the period from July first to August 15th and provide protections for the Brown Trout fishery at other times of the year, using project water by simply rescheduling the timing of the transfer or movement of the water. This is an example of an attempt to increase the beneficial use of the resource.

During the later part of the summer, water users, and irrigators in particular, tend to rely on their senior rights. Those rights are the only ones that our available supply will meet. They supplement their needs with releases from storage. As a consequence of that, water levels in reservoirs are lower, often to the disappointment of flatwater recreational interests.

By October one may expect to see the Bureau of Reclamation begin transferring water that has been imported from the summer months from upper reservoirs down to Pueblo Reservoir to create storage capacity for the year to come and staging it for later allocation and delivery. The irrigation season, by this point, is generally winding down.

By November 1, we are back to the winter storage season in John Martin Reservoir, pursuant to the compact. On November 15th we begin storing water according to the Pueblo winter storage program. That brings us full cycle through a year.

A summary of the record of our administrative decisions is made available to the public. It is published on a daily basis in the *Pueblo Chieftain*. There is a summary of various flows that reflect our administrative decisions that is made available to the public on a subscription basis. I also wanted to add to what Hal talked about regarding the "Water Talk" satellite monitoring system. In addition to providing streamflows at various points in the system, there is also the ability to access the river call that has been established most recently, and people can get that through a touch-tone telephone.

I hope this summary of the typical year has been helpful to in better understanding both how we administer surface water and the sequencing of significant events.

The biggest challenge for us is to better address the issue of groundwater administration. The Special Master, Arthur Littleworth, in his recent report to the United States Supreme Court, has noted that the lack of control over wells is in sharp contrast to Colorado's tightly administered system for the regulation of surface diversions.

Before continuing, I need to point out that there is a class of wells that are, by law, exempt from administration. These are wells that pump less than 50 gallons per minute, and usually less than 15 gallons per minute. These are usually for specific domestic, livestock, and limited commercial use. For larger capacity wells -- non-exempt wells -- there have been

rules and regulations in effect since 1973, intended to limit to a reasonable degree the material injury or effect of pumping on senior-vested water rights. The merits or effectiveness of these rules may continue to be debated, but in his report, now on appeal in the case of Kansas vs. Colorado, the Master has determined that these rules have not been effective in reducing pumping.

Thus, the writing is on the wall. First, it appears quite clear that we must develop accurate means of collecting data for the actual amounts of water being pumped. This will allow accurate determination of the amounts of stream depletions. Rules regarding measurement of groundwater withdrawals were promulgated in July of 1974 and approved by the water court, and we are now in the process of issuing individual orders as needed to secure compliance. Secondly, we must develop and prepare to implement a plan to curtail the pumping of pre-Compact wells at pre-Compact levels of production and post-Compact wells entirely, unless depletions to usable state-line flow are replaced. Thirdly, we need to reevaluate, and if necessary revise, rules for protection of prior-vested rights in Colorado.

These are not popular propositions. They involve issues that are politically, technically, and legally complex, but it is critical that we come to terms with them, just as we have done in the past in the face of other challenges. I have tried to cite some examples for you in which we have tried to come together in this valley to cooperatively solve problems without protracted litigation.

At this point I would like take an aside and plug the Well Users Workshop that has been scheduled for January 27 in La Junta. The groundwater associations of my office, CSU Extension, and others have put together this workshop in an attempt to reach out to the people who deal specifically with the issues regarding rules and regulations, what we see coming in the future, and what people have to do to be able to comply with the various rules and regulations. We are hoping that turns out to be a positive event and that man of you who are well-owners will plan to attend that well-users workshop on the 27th.

I will conclude with a summary statement taken from the Special Master's report:

"If a program of limited conjunctive use has any potential along the Arkansas, the program must also include Kansas' rights under the compact."

Water Administration in Kansas

David Pope
Kansas Chief Engineer

It has certainly been a good program so far, and I appreciate the opportunity to participate. I am here at the urging of Tommy Thompson, prior to his tragic death last year. Even though I am from Kansas, I have known Tommy and many of you for many years and certainly recognize the tremendous contribution he made to the Arkansas River basin development and management. We will all miss him. I may be somewhat of the token Kansan on the program today, but I do appreciate the opportunity to be here. Many of the comments are certainly helpful.

I would like to remind you of how long our states have been fighting over the waters of the Arkansas River. It is my understanding that in the case that began in 1901 that Colorado argued that there are really two different rivers -- the Arkansas River and the "Ar-Kansas" River -- and that was part of the defense. I am only half-joking. I think there actually was some discussion about that as well as the major changes in hydrology and how the river transforms significantly as it gets some distance into Kansas.

I am not planning to refer to the litigation much today. Tommy had promised me that this wouldn't turn into a debate. My real purpose today is to talk about water administration in Kansas. Some of the things you have heard from Hal, Steve, and others have illustrated how water is administered in Colorado. I will try to provide some of the complementary information for our state.

I would like to start by briefly indicating how water law evolved in our state. After Kansas was admitted as a state in 1861, it adopted the English Common Law for those things that were not otherwise explicitly set forth in the Constitution or by statute at later times. Kansas, consequently, was a riparian common law state, in regard to water law doctrine, for a number of years. The legislature attempted to adopt the prior appropriation doctrine on several occasions, beginning before the turn of the century and continuing up through about the 1940's. Ultimately the Kansas courts, however, continued to push us in the direction of maintaining the riparian system, and we had something of a mix for a number of years. That was very difficult. Finally, after additional court decisions and the work of a task force, Kansas adopted a comprehensive system of water appropriation for our state, dealing with both surface and groundwater in a single system of priorities, administered by the position of Chief Engineer. That has become our foundation of water law in the state and has many times stood the test of its constitutionality and other aspects of that particular law. I would say at this point in time that we are pretty firmly rooted in the Doctrine of Prior Appropriation, although I think it would be more accurate to refer to it as a modified version of that, given some of the aspects of our law and that we do recognize those common law rights that had been established based upon pre-1945 usage, to the extent that water was actually applied to beneficial use. Those common law rights have subsequently been determined and established by order of the Chief Engineer. Those are referred to as vested rights in our state. They hold an essentially equal status in regard to priority date, unless and until such time as their relative priorities are adjudicated by the courts. Fortunately there is not a large number of those in regard to the volumes of water. There are some 2000 statewide, as compared to about 30,000 active appropriation rights that have been acquired since that time through our permit system.

The system of water law in Kansas is also quite different than you find here in Colorado in that many of the duties of my office take the place of what you see out here from your water courts. My office is responsible for the determination of whether or not new applications for permit to appropriate either surface or groundwater should be approved, modified, or rejected and all of the later steps in the evolutionary process of the perfection of a water right. This includes certification of the right based on the actual use and perfection of the right; the administration of water during periods of shortage; changes to existing water rights; abandonment matters; and a variety of other things. We are also involved in partnership role with five locally established groundwater management districts that exist throughout western and central Kansas, particularly south-central Kansas, and they play a significant role in determining local policy and recommending rules and regulations to my office. In addition to that, I will briefly mention that there are approximately 25 other statutes related to regulation of water and water courses in our state that are the responsibility of the Chief Engineer, including safety of dams, regulation of other stream obstructions, levees, floodplain management, and matters of that nature.

Our office has evolved into what we hope is a water management organization responsible for regulatory programs and broader management activities, dealing with conservation, management, use, and control of water. We have tried to

develop a philosophy of working with water users and the public to protect our water resources and manage those appropriately.

There are twelve major basins that we use for planning purposes in our state, and we do have a relatively active planning process in our state through the leadership of the Kansas water office and a board called the Kansas Water Authority. As Thelma indicated I serve as an ex-officio member of that group, developing a long-term plan for the conservation, management, and use of water in our state.

The areas that will probably be of most interest to you will be in the Arkansas River basin. There is an east/west line running across our state, and it is the divide between the Kansas basin and the Arkansas basin. Much the eastern part of our state drains to the Arkansas river in Oklahoma. Areas closer to Colorado are some parts of the Cimarron river basin which start in Colorado, the upper and lower Arkansas River basin, and the upper Republican river.

In regard to the Arkansas River itself, much of the drainage doesn't come in until the Pawnee River near and Great Bend. Also, quite a bit of the territory in the upper part, north and south of the river, is non-contributing. In essence we have a very narrow system that has no significant tributaries for about 140-miles, so we have very little surface water resources available in the upper part of the Arkansas River.

We have quite a bit of storage, but most of it is in the eastern part of the state where we do have a surface supply. Our state, like yours, varies tremendously in terms of our precipitation, which is the basis of our water supply. We are basically a plains-state that receives most of our water supply from precipitation runoff. We have very little contribution from snowmelt, like you have here in the mountains. Our average annual precipitation ranges from 16-inches on the West to as much as 40-inches in the East. Our average annual runoff varies from less than a tenth of an inch in the West to 10-inches in the East.

The state's water supply is also very dependent on groundwater. The High Plains Aquifer is the largest one we use in the western part of the state, and the Ogallala is the biggest component of that. Also, the alluvial valleys and systems that are hydrologically connected to rivers and streams are very important to us, and that is a pretty significant issue in our state.

There is a large development of groundwater use in the western and south-central parts of the state and additional development along many of the streams and rivers, based on direct flow surface rights when they are available, or alluvial wells. In our state, we are highly dependent upon irrigation, and about 84 percent of our state's water use is for irrigation, with lesser amounts for municipal, commercial, and all other uses. Our total use in the state now ranges from four- to six-million acre-feet per year. Most of that is groundwater pumping. Unlike Colorado, much of our demand for water is satisfied by groundwater sources.

There are three basic levels of water administration that occur in our state. We have our general administration of water law at the state level through the water appropriation act, and that is involved with vested and appropriation rights. We determine whether or not new appropriations may be allowed. Our primary criterion is whether or not that new appropriation will impair existing vested rights or prior appropriation rights or violate the public interest, including established minimum desirable streamflows which have been determined for 23 rivers and streams in Kansas. None of these instream flows are on the western end, because we don't have enough water to satisfy instream flows, let alone the senior rights that are there.

Some of the criteria we use involves well-spacing, and in recent years we have adopted rules that require that all new appropriations of water, either surface or groundwater, must be sustainable on a long-term basis. This is a concept called "safe yield." We have implemented "safe yield," because over a period of years we found ourselves in a situation where depletion was occurring in some of our aquifer systems. That is a major issue in the western part of the state in the Ogallala areas. Statewide, we have a safe yield policy, except that in certain groundwater management districts there are separate rules that have been developed from prior times that apply different criteria. Most of those areas are closed to new appropriations. In a couple of cases there is still some limited depletion allowed, based on a concept of determining how much water is in storage and allowing a portion of that water to be depleted over a period of years.

In southwest Kansas, with a few exceptions, most of the area is closed to new permits of any kind, and safe yield for new appropriations is a moot point. Each individual water right established under Kansas law is limited by the rate of diversion, maximum annual quantity of water, acreage that can be irrigated, and a variety of other terms and conditions.

Each of those water rights holders are required to keep records on the amount of water they divert and report the same to our office by March 1 of each year. We have done that for many years, but only in the last five years have we put a lot of time and effort into that program. The legislature granted us authority to levy fines and put more teeth into that law. We have done that, and we are getting almost complete reporting from all the water rights in the state of Kansas on how much water is used. Those reports are reviewed in detail in regard to their accuracy. We levy about \$50,000 in fines per year on people for failure to keep acceptable records and report the same to us. This information is used in the perfection process of water rights and for planning, research, and enforcement activities.

We have also spent quite a bit of time in recent years examining that data, targeting those users that are using more water than would seem to be necessary as compared to their peers and the water needs in that particular area, including the limits of their water rights. We have an enforcement program that requires users to respond to concerns in varying ways, depending upon the situation. In some cases it is a requirement to develop a water conservation plan. In some cases it is a requirement to install meters. In other cases it is to cease and desist from diverting water in excess of their authorized amount.

The big issue in our state has been responding to the demand for new uses of water. Because we have a rather active livestock industry, and many of our cities and industries have to meet future water demands with new appropriations not being available. Many water rights are being bought and sold in Kansas, and they are going through the process to convert those to different new and different uses. Like Colorado, we have tried to tighten-up the system, basing any changes in use on the historic consumptive use, and only that amount can be converted. Most of these are groundwater transfers, so it is a different type of situation than you have with some of the ditch rights. We have developed a system through some new rules to try to take out some of the incentives for people to use more water to build up a bigger base and to encourage water conservation. I think we are pretty proactive in that regard. One of the big issues in our state has been the "use it or lose it" aspect of the prior appropriation doctrine. We are trying hard to get around that, because in an area where water is very limited we don't want people using water that they don't need. That comes into play on the abandonment issue quite a bit. We enacted a new system a couple of years ago called the Water Rights Conservation Program. People not wanting to use water in areas closed to new appropriations of water but still not wanting to lose their water rights, can enroll them in a program and we will assure them that they have due and sufficient cause for non-use. That water then doesn't get pumped, and that results in lessening the amount of depletion where that is a problem.

We have six active historic ditch systems that deliver water to lands between the state-line and Garden City. These are mostly on the north side of the river, but one exists on the south side. They were mostly developed back in the 1880's at about the same time as this development was occurring in Colorado. All of these ditches hold vested rights. Also, because of insufficient water to satisfy all of those ditches, even though they are very senior, a court decree was granted early in this century in Federal District Court, setting forth a system of rotation for distributing water to those various ditch systems when the flows are not adequate to meet their total demand. It frequently is not, and that is the normal situation rather than the exception. Our office administers that court decree and the vested rights and distributes water to the ditches that are entitled to it.

We have a common storage account pursuant to the 1980 resolution that Steve Witte made reference to, in which Kansas can call for water as needed to satisfy demand for its ditches. We do not do that on a ditch-by ditch basis. We do it for the ditches as a whole and work out among them when the water can be most effectively and efficiently used, going to the rotation system when necessary. There is about 60,000 acres of historic land irrigated by the ditches in Kansas. That has stayed pretty constant, decreasing a little bit, since the days the compact was ratified. Some of that additional land has been replaced with wells, and most of the land served by those ditches has supplemental wells. That became necessary a number of years ago, because the amount of surface flow was terribly small, compared to their total need.

As Doug Cain mentioned earlier, we are really getting five-percent or less of the total water supply available in the basin, so we don't have a lot of water to work with. I think that further indicates that the reason we have aggressively tried to protect our entitlement under the compact. Surface water, for all practical purposes, is our only renewable resource in the upper part of the Arkansas River basin. Water is very short in that area. Between Garden City and Great Bend there is very little surface water available in the river system, and most of the time the river is dry. I lived in Garden City in the mid-to-late seventies, and to my knowledge not a single drop of water passed Garden City during that entire period. There are other times when there has been some limited flow, but normally that is during flooding events or other unusual circumstances. Sometimes in the winter is it hard for ditches to get all of the water, or the quality is so poor that it is hard for them to divert that water and put it to beneficial use. Water quality, as I have indicated is a very important issue. The

comments from Doug Cain put into perspective for you what can and does happen at times to Kansas.

One of the major issues in the Arkansas River basin has been the extent of groundwater development. Up until the late 1970's we really didn't control that very well. It was a system where rapid irrigation development was occurring, and our laws were not really adequate at that time. They were not mandatory, and they allowed a system of rights to develop without providing for strong state administrative enforcement. That has now been changed, and through the groundwater management districts there are also a variety of active programs in place to deal with groundwater conservation and management.

I would like to mention one of those. Steve Frost, the manager of one of the larger groundwater management districts in southwest Kansas, is here with us today, and some of you may have had the chance to meet him during breaks. That district has become quite aggressive in regard to water monitoring and measurement. In addition to the regulations they have recommended to my office that have been approved years ago closing the area to new appropriations, we also have a situation in which all large capacity wells in the entire district have been required to be metered. That is being phased in during a four period, and we are about half-way through that right now. There about 11,000 large capacity wells, mostly pumping from the Ogallala, that are under mandatory metering orders at this time. Steve tells me that the compliance with that is quite good and that is progressing very well. That is a big step forward, helping in many ways. Lots of discussions are also taking place out there about long-term needs, both there and in the other districts, so we have a big job ahead of us. We have been very active in water conservation. There is a massive shifting of historic flood irrigated lands over to highly efficient center-pivot systems, using a lot less water to produce crops than what was the case. Not all of that reduction is total savings to the aquifer, but a lot of it is. In Kansas, our rights are typically limited to two acre-feet per acre, and most of the users are using far less than that. The average use, district-wide is only about one and a half acre-feet per acre, because the users are doing a good job of conserving water and limiting it to their needs. There are some pretty active programs in the district related to education, research, and water quality monitoring and protection.

We have a system in which we can adopt additional rules through what we call "intensive groundwater use control areas." We have one of those along the Arkansas River from the state line down through five counties just east of Dodge City. There are a total of eight such areas established by order of my office over the last ten or so years. This is a very strong mechanism, allowing the Chief Engineer, with involvement from the local groundwater management district, to address long-term issues related to water level declines, withdrawals in excess of recharge, deterioration of the quality of water, and other conditions that require regulation in the public interest.

In closing I would like to say that, in contrast to the pure appropriation system, the intensive control area statute does allow some flexibility through our office to try to develop a management plan and a system of controls in these areas to limit the use of water in a very comprehensive way. There is actually authority to provide overall limits on groundwater pumping outside the priority system, and we have done this on some occasions where people's use of water has been restricted by a substantial amount. In one case in central Kansas, in the Arkansas River basin down-river a number of miles, we limited the total groundwater pumping from that whole aquifer system in the Wet Walnut Creek area to the long-term sustainable yield. That was necessary to protect the streamflow to some very senior downstream surface rights to a major wetland called Cheyenne Bottoms. This was done not only for the Bottoms but also for all of the water right holders in the basin and to protect the aquifer from long-term depletion. There is not a lot of water in storage in that alluvium. It was necessary to reduce the total amount of water that could be pumped from the aquifer by one-half. There were some pretty substantial reductions made, but there was some flexibility provided in terms of some five year allocations and matters like that. I would also like to mention that we have an active program trying to address long-term problems in a more comprehensive way and avoid some of the controversies that we have had.

Looking Back and Looking Ahead for the Arkansas Valley

Ken Salazar

Former Executive Director
Colorado Department of Natural Resources

I received a call from Tommy Thomson five or six months ago. He asked me if I would be willing to participate in this conference and to share with you some of my thoughts and observations based on my past experience working on Arkansas River issues and other water issues around the state, and to talk generally about some of the things that I see for the future for the Arkansas River. I was very pleased to accept that invitation, because Tommy really was the person who taught me about the issues in the Arkansas River Valley. Tommy was also the person who led the way in developing a new approach to resolving water issues in a cooperative way, as opposed to resolving those issues through the conflict resolution option that we sometimes choose, which can be very wasteful.

I think my basic point to all of you is this: As you look at the future of the water issues of the Arkansas River, whether it is dealing with the remedy that may in fact some day come from the Supreme Court in the Kansas versus Colorado litigation, or whether it is dealing with the wildlife and recreational issues at the Great Plains Reservoirs or Trinidad Reservoir, or the flows of water in the headwaters of the Arkansas River Headwaters State Park, all of those issues can be resolved in one of two ways: You have the choice of either moving forward in a style of confrontation, which can be very wasteful and very expensive; or you can work together to develop cooperative solutions that make sense for everybody that is involved.

Some of you may remember that back in December of 1991 there was a proposal put on the table by the Colorado Water Supply Company to take water from some 50,000 acres of land under the Fort Lyon Canal Company and to transfer that water for the needs of the metropolitan area. The matter was brought to the Governor's concern by some of the people who are in this room. I still remember that on December 24, 1991, the Governor called me into his office on that Christmas Eve Day and said that he wanted to see whether or not there was some kind of solution that we could put on the table to address those issues. He had grown up in the Arkansas River Valley and was very concerned about having 50,000 acres of land dried up. He was concerned about the social and economic impacts of that kind of a huge water transfer from the Lower Arkansas River.

On the one side, he had many significant political players within the Denver Community who were calling the Governor at the time asking that he not get involved, and in fact asking if he would be willing to support this wholesale transfer of water from the Arkansas River to meet the needs of the metropolitan area. The arguments that were being made were:

- (1) It is a transfer that is being contemplated between willing sellers and willing buyers. Nobody is forcing the farmers in the Lower Arkansas River to sell their water rights. They want to engage in these free-market transactions allowed under our system.
- (2) There is a system already in place in Colorado water courts where those kinds of issues can be addressed. The issue of the protection of vested water rights in the Arkansas River can be resolved in the context of the water court proceedings that will ensue.

The Governor, notwithstanding those exhortations, made the decision that it was not the right thing to happen. From his point of view, if the water transfer that Colorado Water Supply Company was proposing succeeded, the whole reach of the Lower Arkansas River would be changed in character. He felt that was not something which was good from the point of view of the state of Colorado. So he intervened through the political process, not the legal process. He made some statements to Colorado Water Supply Company and to others that he was opposed to the proposal and that he would fight it. Colorado Water Supply over the weeks ahead made a decision to withdraw the proposal that it had put on the table.

That particular circumstance illustrates a couple of different things to me in terms of the challenges that you all will continue to face. When you look at the metropolitan area of Denver and the growth that is taking place there, you can rest assured that the needs for additional water have not abated. To be sure, there is currently no water supply plan in place that anybody has devised to offset the 100,000 acre-feet of water that was expected from the Two Forks Project development. One of the things that all of you in places like the Arkansas River Valley need to consider is: What is the threat from outside the Arkansas River, in terms of communities that have a great need for water and who have money to pay for that water, to come

into places like the Arkansas River where farmers, because of the bad agriculture economy, are in a position where they are willing to sell? How will you deal with that kind of issue in the years and decades ahead?

Another past and future water issue relates to the Arkansas River Headwaters Area and the whole discussion and resolution of the issue of the augmentation of flows within the headwater areas of the Arkansas. In 1991, I had been working in the department for only a couple months when Perry Olson, Director of the Division of Wildlife, came to me one morning and said, "Ken, we have a lot of concerns over at the Division of Wildlife because our sister agency, the Department of Parks and Outdoor Recreation has come up with a proposal to try to augment the flows in the headwaters of the Arkansas River." They wanted to augment the flows during the critical time period of July 15 to August 15 because they wanted to continue to develop the nationally recognized rafting program that they have on the Arkansas River. When Perry came to me he said, "I am concerned that we are not going to be able to resolve this issue, even internally within our department in a cooperative way." He said, "I am about ready to go out and sue the Colorado Division of Parks and Outdoor Recreation. I am about ready to sue them because we have concerns about the impacts on the growth of the brown trout in the headwaters area that will occur if those water flows in the headwaters area are augmented."

I quickly called in Laurie Matthews and some of the people in the Department of Parks and Outdoor Recreation, and their point of view was very different. They said their own biological information showed that it would not have an impact on the growth of brown trout and they had a tremendous investment in terms of developing the headwaters of the Arkansas area into a nationally recognized park.

We finally ended up doing several things: The first was that we would recommend augmented flows on the Arkansas River during that critical time period, but at the same time work with the Division of Wildlife to develop other mitigation measures that would improve the habitat within the Upper Arkansas River, so that we could mitigate and hopefully enhance the habitat and avoid the negative impact in terms of the growth of brown trout, so we could establish a quality fishery that would also support the needs of Trout Unlimited, and others.

That example points out a couple of different things. First, through cooperative ways there are approaches that can be designed that will resolve a number of complex and competing issues. If you were to take those issues through the court system, it would simply end up costing a great amount of money on the part of everybody. If those who had been interested in establishing an augmented flow in the headwaters of the Arkansas River had decided that they were going to try to file some kind of instream flow application, either through the process of the Water Conservation Board or in some other way, all hell would have broken loose on the Arkansas River. We would have been subjected to a litigation that probably would have lasted 5, 10, 15, or 20 years without any kind of resolution. But because the water users, the Southeast Water Conservancy District, Trout Unlimited, the rafting industry, and state and local governments and federal agencies, were able to come together and say they could figure out a way of managing these resources for multiple purposes, they were able to accomplish the augmentation of flows in the headwaters of the Arkansas River. They were able to establish a management of flow of water on the Arkansas River without having to try to establish an instream flow, and that flow is able to provide the water that is needed to enhance the rafting industry in those communities. Water users were not impacted because whatever additional consumptive use is associated with those augmented flows in the headwaters is compensated for by the rafting industry. We were able to deal with the issues relating to the trout concerns through a program that hopefully will create the habitat enhancements in the headwaters area.

I think that when we look at the politics of confrontation in water, it doesn't take very long for any of you in this room to come up with a number of examples where there has been a tremendous waste of private and public resources. In the San Luis Valley right across the mountains, which is the area where I am from, some \$30 to \$40 million dollars, I am told, were spent in connection with the American Water Development Inc. fight. In the final analysis, after the expenditure of \$30 to \$40 million dollars not one drop of water moved to meet the needs of the metropolitan area. The farmers and others in the San Luis Valley who fought AWDI lost money in the legal fight and did not advance any of the economic interests in the San Luis Valley. The same wasted effort occurred with Two Forks and what happened in the fight that took place between the environmental community and the water users within the metropolitan area, a project that cost some \$42 million, and in the final analysis was vetoed by a federal administrative agency. Forty-two million dollars to what end? Not one drop of water was provided to the Denver Metropolitan area.

The same can be said about the Forest Service initiative trying to assert reserved rights in the Roosevelt National Forest, where some \$10 million later the U.S. Forest Service lost the fight, and the U.S. Forest Service was not able to address the resource objectives that they had articulated in going after the reserved rights. They were not able to put water into those

streams for the fish and for other purposes that the Forest Service had defined. Yet today they are trying to come at it by another route -- using the Endangered Species Act to try to claim the bypass flows that they claimed.

The problem is, when you approach water issues from the point of view of trying to do things by force, whether it is through an administrative agency or whether it is through the court system, the confrontations cost the people of the state large amounts of resources. So the question then is, How do you keep water matters from being embroiled in those kinds of costly controversies?

I would venture to say to all of you that this program today is the kind of effort that you have underway here in the Arkansas River today that will work. The kind of effort where you brought together the elected officials, the water users, the Southeast Water Conservancy District and others to try to figure out what kinds of solutions make sense for the future of the Arkansas River. Those win-win solutions can in fact be achieved, and more and more I think they will become the norm in terms of how we deal with water resource issues. In a place like Denver, for example, for the first time in a very long time the Denver Water Board and the Colorado River District are at peace because they were able to put together a win-win solution on Clinton Reservoir. Clinton Reservoir and the reservoirs on the West Slope are now being used in a manner where they not only provide benefits to the West Slope, but also provide additional water supply for the Denver Metropolitan Area.

Here in the Arkansas River there are other examples in which win-win solutions have been put together in the past. I think that was probably the greatest legacy of Tommy Thomson. When he looked at programs like the winter storage program, he was very proud of letting me know that it was a program that he had to sell with a lot of help from many of you in this room, going ditch-by-ditch and getting the approval of ditch company after ditch company to entertain the concept of the winter storage program. Now that the winter storage program is in place, at least those who have participated in it, I think, would look at that program as a major win-win for all of those who have participated. The example of the Arkansas River Headwaters State Park augmentation flow issue is another example of a win-win solution that has been put together.

In the years ahead, it seems to me that you need to continue to explore these win-win solutions. I think that you need to continue to explore them because the fact of the matter is that dealing with the implementation of whatever remedy has to be dealt with in the Kansas versus Colorado litigation will require all of you to come together to figure out how that remedy is going to be implemented. If there is a remedy for damages, the question will then be how is that going to be paid for. Is it going to be paid for by all of you here at the local level? Is it going to require some kind of a contribution from the state of Colorado? If so, what should that contribution be? How will the Arkansas River Valley as a whole, as a drainage system, get itself together so that you have the political pull to get some of those state resources to pay for those money damages if in fact if they are ever asserted? How are you going to deal with the water issues in terms of making sure that a program is put together that addresses the compact obligations that Colorado must meet? Where will that water come from? How will that water be paid for? How will it be administered? How will we respond in the Arkansas River to the issues and the responsibilities of the State Engineer, when Hal Simpson is forced to come in and to develop new rules and regulations that will require a curtailment of how pumps and wells have been used for many years here in the Arkansas River? What is going to be the response to those rules and regulations?

One response certainly could be to try the route of litigation, and to see whether or not those regulations could be set aside or changed. Millions of dollars could be spent in moving forward with a confrontational approach to whatever rules and regulations are put on the table. On the other hand, working together with all of you, there may be a possibility that regulations can be developed that will work for all of you and at the same time work for the State of Colorado in terms of meeting its responsibilities on the Arkansas River.

I want to conclude by saying that when I was in the Department of Natural Resources, I spent a lot of time working on issues here in the Arkansas River. I remember when I first went to meet with Frank Milenski and his wife Eleanor at their house. I did so at the beckoning of Tommy Thomson, because he said, "Ken, I really like what you are trying to do in terms of coming up with cooperative solutions to the water resources issues that we are facing in this state, including the Arkansas." He said to me, "One of the things that really has been a major problem and a major sore for many of us in the Arkansas River is what has happened with the Catlin Ditch. The Catlin Ditch is an example of the kind of circumstance that we want to avoid in the future in terms of how we address water resources issues."

As background, the history of the Catlin Ditch is that 20 years ago or so the Division of Wildlife and the State of Colorado with great motives put together a program where they bought, for \$1 million, some shares in the Catlin Canal Company. The stated purpose for the purchase was that some of the water that was yielded from those water rights would be put to beneficial

use in the permanent pool at John Martin Reservoir. Those waters would then be available for maintaining the warm water fishery at John Martin Reservoir. Twenty years later, four Colorado Supreme Court decisions later, Frank Milenski will tell you the Division of Wildlife was stopped every single step of the way. According to Frank (and I think the Division of Wildlife may have other figures), \$16 million or so were invested in that particular foray on the part of the State of Colorado. I ask all of you, thinking back to the meeting that Tommy Thomson put together with me and Frank Milenski, was that the appropriate way for us to proceed? It may have been very appropriate 20 years ago, but when we look at the times that we are facing today in the 1990s is there a better way? Is there a way in which all of the stakeholders can come together to try to develop solutions that make sense without having to waste the kinds of public resources that were wasted on that particular issue? I think that there is.

I think that when you look at the Arkansas River, that those of you who care about living here, who care about your children and the kind of future that they are going to have, you want to have a health community. It doesn't matter what part of the Arkansas River Valley you are from. It seems to me that the components of a health community are: Agriculture needs to be maintained and supported. We have a strong legacy of agriculture within the Arkansas River Valley. It is the mainstay of the economy. It is the area of your economic life which consumes more water, in fact a lot more water, than any other sector within our economic life. It is part of our heritage. It is part of open space. It is part of wildlife habitat protection that is important to wildlife management in Colorado. So, agriculture is important. How you develop plans to assure that you are able to maintain the water that is the lifeblood of those agricultural properties is very important.

Secondly, you also need to understand that maintaining healthy communities means also being able to diversify the economies of rural Colorado. When you look at places like John Martin Reservoir or the Great Plains Reservoirs, and we are talking about taking water from agriculture that might be used for a permanent pool at John Martin or for recreational wildlife needs at the Great Plains Reservoirs, it also can be viewed very much as part of an initiative to try to keep the rural economies healthy -- healthy because what will happen is that tourism and other kinds of industries that come with having a high quality of life in a particular community will follow. That means that the children of the farmers will have alternatives to stay in rural communities.

I have often said that in my own life there were eight kids in my family, we had one farm, and it was not possible for all eight of us to stay on that farm. It also was not possible for all of us to stay within the San Luis Valley. That is where I wanted to stay, and I still have a dream that someday I will return there, but the fact of the matter is that when you look at our rural economies we don't have the diversity and the strength in those economies to be able to provide opportunities for our young children. When you look at putting water into places like John Martin Reservoir, the Great Plains Reservoir and Trinidad Reservoir for wildlife and recreation, it can be very much a part of diversifying our economies besides also addressing the important wildlife values that are associated with those particular ventures. I think that as you all look at the whole future of water in the Arkansas River that it is inherently entwined with the whole question of what you want the whole watershed to look like, whether it is 25, 50 or 100 years from now.

The choices in terms of dealing with water issues are to go down the path of confrontation; or the alternative, to try to develop cooperative solutions. I hope that you will develop cooperative solutions. Thank you.

**Laws, Lawyers, Courts, Supreme Court Decisions --
Impact on Past Present, and Future Water Operations
in the Arkansas River Basin**

Lawrence MacDonnell
Natural Resources Law Center
University of Colorado at Boulder

I have had the pleasure of spending some time in the Arkansas Valley in recent years, working on a book called *Water and Community*. It is a book that tries to tell the story of how people in the West relate to the water resource and how they have built their communities around the use of water. What I did was pick six places in the west in which it is possible to tell that story, and the Lower Arkansas Valley of Colorado is one of those six areas.

In that connection I have spent quite a bit of time in this part of the state, visiting with a lot of people and trying to become more familiar with the setting, the issues, the people and the resource. During that time I have benefited enormously from visits with people like Carl Genova, Vernon Procter, Paul Springer, Orville Tomkey, and of course Frank Milenski. They have been extremely generous with their time, in instructing me on the things that they know very well, and that I wanted to learn. I took advantage of that time in other ways too, because, like anyone who spends some time in an area, you grow to love it and feel very close to it in ways that go well beyond just being here and trying to do a book.

I had a lot of unique experiences in the time that I have spent down here. In La Junta I visited part of a program called Wake Up La Junta. It was an insight into that community. I had a chance to go down into the Purgatoire River with my family and look at the dinosaur tracks. I have two very young kids, and they were absolutely astonished to imagine those creatures walking along that river. I have been to the Great Plains Reservoir several times, and have been very taken by the potential of that area -- not as a water storage system. I think that everybody understands and agrees that water storage has never been its best use, but it has a lot of other potential. In fact, it gets a lot of use right now. I have enjoyed the beauty of that area. There is much in this Lower Arkansas Valley area, in addition to the water resources, that I have been trying to absorb.

While I have been well instructed, obviously those who have tried to instruct me bear no responsibility for my weakness as a student. I only hope that I can report reasonably well what it is that I have learned and what it is that I am seeing here. Being at this conference the last two days has been a chance for me to become reimmersed in issues of the Arkansas Valley. I have moved off onto other pieces of that book and have spent much more time in the last two years working on other places in the west. This has been an opportunity for me to personally become re-engaged in thinking about this area. It has also been a chance to see quite a bit of progress and development and how issues have really sharpened. The discussion is changing, and Kansas vs. Colorado has of course had something to do with that. I have a feeling that there are some big things on the table that you as a community and valley are thinking and talking about and trying to work through. That is exciting to see.

What I think Tommy Thomson might have had in mind by the assignment he gave me was to talk about what David Harrison characterized today as the "rich history of litigation." It has been an integral part of the Arkansas Valley, and there has been quite an extraordinary history in this basin of resolving issues through the courts. The Arkansas is not unique in this respect in Colorado, but if you go outside of Colorado, which I do very often in my work, you are amazed at how we use the courts in Colorado. There is no other state in the west that comes close to our approach to trying to deal with issues in a legal fashion. Other places just don't do it.

I guess the good news from my standpoint is that there were a lot of cases for me to read. When I did a computer search on cases that have to do with the Arkansas River that the Colorado Supreme Court has decided, the machine just kept going and going and going. It was endless, and I decided that I could not read all these cases. I could not hope to. It was in its own way a pretty important finding. It just said that we have used litigation a lot in trying to resolve issues in this area. I listened closely to the plea that David Harrison made today and that Ken Salazar made again at lunch, and I think that there is some real wisdom in that.

I don't mean to belittle the role of lawyers and the courts, because there are times in which you absolutely need lawyers and need to go to court. I think we all recognize that those situations exist. Over the years the Arkansas Valley

has been served very well by some extraordinary lawyers. In some of the historical reading that I have done I have come across the names of Fred Sabin, Watt McHendrie, Henry Vidal, whom you heard mentioned yesterday; Chuck Beise, whom David Harrison mentioned today; Rex Mitchell, who is here today; Clyde Martz, John Carlson, and David Robbins. There have been some extraordinary lawyers that have worked much of their practice in the Valley and have done a real service for the people of the Arkansas Valley.

Let me try in a very short hand fashion to summarize for you what those thousands of cases seemed to me to be about. Obviously I can't give you a whole lot of the details, nor would you be very interested in many of those details. I tried to organize them around what I thought were themes of that litigation. I tried to do it in a historical fashion. If you read a lot of the early water cases, you find disputes about priorities: who has the right to water, how much, and in what priority? That is fundamental to the legal system of Colorado. What happened here in the Arkansas Valley, when people were trying to sort out different interests, is not very different than what happened throughout Colorado during that period of time. In this area there have been some long standing disputes among ditch companies, because of disagreements about who has rights to what. You see that reflected to some degree in a lot of the litigation.

A more recent and positive example, one I want to reinforce, is the winter storage program decree. Though it is very recent, I view it as a continuation of the same series of cases that was trying to sort out the legal right to the resource, the timing, and the quantity. That was a different model, and I think it had a beneficial effect in the valley. It is settling our claims to the resource and trying to do so in a way that benefits the water users.

A second area of litigation in which I found a lot of interesting early cases had to do with land development companies that were interested in selling land, using irrigation as a means to make that land more valuable. In a sense they were trying to make a profit from the sale of water. You may have heard of people like T.C. Henry, and there is an interesting history in the Arkansas Valley of people who followed this approach. That system really didn't work very well, because it turned out that the people who can run ditch systems the best are the farmers themselves. Those areas figured this out, and eventually the Colorado Canal and the Fort Lyons system and the Amity all became mutual ditch companies owned and run by the irrigators themselves. It took a good bit of litigation to reach that point, but in fact that is the outcome.

We have heard a lot about the litigation with Kansas. As you know that is a long-standing set of cases, receiving three U.S. Supreme Court decisions -- the first in 1907. That case is important not only for the Arkansas Valley, but also because it was the very first case in which the U.S. Supreme Court made clear that it would resolve interstate disputes over the allocation of water. That is a pretty unique thing for the U.S. Supreme Court to do. It is not usual for it to deal with the resolution of claims to water, but it does that between states. The 1907 case was the first case in which the U.S. Supreme Court announced that it would do that. Moreover it announced the principle it would apply to do that. It came up with a notion now called equitable apportionment.

In that case the State of Kansas was arguing that it had, as a downstream riparian state, a right to the continuation of flows of water under the Riparian Doctrine. On the other hand, Colorado said that it had, as an upstream state which had established its approach to water under the prior appropriation rules, the ability, independent of any claims by downstream states, to create and allocate water and that its system should be upheld. In a sense, the case was an effort by states to assert primacy under their respective water law systems. The U.S. Supreme Court said that it was not governed by either of those. Though in practice the states themselves were free to allocate water as they chose, the U.S. Supreme Court would engage in a process of reviewing the effects of the states' allocations. They would be willing to consider whether those are equitable. It is kind of a balancing concept. It talks about how one can evaluate the gains from the upstream states' uses and the losses to the downstream state and whether that is regarded as fair in the minds of the individuals. So the first action of the Kansas vs. Colorado case established the fundamental doctrine. It gave us an approach to resolve interstate water issues, and it announced that this general approach would be taken.

In the second action Colorado filed the lawsuit. It was prompted by some private irrigation companies in Kansas that were suing irrigation companies in Colorado, and the state of Colorado sought to preclude that kind of individual action and wanted to elevate it to a state-to-state level. Again the U.S. Supreme Court was faced with the question of whether the upstream development in Colorado was unfair to the downstream uses in Kansas. It reached the conclusion, based on the evidence before it at that time, that Kansas had not demonstrated that Colorado's use had caused this kind of "serious detriment" to Kansas water users. I think it is important to remember that John Martin Reservoir was being built, and a lot of people expected it to resolve the issue. You have heard the results of the third case between the two states. Of course the key finding of that case is that groundwater development in Colorado has caused depletion of flows in the Arkansas

River in Kansas to the material detriment of Kansas water users. We are now faced with the consequences of that decision, and a lot of the discussion here has revolved around that.

Groundwater development has been a rich subject of litigation here in the Arkansas Valley. There are two cases I want to mention. The first is the Fellhauer case. This is a case that, as you may remember, involved the withdrawal of water from a shallow well 35 feet deep. When it was initially dug in 1935 it was at some distance from the river, but by time the court case came around it was a few hundred yards from the river. The state had embarked on a program of regulating groundwater withdrawals, and Mr. Fellhauer's well was one of the wells the state attempted to regulate. The court did a number of interesting things in that case. It said that before the state could engage in regulation of groundwater development they had to develop a comprehensive program. In developing that comprehensive program the state had to define the means by which it could sufficiently demonstrate that the effects of regulation did in fact offset material injury to senior rights. In other words, the court would not approve of the state engineer engaging in a process that was not well planned, wasn't subject to public input, and did not demonstrate clearly that the benefit of that regulation could be measured.

The changes you heard about in the 1969 Act were made following promulgation of rules and regulations for the Arkansas Valley by the State Engineer's office. The three day pumping rule was at issue in the case of Kuiper vs Atchison-Topeka and Santa Fe Railway. In this 1978 decision, the Colorado Supreme Court said, as David Harrison mentioned this morning, that there had not been sufficient time to determine whether the partial curtailment of pumping of wells had adequately addressed the injury to senior surface users. Therefore, the efforts by the state to go forward with full curtailment were precluded. In effect, that ruling put a freeze on groundwater regulation here in the Valley, but with the Kansas vs. Colorado decision there will be changes.

The Arkansas Valley also is the location of the Shelton Farms case -- Southeastern Colorado Water Conservancy District vs. Shelton Farms. This was a case involving a claim to water in the Arkansas River by cutting down cottonwood trees on the theory that these trees consume water and that this consumption makes that water unavailable for downstream users. Therefore, an individual who engaged in cutting down those trees should be able to claim a legal right to that water with a senior priority. A couple of other cases followed after Shelton Farms with variations on the same theme. The Colorado Supreme Court was fundamentally concerned with the notion of authorizing anything that would give someone a senior priority water right -- a water right outside of the water use system. They were also concerned that if this was an incentive for people to gain water rights we would see a rapid run on the sale of chain-saws. A lot of those trees would disappear from the rivers, and the water courts would be quite busy. The idea was not that this was necessarily a bad thing, but that it needed to be done under a carefully administered program. Unfortunately that case has put a very strong damper on thinking about opportunities in that area, and from my prospective that is unfortunate. I think there are some opportunities in that area.

The Arkansas Valley, as we have heard over the last two days has been a fertile source of ligation concerning water transfers. You may not know, however, that the Arkansas River Valley is also the birth place of the law of water transfers in Colorado. This began in 1891, when the City of Colorado Springs purchased a water right from a farm outside the city limits and sought to transfer that water for urban use. This was our first agricultural-to-urban transfer, happening in 1891 in Colorado Springs. The legal issue presented to the Colorado Supreme court was: "Could that transaction occur when it was simply the purchase of the water right and not the land itself?" The court said quite clearly that a water right is a property right in Colorado; that one of the elements or attributes of a property right is the ability to sell, lease, or transfer that property interest; and that, therefore, the City of Colorado Springs could legally transfer only the water right and the use of the water to another use. At the same time it was saying it was all right to move it from agricultural to urban uses.

There is a long history in this basin of water transfers. Most of the transfers in the earlier days happened fairly close to the cities, as the Strickler case did, but as the cities started reaching further out into more remote parts of the Valley, trying to acquire lands and take the water or to acquire the water rights, those cases became a lot more problematic.

We have heard about the Rocky Ford case and the Colorado Canal case. Doug has talked about them, and I think most of you here are familiar with them. Those are cases in which litigation occurred on every issue for which litigation was possible, and even a few issues that couldn't be litigated were litigated anyway. A lot of hard work was done, trying to figure out what we were doing in this water transfer process. One of the things to come from this litigation is that the state legislature recognized the problem of revegetation. You saw the work that the City of Aurora has done in the Rocky Ford area, and from my perspective they have followed through on their commitments and done the job people were hoping they

would do. As a result of the litigation in the Colorado Canal and Rocky Ford cases, the principle is now firmly established that water transfers should not leave behind lands that are sources of noxious weeds.

One of the things that struck me when I went through the list of cases in the Arkansas Valley was the low number of them driven by environmental issues. Some of you are probably saying "Thank God," and some of you are saying, "It is probably because we haven't gotten to those issues." I don't really know the reason, but it is surprising that few cases show up that are focused strictly on environmental issues. One very important case that I have thrown into this category, though not often thought of as an environmental case, is the "A.B. Cattle" or "Bessemer Ditch" case. This case had to do with the effects on the Bessemer Ditch of building Pueblo Reservoir. At issue was the clarity of water that was released from the reservoir as compared to the condition of the water in the Arkansas River, which traditionally has a lot of silt in it. As you put that stored water down the ditch, leakage occurred because of the cleanliness of the water. The ditch company said they had a right not only to a quantity of water but also to a certain kind of water -- a water that contains the natural sediments to which we have become accustomed. This was a very tough decision for the Colorado Supreme Court, and, as many of you know, and they actually reversed themselves on rehearing, which is very unusual. They ultimately decided that there was no right to continue to receive silty water. I think they did so not for any legal reason but simply to acknowledge the fact that we had built and committed to a reservoir. The implications of having a reservoir are that you change the quality of water that is released from that reservoir, and it was unlikely that they were going to go back on that decision. It was a big case, and it has had implications across Colorado and in other states.

In this basin you have the U.S. vs Jesse case -- with claims by the Forest Service for reserved right flows in the Pike and San Isabel National Forests -- and the ongoing question of the role of the federal government. That case is still ongoing and is implicated in a lot of questions. We can all look to some of the tough fighting that has happened in Division 1 over those very issues, and I think that will guide a good deal of what happens down here.

Very recently the Homestake II case was resolved on the issues of the 1041 Authority of Eagle county. Implicated very directly is the question of the environment -- the wetlands and the wilderness values of that area. So there has been some litigation but not as much as in some of the other areas that I have mentioned.

In closing let me just offer a few words on a theme I was not sure would be discussed when I was first thinking about this. It has been emphasized a lot, and it is one with which I began. I am a lawyer, and though I have lots of good lawyer jokes, there are some things about the legal practice that leave me less than excited. There is a time, a place, and a need for the services of lawyers, and the question is: how do you best utilize those services? What I hear is that you are in an interesting place, because you are faced with some tough questions about how you want to respond to the Kansas vs. Colorado litigation. Clearly presented here is the question of how to resolve that issue, and there are some pretty obvious paths and new things for you to think about.

From my perspective lawyers are people who do the things that clients ask them to do. You are the clients, and what I would urge you to do is to think about how you want to use the legal profession in the future. What kinds of talent, skills, needs, and abilities interest you? My guess is that you can find the skills to serve those ends. Sometimes that is litigation -- in some cases, as I have said, nothing else will do. In other cases you may be trying to take a set of pre-made legal arrangements, around which there is always some flexibility, and determine how to do what you want to do. It may be irrigation. It may be getting water to people in cities. It may be running rafts. It may be fishing. Whatever it is that you are interested in doing, use the legal system in a way that will flexibly meet your needs. Don't assume that the only way to get there is to litigate, because that is not always right. There are a lot of other ways in which the legal system can serve your interests or be modified to serve your interests.

Having looked at this history of litigation, I now thank Tommy in retrospect, because it caused me to look at and think about a whole series of developments in the valley that I hadn't seen. I had been trying to learn about irrigation and a lot of other "nonlegal" things when I had been down here, and I needed to do this to see the other things that have been going on. These are things that are close to me professionally, and it is clear, having listened to the dialog here, that you are at a point where you have some important choices in front of you.

Delivery of Water in the Colorado Canal Irrigation System

Allen L. Ringle
Superintendent
Colorado Canal Company

Company System Overview

The Company diverts water from the river, through 5 gates, 10 foot in width, about 3 miles west of Boone, carries the water 4 miles, past 2 sluice channels which allows water taken from the river to be returned back to it, to a 30 foot wide Parshall Flume, which is a measuring device. All river diversions into the system are measured here, the State has a Data Collection Platform at this site, and is responsible for compiling these diversion records.

The average cross-section of the canal is 40 foot wide and 6 foot high. The canal is 47 miles long to the bifurcation structure.

Overflow sections are scattered along the canal where some of the larger areas drain rain runoff into the canal, this allows surplus water to safely spill from the canal and hopefully prevent the levy from failure further downstream.

Near Kramer Creek, a gate can be opened to allow water into Kramer Creek in a flood event to prevent levy failure, or if failure has occurred, to lessen damage at the washout while the diversion is shut off and the water drains down. The water returns to the river.

Kramer Creek flume is a steel structure that carries the canal water over the creek. All of the creek flow passed under the structure. This structure has a capacity of 760 to 800 cfs.

Just west of Olney Springs gates can be opened to allow water back to the river in the event of emergencies.

Bob Creek Headgate allows for water from the canal into Bob Creek, where it is carried into Lake Meredith.

Bob Creek Weir measures inflow to Lake Meredith, and is located 1 mile west of Highway 71, west of Lake Meredith.

Bob Creek Siphon is a concrete inverted siphon that allows for water in the canal to pass under the creek. There is a spillway on this structure for canal over flow to go into Bob Creek and inflow to Lake Meredith. The capacity of this structure is 500 to 550 cfs.

There is a 25 foot wide Parshall flume that measures all inflows to lakes Henry and Meredith.

At the bifurcation structure water is directed into Lake Henry or Lake Meredith.

Lake Henry has active capacity of 8,691 acre foot. Outflow from the lake can be used for irrigation of near 9,000 acres of land, or it can go to the Lake Meredith Inlet Channel.

Lake Meredith Inlet channel carries water from the bifurcation structure around Lake Henry to the north and east side, through a concrete measuring device located south of Highway 96, and into Lake Meredith.

Lake Meredith has active capacity of 39,804 acre foot. The elevation of this lake is lower than the irrigation lands in the system. All releases from Lake Meredith have to go out of the system. Water is released from the lake at Highway 71, 5 miles south of Ordway, where the water is measured by a 15 foot wide Parshall flume. Where the outlet channel intersects the Holbrook Canal, the outlet water can go into the Holbrook Canal, and or go through an inverted siphon under the Holbrook Canal and into the Fort Lyon Storage Canal, where the outlet water can be passed through one of the Storage Canal sluice channels and into the river.

There are 76 laterals off the canal upstream of the bifurcation, primarily in Crowley County, that delivered water to approximately 38,000 acres of land. All waters from the canal into these laterals are measured by Parshall flumes, in

widths from 6 inches to 8 foot. These laterals vary in length from several hundred feet to over 15 miles. The lateral capacities vary from 1/4 of a cfs to 100 cfs.

This system irrigated over 47,000 acres.

Company Water Rights on the Arkansas River

The Colorado Canal water right is 105 years old, and entitles the Company to divert 756 cfs from the river and use the water as direct flow.

The Lake Henry water right entitles the Company to divert 756 cfs for storage in Lake Henry.

The Lake Meredith water right entitles the Company to divert 756 cfs for storage in Lake Meredith.

These water rights are junior water rights on the river. Basically all of the major canals on the river are entitled divert water before these water rights are entitled water.

The Lake Meredith Exchange water right allows the Company to divert water from the river near Boone, and replace the amount diverted with water released from Lake Meredith back to the river, provided that all other entitled water rights on the river between these two points, will not be depleted because of this exchange. This option usually is allowed just prior to, and at the end, of the Company water rights are entitled to water.

The Winter Water Storage Program entitles the Companies to store water that is produced by the river during a 4 month winter period, in lakes Henry, Meredith, and or Pueblo Reservoir, for use during the irrigation season.

Because these company water rights are so junior, the annual average water produced by them is less than 1 acre foot of water per share, 1 share is for 1 acre of land, which is not enough water to produce a crop.

Another source of water is from the Twin Lakes Reservoir and Canal Company system, which is primarily water collected on the west side of the Continental Divide and brought into this river basin. The annual average water produced is about 1 acre foot per share.

The Frying Pan-Arkansas Project is another source of water available to the Company. Water is allocated by the Southeastern Colorado Water Conservancy District to supplement the company water right for crop production. The allocation to the company has averaged less than 1/4 of an acre foot per acre for the past several years.

Company Water Delivery Practices Before 1970

All water diverted at Boone by the Company was entitled to all shareholders, no matter the source of water, delivered to the laterals, so that each acre was delivered the same amount of water, at the beginning of each lateral. It was up to those on the lateral to see that the water was divided properly among them.

The direct flow right entitles the company to divert up to 756 cfs for irrigation as long as the water is put to beneficial use. For those irrigating under Lake Henry, water is passed through the lake. After that right is satisfied, and several other water rights on the river, the company is entitled to store 6,355 acre foot in Lake Henry at an amount up to 756 cfs. Then if there is water available, and yet more water rights on the river are satisfied, the company is entitled to store 26,028 acre foot in Lake Meredith at an amount not to exceed 756 cfs. The capacity of the canal at Kramer Creek is only 760 to 800 cfs, not the 2,250 cfs that the various water rights are entitled to divert under. Therefore, direct flow water is diverted and delivered pro rata to all shareholders for irrigation. When the demands on direct flow water become less, a surplus of direct flow water becomes available, if Lake Henry is in priority, the water becomes inflow to the Lake Henry storage right. If the surplus of direct flow water continued, and the Bob Creek Siphon was passing its capacity, and Lake Meredith was in priority to store, then water would be sent to Lake Meredith through Bob Creek. Then, if and when the Lake Henry storage right is satisfied, that water would be applied to the Lake Meredith storage right. The last time the Lake Meredith storage right was satisfied was during the wet period 10 years ago. During spring runoff over the past 6 years, these

Company water rights averaged 24 days of river diversion at Boone per year. The longest amount of diversion days was 44. The shortest amount of days was 4.

There are about 50,000 company shares, if 500 cfs was available to the Company and a shareholder owned 100 shares, then he would be entitled 1 cfs, or a 100 rate. If 750 cfs were available, the same shareholder would be entitled 1.5 cfs, or a 150 rate. If 250 cfs were available this shareholder would be entitled 1/2 of a cfs, or a 50 rate.

In times of low amounts of water available for delivery, using the 50 rate example, a rotation of delivery might be used, where the delivery would go to 25,000 shares at a 100 rate for a period of time, say 48 hours, then the delivery would change to the other 25,000 shares for 48 hours, and if the run was long enough this rotation would flip back and forth between the two. The goal is to deliver to each shareholder the amount of water that is entitled to each share, and at a quantity to allow the most beneficial use. The smaller the amount of water is to be delivered, the greater the losses are throughout the system.

In order to keep the water level high enough in the canal for lateral delivery at times of lesser amounts of water in the canal, several check structures are throughout the system. They operate the same manner as a door in a house only the hinges are at the bottom of the canal, perpendicular to the flow direction, a lifting device is used to pull the free side of the door upward to hold the water at the desired height.

Usually Twin Lakes water that was carried through the winter from the previous summer would be used for the first irrigation run of the season, and the current years production along with water from the Project, are what is used to maintain crops from July through the end of August or mid September.

The Board of Directors determined when an irrigation run would start, the length of the run, and the quantity to be diverted, and where the water would come from, based on water available to them at the various reservoirs, except when river conditions were high enough to allow for diversion of the Direct flow and storage water right.

The 15 year time period between 1970 and 1985, there were dramatic changes to the Companies and the system. 95% of the Twin Lakes water right was sold to the cities of Aurora, Colorado Springs, Pueblo, and Pueblo West. The Purchase Contracts for the Twin Lakes water allowed for most of that water to remain in the system for the 15 years. Corporate farming came, purchasing 56% of the irrigated lands and Company water rights.

The Company shares could be moved from one lateral to another to “double-up” the water applied to acreage. The Company was notified of these changes before each irrigation season, and in later years, before each irrigation delivery.

Lake Henry developed an individual accounting system for their users. The inflow to the lake was prorated to the shareholders, the shareholder could draw on his account at his preferred rate, and when his account was empty he could not irrigate until more water came into the lake that he was entitled to.

A Water Court decree changing the use of Company Water Rights allows for Company water to be used outside of the system, and currently 85% of the Company water rights are owned by the cities of Aurora and Colorado Springs.

Company Water Delivery Practices after 1985

The Company no longer is just an irrigation company. Company water rights are now in 2 categories, irrigation water and converted water. Of the 47,000 acres that was once under cultivation, less than 7,000 acres still owns a company water right.

The Company irrigation water is used as it was historically and can only be used for that use, and only on land that did not have shares sold from it.

Of the water in the canal that the farmer is entitled during that delivery, the Company will make lateral transfers for him to allow him to “double up” his water on one field, then move this water to another lateral to irrigate a different field, provided that he makes the Lateral transfer request to the Company at least 24 hours before he wants the transfer.

The Company now has to look at the lands with irrigation water rights to be sure water is being applied to them and

not the lands where water was sold from, and in some instances, measure the water at the farm.

Farmers have to acquire Supplemental Water on an individual basis and inform the Company where this water is located and when it is available for delivery into the system. About 25% of the Twin Lakes water still is used for irrigation in this system. At times surplus water may be available from several Cities. The Company will request Project water from the Southeastern Colorado Water Conservancy District for the farmer, if he makes that request of the Company and pays for the Project water allocated to the Company. The Project water has the same delivery restrictions as the Company Irrigation Water.

Converted water can be used anywhere it can be put to any beneficial use. It has to be diverted at the Company headgates at Boone, part of the water has to be used to help make up incremental lateral loss, on the laterals that provide Company irrigation water to lands, part of the water has to be released from Lake Meredith to the river each day to make up for water that would have returned to it from the irrigation of lands that the water was removed from, and when water is stored under the Lake Meredith storage right, part of the water has to help make up canal transit loss for the water exchanged from Lake Meredith to the Company headgates for irrigation. This water can be used for irrigation in the system, or it can leave the system for other uses after it is stored in the lakes.

All Non-Company Waters, and Converted Company Waters can be applied to any land in the system.

Typically the farmers not under Lake Henry want their Winter Water stored at Pueblo Reservoir so that the water can be released from Pueblo to the Company headgates when the farmer wants the water, and that way it is not subject to low river conditions that would not allow an exchange of water from Meredith to the company headgates. The farmers under Lake Henry store their Winter Water at Henry so it is immediately available to them.

The Company usually runs Winter Water to storage at the lakes near the end of the Winter Water Program. The cities run their surplus water to the lakes along with the Winter Water, and continue for a few days after the Winter Water Program ends to provide enough water in the canal to allow any farmers wanting to irrigate a chance to “piggy back” their water on the Cities.

Most of the farmers first irrigation comes near the end of April. To set up a scheduled irrigation run, the date to start and the length of the run is decided by the majority of the irrigators. It takes a minimum of 2 days to set up and divert water for a scheduled irrigation run, 4 to 5 days are preferred.

The amount of water each irrigator is delivered is decided by the irrigator based upon his needs and how much water he has in storage at various reservoirs. All irrigators have to run water during the run in order to have enough water in the canal to operate the system. Other than the Winter Water that was stored earlier, this run is mostly pieced together with supplemental waters. Hopefully the cities have surplus water they want to run to the lakes for storage, to enhance the amount diverted. This run usually is from 10 to 20 days, depending on the amount of water in storage.

Then the crystal ball shows spring runoff starting the first of June, give or take a week. If this water stayed in for 3 weeks it would be an average year. When this water comes, if it does, all water diverted is a company water right, this means that delivery is based on pro rata entitlement. The farmers use their water as it comes down the canal, the cities water is used for its decreed company obligations and then is stored in the lakes. If the entitled rate is too low for the farmers to use beneficially, they are allowed to run at a higher rate for a period of time and then shut off their delivery until they are owed water again, basically the same as the rotation method described above, except now the cities own 85% of the water so usually there is enough water in the canal to allow for delivery and the cities water is used to allow all irrigation delivery at the same time period, then all irrigation would stop until they were entitled to water again. If a farmer has Twin Lakes water at Twin Lakes Reservoir, it is possible for him to take delivery of the Cities Converted water at the lateral, and in return, give the Cities that portion of his Twin Lakes water at Twin Lakes Reservoir.

Any waters stored under the company storage right along with supplemental water, and primarily the supplemental waters, is what is used for the scheduled irrigation runs to finish the crops. Usually 3 irrigation runs of 7 to 12 days take place from the end of spring runoff through the end of August.

Company Water Accounting

All shareholders have an individual account showing type of water and quantity of water available at Lake Henry, Lake Meredith, Pueblo Reservoir, and Twin Lakes Reservoir. If a shareholder acquires water from another reservoir for delivery in the system, then another account will be made to include that. Pueblo Reservoir can have up to 3 different accounts. Lake Henry and Lake Meredith can have up to 10 different type of accounts.

Non-company waters can be diverted and delivered into the system provided that all entitled company water right obligations are satisfied and there is additional capacity in the canal for non-company water.

Most runs usually have 5 different types of water being delivered and accounted for individually. There are 135 accounts in Lake Henry and Lake Meredith. Upstream reservoirs have less accounts. All waters in the system have to be accounted for on a daily basis. The major measuring devices in the system have DCP's installed to aid in accounting. All lateral flumes are read by Company Employees twice a day, and their ride sheets are compiled daily.

Before a scheduled run begins, all waters available to each individual at all reservoirs where waters are stored, is compiled by the Company for the individual to determine the quantity of water he wants delivered that run, and the point of delivery he wants within the system. All of the individual delivery requests are totaled, the various reservoir release times and rates are determined, these waters come down the river and begin diversion at the Company headgates near Boone at the same time.

The individual account may vary the quantity of the water delivered, he may change the point of delivery, or he may stop delivery during the run.

A daily record of each lateral delivery is kept showing the quantity of water, the type of water, and who was delivered the water.

Water Conservation And Water Quality Programs

Jim Valliant

Forum Organizer

Regional Extension Irrigation Specialist, Colorado State University

The Arkansas River, for its size, is the most saline river in the United States. It contains about 500 parts per million (ppm) total dissolved solids or salts in the Pueblo area, and that increases to about 4,000 ppm at the Kansas state line. We are talking, in this situation, of having pickup and concentration of salts in the water as it comes down the river. As the river starts down stream there are two ways it picks up salts: first, as it goes through the different formations (as you drive back to I-25 you will notice a lot of salinity right in that area -- that is a Greenhorn formation and it picks up a lot of salinity there). Then it moves down to the reservoirs and as it concentrates in the reservoirs we have evaporation, and, of course, there is a salt buildup there. The second way we pick up salts is as water is applied to the soil there is evaporation, and concentration; then pick up occurs. Runoff moves the salts back to the river and increases the salts through the agricultural area as we move from Pueblo to the Kansas border. About 14% of the salts in the Arkansas River are from irrigated agriculture, according to Don Miles.¹

In many instances we have a build up of salts, which can severally affect the growth of young plants, for example onion plants. We do see some decrease in yields because of these high salinity levels. We are continuing to work with better ways to utilize this water -- to convey the water to the field and to be more effective in our use of water. When I say effective I don't only mean efficient -- I mean profitable in the use of that water.

One of the tendencies that we have at the beginning of the year is to over-irrigate, because we have an adequate amount of snow melt runoff or we have water coming from winter storage or project water or carryover water. We fill the profile beyond the root zone. We move, in many instances, salts and nitrates far below the root zone into the aquifer. We have a lot of tailwater so we have a lot of salts and nitrates carried to the end of the field and back to the river. But, they are also carried back through the groundwater and then back to the river, again increasing the amount of salts in the river.

Then, in the latter part of the year or more important times of the year, many of the canals throughout the river do not have enough water, so we try to get the water just to the end of the field, as little tailwater as we can, but again get an uneven distribution so there is an area of under-irrigation and, as a result, reduced yields. One of the ideal situations is to work with a particular crop and notice that it has different root zones and different development periods. The major crops we have in our area are, of course, alfalfa, corn, beans, and irrigated grass. We also have many vegetables, especially in the Rocky Ford area. The ideal situation is to keep as much of the water as we can in the root zone. And if you will notice, here we get about 40 percent of our moisture for growth of the plant from the first 25 percent of the root zone, 30 from the second 25%, 20% from the next and 10% from the lower 25%. So, it is essential that we keep water in the area of the majority of the roots so that we can produce the yields that we need for profitable returns.

The ideal situation, of course, would be to move the water across the land fairly rapidly then soak to the needed depth. We can do this with new technology. Now this is a old practice, I tell people, but it has new technology. In the old days many of the farmers would start irrigating; they would see that the water wouldn't get out so they pick up the tubes with water and mud dripping off of them, carry them to the next set, laid them out and irrigate part of that set, then they would pick them back up and carry them back to the first set and the water would go through. Now we have a device that will do part of this work. Two different companies, P&R and Waterman, make an electronic controller equipped with a solar battery mounted on a surge valve. You can program this controller to work two different sets. For those of you who do not know what a set is, it is so many rows. Let's say you have 1,000 gpm and you want to irrigate 25 gpm per row, so you can irrigate about 40 rows. In the past, one of the things we have done was to set water on one set of 40 rows, irrigate it until it gets to the other end of the field, and then let it run until it penetrates the depth or gives us the amount of water we think we need. The ideal situation, though, as I told you, is to get water across the field rapidly then soak the soil, and we can do that with surge irrigation. In this illustration, it takes three hours to get the water out to the end of the field then three hours to soak the field or a six hour set. We have two sets -- so with surge, we are changing two sets every twelve hours instead of one set every 6 hours. We start out with a 26-minute cycle, and automatically the controller on top of our surge valve

¹Don Miles, Colorado State University Cooperative Extension, Retired.

will switch it over so that it will run 26 minutes on the other side without anyone being out in the field to switch it over. The beauty of this is while the water is on the opposite side, the clay particles in the soil are beginning to swell and it reduces the infiltration rate. Now I know some of you have been out in the field and you have seen farmers, with no equipment on the back of their tractors, running up and down the water furrows -- and you wonder what they are doing. They are compacting the furrow to reduce the infiltration rate. We can do this same thing with surge irrigation. In fact, we have run studies throughout the surge industry where we are getting the same effect, but we are doing it without running a tractor up and down the field and we are applying the water at the same time. Now back to the surge controller. It will switch back over to the other side, and will run for about 36 minutes, because water is going over the already wetted area and the advance area, about halfway down the field. The same way on right set. Then we go back to the left set and we go about three-fourths of the way down the field, and notice, we are up to 50 minutes now. The next surge sequence we are at about a hour and 9 minutes on both sides. Now, we have the water to the end of the field. In the old days a lot of the farmers told me, "Well, we slept at the end of the field and when the water hit our feet it woke us up and we had to change it." They didn't have the luxury of storage reservoirs and the winter water storage we have now. They had to irrigate during the winter also, but I don't think they slept out in the field on a cold winter night and let the water hit their feet.

Once the water is to the end of the field, we go into what we call the soak cycle. Now we are applying water on each side, but we have cut back from an hour and nine minutes on the last surge cycle to 27 minutes, because now this entire furrow is wetted so that the infiltration rate has been reduced. We don't want too much water applied there, because we will have too much tailwater. We don't want too little or it will not get to the end of the field. That is the beauty of this piece of equipment. We can go in and adjust the controller, so that once we see where it is going in the field we can continue to soak this field until we get a good uniform application of water, while reducing the amount of water that comes off the end of the field as runoff.

Notice we have also reduced the amount of water that goes past the root zone. We try to apply on enough to leach the salts down past the root zone, but not into the aquifer, so that the majority of the salts are in this area below the root zone. In some instances, part of our nitrates move into this zone. Fortunate for us, we don't have much of a nitrate problem on the Arkansas River.

In 1991 we began a U.S.D.A. funded project with Colorado State University Cooperative Extension, the Soil Conservation Service (SCS), and the Agricultural Stabilization Conservation Service (ASCS) working together to look into Best Management Practices (BMP). This group worked with the Patterson Hollow Water Quality Project area which goes from eastern Pueblo county to the east side of La Junta near King Arroyo. There are about 59,000 irrigated acres in the area, and we decided that surge irrigation was one of the BMPs we needed to study, so we put in two 30-acre demonstrations at the Carl Allen farm. We set the demonstrations up so that we compared conventional irrigation and surge irrigation. We had three conventional sets and four surge sets, so that we could compare the yield data and the water data from each irrigation method. We recorded all the water applied and all the water that ran off. We took samples so that we could determine the amount of nitrates, total dissolved solids or salts, and sediment.

We ran demonstration studies on corn at two locations, one where we used a regular T-type surge valve, where a flap valve moved the water from one side of the valve to the other. The other surge system we used is what I call a check dam surge valve. In this instance we already had a conveyance system, a concrete ditch. We put slide gates in the concrete ditch, and we tied into those slide gates with gated pipe. All we did was divert the water up-stream or downstream, but with the same fashion of surging it from one set to the other. At these two locations over a three-year period we made the same yield, 186 bushels of corn per acre, but we were able to produce these yields with seven inches less water using surge irrigation.

Now the importance of this savings is that most of the water we saved was during the beginning of the year when the furrows were rough, the advance rate was low and we were getting a lot of infiltration into the soil. That is the time when we need the water to pre-irrigate or irrigate the corn for germination. We need to put water on alfalfa and if we are growing small grains, it is needed there. If we are growing vegetables water is also needed there. So it is a very opportune time to save this water. If you take seven inches of water and apply it to some of these other crops, lets say for instance alfalfa, you can produce a ton of alfalfa on seven inches of water. You can produce 20 bushels of wheat on this same seven inches of water. Surge irrigation allows you to be more effective with your water. Rather than putting water beyond the root zone where it can't be used and where it is carrying the salts and nitrates back to the river, let's put it on economically, feasibly, more uniformly and more timely with surge irrigation and improve the effectiveness of our water use. We

used 24 percent less water and we had 20 percent less runoff when comparing surge to conventional irrigation. Now someone said, “ Well, 20 percent isn't much savings.” I said all right, lets reduce your salary by 20 percent,” and he said, “That is a pretty good savings.” What I will make you aware of is that this was run by the farmer. All I did was monitor it. And in this particular instance he is concerned with keeping the crops at the lower end of his field well watered, so we didn't save the amount of runoff waters that we might have.

We will show you another situation, though, where we did save a considerable amount. Notice that we reduced the amount of total dissolved solids that we put onto the land by nearly 29 percent. We reduced the amount of salts that ran off in the water by 18 percent. We reduced the amount of nitrate-nitrogen that we put on the soil and the amount that ran off. We also reduced the sediment we put onto the land. We didn't reduce the amount of sediment lost because we had one irrigation where we had a tremendous amount of runoff because we had a rainfall right in the middle of one of our surge cycles.

Table 1. Yield, Irrigation Amount and Efficiency on Grain Corn. Patterson Hollow Water Quality Project, 1991 - 1993, Two Sites			
IRRIGATION METHOD	Yield Bushels/Acre	Irrigation Inches/Acre	Irrigation Efficiency Bushels/Acre
SURGE	186.5	28.6	6.5
CONVENTIONAL	186.2	35.5	5.2

Table 2. Total Irrigation and Runoff Water, Total Dissolved Solids, Nitrate-Nitrogen and Sediment on Surge Irrigated and Conventional Irrigated Grain Corn Patterson Hollow Water Quality Project, 1991 - 1993, Two Sites				
IRRIGATION METHOD	Irrigation Inches/Acre	Total Dissolved Solids Pounds/Acre	Nitrate-Nitrogen Pounds/Acre	Sediment Pounds/Acre
SURGE	28.6	3006	13.9	14,775
% Less Than Conventional	<u>24.1</u>	<u>28.8</u>	<u>24.5</u>	<u>9.5</u>
CONVENTIONAL	35.5	3872	17.3	16,182
	Runoff Inches/Acre			
SURGE	5.4	542.4	3.3	5,761
% Less Than Conventional	<u>20.4</u>	<u>18.6</u>	<u>15.2</u>	<u>-19.8</u>
CONVENTIONAL	6.5	643.4	3.8	4,809

In the Manzanola area we are working with Cliff Walter on surge irrigation. We have four surge systems in this particular instance, and then at the upper end we have two conventional systems where we also did fertigation. One of the reasons we were looking at fertigation was to find a better and more economical way to apply fertilizer. What we are doing to get uniform application of fertilizer is to wait until we have the water to the end of the field and we are in the soak cycles. We apply the 28% fertilizer solution through the water, normally in the second, third or fourth cycle. Then we use the final cycles, which may be one or two final cycles during the soak cycle, to clean up the system. Notice we got the same yields of approximately 190 bushels per acre regardless of how we applied the nitrogen, but we did it with three inches less water, using surge irrigation.

We made the same yield statistically with conventionally sidedressed nitrogen as we did with fertigation, but we didn't have to run hardware or steel or iron, or equipment through the field, with fertigation. These results are on large plots -- we are talking about 15-acre plots in each one. Again we saved about 3 inches of water in 1994 using surge. We tried to put it on at specific stages of growth, because timing of irrigation is so very important when you are growing corn and crops like that. Now with alfalfa it is not quite as critical, because alfalfa is a more forgiving plant. It has a deeper root zone, for one thing, and also it goes into semi-dormancy. A corn plant is very unforgiving. If you don't irrigate it during the tassel stage, you can certainly knock yields as much as 20 bushels per acre, as has been illustrated in a number of irrigation studies that have been run throughout the corn industry area.

We didn't have near the amount of water in 1994 that we have applied in past demonstrations. We did reduce the amount of solids, salts, nitrates, and sediment that we put on the ground. Notice that we have very low runoff both on surge or conventional irrigation. That is because the cooperater I am working with also irrigates a lot of vegetables, so we don't waste any water. We have very little tailwater in this particular case. But even at that we reduced the amount of runoff by 50 percent; we reduced the amount of total dissolved solids, the nitrate and the sediment that came off the land, so the water going back downstream is a better quality water, and that is one of the main objectives of our project.

**Table 3. Yield, Irrigation Amounts and Efficiency of Grain Corn
Surge vs Conventional Irrigation
Patterson Hollow Water Quality Project
Walter Family Farm, Otero County, 1994**

IRRIGATION METHOD	Yield Bushels/Acre 15.5%	Irrigation Amounts Inches/Acre	Irrigation Efficiency Bushels/Inch
Surge Fertigation	187.0	18.0	10.4
Conventional Fertigation	186.6	20.7	9.1
Conventional Sidedressed Fertilizer	191.0	20.7	9.2
Rainfall during growing season: 3.8 Inches			

**Table 4. Irrigation and Runoff Water, Total Dissolved Solids
Nitrate-Nitrogen and Sediment
Surge vs. Conventional Irrigation
Patterson Hollow Water Quality Project
Walter Family Farm, Otero County, 1994**

IRRIGATION METHOD	Irrigation Inches/Acre*	Total Dissolved Solids Pounds/Acre	Nitrate-Nitrogen Pounds/Acre	Sediment Pounds/Acre
SURGE	14.5	1744	19.5	3735
%Less Than Conventional	<u>7.6</u>	<u>6.1</u>	<u>8.5</u>	<u>12.6</u>
	Runoff Inches/Acre			
SURGE	0.9	95	0.6	559
%Less Than Conventional	<u>50.0</u>	<u>41.4</u>	<u>60.0</u>	<u>61.2</u>
CONVENTIONAL	1.8	162	1.5	1442
*Does not include May 27-28 irrigation as water samples were lost				

We have worked with a number of different types of surge valves. This is an in-line surge valve, and again we irrigate above and below the surge valve. In Manzanola we are irrigating on grasses that are grazed by a cow-calf operation. We have been able to successfully irrigate this area in a two-day run, where before, using conventional irrigation, he couldn't get the water all the way through. This has increased the grazing days on that particular area. Notice how thick the grass is and, of course, the cattle with their calves walk through this area.

Here is a surge demonstration that we are working with in the Trinidad area. With an in-line valve, we have three sets above the in-line valve and three sets below. We point our gates up at a 60% angle up to the surge valve, then below the surge valve we would point them down at a 30% angle. The reason we point the gates up is that the gated pipe becomes a carrier. This way we don't have to have extra pipe going out to the surge valve. Actually, we use the gated pipe as a conveyance as well as a distribution pipe

This is another style surge setup that we use, where we have enough side slope that he didn't want to put in a T-type valves, so we put in an in-line valve. But this in-line valve, when it shuts off, backs the water back up in the underground line to the higher point and the water comes out there. In 1993, at this Bent County site, we made about 25 tons of silage per acre on both surge and conventional, but we did it with 5.5 inches less water on the surge-irrigated area. Again, what we are saying is that surge irrigation allows for more effective use of water. I said timing on corn is very essential -- surge irrigation allows you to get across your corn more timely and, as a result, your total yield off the irrigated acres on that farm, or your total returns is increased by more uniform application of water.

Here is another style of surge irrigation that we are working with in the Bent Fort area in Bent County. This is, again, what I call a check dam surge value, but now we are using it with cutouts. Each cutout runs about 150 gpm, and is distributed into three rows, so we are running about 50 gpm per row on half-mile rows. To give you an illustration on the value of surge irrigation, in one two-day run he could irrigate approximately 3 acres with conventional irrigation, and by using surge irrigation he got across 10 acres in that same time period. So Jim Rutkowski at Las Animas is really pleased with the results he has had this first year with his surge irrigation.

One of the unfortunate things that happens is the river comes down and sometimes it gets out of hand -- it goes over

large areas and picks up a lot of trash. That makes some of our people extremely unhappy, because they go to their gated pipe and everything is stopped up. The gated pipes are stopped up, the water is backed up, it is pouring over the edge, and as one farmer in the Rocky Ford area said, "I don't like gated pipe, you can't sell me gated pipe." But we have been working with a series of trash screens. This is what we call a vibrating screen, it is located in the Rocky Ford area. It is what we call a turbulent fountain screen. This is an innovation that some of our farmers do. Carl Allen, one of our veteran farmers in that area, has modified a pickup bed to serve as a trash screen.. We came upon some stainless steel screen from the coal mines in the Trinidad area that works real well. This trash screen is located on the Cliff Walter farm. We have had a tremendous success keeping the trash out of his pipe. This trash screen is in the McClave area. Many of you may know George Tucker -- he is in his '80s, and he is extremely pleased with his trash screen. His neighbor didn't put one in, and as result he got some "logs" down in his underground pipe. When I say logs, sometimes they will get to be an inch and a half in diameter and three feet long. It got caught in an elbow in some of his underground pipe and he had to dig up the pipe. I talked to him the other day and asked him if he wanted to use the screen that I made for him last summer, and he said, "Yes, I want to use it. Send me a bill." So, he will be using it this next year instead of digging up underground pipe.

This is just another style of trash screen, where it has lifted the water out of the Catlin Canal and dropped it on the screen. It goes down through the screen and back out into his underground system, and he has no problem whatsoever with his gated pipes stopping up. Another system -- we have a lot of rock and gravel in the Crowley County area under Colorado Canal. Again we have a system where he is able to clean his water up. This past year we had a very good irrigation demonstration with it.

Surge irrigation, in the way that we worked with it, saves water to be able to use it more timely on the rest of your farm, so that the returns on the irrigated acres on that farm are increased. Surge reduces runoff, gives us better efficiency, gives us more uniformity of application, and reduces deep percolation. And the majority of deep percolation under conventional irrigation is right up next to the crop, so that in many instances you have reduced crop yield at the top of the field under conventional irrigation, and you also have reduced crop yield at the bottom of the field. By using surge irrigation, with its uniformity you get a good uniform yield across the field.

There is a lot of surge irrigation work going on throughout the Arkansas Valley area. You might check with your local NRCS people. They work very closely with me throughout the entire area. There is a lot of interest in surge irrigation, and, I feel, that is very timely because now people can have the technology because of the research and demonstration work that is being done by the different agencies.

Questions and Answers:

Q: If we continue to irrigate at reduced rates are we going to have a salt buildup in the root zone?

A: I hope I indicated that we put in a leaching factor. If you notice in the one slide that I showed some of the water below the root zone. One of the things that we are trying to do is to apply enough water that we can drive those salts beyond the root zone but not over irrigate. Surge irrigation can help us control over-irrigation. In good water years we can leach these salts just below the root zone, it gets down into what they call the vadose area. When it gets in the vadose, it doesn't harm the agricultural crop. We have taken soil samples each year, and as of this date we have not seen a buildup in the salt in those particular areas, but we are continuing to monitor to see if there is a buildup. We encourage people to work with our office and with the NRCS to determine the amounts that they need to put on and then add the leaching factor to get those salts beyond the root zone. It is something we are aware of, we are monitoring, but we haven't had that situation to occur yet. We have had several people that have been surge irrigating for a number of years.

Water and Wildlife

Jenny Slater
Wildlife Biologist
Colorado Division of Wildlife

My name is Jennie Slater, and I am the terrestrial biologist out in Lamar. About the only building we have this big in Lamar, though, is our community college and their horse training and management building, so I am a little intimidated by the size of the room, but other than that we will proceed. As you have probably all heard numerous times already, the diversity in the Arkansas River basin is pretty incredible. We go, like Doug said, from the highest part of the state to some of the lowest parts of the state, and in that countryside a new buzzword for the '90's and beyond, I suppose, is biodiversity. So now you can all go home and say you learned a new word at this conference, and it's how we are going to be managing everything. Actually it goes back to the beginning of wildlife management, in that Aldo Leopold, for those of you who have ever read any of his works, basically talked about biodiversity even though he didn't call it that. I guess we are beginning to come full circle, but we are having to do it pretty quickly.

To try to cover all the wildlife from the headwaters to the tailwaters of the Arkansas River (I think it's best if you just grab the arms of your chairs right now) we are going to zip through some slides here. I am not going to say anything, but I just want you to remember that word-biodiversity. We will resume the talk here in a minute.

A lot of you probably recognize many of those species that we just saw, and you are saying to yourself, "Well, Leon wanted me to talk mostly about threatened and endangered and species on the Arkansas River." You're probably all thinking, "Well, most of those weren't threatened or endangered -- they are really common." Probably a hundred years ago some of those species that I am going to talk about here in a minute were thought of by the pioneers as not being particularly uncommon either. I think one thing that we all need to keep in the forefront of our minds right now is something that I read a couple months ago -- the population in Colorado last year increased by more than 90,000 people. That is a city basically the size of Pueblo that we added last year to Colorado, and most of the increase was on the Front Range because people are moving away from the rural areas. So, 100 years from now perhaps all these species that we just saw might be some of those that are on the endangered species list that somebody generations from now will have to deal with, just as we are having to deal with some that are our endangered species list now.

Probably the most important ones in Colorado on the Arkansas River are the Least Tern, which is a federally endangered species, and the Piping Plover, which is federally threatened. I want to once again emphasize how wonderful winter storage of water is. It seems to be a common thread here today. These birds were basically designed for winter storage of water because it helps their habitat, and then the water starts to go down just at the time when they come back from their southern climes and need this water. This is the Least Tern -- we have several nesting areas, primarily at Adobe Creek or Blue Lake and at the Queens State Wildlife Area complex which includes Negronda, Neenoshe and the Queens Reservoirs. It is the smallest Tern ("Least" means smallest), so these guys are the smallest North American Terns that we have. They are a real delicate Tern, and a lot of people might think that they are a small gull when they see them fly by.

This is the Piping Plover. It's related to Killdeer, and you can see a little bit of similarity there. Both of these species use basically the same kind of nesting habitat. The Piping Plover got its name from the piping noise that it makes -- it's a delicate little whistle.

This is typical Least Tern and Piping Plover habitat. Personally, I don't think we would want to sit out here when the sand gets to be 110 or 120 degrees in the summer time, but Least Terns and Piping Plovers seem to love it. In fact, oftentimes you will see them standing out there with their wings out trying to shade their eggs from the hot sun and keep them cool, rather than sitting on them and incubating them. They like dry, sandy beaches with very little vegetation, which unfortunately also appeals to a lot of different things, including people. There are some things that you will never be able to protect them from. We have some tremendous storms that go out across the prairies, and personally, I think it is one of the wonderful features about the plains. But the some of the torrents we will never be able to protect them from, no matter how secure the habitat is.

Some other things we can do something about. One is the predators that run around the beaches looking for the eggs and young of the Piping Plovers and Least Terns. Gulls can be a problem. We have quite a few snakes out on the prairies,

I am sure you are aware, and they also can be real predators on eggs. The problem, basically, is that these guys just lay their eggs right out on the sand. Piping Plovers in particular really don't do anything much to keep predators away from their nests. A lot of times they will run off down the beach doing a broken wing imitation sort of thing.

This is a Least Tern Nest. A lot of times when they leave the nest they'll fly over you and they have an endearing quality, in that they will fly over you and a lot of times defecate on you to try and get you away from their nest. It certainly makes summer field work an interesting ordeal at best.

To keep predators away, we have started to put up, on some Piping Plover nests anyway, predator exclosures. These are made of 2x4-inch welded wire and put up with rebar. Now we will be able to set up one of these things in about 3 or 3-1/2 minutes which is crucial to the eggs, because you don't want the adult off the eggs too long. The size of the wire is so that the bird can get back and forth to the nest because they don't fly to the nest, they walk into it. Unfortunately, this also allows small predators like weasels and snakes, which are probably our most predominant predators, to also get to the nest. Once we put this up we string the top with fishing line so that birds that fly in to eat eggs can't get in there.

Another problem we have is with recreationists. This looks like a pretty motley crew. These beaches are popular with people, their dogs, their fourwheelers, and their atvs, and for camping and fishing. In years past we have closed beaches somewhat. We try to wait until the birds are down on the reservoirs so they can tell us where they want to nest. Then we close those beaches, but only for the amount of time the birds are there and for as little an area as we can get away with, so we don't have too many conflicts between the birds and users.

Another thing that we have problems with, and this is where winter water storage helps us, is trying to keep these beaches free of vegetation. We have enlisted a lot of people: this was a Boy Scout troop or a 4-H group, and if you can get little kids a lot of times they are destructive enough that they can really help you quite a lot -- if you can keep their mind on their business and don't give them anything sharp. Winter water storage, though, when it comes up in the fall and the wintertime, covers the beaches enough to the point where it will suffocate the vegetation, and when irrigators start using the water and it starts to be drawn down, these birds usually arrive in May and June or mid to late May. The water is starting to go down then and exposes lovely, sandy beaches. A lot of times they will put up with a lot of vegetation as it grows up around them if they have been on their eggs for awhile already. So we are hoping that flooding a lot of these areas will help us protect and develop more habitat for these birds.

Another thing that we did, and this was at Neeenoshe reservoir, was to build an island. These birds do a lot better in an island situation because there are fewer predators and usually fewer people, because a lot of people can't get to the island. On this island we are going to be doing some work to try and reduce the vegetation on it and also to stabilize the soil to keep it there. We are hoping that in the next two to three summers this develops into an excellent place for Least Terns and Piping Plovers to nest.

I think one of the primary thoughts that I would like to leave you with today (and I may be putting the rest of my career in jeopardy here) is by disagreeing with a state senator. Don Ament spoke yesterday about how obstructive the Endangered Species Act, the Clean Water Act, and things like that can be. I look at that from a different perspective, especially out here in the Lower Arkansas River. I think that actually the Endangered Species Act might help us keep some of the agricultural water down in the lower end of the valley. A lot of the habitat that these Least Terns and Piping Plovers use wasn't even there. It didn't exist a hundred years ago. The irrigators are the ones that started the reservoirs and they are now providing the habitat that is crucial to these birds. Some of the birds have probably come from other areas like western Kansas and the panhandle of Oklahoma where they no longer have any habitat at all, and that is probably why they moved here. But with the Endangered Species Act I think that can help us keep water here, because now that they are here (the endangered species) there are more legal ramifications, if nothing else, for people taking the water off the land where it is today. So right now we are trying to work with the irrigators and the winter storage people, both at the Fort Lyons and Amity Canals, to try and make sure these birds have the water when they need it and that their habitat is ready for them when they come back every year. Personally, I hope they do come back every year, because they are very interesting species.

Questions and Answers:

Q: Untranscribable

A: At Cheraw Lake we are putting in a watchful wildlife area. And Cheraw is well-known in Colorado's bird watching community for having excellent shore-bird populations of all different kinds -- black neck stilts, a lot of different things.

Q: Untranscribable

A: No we haven't had any yet. Every time we find an eggshell or an egg that doesn't hatch from any of these birds, actually any of the shore bird nests we find out there, we send them to the U.S. Fish and Wildlife Service lab, because that has been a problem in other areas, especially with the high alkalinity, evaporation rates, and things that we have here. Not one of them has come back with a high enough selenium level to be a problem. For those of you who don't know what selenium does to birds Kesterson Refuge in California is a really prime example, and a lot of times the birds are born with one eye, or their beaks are crooked, or they have just one leg -- it causes defects in the embryo.

Q: Untranscribable

A. To report unusual sightings of any kind there's a rare bird hotline here in Colorado. I don't have the number. The guy has a recorder so I know you can leave a message. It's a number in Golden. Or you can call your local Division of Wildlife officer.

Water and Wildlife

Doug Krieger

Senior Fisheries Biologist
Colorado Division of Wildlife

When you see that you are nearly last place on the second day of a two-day workshop, you get the feeling that maybe you will be talking to an audience of three people, one of whom is already asleep in an afternoon nap. It's good to see so many people here. I think it is a testament to the program that Jim and his folks have put together that so many have stuck around, and I'm glad to be a part of it.

When you take a broad look at the Arkansas River Basin in terms of fisheries, one feature that stands out is the diversity of the fishery resources that you find there. In Colorado, we have a unique situation in the Arkansas drainage, as it runs from the highest point in the state to the lowest point in the state. With that change in altitude you see changes in geological features, hydromorphology, and water quality. All of those characteristics create a diversity of fisheries along the corridor.

As an example, Twin Lakes at the upper end of the system is clear, cold, what we call an oligotrophic reservoir. It is very unproductive, yet it has been known for well over 100 years for its outstanding lake trout fishery. As you move down into the Arkansas River itself, we enjoy a long reach of very high-quality habitat, some of the best in the state for wild brown trout populations. Moving down into the plains the river broadens out, slows down, warms up and becomes a braided channel. These characteristics have allowed for the formation of a very interesting complex of what we call Colorado's Little Fishes: the dace, darters, and chubs that make up the Plains system. In addition we have the Great Plains Reservoirs, again very different from the upper reservoirs. They are shallow, turbid, warm, and very productive, and result in some of the best warm water fishing in Colorado.

This kind of diversity presents a lot of options for fishermen looking for different types of opportunities, and is one of the main reasons we have so much fishing in the basin. These resources are also in close proximity to the Front Range, and are on a major travel route for out-of-state visitors. In 1990, the Division of Wildlife commissioned a study of sportsmen expenditures throughout the state. That study estimated the expenditures by anglers in those counties that border the Arkansas River at \$26 million annually. There was no multiplier used, so these dollars reflect actual expenditures for food, lodging, tackle, gas -- those types of trip expenditures. The good thing about this economic development in terms of fishing recreation is that it extends throughout the corridor; every county gets a part of it. Also, it is a family recreation that is almost a year-round type of recreation.

However, the river corridor has not been without its problems. Most notable, and of most interest to fishermen, is the heavy metal pollution that has come down from the top end of the system and has affected the brown trout population in the river itself. With the quality habitat in the river and the conditions that are there, you would normally expect brown trout to live for seven or eight years. We actually find that a rare fish is five years old, and this has probably been occurring for the past 100 years. It appears that metals, principally cadmium, are limiting the longevity of brown trout in the river.

But we are starting to see our first optimistic signs of improvements at the base level of the food chain, because of the work by Asarco, the Environmental Protection Agency, and the Bureau of Reclamation on the upper part of the system. Although we have not seen definitive results in the trout, those working on the river and even anglers have been noticing an increase of algae in the river, an increase in the number and the size of bugs, and recognizing species of bugs that have not been seen in the river ever before. Our agency, along with others, will be monitoring the clean-up activities to determine what kind of improvements we will see out of the brown trout fishery.

Another area of concern that I hear about from anglers (and this is probably more general and not just strictly for the Arkansas) is, "How can fish survive in aquatic systems that are so altered by water development features such as dams, diversions and exchanges? How can fish make it in that?" Some of these concerns are legitimate. There have been losses to fishery resources due to water development in the past, but the charge of the Division of Wildlife is to look at and manage the resources as they exist right now.

Probably a more forward way of looking at the situation is to consider the fisheries that have evolved and currently exist, not in spite of water development, but because of water development. We all understand that without water storage reservoirs, most of our flat-water fishing recreation in this state would not exist. We have limited opportunities in just the natural water bodies found in Colorado. If Jack Garner is correct, and the federal government is basically done with the dam-building business, it would behoove the Division of Wildlife to join hands with the Bureau of Reclamation and other water management agencies to assist in managing the systems as they exist right now.

For instance, consider the Upper Fry-Ark components on the East Slope -- the river, Twin, Turquoise and Pueblo Reservoirs. If you were to ask me to devise an operational system which would meet the legal mandates for delivery of water and yet one that would try to maximize the use of that water for fisheries, I would describe to you a system that is nearly identical to the Winter Water Storage Program. Although this program was not designed for fisheries, the current system operations, in terms of flows in the river and reservoir elevational changes, suits the purposes of the various fisheries fairly well.

Since 1990, we have tweaked this system a little to provide some additional benefits to the rafting industry, but at a cost of some negative impacts to the fishery. I guess I will have to disagree somewhat with Ken Salazar in that flows on the Arkansas is probably still a controversy, and I am not convinced that anyone is completely happy with the situation. I suppose I can now respectfully disagree with Ken as he is no longer my boss! Nonetheless, Ken is correct to conclude that there is a constructive and noncombative way to rectify and resolve this situation that we have on the Arkansas; and the way to do that is through more information. Not only more information on the fisheries, but on all the uses and resources. We need to determine what needs there are for water, and how those needs can be met within the legal framework that already exists in the system. To answer these questions we have been involved for the last two years in the Water Needs Assessment. Bob Moore from the BLM described that assessment to you in yesterday's session. It is a cooperative effort with the Bureau of Reclamation, Bureau of Land Management, the Forest Service, and the Colorado Department of Natural Resources. The goal is to gather some non-biased, objective data on various activities and resources and their relation to water flows and reservoir elevations which are needed by decision makers to make the right choices. We may have the correct decision right now, but without that data we do not really know that. We are expecting to have the study completed sometime in 1997.

Yesterday Mike French from State Parks gave a nice talk and showed the excellent facilities at Pueblo State Recreation Area. I have told sportsmen's groups many times that I would love to have ten Pueblo Reservoirs across the Front Range of Colorado. People are literally loving that facility to death. Obviously, Colorado citizens and visitors to the state are looking for more of the same. With that in mind, and for considerations for economics in the lower valley, Governor Romer created the Lower Arkansas River Commission in 1992, to evaluate the potential for developing recreation and fish and wildlife opportunities in the Great Plains and John Martin Reservoir systems. Currently, there are fish and wildlife resources already at those places -- some of our folks have put in a lot of hours and a lot of hard work to try to maximize the fish and wildlife components of those systems with what they have to work with. However, to attract visitors that would come some distance to recreate or to enjoy wildlife, you need to have a consistent source of water and facilities to take care of them once they get there. Unfortunately, the Kansas lawsuit may frustrate the development of the plan for the area, but the need has not gone away. The Division of Wildlife and many others are still optimistic that the recreation and wildlife aspects at the Great Plains Reservoirs and John Martin Reservoir can be improved.

One aspect of the Arkansas Basin that we all must have some concern for is threatened species. Currently, the only federally listed fish species in the basin is the Greenback cutthroat trout. Through the cooperative efforts of the U.S. Fish and Wildlife Service, the Bureau of Land Management, the Forest Service, Trout Unlimited, and DOW, this species has been largely recovered at this point. It has taken some 20 years to do this, but we are looking forward to delisting that species, something that is rarely done, within a few short years. This accomplishment was commemorated last year when the Colorado Legislature adopted a bill that made the Greenback the official state fish of Colorado. However there are other species that are emerging on the scene that we need to pay close attention to. The Arkansas darter has been a candidate species for federal listing for a number of years, as well as a couple of other species that were identified in the past few months. From the Fish and Wildlife Service perspective, the listing of the Arkansas darter probably makes some sense. The fish is found in five states, three of which have the fish listed as a threatened or endangered species. Colorado has it listed as a threatened species. What the DOW is trying to do is avoid federal listing by recovering the Arkansas darter within our own borders. This past fall the Division of Wildlife completed four state species recovery plans, one of which was for the Arkansas darter. If there is a failing of the Endangered Species Act, it is that the spending and emphasis for that program has been on species that are already slipping off the edge. Our belief and approach, and one that has been

supported by many others, is to prevent species from declining and therefore prevent federal listing.

We have just spent two years on the most complete fishery survey of the eastern plains that has every been done. We are trying to define where the darter is, what type of habitat it is using, and why it is limited in distribution. There is still a lot of work to be done. There are many unanswered questions. Ultimately we want to avoid the situation that exists on the West slope right now, with the Colorado River fishes. Any of you who have dealt with that situation know that it is not the type of thing that we want to see in the Arkansas valley. The DOW has held two workshops over the last three years, with water users, the Northern District, the Southeast District, and municipalities along the Front Range to discuss threatened and endangered species. The purpose of those meetings was to get information out to the water users about threatened and endangered species and what the Division of Wildlife is doing about them. Also, and probably more importantly, we were asking for cooperation and assistance in that effort from the water user community. The opportunity and offer to assist in this program still exists. We all have much to gain by trying to reestablish species and preclude further listings that would make all our lives much more difficult.

That, in a nutshell, summarizes some of our fishery interests within the Arkansas Valley. I appreciate the opportunity to have taken part in the Conference.

A Review of the Arkansas River Basin Water Forum

Daries "Chuck" Lile

Director

Colorado Water Conservation Board

Thank you very much. I appreciate all of you staying. When Tommy Thomson asked me to be the wrap-up speaker, I figured that he was trying to determine whether I had anything important to say. Apparently, if I did have something important to say, it would have already been said by somebody else. In reality, I think it was Tommy's way of challenging me to learn more about the Arkansas and to work through the processes on the Arkansas. I thank this group for the opportunity to speak, and I want to thank Jim Valliant and the organizing committee for all the effort that went into this conference. I believe this was a very important conference for Colorado to have, and particularly for the Arkansas Basin. Certainly Tommy was always working hard to protect the basin, to continue a dream and develop a vision for our basin. The challenge to continue into the next century begins with this conference. I would encourage the group to think about putting on additional conferences in the future, because it has been very informative. We have all learned a lot and the information it has been quite focused. As you can see, people have stayed, and this shows their level of interest.

I would like to take a little time to review some of the high points of the speakers before we close. Jim Lochhead challenged us to think about developing a vision for the future, a vision for the next 50 years. He placed it in our hands and asked what each of us could do as individuals as well as in groups. Dennis Montgomery explained the complexities of the compact and offered his reflections on the history that went into its development; how the compact commissioners at that time had ideas of how to try to protect our water entitlements for the next generation, and how hard they worked at it. I think how it was designed was very critical, and we need to learn from the past. We need to learn not only from our own mistakes, but also from their thoughts and ideas. We need to take that knowledge and hope that it will lead us into the future.

Probably one of the most interesting aspect of this Forum was the way the program was set up. We had periods of time where we would be involved with water quantity, and then we would turn around and have discussions about water quality. I am trying to organize water quality comments into one section here. I believe we all learned the importance of water quality, and we learned about some new technology being developed to improve water quality. We saw how some progress is being accomplished, particularly in the Leadville area. I believe water quality is critical, and that it is critical that everyone in our basin be aware of the problems concerning water quality and work towards resolving these kinds of issues.

We have heard a lot of discussion and comments about stake-holders and partnerships, and how we need to work to develop partnerships. I believe that the phrase "win-win", along with the situations in some of those discussions that Ken Salazar mentioned today, show us how we can reach solutions.

I remember what Tom Kourlis said during lunch yesterday, when he was talking about the importance of farming and the importance of agriculture to the basin. He paused, and then said he really didn't like the term "park it" (but used it to illustrate his point). He was talking about parking agricultural land to protect open space. I was thinking at that time that, in a way, we also "park" water in agriculture to preserve it for future generations, because by using it today, and establishing historic use, we are protecting our use of that water. We will then have it available for different uses as demands change.

We have heard from several cities and municipalities about their search for water -- how they have had to go outside of this basin, and how some other basins have come into this basin and acquired water. We have heard how those impacts affect us, not only in terms of impacts to the land but the change in the communities, the change in economies, and the change in the river. We see competition for different needs pulling at this basin. We are on the threshold of trying to develop a new approach to solving problems in the Arkansas.

Senator Don Ament described some of the complexities that he faces in the State Legislature with setting public policy, particularly when it comes to dealing with water. This process is often controversial, and it is always difficult to balance the interests. There is a lot of feeling between the "haves" and "have nots". I think that people who own water rights often feel that they have to go out every morning and fight to defend those water rights. It is critical that we recognize personal

property rights and understand that people whose ancestors worked hard 100 years ago and developed water have a vested interest. When we start seeing these competing interests develop, we have to figure ways to make sure that this particular aspect is recognized.

When the Senator was talking, he said there was one solution: we need more water. He also indicated that we need transmountain diversions. I know the Senator recognizes the complexities that go into developing water, and that some people say it is impossible to have additional transmountain diversions. I thought about these statements, and while I don't agree that it is impossible, I agree that it is extremely difficult. The permitting requirements and the competition between different basins is a very difficult process. However, we have an example of a situation that currently exists where we have a cooperative program going forward on the Wolford Mountain project between Denver and the Colorado River District, where they looked for and found a solution to these sort of problems. It allowed for increased diversions to the East Slope while developing water for the Western Slope. Our agency, the Colorado Water Conservation Board, is a participant in the project, and we are helping finance it. So you see it is not impossible, but you have to develop partnerships and reach for integrated solutions to accomplish a transmountain project. And it will take time.

We have heard from several speakers today about the diverse uses of the wildlife in our basin, the diverse uses of water, and the diverse effects upon the economy. We have talked about recreational use and rafting days, and we had a beautiful presentation on all of the wildlife benefits in the basin. All of these uses are directly or indirectly impacted by everything we do. I was glad to hear someone say that water helps endangered species. I have long maintained that when you bring water to the West, you help the species. I would have also liked to see a picture of a man and a woman, for we are also part of the habitat of the basin.

We heard about the changing role of the Bureau of Reclamation, and the fact that the USBR will no longer be building large projects but is moving into a different era. I think that is one of our challenges: how to operate this basin without the aid of the federal dollars that we have traditionally had, and without the development of water that was previously done by the Bureau, but is no longer available to us.

Lets go back for a moment to what Gary Bostrom said, and his question. How do you plan for the future? It is difficult to predict what the needs of the municipalities will be. We have seen demands placed on the basin for future municipal needs, yet those needs have not been developed. Within that context, I think we have an opportunity to help address issues with Kansas. We have water that the municipalities have identified, or purchased, or converted or brought into the basin. Maybe we can create a short-term solution by using these waters until municipalities grow, to use them to offset some of the problems we are having with the Kansas litigation. Certainly, after hearing from Hal Simpson, I hope we all developed a better understanding of the difficult task of water administration and how we have to recognize the "first in right, first in time" doctrine in our state. I don't envy him the difficult task ahead of trying to protect the economy of the valley while regulating wells in such a way as to offset our impacts to surface water users in Colorado and Kansas.

David Harrison, who is always one to be on the leading edge of trying to develop a vision for the future, outlined some concepts and ideas. He pointed out the important elements of dealing with water issues. One point that he made, that I thought was quite appropriate, was that litigation is costly and that its outcome is unpredictable. In my opinion, he is saying to us very clearly that we need to look for solutions outside the realm of litigation.

Steve Witte did an exceptional job when he explained the complex operations of this river system and how he administered it. But there exist some opportunities and options and operational plans that allow us to have a measure of flexibility. I don't know if David Pope is still here, but I am not sure David and I are dealing with the same river. He is dealing with "Ar-Kansas" River and we deal with the "Arkan-saw" River. The point is, maybe we shouldn't be litigating. I don't know if we are even fighting over the same river. But I don't envy David's position of being from Kansas and coming to Colorado. That was pretty brave on his part.

Ken Salazar always gives a rousing speech and talks about how things should be done, and I guess I have learned some of those approaches to solving problems from working with him.

As for Larry MacDonnell -- I think the litigation history of this basin has set the stage for a lot of other things throughout the State of Colorado. A lot of the case law that was developed in the Arkansas Basin has been exported to use in other basins to solve problems. Unfortunately, litigation is very expensive, and we need to try to avoid it when possible.

I think Jim Valliant scheduled himself last for a reason. I think that you were able to show Jim that we have opportunities out there to find ways to use our water more effectively, to reduce our costs -- the cost of pumping, the cost of fertilizer -- and to improve the water quality. We look forward to working with Jim. He is going to make a proposal to our Board in March about how the Conservation Board could assist with financing and grant money to further this project of Jim's. We look forward to working with Jim and the Colorado State University to improve our ability to meet the challenges of the future.

In conclusion, I was thinking about how I would design a vision for the future of the Arkansas basin. First, we must come together and keep doing just what we did at this conference. This gave us a chance to exchange information and ideas, to provide a lot of education to people, and to help develop better understanding of each others' problems. Secondly, I think we must sit down and resolve our conflict with the State of Kansas. To do that, the first step is to live up to our responsibilities. We must open up our administration and operations so that Kansas can understand that we are trying to do the correct and right thing. Third, we must maintain the economic viability of this valley, particularly for agriculture. We have to sow seeds so there is water available for the next generation. We have to look for ways to keep agriculture surviving so that we can, in effect, use the principle of parking water in one use so that it can be used for other needs in the future. Fourth, we must understand the need for diversifying our economy and our water uses. There are needs for wildlife and recreation, and we must see how those needs can be interfaced with the needs of irrigators and municipal users. Fifth, and finally, we must think about developing partnerships, and decide how we will sit down at the table and develop these partnerships? This is crucial to us in the future. Ken Salazar said that we must not walk down the path of litigation, and I would like to leave you with that thought. We must not walk down the path of litigation, but we should sit down to the table of cooperation and seek resolutions to our conflicts. I look forward to working with this basin, and my Board looks forward to working with you.

List of Speakers

Honorable Don Ament
State Senator
Route 1, Box 142
Iliff, CO 80736

Gary Bostrom
Water Resources and Planning
Colorado Springs Utilities Department
P.O. Box 1103
Colorado Springs, CO 80947

Doug Cain
U.S. Geological Survey
201 W 8th Street, Ste 200
Pueblo, CO 81002

Mike French
Lake Pueblo State Park
Colorado Department of Parks &
Outdoor Recreation
640 Pueblo Reservoir Road
Pueblo, CO 81005

Jack Garner
U.S. Bureau of Reclamation
11056 W County Road 18E
Loveland, CO 80537

David Harrison
Moses, Wittmeyer, Harrison, & Woodruff
Groundwater Users Association Program
PO Box 1440
Boulder, CO 80306

Doug Kemper
Water Resources
City of Aurora
470 South Havana
Aurora, CO 80012

Tom Kourlis
Colorado Department of Agriculture
700 Kipling Street, Suite 4000
Lakewood, CO 80215-5894

Doug Krieger
Colorado Division of Wildlife
2126 Weber
Colorado Springs, CO 80907

Daries "Chuck" Lile
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, CO 80203

James Lochhead
Colorado Department of Natural Resources
1313 Sherman Street, Room 718
Denver, CO 80202

Lawrence McDonnell
University of Colorado School of Law
Campus Box 401
University of Colorado
Boulder, CO 80309-0401

Dennis Montgomery
Hill and Robbins, P.C.
100 Blake Street Building
1441 18th Street
Denver, CO 80202-1256

Bob Moore
U.S. Bureau of Land Management
PO Box 25047
Denver, CO 80225-0047

Mr. Jon Northrop
Chief Executive Officer
Bion Technologies, Inc.
5761 S. Jasmine Street
Englewood, CO 80111

David Pope
Division of Water Resources
Kansas State Board of Agriculture
109 S.W. 9th Street, Suite 202
Topeka, KS 66612

Steve Reese
Arkansas Headwaters Recreation Area
PO Box 126
Salida, CO 81021

Alan Ringle
Colorado Canal Company
PO Box 8
Ordway, CO 81063

Jim Valliant
Cooperative Extension, Southeast Area
PO Box 190
Rocky Ford, CO 81067

Ken Salazar
Parcel, Mauro, Hultin, and Spaanstra, P.C.
1801 California Street, Ste 3600
Denver, CO 80202-2636

Gary Soldano
Colorado Department of Health
720 North Main
Pueblo, CO 81003

Hal Simpson
Division of Water Resources
1313 Sherman Street, Room 818
Denver, CO 80203

Jenny Slater
Colorado Division of Wildlife
1204 E Olive
Lamar, CO 81052

Dave Suhr
ASARCO Western Metals Division
P.O. Box 936
Leadville, CO 80461

Steve Witte
Division 2
Colorado Department of Water Resources
P.O. Box 5728
Pueblo, CO 81002