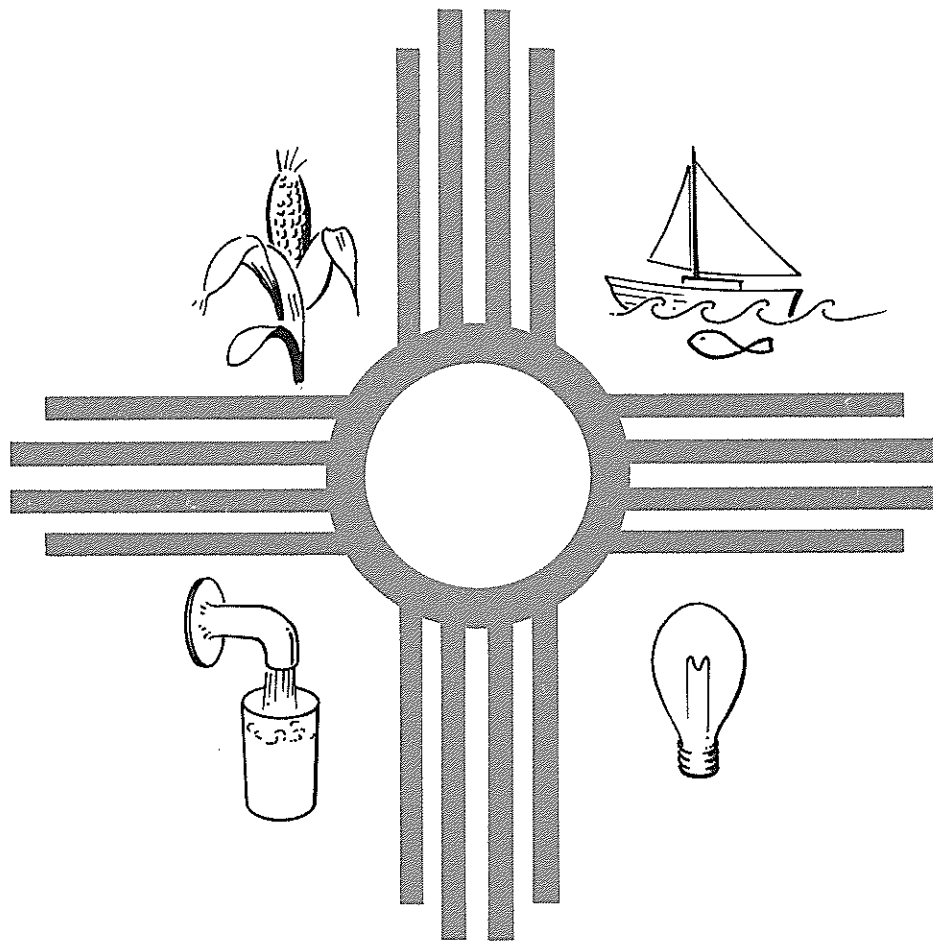


June 1981

WRRRI Report No. 134

**PROCEEDINGS OF THE TWENTY-SIXTH
ANNUAL NEW MEXICO WATER CONFERENCE**

Water for a Growing and Changing Sunbelt State



New Mexico Water Resources Research Institute

New Mexico State University • Telephone (505) 646-4337 • Box 3167, Las Cruces, New Mexico 88003

WATER FOR A GROWING
AND
CHANGING SUNBELT STATE

PROCEEDINGS OF THE TWENTY-SIXTH
ANNUAL NEW MEXICO WATER CONFERENCE

New Mexico Water Resources Research Institute
New Mexico State University
Las Cruces, New Mexico

March 26-27, 1981

PREFACE

The 26th annual water conference was held on March 26 and 27, 1981. This year the theme was, "Water for a Growing and Changing Sunbelt State."

New Mexico is one of the country's rapidly expanding Sunbelt states and we are faced with limited supplies of renewable fresh water. It is generally agreed that our current supplies will accommodate future demands in some sectors of the economy, but there is not enough water to supply all projected demands.

This year's New Mexico Water Conference sought to provide an opportunity to both water users and water managers to ask hard questions about the future. It also provided a forum for public input. Some of the questions addressed were:

- * What new water use conflicts may come about with growing demands for our limited supply?
- * Which sectors of the economy will benefit and which may lose as these conflicts become resolved?
- * Can we develop different management schemes and new technologies to use our supplies more effectively?
- * What new information will be required if we are to minimize future water conflicts and sustain a growing economy?

Due to the contributions of speakers and participants the water conference was once again a success. Special thanks is again in order for the unselfish contributions and helpful suggestions of our State-wide Advisory Committee.

In addition to the formal presentations, the workshops provided a meeting place for people interested in different aspects of water use. The papers which follow present the conference's response to New Mexico's water future.



Thomas G. Bahr
Director

Funds required for publication of the Proceedings were provided by registration fees, the United States Department of Interior, Office of Water Research and Technology, and by State appropriations to the New Mexico Water Resources Research Institute.

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Gerald W. Thomas
Lee Zink

Marjorie Burr
William Humphries
Ken Needham
Steve Reynolds
Ray Sadler
William Stone
Frank Ward

1981 NEW MEXICO WATER CONFERENCE PROGRAM

Thursday, March 26

8:00- 9:00 Pre-registrant check in and late registration
Stucky Hall

SESSION #1 - THE BROAD VIEW TO THE FUTURE

Session Moderator: TOM BAHR, Director, WRI

9:00- 9:15 Herding time to PSL Auditorium

9:15- 9:30 WILLIAM HUMPHRIES, President, NMSU Board of Regents
Welcome to the University

9:30-10:00 GERALD W. THOMAS, President, NMSU
"Growth Impacts on Resources of Arid and Semi-Arid
Regions: A Global Perspective"

10:00-10:45 Break

10:45-11:15 LEE ZINK, Director, Institute of Applied
Research Services, UNM
"The United States Sunbelt - Realities of the Future"

11:15-Noon Open Discussion

* * * * *

12:00- 1:30 LUNCH -Holiday Inn

RAY SADLER, Associate Professor of History, NMSU
"Blood on the Border"

* * * * *

SESSION #2 - CONTRASTING VIEWS TO THE FUTURE

Session Moderator: MARJORIE BURR, League of Women
Voters, Las Cruces

ISSUE PAPERS - Each speaker will share with the audience a
different perspective on anticipated future water problems and
will also serve as a workshop leader in the following areas of
water use:

- 1:30- 1:45 Agricultural - GEORGE DAWSON, Professor and Head,
Department of Agricultural Economics
and Agricultural Business, NMSU
 - 1:45- 2:00 Municipal - KEN NEEDHAM, Director of Utilities,
City of Las Cruces
 - 2:00- 2:15 Industrial - WILLIAM STONE, Hydrogeologist,
New Mexico Bureau of Mines and Mineral
Resources
 - 2:15- 2:30 Recreational - FRANK WARD, Assistant Professor,
Department of Agricultural Economics
and Agricultural Business, NMSU
 - 2:30- 2:40 Workshop Instructions - TOM BAHR, WRI
 - 2:40- 3:00 Break and Herding time to Workshop Locations
 - 3:00- 5:00 Workshops
- * * * * *
- 6:30- 8:30 Informal Attitude Adjustment Period - Cash bar with
complimentary snack buffet at Fat Eddie's, Best Western
Motel.

* * * * *

Friday, March 27

SESSION #3 - PUTTING IT ALL TOGETHER

- 8:00- 9:30 Continuation of Workshops
- 9:30-10:00 Break and Herding time back to PSL Auditorium
- Session Moderator: STEVE REYNOLDS, State Engineer
- WORKSHOP REPORTS - A reporter from each of the workshops will
summarize deliberations and present conclusions
- 10:00-10:10 Agricultural Workshop Report - Fran Kaszeta
- 10:10-10:20 Municipal Workshop Report - Stephen H. Hubert
- 10:20-10:40 Industrial Workshop Report - Gail Stockton
- 10:40-10:50 Recreational Workshop Report - Tom Moody

10:50-Noon PANEL DISCUSSION - Each panel member will comment briefly on the workshop conclusions (5-minutes) and then the session will open to comments, questions and general discussion from the floor.

Panel Members:

COL. BERNARD ROTH District Chief, U.S. Army Corps
of Engineers, Albuquerque

WILLIAM STEPHENS New Mexico Secretary of
Agriculture and Director,
New Mexico Department
of Agriculture

JIM KING Deputy Director, N.M. Department
of Natural Resources

FRED O'CHESKEY Public Service Company
of New Mexico

* * * * * ADJOURN * * * * *

Optional building tours begin at 1:30.

TABLE OF CONTENTS

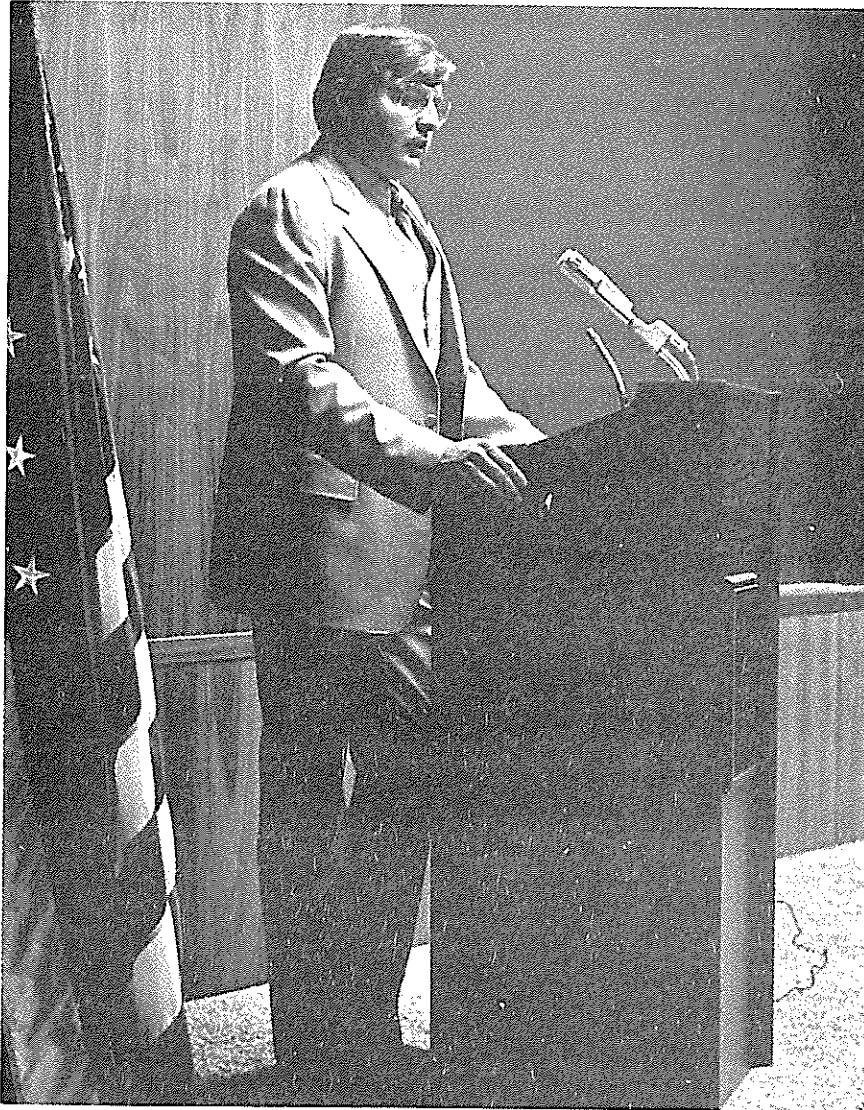
	Page
Preface	
Thomas G. Bahr, Director New Mexico Water Resources Research Institute	ii
Water Conference Advisory Committee Members	iii
Water Conference Program	iv
Welcome to the University	
William Humphries, President New Mexico State University Board of Regents	4
SESSION ONE: THE BROAD VIEW TO THE FUTURE	8
Moderator: Thomas G. Bahr, Director New Mexico Water Resources Research Institute	
Water for the Sunbelt: A Global Perspective Gerald W. Thomas, President New Mexico State University	11
The United States Sunbelt - Realities of the Future Lee B. Zink, Director Institute of Applied Research Services University of New Mexico	29
SESSION TWO: CONTRASTING VIEWS TO THE FUTURE	39
Moderator: Marjorie Burr League of Women Voters Las Cruces, New Mexico	
Water for Agriculture in a Competitive Environment George R. Dawson, Professor and Head Department of Agricultural Economics and Agricultural Business New Mexico State University	42

Table of Contents (continued)	Page
A Municipal Perspective Kenneth M. Needham Director of Utilities City of Las Cruces and Donald Craig Andrews Associate Director of Water Resources City of Las Cruces	50
Water for Industry in New Mexico's Future William J. Stone, Hydrogeologist New Mexico Bureau of Mines and Mineral Resources	62
The Future of Recreation in New Mexico Frank Ward, Assistant Professor Department of Agricultural Economics and Agricultural Business New Mexico State University	78
SESSION THREE: PUTTING IT ALL TOGETHER Moderator: Steve Reynolds New Mexico State Engineer	85
Agricultural Workshop Report Fran Kaszeta, Graduate Student Department of Civil Engineering New Mexico State University	86
Municipal Workshop Report Stephen H. Hubert Martin, Martin, & Lutz	91
Industrial Workshop Report Gail Stockton Turney, Sayre, & Turney Engineers	96
Recreational Workshop Report Thomas M. Moody New Mexico Department of Game and Fish	98

Table of Contents (continued)	Page
Water Conference Panel Discussion	105
Members:	
Colonel Bernard Roth, District Chief U.S. Army Corps of Engineers Albuquerque, New Mexico	
William Stephens New Mexico Secretary of Agriculture and Director New Mexico Department of Agriculture	
Jim King, Deputy Secretary New Mexico Natural Resources Department	
Fred O'Cheskey Manager of Governmental Affairs Public Service Company of New Mexico	
Conference Participants	151
WRRRI Staff Participants	163

Proceedings Editor: Lynda MacKichan
 Editorial Assistant: Cheryl I. Crawford
 Photographer: Jack Devin

WELCOME TO THE UNIVERSITY



Bill Humphries

William Humphries, President, New Mexico State University Board of Regents, delivered the welcoming address at the 26th Annual New Mexico Water Conference.

WELCOME TO THE UNIVERSITY

William Humphries, President
NMSU Board of Regents

First, I have the pleasure of reading the proclamation on behalf of the Governor and presenting it to you.

PROCLAMATION

Whereas, water is vital to all things living; and

Whereas, a continuing source of good quality water is important to the citizens of the State of New Mexico; and

Whereas, the limited water resources of the State of New Mexico must be used in a judicious manner and their care, use and development is the responsibility of all citizens of the State; and

Whereas, the New Mexico Water Conference annually focuses on water resource problems and seeks ways to protect the present level of quality water and to reclaim and reconvert water;

Now, therefore, I, Bruce King, Governor of the State of New Mexico, do hereby proclaim the week of March 22-28, 1981, as:

"Water for New Mexico Week"

and urge all citizens to pay special recognition to this week and the significance of water to the State of New Mexico.

Done at the Executive Office this 19th day of March, 1981. Witness my hand and the Great Seal of the State of New Mexico.

Bruce King, Governor

I always like to brag about New Mexico State University. My association with the University has truly been a pleasant one. I feel fortunate for the honor and the privilege of serving this University and serving with some people -- like the administration, the staff, and the faculty of this University. I think one of the important things the University does is to bring people together who have a common need to solve a problem and hopefully to look into the future and deal with some problems.

This University is almost a hundred years old. The East Coast is not the only place that has old universities with histories and reputations. We think that in New Mexico State University's short one hundred years (approximately, it will be 1988 when we have our centennial year) we have accomplished a great deal. Probably in the last ten years, education at this university and all the outreach programs of this university have exceeded all that went before it in the 90 years previous to it. I think New Mexico State University is now a major university, and can make that claim on an international level. It is not just a small A&M college anymore. We have five branch campuses and a very large main campus. In the Fall of 1980 we had almost 17,000 students at this University. There are over 3,000 employees, faculty, and staff. This year our budget is approximately \$150 million, depending on whether we get any more out of the Legislature or not. The graduating class has 500 two-year Associate Degrees annually, 1,500 Bachelor's, 330-350 Master's Degrees, and 40-50 Ph.D.'s each year. The additional things that make this University great, I think, are things like the Water Resources Research Institute,

New Mexico Department of Agriculture, the Extension Service, the Physical Science Laboratory -- who by the way is now, I think, the tenth largest defense contractor amongst universities in the United States.

Those are things people often overlook about New Mexico. They think we are hidden away in the Southwest and maybe we take advantage of some facets of being hidden away in the Southwest, but in general we have some good things going for us. The Solar Energy Institute, the Experiment Station, put New Mexico State University on the leading edge, I think. We are doing things that are important for the survival, not only of the Southwest, but of mankind in general. I think we have international projects of major scope and sequence. We are dealing with Egypt now on a project that is -- the ultimate dollar figure I think is \$48 million on a cereals and legume project. We have an education project in North Yemen and I think any project that we get on -- and Dr. Bahr was just telling me that he was going to work on a project in Algeria -- any kinds of educational understanding and projects that have impact for positive impact in the Middle East are certainly worthwhile programs. We have worked with the great nation of Mexico to the south for a long time. This University was not just aware of Mexico when they discovered oil. We have got exchange projects with universities or cooperative agreements with universities in Taiwan and in Italy and probably others that I may not know about at the present.

Our international scope is something of major interest. We generally have people in between 8 and 11 foreign countries at any given time. I think that size is not the most important thing. The most important thing is the quality of what we are doing.

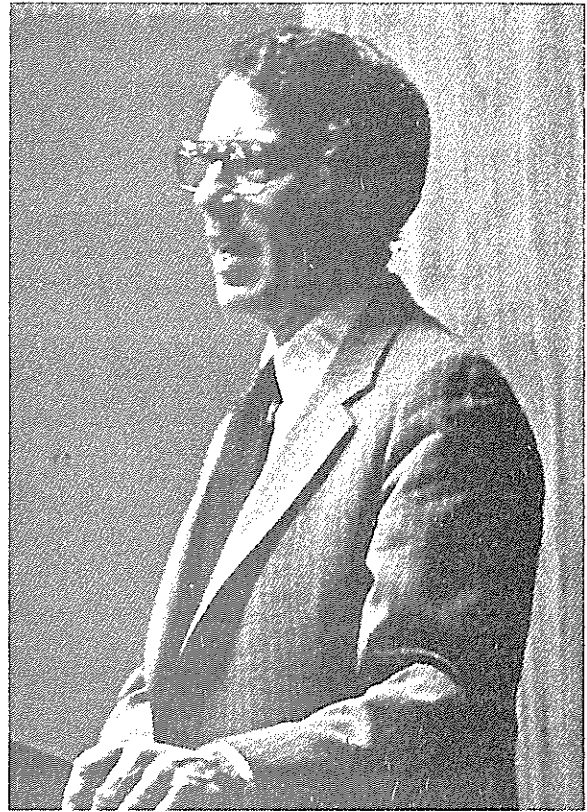
I believe the staff, faculty, and administration that Dr. Thomas has put together have been uncommonly excellent. I think that we have had growth without sacrificing excellence. Sometimes its easy to grow and sacrifice what made you grow or what you are striving for -- and that is excellence -- and I think New Mexico State University has managed to retain that. I think that there is not a person in the State of New Mexico that somehow this university does not affect their life or touch it. In some program, some form, we have dealt with just about everybody in the State of New Mexico, and not only in New Mexico, but on a regional and national and now an international basis. But more importantly yet I think is the very reason you are here -- that is that we are looking for ways to bring people together and solve problems. I think providing research, the technical assistance and the opportunity to mutually address and hopefully solve some of the burning questions and some of the problems of the future of New Mexico and the Southwest, the Nation, and the world in general are opportunities that a university certainly can not turn its back on, and I hope this university continues to address them as they have in the past. I think the hope for the future is in education and the university provides that opportunity. I thank you and welcome you to New Mexico State University.

SESSION ONE: THE BROAD VIEW TO THE FUTURE

Speakers



Gerald W. Thomas



Lee B. Zink

MEET THE SPEAKERS

GERALD W. THOMAS became President of New Mexico State University in August, 1970. Prior to assuming the Presidency of New Mexico State University, Dr. Thomas was Dean of Agricultural Sciences at Texas Tech University. He also worked for Texas A&M, for the US Soil Conservation Service, and the US Forest Service. He served as a Naval Aviator during World War II.

President Thomas has received international recognition in the fields of agriculture, ecology and resource management. He has had many assignments abroad and has been a consultant to government and private industry. He is the author of the book Progress and Change in the Agricultural Industry, and co-author of Food and Fiber for a Changing World. He has contributed chapters to several other books and has written over 100 professional articles.

As President of the Land-Grant University of New Mexico, Dr. Thomas is responsible for academic programs on five campuses in the State. New Mexico State University also has extensive research and extension programs throughout the State and personnel in over 30 locations world-wide.

LEE B. ZINK is the Director of the Institute for Applied Research Services at the University of New Mexico, as well as an Associate Professor of Economics at UNM. For the past 20 years, Dr. Zink has

served as a consultant to federal, state and local agencies, as well as to private industry. Zink is a graduate of Indiana University, and has his Doctoral Degree from Oklahoma State University in Economics.

He is the past President of the National Association for Business and Economics Research, and past Chairman of the Governor's Council of Economic Advisors, New Mexico. Currently, Dr. Zink is the President of the Greater Albuquerque Chamber of Commerce, a member of the Board of Directors of the National Training Institute for Community Economic Development, and serves on a number of other executive boards as well.

WATER FOR THE SUNBELT: A GLOBAL PERSPECTIVE

Gerald Thomas, President
New Mexico State University

Introduction

I have had a long and continued interest in water. When I was a young boy living on a farm on Medicine Lodge Creek in Idaho, I remember the fights over the limited water supply in the stream. The Water Master had to carry a gun to enforce the headgate flows to the farms along the creek. Even then people at the head of the creek used some water illegally at night. The water rights on our farm were filed in 1890 -- too late to get first call on water during the dry years. In a good year with heavy winter snows in the mountains, we had enough water to irrigate three to four times. In a dry year we were lucky to get one "watering" during the early spring, and on those gravelly soils in Idaho, the crops dried up to the point where we could not mow and stack hay, but could salvage some production by turning the cows into the fields.

Water supplies became even more critical during the 1929 Depression and the drought of the 30's, forcing my father to seek other employment. We contracted to stack hay in the Big Hole Valley and Horse Prairie in Montana and leased a hot springs resort in Idaho to try to make ends meet. Our access to open range for our horses and cattle was substantially curtailed when the Taylor Grazing Act was passed in 1934. Several farm/ranch operators went out of business as a result of cuts in grazing allotments, including some of my relatives.

The lack of water on our old farm in Idaho served as one good reason for me to join the Navy during World War II. For nearly four years I saw

plenty of water as I served on three aircraft carriers in the North Atlantic and South Pacific -- frequently seasick. And, while salt water was abundant in every direction from the carrier, I well remember the orders to conserve fresh water on board and the limitations in the showers and mess hall. "Water, water everywhere, but not a drop to drink." Even now, good economical techniques for salt water conversion are not within our grasp. Despite this, we have word that the new administration will close out the desalinization research at Roswell and at other locations in the west. The challenge to convert salt water to fresh water and to develop methods to utilize brackish water is still a major goal of the scientific and business community, as well as a problem for the Navy. Indeed, it might be logical to seek National defense funds to maintain the valuable desalinization research at Roswell.

After World War II, I left the farm, but two of my brothers tried to salvage the old home place by digging a well for supplemental irrigation. My older brother cut an apple limb from a tree in our yard and "waterwitched" the first hole. It turned out dry so he moved closer to the creek. A second well did hit water, but the cost and erratic supply never made an economic operation. The old home place is now dried up and abandoned. There is something both nostalgic and sad about an abandoned, formerly-irrigated farm turned back to weeds. And my story has been repeated in many areas of the west. A Newsweek special calls this "The Browning of America," stating that "...the water wars have erupted once again...." (1)

My early work with the Soil Conservation Service in Idaho from 1946-50 was aimed at developing one of the first systems for contour irrigation of potatoes in the United States. Our work unit received a special merit award from USDA for this early water conservation work. At Texas A&M, my interest in water was enhanced from my research on the dry range lands of the Edwards Plateau of Texas. I have conducted studies on range pitting, soil compaction, soil aggregate-size distribution, the effect of roots on water infiltration and other matters that relate to effective water use on rangelands.

As I moved into the Dean's position at Texas Tech, my interests shifted from specific concerns about water conservation and range management to the larger issue of world food production. It became increasingly clear from my latter studies that water was a limiting factor in food production and water use was critical to world food supplies. Also, since the economy of the High Plains of Texas is sustained from water stored in the Ogallala formation, the wise use of this depletable underground resource was of utmost importance to our future. Consequently, I helped organize the West Texas Water Institute at Texas Tech and argued for a share of the Water Research funds through the Department of Interior. Later, we formed "Water, Incorporated" as a means of organizing support for possible water importation into the High Plains of Texas and Eastern New Mexico.

When I moved to New Mexico, I had the pleasant opportunity to work closely with Dr. Ralph Stucky, Professor John Clark, Dr. Garrey Carruthers, and now, Dr. Tom Bahr, as we have strengthened our research and education programs relating to this important resource.

My assignment at this conference is to help bring to your attention a global and regional perspective on the water situation and to set the stage for more specific discussions of water for the growing Sunbelt. I have divided this presentation into three sections:

- (1) Water - our most critical resource;
- (2) The evasive nature of the water resource - A global perspective; and
- (3) The research imperative.

Water: Our Most Critical Resource

First, how important is water, as a resource, in comparison with other resource needs, such as land and energy? It is my belief that for the next two, perhaps three decades, energy (both cost and availability) will be the most critical factor in food production and economic development both at home and abroad. But energy is different from the other resources in that there is an adequate supply of energy in our system if we can capture it and make it available to people in a usable and economical form. Some of the new research on energy alternatives looks promising -- particularly the developments in solar energy, geothermal, and in bioconversion. If we can gear up our research effort, which should be multiplied by a factor of ten, we can find solutions to the energy problem and design systems for food and fiber production and industrial development based upon renewable rather than depletable energy supplies.

The second important resource, then, is land. While I am concerned about land, and particularly about the rapid transfer of good crop land to other purposes such as buildings, asphalt, and concrete, I believe that land will not become limiting in the United States for many years into the future. At the present time, we are losing well over three million acres of agricultural land in the United States each year to other purposes. The recently released "National Agricultural Lands Study" points to this loss in America's agricultural land base (2). Dr. David McClintock, in a technical paper supporting the National Agricultural Lands Study, stated it this way:

"International relations in the 1980's and 1990's are likely to be influenced by resource scarcities to a considerably greater extent than in the past. These, rather than conventional rivalries, will pose increasing dangers to global security.... American cropland must be perceived as a global as well as a national resource." (3)

The loss of cropland is not only a problem in the United States, but is a world-wide phenomenon with industrial development and population increases. Indeed, we must become more concerned about this loss of land to irreversible transfers and to erosion. Nevertheless, as new technology develops and crop yields increase, the amount of land required to sustain each person decreases. We still have some flexibility in this resource.

That means, then, that water is more critical in the long term than either land or energy. We can, and must, find solutions to the energy problem; we can, and will, determine ways to operate with a smaller relative land base, but the amount of water in our system is fixed.

There is no substitute for water. Water is a renewable resource. Man uses it as it moves through the hydrologic cycle, usually pollutes it to a certain extent, and feeds it back into the system. While we can reduce the dependence upon water by increasing the efficiency of water use, there is a very limited supply which must be husbanded with great care as the world population increases.

Let us first look at the value of water to world food and fiber production. A few years ago scientists were talking about the great potential in the higher rainfall zones of the tropics. Much of this optimism has disappeared as we have learned more and more about the sensitivity of the tropics and the difficulty in producing food under these kinds of situations. This means, of course, that the arid and semi-arid lands, the vast moderate to low rainfall areas will still be the major areas for world food production. At the present time there are only about eight countries in the world with surplus food production potential, and the United States and Canada contribute about 70 percent of this export production. We also hold about 40 percent of the world's grain reserves. In 1980, for the second year in a row, the world ate more grain than it produced (4). This emphasizes our vulnerability and our dependence on annual production.

Irrigated agriculture is becoming much more important with time as the world's population increases the demand for food and fiber. The recent growth in irrigated land has not only been in the traditional irrigated areas, but in the moderate to high rainfall zones as a risk reducing factor. For example, in the United States, Nebraska has become

the fifth most irrigated state in the nation. Also, irrigation is becoming more important in the less-developed areas of the world -- perhaps the major hope for many of these poor countries. McNamara, retiring president of the World Bank, recently stated that on a global basis, the major increase in total food output in recent years has been associated with expanding the area under cultivation -- particularly the irrigated sector. He states that in the last ten years, roughly 40 percent of all increases in developing country food production has come from expanded irrigation (5). In the past 50 years the areas of land under irrigation has increased threefold and the costs have escalated far more rapidly than the general inflation rate. He also states that despite this development, water has been traditionally treated as a free good and this encourages waste. As you know, the irrigated acreage in the United States comprises about 15 percent of the total harvested crop land, but provides in excess of 25 percent of all crop production. The statistics coming out of the High Plains Study emphasize even more the importance of irrigated agriculture in the United States food situation.

The Evasive Nature of the Water Resource - A Global Perspective

The evasive nature of water as a resource is emphasized by the highly variable patterns of precipitation (in time and space) and the complicated pathways of water as it passes through the hydrologic cycle -- from ocean to land and back to the ocean. While water is, in a very real sense, a renewable resource, the use of this water as it moves

through the cycle is the basis for life itself. Thus, the "rate of movement" of water through the ecosystem is more important to mankind than the location of water in the system at any point in time.

Water can be transferred in space from so-called surplus areas to water-short regions by water diversions or inter-basin construction facilities or, to some extent, by weather modification techniques. The latter approach, that is, the effectiveness of "rainmaking," is very difficult to measure.

Water can be transferred in time by constructing storage facilities along streams or by variable withdrawals and variable recharge of underground aquifers. Desalinization can also be considered as a technique for transferring water in time. Desalinization is an established but expensive technology presently applied to only minute water quantities on a global perspective.

I have stated that water movement through the hydrologic cycle is probably more important to man than the location of water at any given point in time. Nevertheless, some statistics on the location of water at any given time can be used for comparisons among countries and regions. Some generalizations from these statistics follow:

(1) About four-fifths of the precipitation falls over oceans and only one-fifth over land.

(2) The proportion of the water resource in the freshwater form is a small fraction of the total supply -- most of the world's water is salty.

(3) Two-thirds of the fresh water supply is to be found in the glaciers and ice cover of the polar regions.

The "Global 2000 Report to the President," released in 1980, defined six general properties of water (6):

(1) Water is ubiquitous, that is, no place on earth is wholly without water -- although I have personally visited some places on earth with no "measurable" precipitation.

(2) Water is a heterogeneous resource. Water is found in liquid, solid or gaseous states.

(3) Water is a renewable resource. However, it is important to recognize the difference between "consumptive" and "non-consumptive" use.

(4) Water may be a common property. Here the report emphasizes the difficulty in defining water rights and the overall attitude that water is a free good.

(5) Water is used in vast quantities. The global 2000 committee estimated that total water withdrawals is three orders of magnitude larger than the world's combined production of minerals, petroleum, coal, and all metal and non-metal ores.

(6) Water is very inexpensive. While this generalization is also true, my pocketbook hurt when I had to pay \$3.60 per liter for bottled (but non-contaminated) water in African Sahel.

To this Global 2000 report we should add several other generalizations about water:

(1) As our standard of living rises so does our per capita use of water for domestic, industrial, and agricultural purposes. An individual needs only about 2 liters daily for drinking, but water use rises rapidly with the level of income. My study in sub-Saharan Africa indicated that

the average water consumption from wells was 10-15 liters per person per day for home use, about 20 liters for cattle and about 3 liters for sheep and goats. In the United States our home use is about 681 liters (180 gallons) for personal use. However, to sustain our present life style for industrial purposes, the average American uses over 2500 gallons per day (5).

(2) Our largest per capita water requirement is for food. For example, we spend about a ton of water to produce a pound of bread and on some of our Southwestern rangelands over 100 tons of water are associated with the production of a pound of beef (7). Much of the water "associated with" the production of meat is dissipated by undesirable weeds and brush or evaporates from the unprotected soil surface. Such statistics provide a convincing argument for better water management in the food sector. "It is time to assemble better data on such water use and to design systems for food production which value water with the concern of the desert Nomad" (8).

(3) Agriculture cannot compete for water against municipalities, business and industry. These other uses can afford to pay more for water and will continue to purchase water rights away from the food sector. We see this transfer every year in New Mexico and in other agricultural states -- and this moves land out of food production just as surely and as effectively as housing or highway encroachment directly on the land. Substantial transfers have been made in recent years in our state to energy, mining and utilities. There is no doubt in my mind that, if all of the land that you can identify from the air that is marked out for

potential housing development along the Rio Grande watershed, was to develop as the promoters state, there would be little, if any, water left for food and fiber production in this State.

An FAO water study indicated that irrigation used 70 percent of the world water in 1967 but, because of the increase in demands from mining and industry, agricultural use would drop to 51 percent by the year 2000 (6). At the same time that we see this shift of water out of the agricultural sector, we still see more expansion of irrigation into dry farm lands -- particularly in the Third World countries. The amount of irrigated land in the world is projected to reach 273 million hectares (acres) by 1990 (6).

If we look again at world-wide water supplies, considering run-off as the primary measure of availability, we note that South America is wealthy, North America and Africa intermediate, and Australia and Asia "water poor." A Rockefeller Foundation report recently stated that "Asia, overall, has the most restricted water situation in the developing world and...." "...the most critical water resource problems exist in the very high population areas of Hong Kong and Singapore." (9)

A few comments about water and the Soviet Union might be appropriate at this time. Agricultural production has been a high priority for the Soviets for many years -- but they seldom reach their goals. One of their major agricultural zones is around the Aral Sea, which is the fourth largest inland fresh water body in the world. The Aral Sea is now dying -- its level is falling and the salinity is rising as river waters that normally keep it fresh are increasingly diverted to irrigate

cotton. The Soviet Union is the world's leading producer of cotton, mostly from irrigated land. The USSR cotton exports in 1980 were worth about \$500 million. In this area, as well as in other parts of the USSR, salt is a serious problem on the irrigated lands. One report estimates that 40 percent of the irrigation water in the USSR is now used to leach out or wash away the salts on irrigated lands (10). This brings to mind another point about water: we cannot discuss water without examining both the quantity and the quality aspects.

The Soviets have done more experimentation with weather modification and have planned more water transfer schemes than any other Nation. A gigantic water diversion project is now being planned to bring water from Siberia to the southern deserts north of Iran and Afghanistan at an estimated cost of \$20-30 billion. This would dwarf our modest proposals for inter-basin transfers being studied by the eight-state High Plains Study team in size, but our cost estimates are higher than the Soviets. Many members of the scientific community, including some from the USSR, are concerned about the ecological consequences of the USSR massive water diversion project. We are also concerned about some of their other schemes to influence the environment.

From a world perspective, it is not possible to separate the water resource from climate, since evaporation, transpiration, and precipitation are a part of the climate complex. Decisions made in this decade about our energy options will have a profound effect on future climate and water supplies. There is increasing and irrefutable evidence that the increasing CO₂ content of the upper atmosphere is resulting

from the burning of fossil fuels as we attempt to satisfy our insatiable energy appetites. About one-third of the man-made CO₂ comes from America. And, as the CO₂ content of the upper atmosphere increases, a corresponding gradual warming of the globe takes place. Dr. James Henson of the National Aeronautics and Space Administration states that the existence of the warming effect has been confirmed to his satisfaction (11). Several recent issues of "Science" have carried articles of concern about this CO₂ phenomenon.

There is increasing evidence that coal, if used in large quantities, may be our most hazardous future fuel option from the environmental standpoint. A gradual warming of the climate will work to the distinct advantage of the Soviet Union and will increase drought and water shortages in the United States and certain other parts of the globe. As an ecologist, this problem reinforces my conviction that we must increase our research on non-fossil fuel energy options -- particularly solar, geothermal, wind and bioconversion. Even the nuclear option may be preferable to massive use of coal. There is no doubt that our water future and our energy future are inseparably intertwined.

To an increasing extent water is becoming the subject of litigation. There are now over 160 Supreme Court decisions relating to water issues, and Steve Reynolds, who many of you know, the State Engineer for New Mexico, stated that a Supreme Court judge told him recently that because of his association with water he was the most litigious S.O.B. in the history of the state. There have been about 60 Supreme Court opinions involving the New Mexico State Engineer alone in the last 25 years. The

El Paso challenge to New Mexico underground water will now be added to the list. Personally, I am very leery about the decisions involving water that have been relegated to the courts, but this trend seems to be increasing. It is interesting that in Steve Reynolds' opinion, and I quote, "These cases seem to demonstrate the wisdom and sound common sense that the court has applied to our water law. I submit that we have reason to be profoundly grateful for the contribution that our judicial system has made to water management in New Mexico." Steve may be optimistic because he has often been on the right side. Generally, I do not favor developing water regulations or any other regulations in the courts.

The Research Imperative

It should be obvious from my overview on the importance of water as a resource that more research must be one of our highest priorities. The rush to the sunbelt may come to a screeching halt after a decade if we do not plan now to meet our water needs. Data from the 1980 census shows that, while the United States grew 11.4 percent during the 70's, New Mexico grew 27.8 percent; Texas 27.1 percent; Arizona 53.1 percent; Nevada 63.5 percent; Utah 37.9 percent; California 18.5 percent and Colorado 30.7 percent (12). All of these states are water short and solar energy rich, which says something about research priorities. But, both water and solar energy are being considered by the new administration for substantial cuts.

We must learn to measure everything that we do in units of water and become more conscious of water in all aspects of our daily life. Unfortunately, too much of our research is not designed with water as a constraint. How can we increase the efficiency of water use in food production, processing and distribution systems?

We must step up our research on photosynthesis, not only to capture more energy from the sun by this process, but also to determine more effective ways to increase the efficiency of water. More emphasis must be placed on plant breeding using water as the prime measurement unit. Some of our research already indicates that by selecting plants for various water regimes we can increase the production potential in excess of 200 percent over the nonselected plant varieties. We must also learn to reuse water and shortcut the hydrologic cycle.

The High Plains Study is one example of a major research effort which was long overdue. This multistate study is just beginning to yield valuable information for those of us concerned about the resource and involved in the decision-making process. It was the subject of a MacNeil/Lehrer Report on November 27, 1980 called "Running Dry." In the interview with Mr. Lehrer, Governor John Carlin of Kansas, Chairman of the eight-state Board of Governors said, "The solution (to our depletion problem) must start right now ... not in 20 years!" The High Plains Study, as you know, has concluded that by the year 2000 the Ogallala will supply only enough water to irrigate 56 percent of the needed acreage in the six-state area. The aquifer, of course, is the primary source of irrigation, municipal and industrial water in the states of Texas, New

Mexico, Oklahoma, Colorado, Kansas and Nebraska. I serve on the advisory committee for Governor King on this council along with Steve Reynolds, Bob Lansford and others. Today's research on the Ogallala aquifer will be essential to our decision-making process as we plan for the future. It is now obvious that we will reach the "economic limits" of the Ogallala long before we reach the engineering and technological limits. No doubt the high cost of energy is leading to more careful conservation practices. At this point, the possibilities for water importation do not look very encouraging.

In our recent attempt to defend the work of our Water Resources Research Institute against proposed cuts by the Reagan administration, we submitted three examples of substantial payoffs from investments in water research (13):

(1) Funding from the Department of Interior of \$60,000 over a three-year period was used to support a study to reduce the amount of leaching water without adversely affecting soils or crop yields. The computer model developed showed that the Pecos River Valley in New Mexico could reduce water costs by \$500,000 per year and reduce salt input into the Pecos River by 235,000 tons per year.

(2) Seven related water projects in Texas and New Mexico were instrumental in the development of a low pressure drip irrigation system which is now saving both energy and water in the High Plains. Over a 20-year period the value of water saved is in excess of \$800 million and energy savings could be about \$100 million per year.

(3) A new drought-resistant alfalfa has been developed at NMSU which should save 100,000 acre-feet of water for New Mexico without significant losses in yields. Other drought-resistant and salt-tolerant crops can be developed through research.

There are many more examples of the potential pay off through investments in research and education. The future of our Sunbelt lies in our ability to analyze more carefully our water options and in our ability to better conserve this essential and evasive resource.

LITERATURE CITED

- (1) "The Browning of America," Newsweek, February 23, 1981.
- (2) National Association of Conservation Districts. "National Agricultural Lands Study," December 1980.
- (3) McClintock, David. "The Global Importance of American Cropland Availability," Technical Paper XII, National Agricultural Lands Study, February 2, 1981.
- (4) UN Food and Agriculture Organization. "FAO at Work," January 1981.
- (5) McNamara, Robert S. "Food as a determinant of world development," Congressional Roundtable, Washington, D.C., March 4, 1980.
- (6) Council on Environmental Quality and the Department of State. "The Global 2000 Report to the President," U.S. Government Printing Office, 1980.
- (7) Thomas, Gerald W. "Environmental sensitivity and production potential on semi-arid range lands," in Frontiers of the Semi-Arid World. Published by Texas Tech University, 1977.
- (8) Thomas, Gerald W. "Profile of a Fragile Environment," Report to the Rockefeller Foundation, NMSU, September 1980.
- (9) Levine, Gilbert, Oram, Peter, and Zapata, Juan A. "Water." Report prepared for the Conference on "Agricultural Production: Research and Development Strategies for the 1980's," Rockefeller Foundation, Bonn, Germany, October 8-12, 1979.
- (10) Gillette, Robert. "Ecological Crisis Looms in Face of Soviet Cotton Area's Water Problems," Los Angeles Times, March 1, 1981.
- (11) Jastrow, Robert. "The Battle to Control the Weather," Family Weekly, March 15, 1981.
- (12) Population Reference Bureau. "Rush to the Sunbelt," Intercom Vol. 9, No. 1, January 1981.
- (13) Bahr, Tom. "Examples of Economic Benefits from Water Resources Research," NMSU, March 1981.

THE UNITED STATES SUNBELT - REALITIES OF THE FUTURE

Lee B. Zink, Director
Institute of Applied Research Services
University of New Mexico

Introduction

It was my good fortune to come to New Mexico almost thirteen years ago. As I learned more about the beautiful state I was terribly concerned by its relative poverty, its loss of population, its small economic base and its heavy dependence on the federal government for basic economic activity. On more than one occasion I predicted that we faced a dire situation if our path toward the future did not change.

The mid-seventies brought the shock that began a dramatic change in that path's direction. The first oil embargo was that shock wave. Repercussions continue to ring in our daily lives. A trend of looking with mild interest to the Sunbelt, which had started earlier, became an avalanche of interest in our part of the country. We not only had more energy available within our own reserves, we had a relatively mild climate, much underpopulation and, apparently great economic opportunities for the future. The Sunbelt began to grow and to catch the fancy of the country.

The actual definition of the Sunbelt varies. For the purposes of what I am saying here today we will use a loose definition which includes the states of Arizona, Nevada, New Mexico, Oklahoma, Texas, Kansas, Colorado, and Utah. One key holding these states together is water.

Since 1974 the pressures of economic change have grown much more intense. The reasons for those increased pressures come from two basic

areas. One is the great energy resource available in the Sunbelt: oil and gas, uranium, coal, geothermal, solar, shale oil, tar sands, etc. The other is the desire of the federal government to make a very major investment in our national defense: the MX missile system. When these two gigantic programs are coupled with the already growing demands for the region's agricultural products and the acceleration of industrialization in most parts of the area, the pressures of all kinds become intense.

I spoke at a meeting of the Western Governor's Policy Office in Las Vegas, Nevada this past Monday. The purpose of the conference was to begin to plan for meeting the tremendous manpower requirements that the West will be facing these next ten to twenty years. Let me quote from a WESTPO Resolution passed unanimously by the Governors in the fall of 1980:

"The United States Air Force has announced plans to deploy an 'MX missile system' in the rural West. The location of the primary site is the Great Basin area of southeast Nevada and southwest Utah.

"The Rocky Mountain West is also the location of efforts to accelerate the production of energy--including coal, oil and gas, uranium, the generation of electricity and a variety of synthetic fuels. Synthetic fuels development will be expedited through the investment of over \$20 billion by the U.S. Department of Energy and the Synthetic Fuels Corporation.

"Each of these federally mandated initiatives carries a number of conflicts and impacts for the region. However, the deployment of MX, combined with the development of synthetic fuels and accelerated production from conventional energy sources, create an unprecedented level of developmental pressure on western states. The potential cumulative impacts of these simultaneous efforts include:

- a. severe competition for skilled labor,
- b. potential significant and widespread materials shortages,
- c. a staggering level of population growth in Nevada and Utah,
- d. vastly insufficient funds to provide public facilities and community services,
- e. unprecedented competition for other resources--including capital, water and electric capacity.

"Labor requirements are of great concern to state and local officials. The Air Force projects MX labor needs on the order of 16,000 people involved in direct construction, with another 15,000 needed as an operational labor force. Four power plant complexes, planned for simultaneous construction within the Great Basin area, will generate additional labor needs of 6,000-7,000 skilled workers. It must also be noted that additional labor requirements conservatively projected at 100,000 workers, will be necessitated by the development of coal, electric generating plants and synthetic fuels facilities throughout the Rocky Mountain West.

"There is no evidence that federal MX and energy activities are presently being coordinated. Additionally, no structure has been established within the federal executive branch to integrate the planning of MX deployment and synthetic fuel development in the West."

That gives you an idea of the great concern expressed by our Governors. Note that they mention water.

Our Sunbelt has been on a population growth curve that seems to be moving upward almost continuously since 1970. Nevada had the highest percentage increase of any state in the nation between 1970 and 1980--63.5 percent. Arizona was second with 53.1 percent. All of our Sunbelt states grew much faster than the national average of 11.4

percent. (New Mexico was 27.8 percent and only Texas, Oklahoma, and Kansas were higher.)

Population growth projections to 1990 and 2000 show all Sunbelt states growing considerably faster than the national average of 0.8 percent per year. (These population projections were made without consideration of the impact of MX, so they may be understated.)

What of industrialization? Where can we predict its greatest impacts to be? Day before yesterday I was in the Los Angeles area which is a part of what was the last frontier for industrialization several years ago. The bloom is off there. Housing for workers is impossible because of cost. Wage rates are high. Living conditions are crowded. Land for plant sites is prohibitive. So what are the industries there doing when they must expand? They are moving to our area. Albuquerque is a clear example of that trend. Most of the industries that are establishing plants in the Sunbelt are related in some way or another to electronics, a growth industry predicted to remain so for the next twenty to twenty-five years.

Based upon this industrialization and increase of demand for Sunbelt resources, total personal income is expected to grow rapidly between 1978-2000. All Sunbelt states will exceed the national average of 3.3 percent per year.

What then are the realities for the future for the Sunbelt area? It seems to me that a word which says it all is change. The Governors' statement would indicate change which is now largely out of control and, at present, beyond reasonable comprehension.

What are some of the realities that we might suggest?

Helen Ingram in her 1980 book, A Policy Approach to Political Representation: Lessons from the Four Corner States, says "Every recipe for energy development has 'add water' in its instructions."

A coal gasification plant in New Mexico or Arizona, processing 24 million tons of coal per year to meet the energy needs of a million people, would use about 300,000 acre feet of water per year.

A 10,000 megawatt coal-fired thermal electric power plant in the Four Corners region requires about 230,000 acre feet of water per year.

(To get some perspective on how much water this is, at a recent Sierra Club presentation on Energy Development in the San Juan-Bisti Region the statement was made that the city of Albuquerque consumed 69,000 acre feet of water last year.)

PNM's proposed New Mexico Generating Station (NMGS) is said to consume about 35,000 acre feet per year. This is for a 2000 MW_e plant.

Proposed coal slurry pipelines, using water to transport finely crushed coal to power plants in other states, would also require substantial amounts of water.

Uranium mines also require a considerable amount of water for their operation.

Of course, with energy development come the people and boomtowns, and with them more pressure on the water supply. Towns such as Grants, Gallup, Thoreau and Crownpoint in New Mexico have had to face the problems of depleting water supplies.

Ingram continues,

"While energy production consumes less than 3 percent of the available water supply in the Four Corner States at present, its share is likely to increase dramatically as development proceeds. Because water is an essential and relatively inexpensive input in most energy processes, the energy industry is likely to be aggressive in securing whatever water supplies it needs for development. Certainly energy can afford to outbid agriculture in an outright sale of water or water rights.

"Groundwater is the other major source of water in the Four Corners states. Over thousands of years the earth has stored substantial amounts of water beneath the arid landscape. However, in some places irrigated agriculture has mined the aquifers, withdrawing water at rates far in excess of the slow recharging process. Today, groundwater tables are falling precipitously in some areas."

Tucson is a city having to face this problem. It is unlikely that energy industries could withdraw additional groundwater in substantial amounts in other areas without affecting costs and availability to irrigators.

A 1980 General Accounting Office publication called "Overdrafting Must Be Controlled" calls attention to the depleting groundwater resources of the West and Midwest. Overdrafting, they say, refers to the extracting of more ground water than will be replenished over a long period of time. Overdrafting can cause land subsidence, salt water intrusion into fresh water aquifers, reduced surface water flows, increased energy consumption, and disruption of social and economic activities. The report states that overdrafting is most serious in the arid and semi-arid western states where irrigation of crops accounts for

over half of all ground water use. The report then goes on and pinpoints some states in which the effects of overdrafting occur:

New Mexico and Colorado are both faced with the problem of overdrafting, reducing surface water supplies that have already been legally committed to surface water users. The two states have handled the problem differently.

For example, in 1956 the State Engineer of New Mexico, Steve Reynolds, declared the Rio Grande River Basin a critical groundwater area and closed the basin to additional water users. Proposed agricultural development threatened to reduce the flow of the Rio Grande, a flow already fully committed to surface water users. Agricultural interests and expanding communities opposed the state engineer, and the State Legislature attempted to reverse the closure. The State Supreme Court in 1963 supported the state engineer's action. Current state policy requires the purchase and retirement of sufficient surface rights before additional groundwater can be extracted.

This same GAO report called New Mexico flexible in accommodating requests by additional water users. The report used the example of PNM's search for additional water to supply the town of Santa Fe. Around 1970 the state engineer, Reynolds, approved PNM's proposed withdrawal of groundwater from the Rio Grande Basin on the condition that it offset potential effects on streamflow by: 1) importing water to the Rio Grande Basin, or 2) purchasing and retiring surface water rights. PNM chose option number one and imported water from the Federal San Juan-Chama Project to the Rio Grande Basin.

Colorado has also been affected by diminishing surface flows as a result of overdraft, but has handled the problem differently than New Mexico. Colorado enacted the Water Right Determination and Administration Act of 1969, which allowed water users to draw on either surface flows or the aquifers that supply them, but limited groundwater pumping to preserve the existing water rights of users. The Act then allows pumpers to increase the amount of water extracted only if other water users' rights are protected.

Continued depletion of groundwater resources ultimately leads to resource exhaustion. Irrigation becomes more and more limited; farmers are forced to turn to dry farming (that is, land watered only by rainfall); and if agriculture, as well as its directly and indirectly related industries are affected by inadequate or depleted surface supplies, what may result are local recessions, economic and social dislocations, and a general weakening of important sectors of the regional economy.

The GAO report pinpoints the high plains region of western Texas and eastern New Mexico as the most likely place to have an economic breakdown due to groundwater depletion. The report cites two reasons for this: 1) this region is highly dependent on groundwater, and 2) lacks an alternative water supply. Underlying this region is the Ogallala Formation, an interstate aquifer system extending into New Mexico, Texas, Colorado, Oklahoma, Kansas, and Nebraska. The sole source of recharge to this formation is a negligible amount of precipitation.

More was said about this region in the February 23 issue of Newsweek:

"Easterners may not have been thinking much about the Ogallala Aquifer last week, but it could soon be as familiar to resource-minded Americans as the North slope....Those ancient waters now trickle through West Texas cotton fields and spurt from the quarter-mile-long arms of centerpivot irrigation systems, making hundreds of circles of green corn in the Nebraska plains. Each year farmers withdraw more water from the Ogallala than the entire flow of the Colorado River. But because sparse rain barely penetrates to the aquifer, very little water flows back in. Water tables are falling from six inches to three feet a year, and, on average, the Ogallala has forty years of useful life remaining; in some localities the bottom will be reached much sooner...already, irrigated acreage is declining in five of the six states that draw water from the Ogallala, with predictable results: lower yields and a shift down the water scale from corn crops to cotton or sorghum."

In another part of the article Newsweek said,

"Texas law acknowledges that the underground water will run out eventually; farmers get a groundwater depletion allowance just as wildcatters get one for oil. But like most states, Texas lets its farmers pump away. The last American frontier is underground, where miners, developers and big farmers race each other to the bottom of the aquifer."

A recent article in The Wall Street Journal emphasizes the problem.

"DELTA, Utah--The 2,200 residents of this central Utah town face an agonizing but clear-cut choice: whether to use their precious water to irrigate farm land or to help develop the nation's energy potential.

"Water from the Sevier River has flowed into irrigation ditches to moisten the arid land here ever since Mormon colonists arrived a century ago. But now Delta has been selected as the home of the nation's largest coal-fired generating plant, a 3,000-megawatt behemoth that will slurp up enough water to retire perhaps 35% of the land in this area known as 'Utah's breadbasket.'

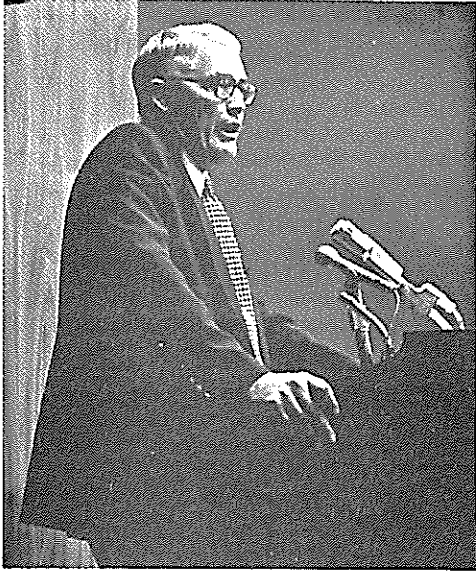
"Some residents welcome the economic opportunities that will come from the \$8.7 billion, municipally

owned plant called the Intermountain Power Project, or IPP. But many others feel they're at the noose end of a rope that stretches more than 2,000 miles back to Wall Street, where money for the project is being raised. And they feel that if they hang, they won't even be doing their fellow Utahans much good, since most of the plant's electricity will be consumed more than 500 miles away in Southern California."

Is there anything we can do to make our Sunbelt realities more agreeable to us who live here? Governor Richard Lamm has said that we'd best not depend on the federal government for much help. WESTPO is an attempt to gain more collective regional influence. Our state must start to deal intelligently with these realities from a base of sound planning and strength. We do that now in the water area. We do not do so in others. If our future is to be positive we must plan and implement plans vigorously and wisely.

SESSION TWO: CONTRASTING VIEWS TO THE FUTURE

Speakers



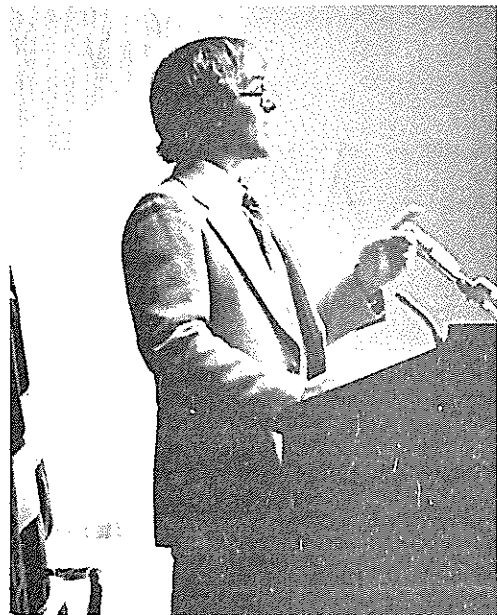
George Dawson



Ken Needham



William Stone



Frank Ward

MEET THE SPEAKERS

MARJORIE BURR was born and raised in Newton Falls, Ohio. She graduated from Oberlin College in Ohio with a degree in Psychology, later obtaining a Master of Arts in Teaching Degree from Johns Hopkins University. She also has a Master's Degree in Government from New Mexico State University.

She has taught high school English in Baltimore, Maryland, and currently works for KOBE radio in Las Cruces.

Marjorie organized the League of Women Voters in Las Cruces, and has served on the local board for many years. She has been local League President and State League President. The League has been active in water issues for at least 15 years; formerly the New Mexico League of Women Voters co-sponsored the Water Conference. The National League has policy positions on clean water; the local League has positions on land use, and is undertaking a study of economic development in the Mesilla Valley.

GEORGE R. DAWSON is Professor and Head of the Department of Agricultural Economics and Agricultural Business at New Mexico State University, where he is involved in administration, teaching, and research. Dawson is currently a member of Governor Bruce King's Council of Economic Advisors. He is a graduate of New Mexico State University, and has a Master's of Science from the University of Missouri and a Doctoral Degree from Cornell University in Farm Management.

KENNETH NEEDHAM is a professional engineer who graduated from New Mexico State University, having his Bachelor's and Master's Degrees in Civil Engineering. He is currently the Director of Utilities for the City of Las Cruces. Previously he was employed by the city as associate Director of Water Resources and as Chief Utilities Engineer, for a total of five years. He has also served as an officer in the US Air Force.

WILLIAM J. STONE is a hydrogeologist with the New Mexico Bureau of Mines and Mineral Resources, as well as an Adjunct Associate Professor in the Geoscience Department at the New Mexico Institute of Mining and Technology. He holds both a Master's and a Doctoral Degree in Geology. Dr. Stone has been deeply involved in evaluating the potential impact of energy-resource development in the San Juan Basin in northwestern New Mexico.

FRANK A. WARD is an Assistant Professor of Natural Resource Economics at New Mexico State University in the Department of Agricultural Business and Agricultural Economics. He is a graduate of Colorado State University, and has both his Master's and Doctoral Degrees in Economics from Colorado State University.

Dr. Ward was the 1978 winner of the Annual American Agricultural Economics dissertation research award for his dissertation entitled, The Welfare Effects of a Market Allocation of an Exhaustible Resource.

WATER FOR AGRICULTURE IN A COMPETITIVE ENVIRONMENT

George R. Dawson, Professor and Head
Department of Agricultural Economics
and Agricultural Business
New Mexico State University

There are some tough resource allocation decisions ahead. We do not have the answers to those questions. Once upon a time the future was left to just take care of itself. And it did. We have that option today. But should we? That is part of our challenge.

This morning Dr. Thomas and Dr. Zink stimulated you to consider other courses of action, rather than to let the future just take care of itself. It is my responsibility to speak on the first of the four topics that will be addressed this afternoon in the workshops -- water for agriculture in a competitive environment.

The future for water in agriculture might be considered both good and bad. Food will always be in demand, and it is a growing demand, so that is good for agriculture. But, based upon remarks made just this morning, unless longer range views of resource allocations are adopted, that future could be bad. Our focus then today is to consider a proper resource allocation for water. How much water should be used by certain economic sectors of the New Mexico economy? This necessarily causes us to consider socio-economic impacts of alternative decisions. Our major problem is to decide how to look at the future. That is, what will the future be? Actually, there is a different future for every set of allocation decisions that could be made. And the larger problem, then, is to agree upon the desirable future.

Each of us has a different concept of what a desirable future is. This creates the big challenge and, I would say, the crisis. To examine various futures so as to select a most favorable one, it is necessary to study past and current trends, to evaluate economic and social consequences of past and short-term actions. It is also necessary to consider -- and I want to stress this -- it is also necessary to consider the rights of each generation.

Just because we have enough water for the next twenty years in Tucson or Albuquerque, or for the next fifty years or, as President Thomas alluded this morning with regard to land and water, for the next indeterminable number of years, is that necessarily the basis for our going ahead with business as usual without concern for some future generation? Further, we need a knowledge of the technology that will be available which will influence the outcomes of the alternative allocation decisions. These are not simple matters. We need such information as: What will be the global prospect, peace or war? Will we need to produce food locally because we cannot ship it in? (Tucson might be in a little bit of difficulty if that were the case.) What will be the technological advances for all industries with regard to saving and protecting water? And what will be the population pressures on the land and water which will influence our ability to feed ourselves?

Crisis is the mother of invention. That is probably the way we will resolve all these problems. We never do much about our shoes until our feet start hurting. And crisis will be the thing that causes us to take the action to clean up the water in the Albuquerque well, etc. Those

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mini-crises will be the stepping stones to solving the longer-term crises. The question is, will solving the mini-crises, without concerning ourselves with the potential major crises, be enough?

At the 13th Annual Water Conference, Lloyd Calhoun, who is a steadfast attendee of these conferences and has participated extensively, made a statement in which he said (and he was developing a scenario for the future of water in New Mexico) that "food production for our own and for others outside New Mexico and the United States will be our most critical need by the year 2000."

The Council on Environmental Quality, in its 1979 report, places special emphasis on water as the paramount issue for the nation in the 80s: both quality and quantity of water in surface and underground sources is targeted as the areas of critical concern. Certain areas of the United States are pinpointed as major problem areas. What I wish to highlight is the fact that water is not just a local problem; the use of water will be a critical concern nationwide.

Water use in New Mexico is in pretty good shape, thanks in large part to Steve Reynolds and his able assistants. We have water right laws in this state which make water a marketable commodity. And it is through that market that water will move to alternative uses. I am not so happy about some of the directions it is going to move, but nevertheless it is movable by that mechanism. So agriculture has a protection right now in the fact that it owns much of the water right. But you heard statements this morning that such protection for keeping water in agriculture is not going to mean much, because "water flows uphill to money."

I have appeared on this program several times in the last twenty plus years, and I have basically told you the same story each time. Today I am going to try a little different approach to tell you again what you already know. I might make somebody a little unhappy and I might get some numbers out of order, and I apologize for that.

It has been charged before, and probably will be today by some speakers, that agriculture is really insignificant in New Mexico compared to the United States, or even compared to other sectors within the New Mexico economy; that if we produced nothing, no one in the world would starve because of the loss of our production. That may be true, except that there would be several New Mexicans who might go a little hungry because of the loss of a job.

How important is agriculture in New Mexico? We say it is a billion dollar plus cash receipts industry, and if we apply a multiplier, it is a 2 1/2 to 3 billion dollar industry. The value of agricultural production in New Mexico compared to the United States would make up about 8/10 of 1 percent of U.S. agricultural value. Cotton contributes only about 1.14 percent of the cotton value in the United States. Wheat is about 0.3 percent of the wheat value in the United States; beef, 1.1 percent; livestock 1.8 percent. On a commodity-by-commodity basis agriculture is not very important. Some would say it is insignificant! On a sector-by-sector comparison within the state, it goes something like this: mining, oil, gas, and minerals, government spending, and recreation, and somewhere down the line comes agriculture. Therefore, agriculture seems not very significant! Since this type of comparison

would lead us to conclude that there may be a basis for the "insignificant" argument, I would like you to consider the other economic activities to draw a similar comparison.

These other economic activities are the kinds that are touted as the heroes in the New Mexico economy; and are considered the places to which we might better transfer our water for more money, more economic impact. Look at government spending. If we took all of the New Mexico budget and compared it to the United States government budget we find it to be only 0.31 percent. Housing starts 0.77 percent; mining 3.76; construction 1.03; manufacturing 0.12; and we cannot even find numbers for recreation for comparison. We simply cannot put a value on it for New Mexico versus the United States. I want to point out very quickly too, that our population only makes up 1/2 of 1 percent of the United States population. We are not very important. Folks, we are insignificant by those measures as well.

Now before somebody claims foul, I do not proclaim to have reported all, or even necessarily the proper sectors. But what I have tried to do is to indicate how improper it is to use the "insignificant" argument in taking the resources out of one sector, in this case agriculture, for the use in the short-run higher and better economic return activities we commonly have proclaimed as better for New Mexico.

I am not talking about taking all the water out of agriculture, but the impact is better when I allude that it is. An important question to address is, does the United States have enough land and water to maintain the level of food abundance to support our own food needs and export

needs? What is New Mexico's role in that effort? Insignificant, you say? President Thomas talked a little bit about the importance of water this morning and I have a little different approach. Without water there is no plant life, no animal life, no human existence. With water there is a little plant life and animal life. With more water you start getting some industry and affluence associated with a higher standard of living. Are we allocating our limited water in the proper mix of uses to yield the highest economic and social returns over the long haul, or are we making allocation decisions for short-run economic gains without considering the long-haul social and economic consequences? This is our dilemma.

I want to give you a forecast of the future of the next 20 to 40 years. These are some of the things I would like you to consider as you enter the workshop sessions this afternoon.

Short-run economic returns will continually guide the resource allocation decisions. Two speakers have already said that this morning. Agriculture will be the low bidder for water and nonagriculturalists will purchase the water out of agriculture. Our agricultural base will decline because of population pressures and the loss of water. The demand for food will continue to increase. The nation will shift from a food surplus to a more balanced supply-demand situation, to a possible deficit. Food costs will likewise increase in real terms. Increasing pressure for food exports will strain our land and water resources. All-out production will then be called for. Population growth in New Mexico will at least triple the rate for the United States, (and I think

that is conservative after what I heard this morning). Irrigated acreage will decline to less than 750,000 acres from over one million today. There will be fewer and larger farms, with an increase in small part-time farms. Water will be the principal limiting factor in our efforts to increase production to meet increasing world needs. Water-saving technologies will be the major research focus (and research effort has never been more critically needed). Water will be significantly more expensive, like oil, production inputs will be more scarce and expensive. Agriculture will be the residual economic user of water.

My basic point today is that allocation decisions cannot -- that is, should not -- be made on the basis of the short-run economics alone. There are long-run social and economic costs and returns which we are apparently unable or unwilling to consider. Economic efficiency criteria provide a necessary set of guidelines. They, however, often ignore the legitimate long-term social issues and consequences which, in turn, have economic consequences. We do not know how to measure them. That is why we as economists fail to do a better job. The short-run economic value of water is higher in uses other than agriculture. And my challenge to you today is to consider the longer run in the decisions you help make with regard to the allocation and conservation decisions. How are we going to have water for agriculture in the future?

Like Lee Zink, I am not only an economist, but I am somewhat of a humanist. So I would like to close with a quote of Abraham Lincoln's in which he said, "A child is a person who is going to carry on what you have started. He is going to sit where you are sitting, and when you are

gone, attend to those things which you think are important. You may adopt all the policies you please, but how they are carried out depends on him. He will assume control of your cities, states, and nations. He is going to move in and take over your churches, schools, universities, and corporations. All of your books are going to be judged, praised, or condemned by him. The fate of humanity is in his hands."

A MUNICIPAL PERSPECTIVE

Kenneth M. Needham
Director of Utilities
City of Las Cruces

and

Donald Craig Andrews
Associate Director of Water Resources
City of Las Cruces

In this presentation we will concentrate on water rights for municipal use, recognizing that quality and use rates are also important and worthy of discussion.

On September 11, 1980, the State Engineer issued an Order declaring the Lower Rio Grande Basin in order to protect existing water rights from being impaired by further ground water development. The Lower Rio Grande Basin extends from Broad Canyon north of Radium Springs to the New Mexico-Texas state line on the south; the area includes approximately 1585 square miles.

Quoting from the press release issued by the State Engineer,

"The Order recognized that the surface and ground waters within the basin are interrelated; under such circumstances any ground-water withdrawal results ultimately in an equivalent diminution of surface water flows.

"Ground water appropriation will be permitted, provided that there is no impairment to other existing ground water rights and provided that the immediate and potential effects on the flow of the Rio Grande are offset by the retirement of usage under existing water rights so that the water supply to the surface water rights will be unchanged. This administrative procedure is presently used in the Rio Grande Underground Water Basin, which was declared in 1956. This administrative procedure provides for the fullest utilization of the groundwater resources in a stream related underground water basin without impairment to existing rights."

This order generated great concern within the City of Las Cruces. The full implications of the Order were not soon recognized since the City had been operating in an undeclared area, drilling wells as the need arose. No one within the utilities staff or the legal staff had experience dealing with water right questions.

We can also expect that the Order generated concern in many other community water supply organizations. In the declared basin area we have listed approximately fifty (50) domestic water suppliers. These include the mutual domestics, mobile home parks, private water systems, New Mexico State University, and others. Each of these suppliers will face similar problems securing water for growth.

We would like, in this presentation, to focus on the Las Cruces municipal water supply as a typical domestic water supplier in the basin. What are our water rights? How long will they support the City and what are the options for securing water rights for the future? What impacts will this have on growth?

First, let's discuss the existing situation. Let me state that this is as we now understand our position. These numbers do not have the blessings of the State Engineer's office. The basin management criteria has not been issued, so some modifications to these figures may be in order as things develop. As we concluded our deliberations on this paper, we began to feel like Zymurgy. As you all know, I'm sure, Zymurgy's law states, "Once you open a can of worms, the only way to recan them is to use a bigger can." At times while preparing this paper, we felt like we needed a bigger can. We may have to rely on able assistance, hopefully, in the workshop to recan them.

When the Basin was declared, the City of Las Cruces had a total system capacity of 28,399 acre-feet per year. We learned that municipalities are allowed to pump sixty percent (60%) of their total pumping capability before retirement of additional water rights is required. This amounts to 17,040 acre-feet per year.

The 1980 pumping rate was about 13,000 acre-feet, so we can continue to grow to the 17,000 acre-feet level. Because of the nature of municipal water demand, supplemental wells are permitted to meet peak flows. The annual withdrawal under existing water rights cannot exceed 17,000 acre-feet.

In analyzing our situation, we find that Las Cruces are using an average of about .29 acre-feet per capita per year (13,000 acre-feet divided by 45,000 people served). This per capita figure includes existing commercial and industrial use rates. Another approach reveals that Las Cruces require about 1.3 acre-feet per developed acre per year (13,000 acre-feet were used on 10,000 develop acres). These numbers give us a basis for projecting future water requirements. Our projections are that the 17,000 acre-feet/year permitted pumping will serve about 58,800 people or 13,000 acres of development. At expected growth rates, this population should occur in 1990.

The question then is, what happens in 1990? Where will additional water rights come from? According to the Order, and again I quote,

"Ground water appropriation will be permitted, provided that there is no impairment to other ground water rights and provided that the immediate and potential effects on the flow of the Rio Grande are offset by the retirement of usage under existing water rights so that the water supply to the surface water rights will be unchanged."

Let's look at the arithmetic of retiring surface water rights to supply municipal requirements. Surface water rights in the valley amount to 3 acre-feet per acre. We have learned that of the 3 acre-feet, .94 acre-feet finds its way back to ground water when applied as irrigation water. The remaining 2.06 acre-feet are lost to consumptive use such as plant uptake and evaporation. So, when one acre's worth of water rights are retired only 2.06 acre-feet of water rights are available for consumptive use. If, in the same case of a municipality, we assume that 50 percent of all water pumped returns to the river as sewage or to ground water through lawn irrigation, we conclude that we can actually pump twice the 2.06 acre-feet, or 4.12 acre-feet for municipal use to achieve the same consumptive use as irrigation. So, the retirement of surface water rights on 1 acre of land will allow us to serve 3.2 developed acres. We arrive at this by dividing the 4.12 acre-feet available by 1.3 acre-feet per developed acre requirement. If these assumptions are valid, and assuming that consumptive use rates for municipal and agriculture do not change, this means that for each acre of valley land that is developed, 2.2 acres of mesa land without existing water rights can be developed. The impact on the growth of Las Cruces will be that as land must be annexed land water rights must be turned over to the City at the ratio of at least 1 acre of valley land to 2.2 acres of mesa land in order to secure adequate water rights.

Another interesting administrative procedure regarding water rights retirement is that which is used in the Upper Rio Grande Basin. We assume that a similar procedure will be followed in the Lower Rio Grande

Basin. That procedure is the scheduled retirement of rights based on the projected effect on the River. A memorandum from the State Engineer's office states,

"This scheduled retirement of use under surface rights will allow municipalities and industries to appropriate ground water without impairment of existing rights and with the smallest possible disturbance to the agricultural economy of the valley. That is, the total water usage in the valley can be materially increased for a number of decades by mining a portion of the vast amount of water in storage in the aquifers; the rate of usage eventually stabilizing at approximately the present rate of consumption of both surface and ground water. The increased usage over the intervening decades can be accomplished without impairment of existing rights."

This procedure will "soften the blow" of retiring water rights.

A point that is of interest to us in a recently declared basin is how Albuquerque has handled its problem in the Upper Rio Grande Basin, which was declared in 1956. This information comes from an article written by Mr. S. E. Reynolds that was published in the Albuquerque Tribune. The article indicates that sufficient water rights exist in the Upper Rio Grande Basin for Albuquerque to grow to a 1.5 million population. Dr. Zink said this morning that Albuquerque will not reach one million in 70 years. Vested water rights allow the depletion of river flow by 18,672 acre-feet/year. This will serve 138,000 people at projected per capita consumptive rates. The City will be allowed to pump an additional 96,400 acre-feet/year which is offset by 48,200 acre-feet/year which the City has contracted from the San Juan Chama Project and by 48,200 acre-feet/year of sewage return flow. This will offset the effects of 357,000 people. Non-Indian irrigators above Elephant Butte Reservoir

have rights to deplete the flow of the river by 128,000 acre-feet per year. Transferring this right to the City of Albuquerque would offset the effects of 950,000 people. Totaling the available rights to deplete the river flow, and adding the right to pump additional water which is offset by the San Juan Chama Water, Albuquerque has potentially available the right to use consumptively 195,000 acre-feet per year. These population figures are based on a consumptive use rate of .13 acre-feet per capita per year. Considering that half of the water pumped is used non-consumptively and returned to the basin, Albuquerque must pump about .26 acre-feet per capita per year. We can only compliment them on their farsightedness in acquiring the San Juan Chama water.

Performing a similar analysis for the City of Las Cruces, we have the right to deplete the river flow 8,500 acre-feet (50% of 17,000 acre-feet). If all agricultural rights in the valley were retired to the City, as assumed in the Albuquerque example, 187,000 acre-feet of river flow depletion would be allowed. At our present consumptive use of .14 acre-feet per capita, these water rights could support a population of 1.4 million. You might be interested to know that at current densities this population would require almost 300,000 acres to live and work. Again, considering that half of the water pumped is used non-consumptively and returned to the basin, we must pump about .28 acre-feet per capita.

Mr. Reynolds concluded his article by stating, "An Albuquerque population of 1.5 million people would surely pose some difficult problems, but the water supply problem would be manageable." We could

shorten that to: A Las Cruces population of 1.4 million people would surely pose many problems!

We have, therefore, established that a population of 58,800 -- which represents an increase of 13,000 -- can be served with existing water rights. At projected per capita use rates a population greater than 58,800 can be served on a perpetual basis by retiring existing water rights under a co-development program of 1 acre of valley land for every 2.2 acres of mesa land, emphasizing that the agricultural land need not be developed immediately because of the scheduled retirement procedure. This appears to optimize water use for development and minimize the impact of development on agricultural land.

The major hurdle that we have identified is that there is now apparently no procedure within the Lower Rio Grande Basin whereby surface water rights can be secured by domestic water suppliers as land with water rights is converted to residential, commercial, or industrial uses. We are presently in discussions with the irrigation district staff to resolve this problem.

We can conclude that from a municipal perspective the Lower Rio Grande Basin can be managed so that agricultural, municipal, industrial and recreational needs can be served at present use ratios, and, if water is not transported out of the basin. Cooperation and understanding among the users is imperative. While no one likes the extra burden of operating in a declared basin, I think we all appreciate the need to carefully manage one of our most valuable resources.

FIGURE 1. WATER RIGHTS AND WATER USAGE - CITY OF LAS CRUCES

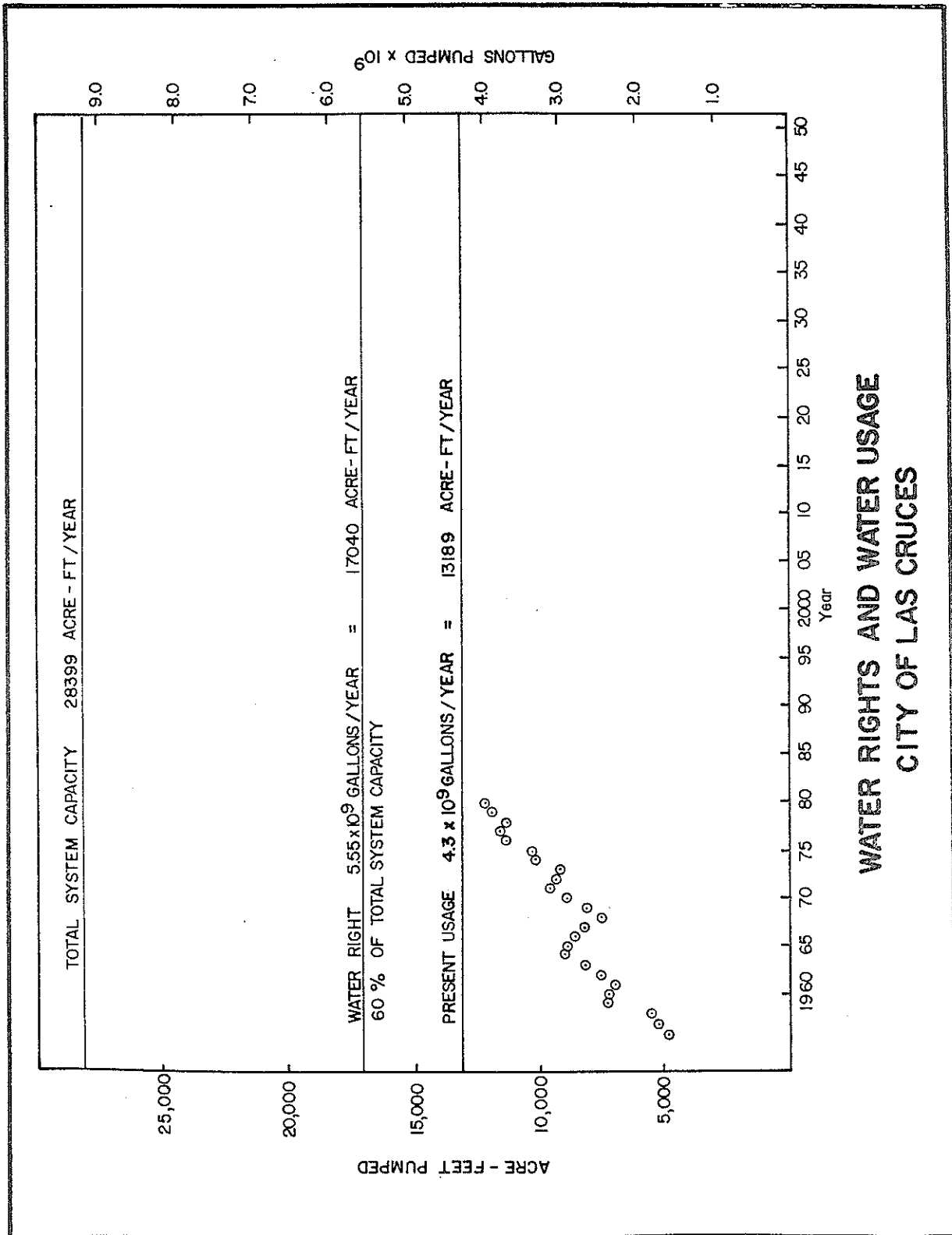


FIGURE 2. SCHEDULED RETIREMENT EXAMPLE

ASSUMPTIONS:

WELL LOCATED FIVE MILES FROM THE RIO GRANDE.

REQUIRED APPROPRIATION IS 1000 ACRE- FEET OF WATER PER ANNUM FOR MUNICIPAL USE.

APPROXIMATE CUMULATIVE AMOUNT OF IRRIGATION WATER RETIRED UNDER SURFACE RIGHTS

1st year	90 a.f.
5th year	210 a.f.
10th year	290 a.f.
15th year	370 a.f.
20th year	420 a.f.
25th year	460 a.f.
30th year	500 a.f.

LATER, ADDITIONAL RETIREMENTS WILL BE REQUIRED SO THAT AT ALL TIMES THE TOTAL IRRIGATION WATER RETIRED WILL FULLY OFFSET THE EFFECTS OF THE GROUND-WATER WITHDRAWALS ON THE RIVER.

FIGURE 3. COMPARISON OF AGRICULTURAL AND MUNICIPAL CONSUMPTIVE USES

	<u>Water Right</u>	<u>Consumptive</u>	<u>Returned to Basin</u>
AGRICULTURAL	3	2.06	.94
MUNICIPAL	2.06	1.03	1.03
MUNICIPAL ADJUSTED FOR 50% RETURN FLOW	4.12*	2.06	2.06

All values in acre-feet/acre

* Municipalities may pump 4.12 acre-feet for each 3 acre-feet of retired surface water rights to realize a consumptive use of 2.06 acre-feet which is equal to an agricultural consumptive use of 2.06 acre-feet when 3 acre-feet are applied.

Municipal Water Requirement = 1.3 acre-feet per acre of developed land

ON A CONSUMPTIVE USE BASIS WATER REQUIREMENTS FOR AGRICULTURAL USE PER ACRE ARE 3.2 TIMES THE WATER REQUIREMENTS FOR MUNICIPAL USE PER ACRE.

FIGURE 4. CITY OF ALBUQUERQUE WATER RIGHTS

VESTED RIGHT TO DEplete RIVER FLOW	18,700 acre-feet/year
SAN JUAN CHAMA WATER	48,200 acre-feet/year
POTENTIALLY AVAILABLE DEPLETION RIGHT FROM IRRIGATORS	<u>128,000</u> acre-feet/year
TOTAL DEPLETION RIGHT AVAILABLE	194,900 acre-feet/year

$$\frac{194,900 \text{ acre-feet}}{.13 \text{ acre-feet/capita consumptive use rate}} = 1,500,000 \text{ people}$$

FIGURE 5. CITY OF LAS CRUCES WATER RIGHTS

VESTED RIGHT TO DEplete RIVER FLOW	8,500 acre-feet/year
POTENTIALLY AVAILABLE DEPLETION RIGHT FROM IRRIGATORS	<u>187,000</u> acre-feet/year*
TOTAL DEPLETION RIGHT AVAILABLE	195,500 acre-feet/year

$$\frac{195,500 \text{ acre-feet}}{.14 \text{ acre-feet/capita consumptive use rate}} = 1,400,000 \text{ people}$$

*271,800 acre-feet/year irrigation allotment x .69 (consumptive use ratio)

WATER FOR INDUSTRY IN NEW MEXICO'S FUTURE

William J. Stone, Hydrogeologist
New Mexico Bureau of Mines
and Mineral Resources

INTRODUCTION

The mild arid climate which attracts people to the Southwest is also the most limiting factor for the region's growth. Unlike the Southeast, water resources are limited in this arid setting. Although some people can relocate in New Mexico for reasons of climate alone, others cannot unless suitable jobs are available. Manufacturing industries, a principle source of jobs elsewhere, are limited in New Mexico to nonwater-intensive activities. The mineral-resource extraction industry affords additional jobs, but because such activity is water-intensive it depends on the availability of water supplies.

Establishment of a new extractive facility is costly. The Hidalgo Smelter, constructed south of Lordsburg in late 1977 by Phelps-Dodge Corporation to handle copper concentrate from their Tyrone Mine, reportedly cost \$320 million; because of its isolated location, the construction of a \$10 million townsite was also necessary (Kotovskiy, 1978). One of several factors the company considered before making such an investment was the availability of a reliable supply of suitable quality water.

The purpose of this report is to review the role played by water in New Mexico industries. More specifically, present and future water problems and conflicts are examined. Based on these considerations,

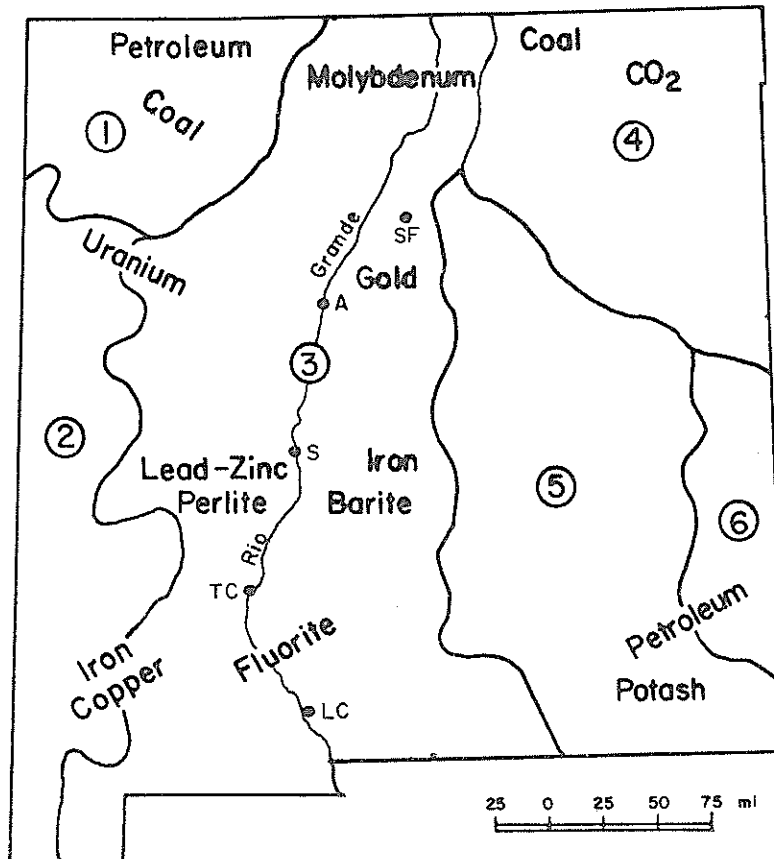
several implications for future water-resource efforts in the state are noted. In this report, New Mexico industry is divided into two categories: extractive and non-extractive.

EXTRACTIVE INDUSTRY

Extractive industries are those involved with the mining, milling, smelting, or other processing of mineral resources. In New Mexico, the extractive industry centers on the production of coal, copper, industrial minerals (aggregate, clay, stone, etc.), lead, molybdenum, petroleum, potash (and other soluble salts), precious metals, uranium, and zinc (Fig. 1).

Projected water requirements of the extractive industry may be approached in three ways. In terms of the estimated volume of new water required for use in the year 2000, the processing of fossil fuels (coal, carbon black, gas) ranks first, the copper industry ranks second, and the potash industry ranks third (Table 1). By volume of this water which may be depleted (in the year 2000) the first and second ranks remain the same, but the uranium industry moves into the third position (Table 2). If such depletion is viewed in terms of the percentage of new water exhausted in 2000, fossil-fuel processing remains in the first position, the uranium industry moves to the second position, and the copper industry drops to third (Table 3).

The rankings change little for the year 2020. The molybdenum industry jumps into second place and the copper industry drops to third



River Basins

- | | |
|---------------|--------------------------|
| ① U. Colorado | ④ Arkansas - White - Red |
| ② L. Colorado | ⑤ Pecos |
| ③ Rio Grande | ⑥ Texas Gulf |

Figure 1. Mineral resources and river basins in New Mexico (Sorensen and others, 1973).

Table 1. Ranking of New Mexico's mineral industries by water requirements (modified from Sorensen and others, 1973).

Resource	2000 (ac-ft new water)	2020 (ac-ft new water)
Fossil fuels (proc.)	117,270	154,180
Copper	52,770	76,280 (3)*
Potash	42,410	56,510 (5)*
Uranium	36,890	68,900
Molybdenum	33,980	82,830 (2)*
Petroleum (sec. rec.)	18,000	20,000
Industrial Mins.	4,330	6,860 (8)*
Lead-zinc	4,060	7,750 (7)*
Petroleum (drlg.)	2,670	4,500

*New rank in year 2020

Table 2. Ranking of New Mexico's mineral industries by volume of new water depleted (modified from Sorensen and others, 1973).

Resource	2000 (ac-ft depleted)	2020 (ac-ft depleted)
Fossil fuels (proc.)	108,420	143,260
Copper	37,110	57,220
Uranium	27,670	55,190
Potash	21,210	31,090 (5)*
Molybdenum	18,690	49,700 (4)*
Lead-zinc	2,030	4,650
Industrial minerals	1,400	2,860
Petroleum (drlg.)	270	450
Petroleum (sec. rec.)	0	0

*New rank in year 2020

Table 3. Ranking of New Mexico's mineral industries by percent depletion of new water (modified from Sorensen and others, 1973).

Resource	2000 (% depletion)	2020 (% depletion)
Fossil fuels (proc.)	92	93
Uranium	75	80
Copper	70	75
Molybdenum	55	60
Lead-zinc	50	60
Potash	50	55
Industrial minerals	32	42
Petroleum (drlg.)	10	10
Petroleum (sec. rec.)	--	--

place in water requirements. There is no change in the positions of the industries for volume or percentage of water depleted.

Inasmuch as the fossil-fuel processing (especially coal) uranium, and copper industries are the most water-intensive in the state, and have the greatest potential for growth, they will be the focus of the remainder of the discussion of the extractive industry.

Coal

Major coal extraction occurs in the San Juan Basin of northwest New Mexico. Production there is expected to nearly triple in the next 10 years (Table 4).

In the San Juan Basin, coal is extracted mainly by strip mining. Most of this coal is used in mine-mouth electric-power generation. Water is required for various mining, reclamation, and power-plant functions (Table 4). Present water needs are met by surface water (San Juan River).

As strippable reserves are diminished, underground mining and in-situ extraction techniques (gasification, liquefaction) may replace stripping; these methods will require dewatering of the coal and adjacent strata. Should surface gasification plants or coal-slurry pipelines be constructed, additional water will be required.

Future water needs may be met partly by surface water, as at present, and partly by ground water. Ground water may be obtained from: 1) underground coal-mine dewatering; 2) deep wells on the mine sites; 3) well fields tapping Tertiary strata in adjacent areas to the northeast; and 4) uranium-mine dewatering in the Grants Mineral Belt,

Table 4. Role of water and production trends for coal, uranium, and copper mining in New Mexico. Parentheses indicate future water concerns.

<u>Resource and Role of Water</u>	<u>Recent Production Trends/Location</u>	<u>Anticipated Production Trends/Location</u>
COAL	1979-18 mt up 31% from 1978 production	1985-47 mt/yr 1990-50 mt/yr
drilling dust control washing cooling boiler feed revegetation (dewatering) (gasification) (liquefaction) (slurry)	San Juan Basin	San Juan Basin and to south
URANIUM	1966-1978= 47% of all U ₃ O ₈ in nation	to increase four-fold in next 10 yrs
drilling dust control transport milling dewatering (in-situ mining)	San Juan Basin	San Juan Basin and to south
COPPER	1979 production up from 1978 production	will continue to increase gradually
drilling dust control transport milling smelting cooling (dewatering) (in-situ leaching)	SW part of state	SW and NE parts of state

along the southern edge of the basin. The latter two would require transporting the water considerable distances.

The problem with relying on surface water as a source is that New Mexico's share of the San Juan River is fully appropriated. Should existing water rights be purchased, necessary transport to the more distant parts of the coal belt would be costly. Drilling for deep ground water on site, drilling wells and transporting ground water from nearby Tertiary strata, and taking delivery of excess ground water from the uranium mines would also be expensive. More water may be required than is available from the uranium mines alone and some combination of these alternatives is necessary.

Two major conflicts are recognized. First, energy development will be competing with irrigated agriculture for a fixed amount of surface water. Industry may be able to afford the more expensive ground water alternatives, but agriculture can not. Such alternatives should be little more expensive than buying surface water and transporting it by truck or pipeline. The other conflict involves the area of Indian water rights. The amounts of surface and ground water to be reserved for Indian use and the administration of this water is far from clear at present.

Uranium

Major uranium extraction occurs in the Grants mineral belt at the southern edge of the San Juan Basin, northwest New Mexico. Uranium production was expected to quadruple in the next 10 years, but the

moratorium on nuclear power plant construction has severely reduced production. Several New Mexico mines have closed.

Most uranium is extracted by conventional underground methods. Water is required for various mining and milling functions (Table 4). In most places present water needs are met by water encountered in mining; in others, water is transported short distances.

As mining moves into areas of lower-grade and deeper ores, in-situ methods (solution mining) may become more prevalent. Mobil Corporation is currently operating a pilot project to evaluate such methods near Crownpoint.

The main water problem in mining is dewatering. Removal of large volumes of water are necessary because the principal ore-bearing zone is also a regional aquifer. Several water-resource impact problems are also associated with uranium extraction. First, oxidation at the face of mine workings makes radionuclides soluble and mine waters are thus enriched with these constituents. With proper collection and treatment of mine waters there need be no environmental damage. Second, mill tailings are disposed of in ponds and dumps; again, with care, there need be no impact. Third, abandoned mines may release radionuclides to area ground water. Recent work has shown that the chemical conditions that develop around such sites may naturally limit migration of undesirable constituents to a short distance from the abandoned mine shaft (Stone and others, in review).

In addition to dewatering, in-situ operations will be troubled by problems of controlling the mining solution. The major

water-resource-impact problem in in-situ mining will be the cleanup of underground cells after leaching ceases. Experience in other areas of such mining will be most helpful in this matter.

The main conflict centers around water-level declines produced by dewatering for conventional mining. Lyford and others (1980) showed that water-level declines will be greatest near the mines, but the edge of the cone of depression resulting from a high level of uranium-mine dewatering could reach the San Juan River by the year 2000. Such declines could reduce the availability of deep ground water for coal development. Ironically, dewatering also provides an alternative source of ground water for coal development. As in the case of coal, Indian water rights are also an issue in uranium extraction.

Copper

Major activity associated with copper extraction centers in the southwest part of the state. New mines are planned near Hillsboro and Pecos. Although specific figures are unavailable, copper production is expected to increase gradually over the next 10 years.

Most copper is extracted by open-pit methods. Water is required for various mining, milling, and smelting uses (Table 4). Leaching of copper from abandoned mine dumps and specially designed heaps is also a common practice. Underground or in-situ leaching in areas of low-grade, high-volume ores may become more common. Recent attempts to implement this method at Cerillos failed largely because of public concern for the environment.

On the average, approximately 100,000 gallons of water are used to produce a ton of copper -- more than for producing a ton of any other major metal (Mussey, 1961). Of this amount, 70,000 gal are used in mining and concentrating the ore and 30,000 gal are used in refining the copper. Slightly more than half this average is used in areas where water is scarce or expensive. According to Mussey (1961), 18 percent of the water required is used consumptively; highest consumptive use is in the West.

The major water problem in copper extraction is supply. Locating a suitable source of water reasonably near a minable copper deposit is by no means assured in the arid setting of New Mexico. Water needs may be met by developing new supplies or by purchasing existing supplies.

The main conflict is competition for water with agricultural, municipal, and recreational users. Table 1 shows the copper industry to rank second in projected water requirements and Table 2 shows it to rank second in volume of water depleted. In view of these large amounts of water, other uses may be restricted or totally excluded in areas where copper is produced.

NON-EXTRACTIVE INDUSTRY

Non-extractive industries are those which manufacture goods or provide a service.

Manufacturing

Although a recent study shows New Mexico dropped from fifth to seventeenth place among the continental United States in terms of the

attractiveness of its business climate (Albuquerque Tribune, 1981), manufacturing will continue to employ a significant segment of the population. The manufacturing industry in New Mexico is concentrated in major municipalities. Products are small by industrial standards and include such things as clothing, electronic parts, jewelry, and medical supplies. Fabrication of such goods is not water intensive and water is used mainly for employee comforts. Water is generally obtained from public supplies available from the municipality in which the industry is located. Similarly, any water problems or conflicts associated with manufacturing are largely the concern of the municipality involved.

Waste Disposal

The service industries are similar to the manufacturing industries in that they are not water intensive, they seldom threaten water resources, and they are generally located in major municipalities. An important exception is the waste-disposal industry. As used here, this includes the operation of sites for disposal of toxic waste. Such waste may be radioactive or otherwise toxic. Radioactive waste may be low-level radioactive materials, discarded by hospitals or universities, or high-level radioactive waste.

Unlike the extractive industry, water supply is not a problem. In fact, water requirements are very low by comparison. The major problem is rather one of assuring isolation of the hazardous waste, especially as regards area water resources. Depending on location, activity by other industries may be restricted by the presence of a toxic-waste-disposal

site. For example, potash mining and oil exploration would be curtailed in the vicinity of the proposed Waste Isolation Pilot Project (WIPP) site in southeast New Mexico.

IMPLICATIONS FOR FUTURE WORK

The foregoing sketch of water problems and conflicts associated with industry in New Mexico suggests a number of topics for future water resource work. Research in the areas of conservation, management, regulation, and alternative supplies is clearly warranted. Conservation studies might result in reduction of the large depletion percentages shown in Table 3. The use of more saline water by industry and economical ways of desalting water for industrial use, such as by solar stills, are also topics deserving further attention. Competitive-use conflicts might be resolved through improved water-resource management schemes. The possible consequences of the anticipated water-use transfers should be examined. Although existing regulations for protecting water resources are probably accurate, enforcement/implementation of these regulations may need enhancement. Additional regulations may be required to ensure conservation or to minimize consumptive use. Although reports are available on the regional hydrogeologic conditions for most areas of industrial activity in the state, additional site-specific studies would be useful in the cases of the extractive and waste-disposal industries. The growth of the manufacturing industry will be closely linked to the growth of the major

municipalities. Thus, any work that strengthens their water-resource position, also strengthens the position of the manufacturing industry.

SELECTED REFERENCES

- Albuquerque Tribune. 1981. Study says state less attractive to manufacturers. February 18, p. B-1.
- Arnold, E.C., and Hill, J.C. (compilers) 1980. New Mexico's energy resources '79. New Mexico Bureau of Mines and Mineral Resources, Circular 172, 55 pp.
- Kotovskiy, G. 1978. Playas -- a new community for Phelps-Dodge. Albuquerque Journal, Oct. 22, pp. E-1 and E-2.
- Lyford, F.P., Frenzel, P.F., and Stone, W.J. 1980. Preliminary estimates of effects of uranium-mine dewatering on water levels, San Juan Basin. In Geology and mineral technology of the Grants uranium region 1979. New Mexico Bureau of Mines and Mineral Resources, Memoir 38, pp. 320-333.
- Morgan, H. 1980. Copper -- improving prospects. New Mexico Business Journal, May, pp. 25-34.
- Mussey, O.D. 1961. Water requirements of the copper industry. U.S. Geological Survey, Water-Supply Paper 1330-E, 219 pp.
- Sheffer, H.W., and Eveleth, R.W. 1979. Minerals in the economy of New Mexico. U.S. Bureau of Mines, State Mineral Profiles, 20 pp.
- Siemers, W.T., and Austin, G.S. 1979. Mines, processing plants, and power plants in New Mexico. New Mexico Bureau of Mines and Mineral Resources, Resource Map 9.
- Sorenson, E.F., Stotelmyer, R.B., and Baker, D.M., Jr. 1973. Mineral resources and water requirements for New Mexico mineral industries. New Mexico Bureau of Mines and Mineral Resources, Circular 138, 26 pp.
- Stone, W.J. 1979. Water -- key to energy production, northwest New Mexico, USA. Third World Congress on Water Resources, Proceedings, v. II, pp. 868-877.
- Stone, W.J. 1980. Water-resource information available from New Mexico Bureau of Mines and Mineral Resources. New Mexico Bureau of Mines and Mineral Resources, pamphlet, 7 pp.
- Stone, W.J., Lyford, F.P., Frenzel, P.F., Mizell, N.H., and Padgett, E.T. (in review) Hydrogeology and water resources of the San Juan Basin, New Mexico. New Mexico Bureau of Mines and Mineral Resources, Hydrologic Report 6.
- Trauger, F.D. 1972. Water resources and general geology of Grant County, New Mexico. New Mexico Bureau of Mines and Mineral Resources, Hydrologic Report 2, 211 pp.

THE FUTURE OF RECREATION IN NEW MEXICO

Frank Ward, Assistant Professor
Department of Agricultural Economics and Agricultural Business
New Mexico State University

No one can live in New Mexico for very long before discovering that there is not enough water to satisfy everyone's need for water-based recreation. As all the speakers have indicated today, recreation is not the only user. In fact, I would guess that if you asked most recreational water users what single thing was wrong with New Mexico water recreation, you'd get the following response: "Too many people who are trying to use too little accessible water."

Over half of all our state's outdoor recreation is water oriented. As you know, New Mexico's population has increased by 27 percent in the last ten years. Leisure time is on the increase. Outdoor recreation in New Mexico has been growing and will keep on growing.

In New Mexico, several kinds of outdoor recreation become severely constrained when water becomes unavailable for recreation. The quality of fishing, boating, swimming, water-fowl hunting, and other water-based recreation uses is reduced without enough water available.

I'm not going to suggest that New Mexico would be necessarily better off by making "more water available for recreation," because I don't believe that it is necessarily so. As you no doubt know, providing more water for recreation, with a fixed supply, often means taking it away from other uses. Agricultural, municipal, and industrial users all need water, too. It is my belief that the question of how New Mexico's water should be used in the future cannot be answered by finding out which use

"needs" the water most. All water users in New Mexico "need" more water. All water users in New Mexico would likely benefit if there were more water to spread around. The state's income and employment would grow as a result. Unfortunately, wishing for more low-cost water to spread around New Mexico, as you well know, will not get it here, and that is not likely to change.

Our water law recognizes that there is not enough water to go around for all beneficial uses, and as a result, it treats the use of a water as a property right. These rights can be bought and sold in the marketplace. In providing for the exchange of water rights in the marketplace, our state's water law has conferred an immense benefit on our state's people. If, for example, an acre foot of water has a higher beneficial use in producing coal than in agriculture, our water law allows the transfer of that right, through the market process, to the higher beneficial use, subject, of course, to approval by the State Engineer. By allowing for the buying and selling of water rights in the market, our water law helps to bring what precious and costly water supplies we have to their highest beneficial and, presumably, to their highest economic-valued use for our state. However, for agricultural, industrial, and municipal uses, the economic benefits of water to the people of New Mexico is determined mostly in the market through the purchase and sale of water rights.

However, the economic value of water to the state when used for recreation, is an altogether different story. The recreational water user, and hence the state of New Mexico, receives a benefit from the

water use as it does from agricultural, municipal, and industrial users. Unfortunately, our water markets do not tell us what the recreational value of water is. The recreational water user spends money that gets spread around New Mexico communities, and those communities near recreational water sources, such as Truth or Consequences, benefit too. The monetary value to New Mexico of water used for recreation has been increasing steadily and will continue to do so, as more people move here, and people find themselves with more leisure time. This trend will not likely reverse itself, however, regardless of what that increasing value of water in recreation might be. Nobody, to my knowledge, has a very precise estimate of what this recreational value of water is. As I said a few minutes ago, I do not believe that the key to the best water allocation in New Mexico's future necessarily lies in making more water available to recreation, although it might. But we certainly do need one thing: decision makers need to know what water will be worth in recreation, so that its value can be contrasted with values in agriculture, industry, and municipal.

Based on some interpretations there is nothing in New Mexico water law or in engineering principles which would prohibit the acquiring of water rights for recreation. As you are probably aware, we have set aside some minimum pools for recreation at Elephant Butte. When and if we should reserve more water for recreation in the future is more a question of economic worth. I would guess that our State Engineer's Office and other agencies would be more prepared than they are now to recommend committing public resources for water-based recreation, if we knew what the water was worth when set aside specifically for that use.

People need water for recreation. But just saying that water is nice to have for fishing, swimming, hunting, and boating, is not good enough. Reserving water for those uses often means retiring it from or delaying its use for other valuable purposes. Most of you probably would not support spending public resources in order to buy recreational water rights in the future unless you thought that the purchase was worth the price.

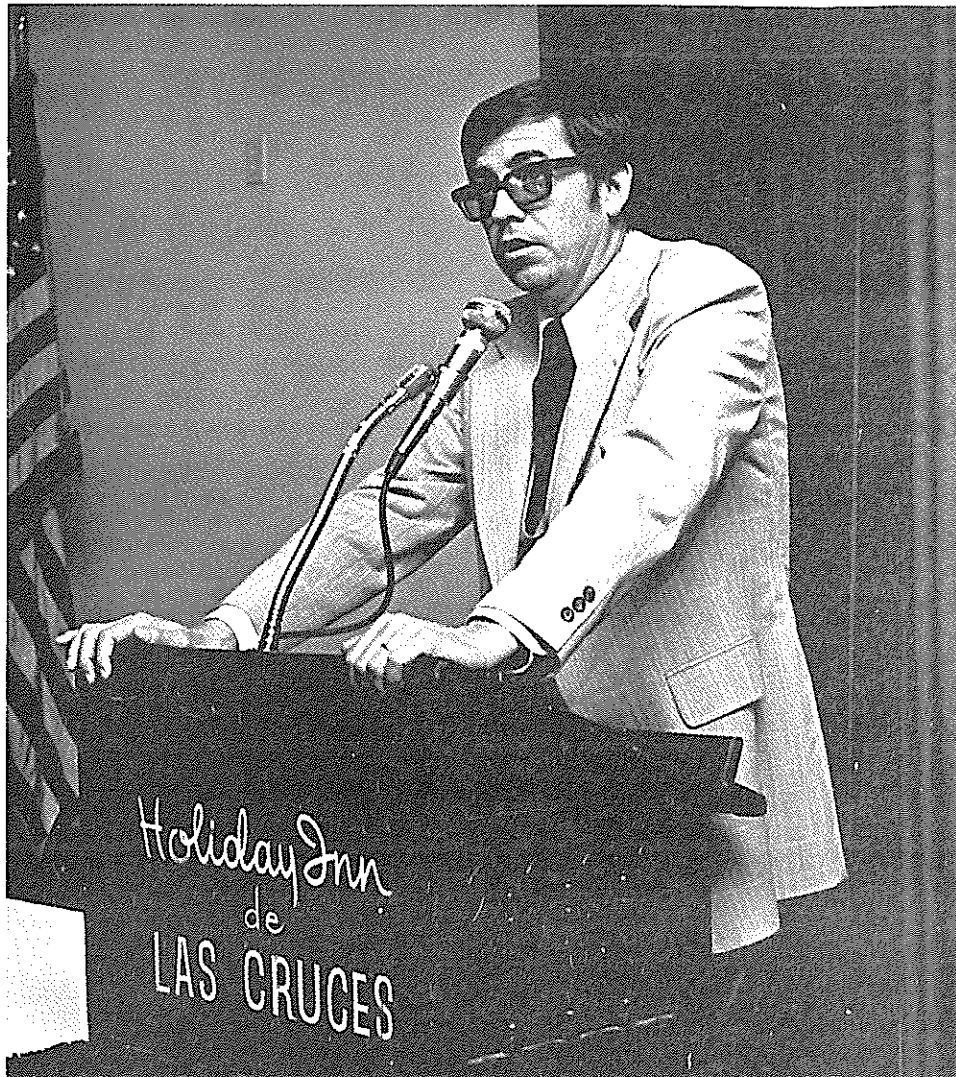
The only way we can find the value of water allocated to recreation, as compared to its value in other uses, is through scientific research. We currently have far too little good information on that subject to be of much use to decision makers.

We must not only devote research effort to quantifying the current economic value of water in recreation, but we must look to the future. Many recreation management choices which we can make today will affect the future recreational benefits of water. We can change access to sites, construct additional impoundments, change release patterns from existing impoundments, and change diversion patterns. We can ration the use of facilities in order to reduce congestion. All these ways of managing water will affect the future benefits of that water for New Mexico. Only with more research resources devoted to that cause, can we more effectively plan for New Mexico's water future.

In summary, as I see it, a fundamental problem regarding the recreational use of water, a problem which we can address through proper planning, is this:

Recreation is but one of the many competing uses of water in New Mexico, each of which contributes to the economic prosperity of the state. With future probable population migration and economic growth coming to New Mexico, the demands for water, especially in recreation, will be rising. In order to bring the greatest economic prosperity to New Mexico, arising from water use, we must first know what water is going to be worth in these end uses. Water markets will give us very few clues to the value of water in recreation. The state of New Mexico needs this knowledge to be obtained through scientific research before well-informed choices can be made.

LUNCHEON SPEAKER



Ray Sadler

Dr. Ray Sadler, Associate Professor of History at New Mexico State University, was the luncheon speaker. His amusing talk on the history highlights of the area was entitled "Blood on the Border."

AGRICULTURAL WORKSHOP REPORT

Fran Kaszeta, Graduate Student
Department of Civil Engineering
New Mexico State University

The first question that the agricultural workshop addressed was that of the water use conflicts that come about as demand grows for our limited supply of water.

I'd like to make note that in our workshop we did not restrict ourselves to only "new" conflicts, but we covered all the important water use conflicts. Although some of these conflicts have been discussed and dealt with before, they still remain vitally important. They become increasingly important as time goes on and the inevitable water shortages draw increasingly near.

The agriculture workshop was the largest of the workshops and I think it is worth mentioning that we had a high degree of participation. Almost everyone contributed to the discussion and we made an extensive list of water use conflicts.

The over-riding theme of the discussion was the survival of agriculture. Of prime concern was the evergrowing problem of agricultural land being taken out of use and converted to residential tracts. This process is not reversible. With world hunger a major problem, we should not even be removing a single acre of land from production; other compensating steps should be taken.

The term "beneficial use" has multiple meanings and is intimately related to the state's water problems. Should it continue to be defined in economic terms such as, the best use of water is that which brings

the highest economic return? A conflict arises. Other benefits should also be considered, such as the importance of the food produced. Also, both the short-term and long-term impacts of water use need to be considered. In some cases it might become "more beneficial" to save a water supply for a future use. In some cases the water supply is not a renewable resource -- it is mined and will eventually become extinct.

Many conflicts concerning the allocation of the water supply will arise. Just how should the water supplies be divided up during shortages? Is it solely a problem of economics? How will it be divided between the "haves" and the "have-nots"? How will domestic water shortages be dealt with? Lifestyles, health, and welfare are bound to change. The "eminent domain process" associated with water rights have already been evoked! Raton, New Mexico, is an excellent example of this. Cities do have this right to take land and water rights away from the farmer through the power of eminent domain. Interstate conflicts will also appear more often in the future. Both surface and groundwater resources need to be evaluated and the two are interrelated. Two current conflicts exist: 1) Texas and New Mexico boundary, and 2) El Paso case. We cannot, however, close the borders of New Mexico to the exportation of water by-products such as electricity. Closing our borders to export will inevitably harm our imports. This problem of state sovereignty of water rights will be more directly addressed as water shortages increase.

Another allocation conflict is that which is based on our treaty obligations. Indian rights to water will probably be decided in court. We also have our obligations to Mexico which will be increasingly difficult to meet.

One additional category of conflicts is also of major importance -- the concern of water quality. Ground water and surface water pollution control regulation is in question. Different qualities of water have different uses -- this needs to be recognized. Increasing salinity also continues to be a major problem and needs to be solved.

All of these water use conflicts will be surfacing more often and more severely in time and will need to be solved individually.

The second question our workshop addressed was the development of management schemes and technologies to use our water supply more effectively. Again, we did not limit ourselves to only "new" ideas. We were unanimous in agreeing that we can use our water much more efficiently -- the major principles being: 1) reuse and recycling of water (greenhouses are a good example of water reusing); 2) more efficient routing procedures (why store water in Elephant Butte which has such a large evaporation rate, when we can use other reservoirs such as Abiquiu); and 3) better agricultural practices need to be adopted.

The most important concept is to reduce evaporation and seepage. Drip irrigation is only one of the practices that strikingly reduces the total amount of water applied to a crop. But we also need to learn to use our poorer quality water resources more efficiently. Perhaps then we can save the better quality water for other uses.

We need to develop better breeds of plants, especially ones that are more salt-tolerant and use less water.

Finally, we need to look into public education. We need research and education to prevent the usual increase in per capita use that comes with time and affluence. Incentives to conserve need to be aroused.

New Mexico has the rare opportunity to live on the mesa and farm in the valleys -- we should change our ways and do so.

The last question addressed yesterday was that concerning information required (again, not only new information). The discussion evolved around the need to develop alternatives to our present practices. We need new incentives, new ideas. Biologists, engineers, and economists are currently approaching the problem with models. This is an important beginning. We then need to communicate our new ideas -- teach the people of New Mexico, explain the alternatives they have to minimize future water conflicts. Early awareness should be stressed in the schools. Because this is a democratic society, the people of New Mexico will make these decisions.

This morning other special problem areas were discussed. I'd like to restate these as a summary of our workshop.

The first was water allocation. In addition to what I stated earlier, the future involvement of the courts was stressed. If unresolved, serious water shortages will exist, affecting all the people of New Mexico, both those involved in agriculture along with those involved with municipal, industrial, and recreational uses.

The second issue discussed in the morning session was water quality. In addition to items discussed earlier, it was stressed that it is not necessary to remove or prevent all water pollution. Agriculture does not need water of as high quality as the home owner does for consumption uses. If the water quality issue is not resolved, unnecessary

compromises will be made. Domestic water quality may suffer to the same degree as agricultural water. This could cause severe health hazards.

Thank you.

MUNICIPAL WORKSHOP REPORT

Stephen H. Hubert
Martin, Martin, & Lutz

Thank you, Mr. Reynolds. My name is Steve Hubert. I am an attorney here in town. We represent Elephant Butte Irrigation District. It is an honor to be on the same side of the stage with the most litigious man in the state. We concentrated in the municipal workshop on the finite amount of water that is available according to whether it's being used at the maximum level now and how best to use it. The city official that was our moderator was Ken Needham, the Director of Utilities of Las Cruces. He expressed concern over how we are going to get more water for future growth. The city proposes to retire certain Elephant Butte water rights and use those to obtain drilling rights to underground basin waters here in the valley. Under this system the State Engineer will set up a schedule, as Mr. Needham said yesterday, for the retirement of the surface rights, and allow the city to drill new wells when an appropriate amount of these surface rights have been retired. But a large part of our discussion centered on better uses of the water that we have available for us now.

One of the principal areas of discussion was the better use of the effluent discharged in the city. Today our effluent in the city of Las Cruces is being dumped into the river, as it is in many cities in New Mexico. The State Engineer gets certain credits for this effluent, but the suggestions were made that better use be made of this effluent for municipal purposes such as parks and golf courses and even in the long

run for irrigated agriculture as a trade-off for the exchange of these water rights. The city would still get credit from the State Engineer for recharging some of the groundwater, but this would be a better conservation use. We understand that Silver City is using this now and they are also proposing to use this in the copper mine. So we spent a large part of our time discussing the effluent and the possible uses of it.

Because we had the city planner from the City of El Paso in our group, we had a rather lively discussion. The question arose whether or not the City of El Paso had considered recycling their effluent for use in their domestic water system. The city planner said that studies had been made, but it would cost about -- I believe he said -- \$2.00 per 1,000 gallons versus 20¢ for drilling in New Mexico. So they rejected that idea. They thought it was cheaper to come get our water.

Another area that we discussed was the facilities and technologies which would limit the use of water and help us to conserve water. The discussion here centered around the fact that water seems to be in plentiful supply, or at least the public perceives that it is in plentiful supply. New technologies that our group suggested would include drip irrigation and laser leveling in agriculture for better use of agricultural water, as well as uses around the home, such as new forms of showerheads and toilets that would help us to conserve the use of the water that we have now. Another suggestion in the municipal group was a proposal for an escalated rate structure in the cities. That is, the more water you use, the more it is going to cost you. The first 1,000

gallons might cost you \$10.00, but the next 1,000 gallons would cost you \$20.00. This is usually not a very politically popular scheme. People seem to think that the water supply is inexhaustible, and consequently most municipalities tend to base their rate structures on the cost of production, maintenance, and delivery. This is usually a very effective method since people tend to conserve when it hits them where it really hurts, and that is in the pocketbook.

The next area that we discussed was the zoning question: whether or not a city could zone and set aside certain lands by zoning for agriculture and set aside other lands for drilling purposes. Municipalities are planning for growth and some discussion centered around whether or not it is time to start restricting growth and restricting the number of people that come in based on how much water we have. An example that was given was by Mr. Hilton Dixon of Silver City where they were forced into this situation. They are out of water, and they did research their growth because of a lack of water. The town just can't grow any more. The question was asked if it was feasible or practical to limit the growth of our cities and I don't think we ever reached any conclusion on that. Some people seem to think it would lead to stagnation of the cities and the economy. Other people thought that our valley is fine the way it is and perhaps the city and county ought to get together and make some zoning changes to protect what we do have now.

The next discussion that we had centered around the feasibility of importing water from another state or from northern New Mexico to the southern part. It didn't last very long because almost everyone agreed

that this is an extremely costly measure, bringing water in, and that this type of thing didn't happen until we were completely out of water -- as is happening in Arizona right now with the central Arizona project.

Perhaps the most important thing that everybody agreed upon was that the public within a municipality needs to be educated towards using the water that we have more efficiently and more practically in a more conservative way. But the problems that we have are: "How are we going to educate the people?" and "Whose responsibility is it to educate?" There was one good comment that was made at the end of the discussion group and that was, "We're here today because we're concerned about water. How do we get the general public and the general population concerned about water? Whose responsibility is it to go out and educate the public?"

The agricultural committee discussed certain things that we covered also, and our discussion group was in agreement that the farmers and the agricultural folks both have already made efficient use of their water and that they have done it from an economic standpoint. They use laser leveling which promotes better irrigation, higher yield. The farmers, because they have to pay for the water, realize that it's not economic to waste water. Municipalities, on the other hand, we concluded, were setting relatively bad examples. As I walked into this building today, I noticed that New Mexico State was watering part of the street and part of the sidewalk. As we drive around our town and around Albuquerque, we can see that a lot of the water is being wasted. I think we generally agreed that the municipalities have some burden to go forward and set a good

example for the general public in conserving water and perhaps in taking a more active role in educating the public towards conservation.

In conclusion (and as a lawyer it's probably one of the first times in my life that I've been brief), we decided that conservation and education from the municipal point of view have to take the forefront and, hopefully, when people become better educated they will react to the conservation measures. Thank you.

INDUSTRIAL WORKSHOP REPORT

Gail Stockton
Turney, Sayre, & Turney Engineers
Santa Fe, New Mexico

The Industrial Workshop addressed the assigned problem of how to manage increasing competition for limited fresh water supplies among industry, agriculture, municipalities, and recreation.

After considerable haggling and general disagreement during yesterday's workshop, we resumed our meeting this morning by trying to focus on general areas of agreement that surfaced during our earlier discussions.

We agreed that competition for water should and probably would be resolved in the marketplace. Existing legislation and regulation of water resources in New Mexico provide sufficient guidance to reduce water conflicts and sustain a growing economy.

Our group, however, developed a list of seven very general recommended actions that are needed to augment and aid the decisions made in the marketplace and the courts. These are:

1. Expand research and development in water conservation technology; specifically, saline water development, water reuse, drip irrigation, and improved technologies for efficient industrial water utilization.
2. Improve water practices management by the competing water users, developed through economic incentives for the application of new technologies. (It was generally recognized in this workshop

that New Mexico's water resources were satisfactorily managed through existing legislation, agencies, and commissions.)

3. More thorough enforcement of already existing water quality and quantity legislation and regulations by providing adequate manpower and funds to state regulatory agencies.
4. Better education of the public and their elected representatives in water resources needs; ongoing training and updating of technical people to implement development in new technologies.
5. Better coordination and interaction of all agencies that are presently involved in water resource planning in New Mexico; determination through informal meetings of what is being covered already.
6. Voluntary cooperation between competing water users, such as industrial or agricultural use of municipal wastewater treatment plant effluent when high quality water that is better utilized for domestic purposes is not necessary, or design of wastewater final polishing ponds to also serve as a natural habitat for a variety of fish and wildlife.
7. Increase communication and interaction between competing water users as provided by these annual water conferences sponsored by the New Mexico Water Resources Research Institute; the possibility of having more frequent meetings, or at different locations in the state was also recommended.

Thank you.

RECREATION WORKSHOP REPORT

Thomas M. Moody
New Mexico Department of Game and Fish

I want to express appreciation particularly to the people who attended the Recreation Workshop for their enlightened comments. Our workshop was attended by a cross-section of people, many of whom had much less of a particular or vested interest in recreational use of water than I do. We felt we had the toughest assignment because the recreational use of water is hard to place a value on in the marketplace. We've heard throughout the last couple of days dollar figures on the value of agriculture, dollar figures for the value of industrial use of water, and precise use estimates by municipal interests. This is pretty tough to do for recreational situations. There are methods available to estimate the exact amount of money spent on water-based recreation, but these estimates are not completed in New Mexico at this time. There are some studies being done on it. One of the main problems is, how do you estimate the aesthetic value of water-based recreation? Lots of us like to go out and camp by public streams just because the public stream is there. One of the things that recreational use of water affects is the lifestyles of all of us. It was succinctly put by one of the members of the workshop -- to paraphrase him just a little bit -- we can either provide for recreation or we can build lots of asylums.

Now there is all kinds of recreation, some of it water-based, some land-based, some urban-based. Is bowling just as good recreation as maybe water skiing or fishing? It might be, I don't know. That's

something we have to determine. It's probably the crux of the entire discussion in the recreation workshop. In fact, can water-based recreation compete? Is it viable under the present and the future water constraints in the state of New Mexico? That has to be determined. The best way to determine that probably is through an evaluation or a market test to see what recreational use of water is good for. How much value can we actually put on it? As I have said, there are some studies underway presently. Some more are undoubtedly yet to come.

Maybe there's not as much current conflict with recreational water use and other water users as some of us might imagine. For most of the history of the state, recreational use has piggybacked on other water uses. Because the agricultural uses have to store water, the storage and conveyance mechanisms provide some recreational opportunity. Really the only very specific conflicts that we see coming up are water exports from the state -- whether they be in coal slurry lines, or in the consumptive use of water by the indirect export, previously mentioned, of electrons over the high lines. What will hurt if there is no so-called negative alternative, if there is no water-based recreation or no recreation in the state of New Mexico? That discussion took about thirty seconds. Another one of the individuals, without a vested recreation interest like mine, said everybody will hurt. Without recreation we will directly affect the lifestyles of the whole population of the state, both individually and economically.

There are some values for water-based recreation that are available. The consensus of the workshop was that probably those values are

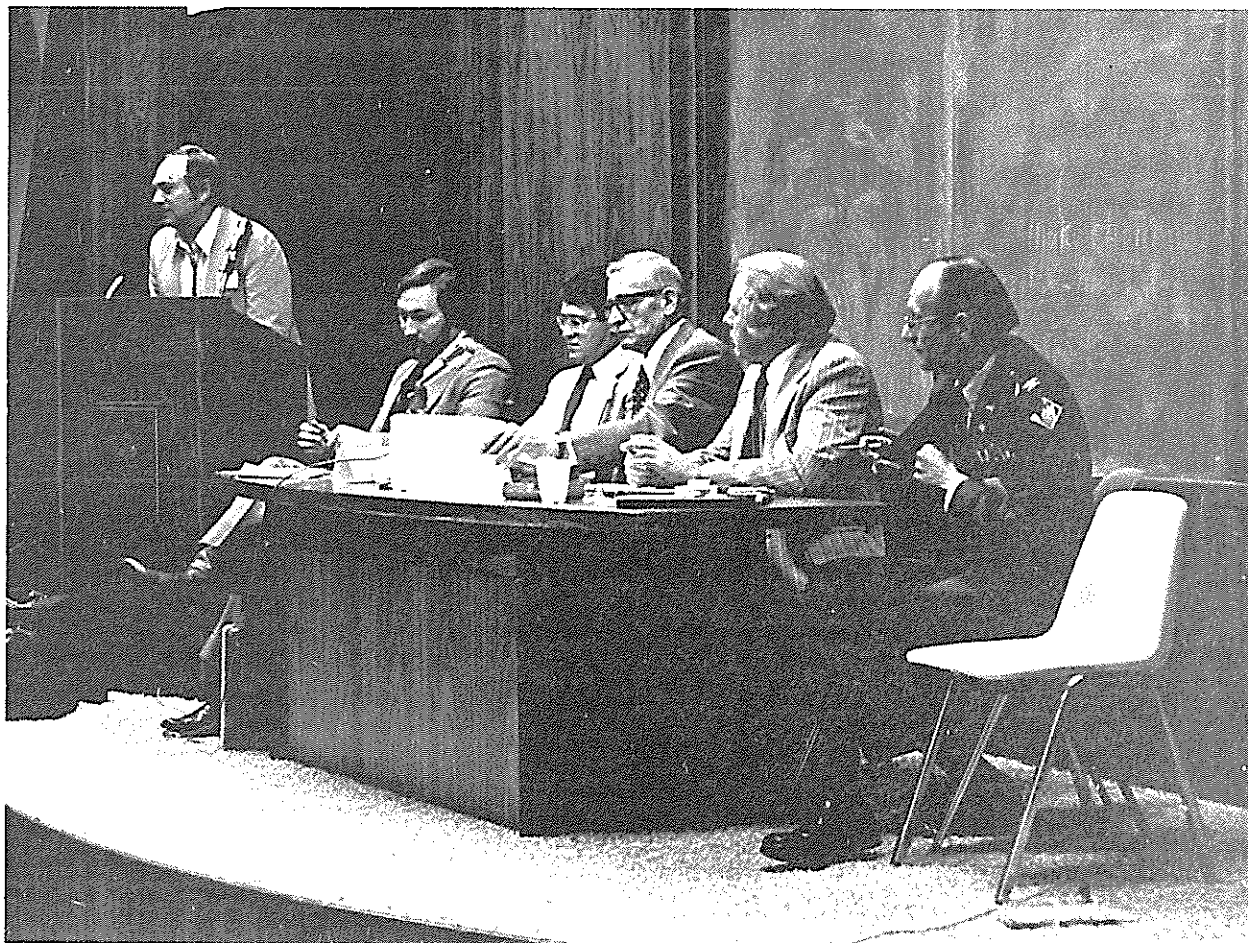
competitive with other uses at this time. That is a wild guess, but it probably is the case.

We spent quite a bit of time on the discussion of strategies to improve recreational uses of water. One of the main ones brought up was development of management schemes for conservation of water throughout the system. Previously mentioned, at least in the agricultural workshop, was the storage of water in the less evaporative intensive areas, and possibly more efficient conveyance mechanisms. Another thing was, in all water projects consider the possibility of recreational opportunity. An example was brought out from Scottsdale, Arizona, where the federal government and the local people improved on a very severe potential flood situation with a park. The park is, in fact, a portion of the flood control works in this situation. This is the Indian Bend Wash at Scottsdale. Scottsdale, as you know, is a very affluent community. The people there, for some recreational benefit, put in lots of bucks.

The new information that is needed in the area of recreational water use is the value of that use. They have to test the market, determine what the value of the water-based recreation is, and probably people concerned with water-based recreation will have to start forking over the bucks. We've probably piggybacked along with other water uses too long.

Thank you.

SESSION THREE: PUTTING IT ALL TOGETHER



WRI Director Thomas G. Bahr introduced panel members Jim King, Fred O'Cheskey, Steve Reynolds, Bill Stephens and Bernie Roth.

MEET THE SPEAKERS

STEVE E. REYNOLDS is the State Engineer of New Mexico. He has spoken at numerous Water Conferences, including the first one in 1956 when his topic was "The Effect of Interstate Compacts on New Mexico Water Supply." When a statewide research committee was established in 1966 to exchange information and research needs between the various agencies in New Mexico, including the New Mexico Water Resources Research Institute, Reynolds was a member of the first committee.

He is the author of numerous papers in the field of water development, conservation, use and law, as well as having authored more than 20 papers in the field of thunderstorm electrification, precipitation mechanisms, and electrical effects associated with the freezing of dilute aqueous solutions. He is a graduate of the University of New Mexico, having a degree in mechanical engineering; he has also received an honorary degree of Doctor of Laws, from New Mexico State University in 1977.

COLONEL BERNARD J. ROTH became the 18th District Engineer of the US Army Corps of Engineers' Albuquerque District in July 1978. Colonel Roth is responsible for water resources development in New Mexico, parts of Texas, southern Colorado, and western Kansas. He holds a Bachelor's Degree in Civil Engineering from Polytechnic Institute of Brooklyn, New York, and a Master of Science in Civil Engineering from Ohio State

University. In addition, his military education includes attendance at the Army Command and General Staff College and the Army War College.

WILLIAM P. "BILL" STEPHENS was born and raised on a farm near Elizabethton in east Tennessee. During high school he was very active in the Future Farmers of America. As a young man he served 44 months in the US Air Force. He received both his Bachelor Degree and his Master of Science Degree in Agricultural Economics from the University of Tennessee. His doctoral dissertation, earned at the University of Minnesota, was based on research conducted in New Mexico relative to the transportation of New Mexico feeder cattle.

After finishing his education, Stephens joined the staff of New Mexico State University as an instructor, and subsequently moved through the ranks to full professor.

In 1966, Stephens was appointed Assistant Director of the Agricultural Experiment Station in the College of Agriculture and Home Economics. From 1970-1971, Stephens served as the coordinator of environmental research for New Mexico State University. In January, 1972, he was appointed to his present position as Director of the New Mexico Department of Agriculture. In March 1978, Dr. Stephens was sworn in as the first Secretary of Agriculture on the Governor's Executive Cabinet for the State of New Mexico.

JIM KING attended New Mexico State University in Las Cruces, New Mexico, and received a Bachelor's Degree in January, 1975, with a major in mathematics and a minor in economics. He then entered Graduate School at NMSU in mathematics. Since then he has worked as an Economist with the Governor's Office for Manpower and Training, Manager of family-owned business holdings, Administrative Services Division Director for the Natural Resources Department, and for the last two years, Deputy Secretary of the Natural Resources Department. Jim left the Natural Resources Department for six months last year (March through August) at the request of the Governor to set up the newly created Data Processing and Data Communications Planning Council. Jim has been active in the development of Natural Resource Information Systems and has developed a comprehensive Natural Resource planning capability for the Natural Resources Department.

FRED O'CHESKEY graduated from the University of New Mexico with a Bachelor's Degree in Business Administration. He had an eleven-year career in state government, serving New Mexico as Secretary of the Taxation and Revenue Department, Secretary of Energy and Minerals Department, and as Secretary of the State Highway Department. He is presently the manager of governmental affairs for the Public Service Company of New Mexico.

PANEL DISCUSSION

Steve Reynolds: Thank you, Tom, for that good report. I'm pleased to note that we are right on time and I thank the reporters for that. We move now to the comments of the panel, asking that they too note the five-minute limitation. I think it is very important that we give the audience an opportunity to participate. To keep matters simple, I will simply follow the listing on the program, and ask Colonel Bernie Roth to offer us five minutes of comment on these four excellent reports. That's gonna be tough!

Col. Roth: I'm struck by the excellence of the reports. I hate to say that I'm the only honest guy in the room. That's not fair -- it may be true, but it is not fair. My biases are very simple. I protect the public interest. My only problem is I'm not sure I know who the public is. I would tell you very honestly, and I said to this group and others, that I find a great deal of hypocrisy in the agricultural community saying, "Not one acre ever leaves agriculture because 'farmers are wise and efficient people and will get the best out of their water'." Now, as an outside observer of competing water interests, I must tell you, in my opinion, I don't

agree with that. I think you avoided the issue. There is no efficient use of water in New Mexico, or probably any place else. I could give you case after case in point. Some of you at the Rio Grande Compact Meeting yesterday heard some folks up north say because they were not afforded the legal right to store water and release waters the way they wanted to, they were going to put that water on their fields whether they needed to or not, recognizing the inherent losses in doing that. I think if you look at the Rio Grande and the potential for storing and moving water other places or other ways, one could make some very significant savings in the amount of water available for competing uses. If you look at irrigation companies, I think the Tucumcari project below Conchas is an example. It seems to me they lose about 40 or 50 percent of their water between Conchas and headgates in inefficiencies. So you cannot tell competing users of water that farmers are using all they have effectively and efficiently and therefore we are not subject to providing excess water. What you can say is that given the appropriate incentives, we could use our water more effectively, or efficiently. I think therein lies the major problem.

What are the incentives? I would suggest it is very nice to say that the marketplace will take care of the incentives. There is no greater believer in that than I am, but I would suggest that the marketplace is not in a position to do that today. It does not do it, otherwise we would not suffer such a magnitude of losses in water in any of the four sectors addressed. It is akin to being told that the way to conserve gasoline is to drive at 55 miles an hour. The marketplace will require you to do that. I would suggest that in this audience there may be three or four people that believe that, but the rest of us drive at 55 miles an hour because we will go to jail or pay a fine if we do not.

I would suggest that you think about the second kind of incentive that one has in an economy. There is the marketplace, but there is also a punishment incentive. Now, in all deference to Steve, I suspect that the State Engineer of this State and other Southwestern states are prohibited from punishing people for not using their water to public advantage. It is true. But if, as the agriculturalists say, the people of New Mexico will have the final decision, I wonder whether the public does not want to start punishing a lack of efficient use of water. I think

in the long term that is the issue. Otherwise the marketplace will take over and, yes, you will lose agricultural acreage. And, yes, the industries, by virtue of money, and the municipalities and governments, by virtue of the right of eminent domain, will take priority. I find all the workshops agreeing that everybody needs more water, but I do not really find you doing much more than paying lip service to how one legally can insist on more water being available. I, for one, think it is there. Thank you, Mr. Chairman.

Steve Reynolds: Mr. Bill Stephens.

Bill Stephens: Thank you, Steve. I think I should make my position quite clear, too. I am an advocate of agriculture. And they are a big part of the public in my mind. I am also an optimist, and I assume you know the definition of an optimist and a pessimist. The optimist gets up in the morning and goes to the window and looks out and he says, "Good morning, God!" and the pessimist says, "Good God, morning!"

But as I see it, the future of agriculture is bright in New Mexico. I do not see major declines in agricultural production in New Mexico. Now I would

compliment the panel for what they identified. I did sit in on part of the discussion. Five of the main points that were mentioned this morning were: beneficial use, court decisions, water quality, better breeds of plants, public education systems, and information dissemination. I think they hit the major areas.

I made my outline before I heard this presentation, so rather than to rehash what they said, I will try to give you my interpretation of what all this means to agriculture. Again, as I say, I do not see a major decline in our production. I see much of the east side (of New Mexico) going out of production because of the Ogallala formation -- it is a mining operation over there. Now the use of brackish water has been mentioned. I'm sure it has been discussed in some other committees: salt tolerant plants. I think we can do much to develop plants that will produce more with lower quality water. I believe Dr. Wilson has already developed an alfalfa that uses less water than we now use with alfalfa production.

Improved technology has already been mentioned; our dead leveling, our irrigation technology. I see this coming to the forefront. The use of effluents from our cities and communities. This was mentioned. I would say that I feel we can double what we have

right now as far as population uses, domestic uses, and industrial uses are concerned, without having a major impact on agricultural production in this state. It will not happen overnight; it will happen over a gradual time period. We can increase our efficiency not only in agriculture, but in domestic uses, in industrial uses. There are a number of things we can do. They tell me over in the Tularosa Basin we have as much brackish water as they have in Lake Michigan. So I think much can be done in that area to use those waters and to clean up some of those waters.

An area that has not been mentioned here, and this is one of the things that is going to keep our agricultural production up, is our rangelands. I think we can do much to improve our rangelands. Now I did not make out too well in Santa Fe this time with a proposal for about a third of a million dollars to help get that off the ground, but we will come back next year and try again. I think by improving our rangelands and better utilizing the water on our rangelands we can hold up and increase our production there -- and after all, the income to agriculture in New Mexico, or about three-fourths of it, is from the livestock industry. So I foresee grass growing out

there instead of greasewood and mesquite, and better utilization of the water that we have.

I also see the demand for agricultural products increasing. There is no question about that. I think that we are going to have to bring up prices in order to give the farmer and the rancher a profit motive. Again, I think we are going to have to do a lot of things to accomplish what I have indicated here, but I think we can do it. I might just mention briefly, Steve, the proclamation that the President of our Regents, Bill Humphries, read yesterday morning in which the Governor proclaimed this "Water Week." We talked about this the other morning at the Cabinet meeting, and the Governor thought about sending it down as maybe a joint House-Senate Memorial. It would be more significant if we had the whole legislative branch supporting this, as well as the executive branch. But as he talked about it, he said, "Well, we would probably get it through the Senate all right, but if it went to the House it would probably get a quadruple reference and we would never make it in time!" So Steve, thank you very much for an opportunity to comment.

Steve Reynolds: Thank you, Bill. Moving next then, to Jim King, Deputy Secretary of our Department of Natural Resources. I

know Jim still looks a little tired and I do not think he has really recovered from that last session of the legislature yet.

Jim King:

Not yet, not yet. I tell you, after being up and playing with the legislature for sixty plus days, and having to guard every word you say and watch it closely, it is a pleasure to be able to come here and loosen up a little bit. When Bill Huey called me into his office and said he could not make this and wanted me to come down in his place, he handed me this program and I looked at it and I see we got Colonel Roth, Bill Stephens, Steve Reynolds, and Bill Huey, and then I get here and we got Fred O'Cheskey and I said, "Bill, you know, I know what Tom Bahr's up to. He's putting all these heavy weights on there and see if some sparks can get going." And then I said, "You know I think you better go." And he goes, "Well, Jim, just go put on fifteen years of experience and get in there and hold your own." So, I wasn't able to put on the fifteen years of experience, but this does give me an opportunity to beat a drum that I like to beat once in a while. It centers around the concept that the marketplace for water, as it now exists, will bring water to its highest and best use.

Yesterday I came in here a little concerned that this probably was not true. Then George Dawson got up here and he was talking about water and economics. He started to say that the marketplace would bring water to its highest and best, and he did not finish saying it, he switched to alternative use. Then Dr. Frank Ward from the college got up and he did say that the marketplace brought water to its highest and best use, but he put a qualifier on that: "for certain uses," if I'm paraphrasing correctly. During the workshop meeting yesterday, I tried to stay quiet and sit back and listen, knowing that I was going to be up here today. I had some very strong feelings about how we make resource allocation decisions in New Mexico and I wanted to listen for a while to see if my concerns, at least with respect to water, were generally recognized by the various participants. I think generally they were.

However, given this opportunity to espouse my philosophy and concerns, I am going to state what I see which may deviate from or place emphasis differently than the recreation workshop did. I am going to concentrate on the issue of water for recreation.

In a nutshell, let me take the following liberties which I would not have dared take with the legislature. In New Mexico, we operate under the philosophy that the marketplace will bring water to its most beneficial use. In the short run, this may be true. In the long run, however, personally I am not convinced that that is true and I am concerned about the consequences to future generations. With respect to recreational uses of water, I view the issue as follows.

Presently, recreation does not compete effectively in the marketplace for water rights. That was generally agreed upon in the workshop. Given New Mexico's continuing increase in population and industrial growth, we can expect consumptive uses of water to increase relative to the less consumptive uses, such as agriculture and recreation. Presently, and in the past to a greater extent, recreationists have been able to rely somewhat on the availability of water for recreation, even though that water was committed to other uses. However, as consumptive uses continue to increase, I believe that recreational uses of water will decrease. If we are to continue to make water available for recreation at present levels, or perhaps at greater levels as our population grows,

then it appears to me that we have two options. One would be to alter the structure of the market system wherein water is brought to its "highest and best use." Some ideas came out of the workshop and this would involve changing the tax structure, or perhaps having recreational water set aside on transfers. All of this probably will not happen, but maybe it will. Second, would be to give the recreational use of water standing in the marketplace. That would be to make funds available for the purchase of water rights for recreation. That is probably the most feasible alternative.

Essentially, I feel that if we fail to specifically identify and provide for the designation of water rights for recreation in the not too distant future, New Mexico will begin to experience a marked decrease in the availability of water for recreation. Of course, recreation is in there with everything else, with the municipal, industrial, and the agricultural uses. You have to ask yourself, "Why should we be any more concerned about water for recreation than for any other use?" Maybe we shouldn't.

Basically, I think that the best comment I have heard is by Dr. Garrey Carruthers a couple of months

ago. He said, "Well, do you think you could get one of the politicians up in the legislature to actually stand up and say he was against having water for recreation and that he didn't want to fund any more of these state parks or any of the other activities having to do with water?" So I think there is a concept of value and that people do value having water available for recreation, and legislators and bureaucrats and other people do too, but it is nebulous as to what that value is and how it should compete. That's a hard point to get across when you are going for the money. Thank you, Steve.

Steve Reynolds: Fred, as I understand, has been persuaded to take the place of Marion Cottrell. Here is Fred O'Cheskey of the Public Service Company of New Mexico.

Fred O'Cheskey: Thanks, Steve. I am sorry I was not able to attend the conference yesterday. I was at the Legislature and I want you to know that that old axiom is true. You should not watch laws or sausages being made, because they will both make you sick. That is where I was yesterday -- I was working out some laws, but no sausages.

I work for the Public Service Company of New Mexico and represent the industrial or business user of water. I think we ought to keep things in perspective when talking about water. First of all, I think it is a fact (and Steve can argue with me when he has the floor), that agriculture utilizes 85 to 90 percent of the water in New Mexico. If you look at the other uses, municipal and industrial, they only include about 10 to 15 percent of the water consumption in New Mexico. If you further break that down, the industrial use is probably only about 5 percent of the water in New Mexico. I think you ought to keep this in mind when talking about the competing uses of water. Several speakers, both in the program this morning and during the program yesterday, talked about the future use of water in electrical generation in New Mexico.

I would like to make a brief comment about that because my company is looking at building a 4 1/2 billion to 5 billion dollar generating plant in New Mexico. Now at first blush, I'm sure that many of you would be very concerned about the water use and there has been some indication there is a concern about the use in the northwest quadrant. An electrical generation plant at one time used a great amount of

water. If you look at the San Juan plant that was recently constructed by PNM and other participants, PNM recently received a national award for zero discharge from that plant, zero water discharge. It is all being reused, essentially. There is some loss of the water through evaporation, but that has been reduced by 35 percent from the usual 500 megawatt plant consumption. So, what I am here to say is that industry does have a responsibility and is taking that responsibility in reducing water consumption. Hybrid wet-dry cooling towers can reduce the water consumption by 35 percent from the normal operating power plant. I will hope that in looking at industrial uses that you would keep some of those water-use conflicts in mind: that the percentage is relatively small and that industry is doing something to reduce its consumption in the water area. Thank you very much, Steve.

Steve Reynolds: Thank you, Fred. Now we are prepared for that very important audience participation by way of comments, questions, or discussion.

Bob Lansford: My name is Bob Lansford. The recreationalists kept talking about value. I never heard the word demand

mentioned once. It appears to me that before you start valuing something, you have got to have a demand for that resource. Has anything been done on demand for water-based recreation in New Mexico?

Steve Reynolds: Tom Moody, would you like to respond to that?

Tom Moody: Our department (Fish and Game) does not have the expertise to determine it. There are some contracts that we have currently through WRRRI in the College of Agriculture to work on some of this information that is needed.

Bob Lansford: My major concern is that you are talking about value which appears to me to go back and look and see if there is a demand out there. Sure there is a big demand for fishing, but could you provide more if it was allocated around the state properly?

Tom Moody: I believe Mr. King addressed the allocation question. There are undoubtedly some inequities in allocation between some of the various uses.

Steve Reynolds: Would any of the panel care to respond. Jim?

Jim King:

The fact of the matter is that with respect to the other uses I think we should be answering those questions more specifically. If we want to know if there is excess demand, we can go down to Elephant Butte on Memorial Day. The full concept of value has to become more scientific before we can convince legislators and other decision makers that, in fact, they should spend public money on acquiring water rights for recreational uses.

Steve Reynolds

I would like to offer just one comment on this point. Jim King said in his presentation that recreation does not compete effectively. Well, I think that Tom made it clear that recreation has not had to compete. It enjoys the incidental recreational benefits of stream flows preserved by water rights and compact provisions, and reservoirs constructed for irrigation and other purposes.

I think perhaps the important point when you start talking about recreation is that there is an element of aesthetics involved. This is entirely subjective. That is, a hungry man is not going to buy a Picasso -- not first, anyhow. The way you determine these things, it seems to me, is political. As the legislature can determine what recreation is worth to

the people of the State, and therefore what price the State, for example, should pay for water rights to create additional recreational opportunity when that demand becomes high enough. When that demand becomes high enough, the legislature and the congress will do something about it. Dr. Dawson?

George Dawson: I merely want to correct Jim King, if the rest of you misunderstood me as badly as it sounds like he did. I did not say that the marketplace was the sole criteria for the highest and best use. I hope I did not say that. I think I have gone on record in years past, and this one also, that the highest and best use is determined in actuality on the basis of economics in the short run. That is not necessarily the way it ought to be in the long run. There are other factors, other criteria, that ought to be used other than economics.

Jim King: I understood yesterday exactly what you just said now. I probably did not get that across well. The point I was trying to make was that you were starting to say highest and best and switched to alternative use. We are in agreement, I just did not bring it across.

Steve Reynolds: Yes sir?

Arturo Sais: My name is Arturo Sais, Middle Rio Grande Conservancy District. The subject of educating the public in water conservation was brought up. Specifically, what I wanted to ask was how useful is water coming from treatment plants? This is your secondary treatment effluent. We have been confronted with this issue at the Middle Rio Grande Conservancy District. One of the questions related to this is, how do you reduce people's fears about using this treated water? Also, how do we educate a public board, such as the Middle Rio Grande Conservancy District, to encourage the use of treated water? This is more or less a three-phase question that I'm presenting to the panel. Maybe they can give me some information on this. We are currently confronted with this problem.

Steve Reynolds: The question is, how do you encourage official bodies and the water users to use secondarily treated sewage effluent for irrigation. Bill Stephens is also a member of the Water Quality Control Commission, as am I, and I find it difficult to respond. I will say this, however, that certainly in New Mexico this re-use of water has been practiced for many years. It

is common practice for the irrigators to use sewage effluent in irrigation. In fact, in some municipalities it is sold directly from the sewage treatment plant to farmers without rights to use the public water. As far as I know, it is common practice throughout the United States for the downstream municipality to drink the sewage effluent of the upstream municipality. The reluctance comes in drinking their own sewage effluent. Yes sir?

Adrian Ogaz:

I am Adrian Ogaz and I belong to that group of water users that have been cursed in the county for centuries. I would like to take issue with something here today. I don't think we are competing against each other. I would rather use the word partnership. We should be partners in the use of water, not competitors. After all, I do not see anybody here that is not a user of water in one form or another. Of course, agriculture is one of the major users of water, but we want to consider ourselves as partners. We want to share what we have with everybody, but at the same time we would like to see other users carry their own weight. That is one thing that has never been done up to now. Everybody wants to use what the farmer has done to preserve our water and to have the

facilities. Everybody wants to use them, but at the same time they do not give the farmers enough credit for what they have been doing. The only thing I want to say is that we should consider ourselves partners, not competitors. Thank you.

Steve Reynolds: Pete?

Peter Wierenga: My name is Pete Wierenga. I would like to reinforce what Colonel Roth just said about another avenue of using the water. In fact, he was alluding to enforcement. I believe that in Arizona they just adopted a law that all the farmers have to use best management practices, in this case irrigation scheduling systems, to optimize their water use. That's mandatory. I can see that if we get in a crunch in New Mexico that similar practices, similar laws might be adopted in New Mexico. I think what Colonel Roth means is to warn us that we better watch out and try to improve our water management practices so it does not become a law, but it is more a voluntary practice. I would also like to ask him to clarify something. I am sure Colonel Roth did not mean to say that all inefficient farming practices, or irrigation practices, are necessarily a loss of

water. If you have a 50 percent irrigation efficiency, that does not necessarily mean that all the water is lost, because much of that or almost all of that goes back in the drain and is available for downstream use. I do not know exactly the situation in northern New Mexico, but I have seen some very inefficient systems where a great deal of water is lost, but then it becomes available again downstream. The only problem is that generally the quality is degraded; and I think that is a very significant point, anytime you feed water through a system, whether it be soil, or a factory, or a municipality, the quality is degraded. I think we should keep that in mind in our future discussions also. Thank you.

Steve Reynolds: Would any of the panelists like to respond? I might offer a comment. I'm sure of course that everybody is aware that under New Mexico water law, waste of water is a misdemeanor, and one can be fined or jailed for committing a misdemeanor. What one must be very careful about in talking about conservation and more conservative use in irrigation is, again, the economic incentive. I think that a law that required irrigation management services could put a lot of good farmers in New Mexico out of business. I do not think

that we are ready for that. Now one of your comments particularly, Pete, is relevant. That is that much of what might be considered waste arrives as return flow available for use downstream and, if you like, in many situations constitutes a good bit of the water with which we meet our interstate compact obligations. Next? Dr. Steinhoff?

Dr. Steinhoff: I have been a drinker of tertiary treated water for many, many years and many people where I grew up did the same. There have never been any detrimental health effects found. Two years ago I had a physical test which shows that I am in good shape and, I would say, in above-average health, so from that point of view I don't think there's any problem to be feared.

Steve Reynolds: Thank you. All right? Yes sir?

John Lyman: My name is John Lyman and would the fifth member of the panel give us five minutes overview of what the water situation is in New Mexico in his view right now, Mr. Reynolds?

Steve Reynolds: Right now with respect to surface water supply, not good. We are in a lot better shape than we were the

first of March, but we are still looking at, within New Mexico, runoffs 30 to 50 percent of normal in the upper Rio Grande. The Rio Grande in Colorado is not in a lot better condition. As of the first of March the projected flow at San Marchial, just above Elephant Butte Reservoir, was 18 percent of normal. I think that's going to be a little better when we see the first of April readings.

With respect to municipal/industrial supplies, about 85 percent comes from ground water. A brief period of drought will not have a serious adverse effect on those uses. Also, particularly here in the Elephant Butte Irrigation District, most of the farmers have supplemental wells which they are able to use during periods of shortage of surface water supply to carry them through. This is also quite true in the middle valley. But those farmers in northern New Mexico, for example, irrigating from tributaries with no advantage of storage may suffer very severely this forthcoming irrigation season.

Bill Stephens: But, Steve, we do have in Elephant Butte adequate water for this year's irrigation, even better than we had last year as far as storage in Elephant Butte, so as I see it there will be no problems in irrigation in

the Mesilla Valley this year. But if we do not get good snowpack next winter we will be in real difficulties the following year.

Steve Reynolds: Matter of fact, I think you have got enough in Elephant Butte with just reasonable precipitation, reasonable management, you could get by in pretty good shape for two years so, Bill certainly is right, that here below Elephant Butte this current shortage is not an immediate threat. But we can not stand to continue with the kind of snowpack we had this year. At the same time, let us express proper gratitude for the two years of excellent spring runoff that we have just enjoyed, and while I am about it express gratitude particularly to the Colonel and the Middle Rio Grande District board for the excellent work they did particularly in 1979 in getting things in shape to handle that heavy 1979 runoff. They served us very well also in the 1980 runoff. Of course, that is the trouble with the water business as people like my friend Glenn Stout would know. It seems there's always too much or not enough; it never comes just right.

Bill Stephens: Steve, I'd like to pose a little different area for just a second here and perhaps a question to you

relative to the some of the court actions or some of the law suits that are now going on -- particularly the Indian water rights. Could you just give us a quick update as to where we are on that, and if the decision goes one way what impact it might have, and if the decision goes the other way what impact it might have. Now this was mentioned in some of the discussion in the workshops.

Steve Reynolds: As a matter of fact, New Mexico is, I think, proceeding wisely and aggressively in resolving the Indian water rights questions. We have pending before the federal district court adjudications of Pueblo water rights. And it seems to me we've got six of them involved in adjudication suits. These are very important and certainly, in our view of the matter, the Pueblo water right issue is a good deal different than the reservation water right issue. The Pueblo's water rights, as we see it, are not based on what is known as the reservation doctrine, that doctrine being that whenever the United States withdrew from the public domain certain lands as a reservation, the United States at the same time withdrew the waters arising on that land from the administration under state law in the amount necessary for the purposes of the reservation with a priority date as of the date of

the reservation. This had the effect, then, of providing for many of the Indian reservations the amount of water needed for the practicably irrigable acreage on that reservation and it was not necessary for them to forthwith put that water to beneficial use in order to have a water right. They could proceed to put this water to use much later without any forfeiture of that right. Many difficult issues, both factual and legal are involved, but I think at this point in time, New Mexico certainly is in a position of leadership in resolving those rights. We have pending in the state court an adjudication suit on the San Juan River system in the northwest part of the state involving the water rights of the Navajo Tribe, the Jicarilla Apache Tribe and the Ute Mountain Utes. We have pending in state court in the Pecos River system resolution of the rights, reservation rights, of the Mescalero Apaches. So these two very different foundations for Indian water rights will be resolved within a reasonable time -- and by that I don't mean next month. I think it quite likely that ultimate resolution will require the attention of the United States Supreme Court. But we are certainly headed toward that and I will not speculate about the results of one decision versus another. The matter of either

of those classes of Indian water rights will allow you to do that for yourself, Bill.

My reason for not speculating is that most law suits that I've known anything about do not result in a decision which favors one party entirely. Let's wait and see what the court says. Now, do we have another discussant from the floor?

Ted Sammis: I am Ted Sammis in the Agricultural Engineering Department here. Could the panel discuss the implications of trying to maintain our groundwater quality? What's going to happen if our cities, or other people, are allowed to contaminate our groundwater system? What long-term implication would this have?

Steve Reynolds: Dr. Stephens, as a member of the Water Quality Control Commission....

Bill Stephens: I am a member of the Water Quality Control Commission. If you've heard of Section 208, that is non-point source pollution. Another is point source pollution. If you can identify the source, like a sewage pipe coming out, that's point pollution. We have a number of regulations on that. The non-point

source pollution is a little more difficult to get a hold of. An example would be some of your return irrigation flow. It's best management practices which are needed there. I may be drifting a little from the answer you want, but in connection with what Dr. Pete Wierenga indicated back here, the position that I have taken is it should be a voluntary thing, as far as these non-point source pollution practices are concerned. I might just indicate that at a recent hearing for the Water Quality Control Commission they proposed a regulation which said, in effect, if there's a hazard to public health from an irrigation well they would require a permit and a discharge plan. I took issue with that and I got the permission of the Commission to look at the system in New Mexico to try to determine if there was, in fact, a hazard to public health as a result of irrigated agriculture. The legislature this past term -- I think it got all the way through and I believe the Governor will sign it -- said in effect that if there was a hazard to public health then they would have to file a discharge plan and get a permit. But it left the burden of proof on the director of the EIA to prove that there is a hazard to public health and not just to conjecture on his part. That's a quick summary of some of the things I see on pollution.

Steve Reynolds: Is that responsive, Dr. Sammis?

Ted Sammis: Yes. The only other question I had was brought up in our discussions yesterday. Apparently one of the wells in Albuquerque has been contaminated. I don't know anything more than that fact was brought up. I was curious, as we have waste dumps trying to go into an area, are we being sure that these waste dumps are going to be constructed in such a manner as to protect our underground water sources?

Steve Reynolds: I think that our Water Quality Act does provide protection. I might add that New Mexico is recognized nationally as having perhaps acted more effectively than any other state with respect to regulations under law for the protection of our groundwater. Bill Stephens has probably adequately described it, but our law requires any person discharging water that may find its way into waters that can reasonably be expected to be used for beneficial purposes to have a discharge plan. It's the person or entity filing the discharge plan that has the burden of proving that his discharge will not contaminate groundwaters. There are certain standards set for various pollutants to govern such plans.

Bill Stephens: Steve, I might just comment briefly. If you're talking about waste disposal sites, there was another law that passed in the special session. It died after hearings from both Senate and House sides on hazardous waste disposal which gives the EID some responsibilities in our department and the pesticide area for waste disposal sites. I think this might head off some of the things that you're talking about here. If those sites are properly selected and maintained, it would prevent the pollution from the waste disposal sites.

Steve Reynolds: Were you finished, Dr. Sammis?

Ted Sammis: No. I just wanted to say that I think that this is of great concern because the city of Hatch had the opportunity to accept or reject one of these, and the people rejected it. I think there's a great concern by the people about these things coming in and contaminating our whole underground water supply even with regulations to control it.

Steve Reynolds: It's perhaps a collateral point, but certain of these esoteric hazardous wastes are becoming more and more important, and I think that there are many who see

that it is important that there be created a hazardous waste site or sites in New Mexico. It is not the sort of thing that you can just say well we don't want any hazardous waste disposal here. It is, I think, important to the development of the economy and the welfare of the people that we carefully create a system of hazardous waste disposal in the state. Dr. Dawson?

George Dawson: I'd like to piggyback on a couple of comments that have been made. I'd like to go back to Adrian Ogaz' comment on agriculture and its use, and that industrial and municipal uses should not be necessarily considered as "competing," as though we are at each other's throats about the quantities of water that each might use to provide the services that each one of those uses can. Also, I guess I would take Colonel Roth to task just a little bit -- we haven't really jumped on anybody here today, so I want to pick on him. He came out rather strong and hard I thought about the report that Fran gave from the Agriculture workshop. I hope he bears in mind that she was trying to take notes out of three and one-half hours of discussion and condense it into a report. She might have some words in there that are part of

another whole broader discussion as it relates to whether we should take one acre out of agriculture, and therefore you took a dim view of a stand like that.

I would like to piggyback then, that onto what Adrian Ogaz said. Let's think about agriculture. Yes, it uses 80 to 90 percent of the water in the state. Think about what Dr. Thomas said yesterday. It takes, I don't know, how many tons of water to produce a pound of beef. But we're all partners in that effort because we all like to consume the stuff; and it takes so many pounds of water to produce a loaf of bread. That does not mean that necessarily that water was consumed in its ultimate sense in those capacities. If you look at the literal sense of how much water is used in agriculture (and we piggyback on Dr. Stephen's reminder that most of our agricultural income in the state does come from the livestock industry) then you see that we're also providing a lot of wildlife habitat, recreational opportunities, timber opportunities, vision opportunities that center out there on these wide open expanses called ranges. I think it is important that as we leave this conference we recognize that we have a lot of problems as we determine the allocation priorities that should go with this water supply, whether it is limited or

not. We recognize that we are in a partnership in the determination of how we are going to use that water.

Agriculture, Colonel Roth, did not make any statements whatsoever that it should be left alone -- "we're using our water efficiently," etc. Agriculture assumes the responsibility, and recognizes its responsibility to become more efficient in the use of its water; but I think I want to state that agriculture does not necessarily use all that 80 to 90 percent. We wouldn't have any recreation in this state if agriculture wasn't building the facilities or wasn't being charged with the use of the water that's stored in those facilities for agriculture, but on which recreation is piggybacking. There are a lot of activities in this state that are associated with the use of the water that's being charged to agriculture. I think we ought to bear those kinds of things in mind. Let's not single out agriculture just because it's the place we're going to have to go to get the water, as the culprit in the whole operation.

Colonel Roth: Can I defend myself?

Steve Reynolds: No.

Colonel Roth: I've got to tell you, George, I might very well pick on you. I would never pick on Fran, however. The point I was making is that if we all don't get our act together and think about your question this morning to your group, "What are we talking about when we talk about conservation? What does that mean?" I would hearken to Steve: it really means to use water conservatively, whatever that means. We better get our act together, because as Steve points out there are just case after case where "the public" has said, "We are going to pass laws that ensure that from the public viewpoint water is used conservatively." That may not be in the farmer's interest. One attacks agriculture in this state because they have most of the water. Fred says that he only uses 5 percent, and the cities will tell you that they only use 5 percent. Agriculture has most of the water. If you're going to look to use your water in the state more effectively, you have got to look to the farming community.

Bill Stephens: Steve, I might react quickly to that. I don't think the agricultural committee really meant that we could not take one single acre out. I would say agriculture is not an untouchable in this area. I hate to see

them close down the saline plant over in Roswell. Maybe the administration will see the light and come back with those worthy projects. But I do feel that we have to give some in agriculture. Much of that can be made up by research results and efficiencies in the system itself.

Steve Reynolds: If I may add a point. The Colonel made the point well that if, in fact, you could by conservation save 10 percent of the water used for municipal and industrial purposes, it wouldn't solve much problem at all. But if I could save 10 percent of the water used in agriculture, it could double the municipal and industrial economy virtually. So it's a reasonable target. If you really want to save, agriculture is the place.

George Dawson: That's the place, but at the same time I don't think industry and municipalities can sit on their hands and say that they can use what we save.

Steve Reynolds: Well, of course not, except for one point. It is simply not possible to enact a law which says that you may not transfer water from irrigation usage to municipal and industrial usage to preserve your

irrigation economy. Governor Lamb tried that in Colorado. The farmers killed it -- for obvious reasons. For instance, take the middle valley, (and it will soon be true in this valley); a water right's worth now \$3,000 an acre. Now if you tell a farmer that he cannot go out and realize the value of that right by transferring it to municipal and industrial purposes, you've deprived him of a very substantial property right without due process. You cannot do that to the owner of a water right.

George Dawson: We have said you cannot do it so damn long that we have begun to believe it. I say that that is the fault of the public. It is possible to pay that farmer for that water right and preserve it for future society's benefit in agriculture and not deprive him of his inherited rights and so forth.

Steve Reynolds: Then you have not deprived him.

George Dawson: There are proposals to do that in this state, and here we have the golden opportunity among all states to do this. But we are not giving them a proper hearing; we are not even willing to discuss it. Farmers are the first ones that want to shoot me when I start raising

the question. But I am going to insist on raising it until they either accept listening and you accept listening, or somebody better shoot me. There is an alternative instead of saying that we can't do that. I think we've got to dialogue about it.

Steve Reynolds: That's right. You can't do it without properly compensating the farmer.

George Dawson: I've said that loud and clear.

Steve Reynolds: And I agree with you.

Bill Stephens: Steve, again I'm probably talking too much. I would like to comment just briefly on that. That just spills over into what we call land use planning. I would say that agriculturalists had their heads in the sand on this issue of both water and land and I think that we need to address the issue. I agree with what George Dawson is saying here. Now, we don't want to do what Steve said. We don't want to take this without proper compensation. But I think really the thing is happening here, plans are going to be made, and I think we in agriculture have really not been up front on some of these things.

Jim King: I'm not sure what Dr. Dawson has in mind, but I think he's brought up a very critical point. That is, in the interests of the State and the future of the State, I don't believe that we should have reluctance to discuss changes in the way we address issues like this. To that end, particularly since I'm interested in those kinds of changes, could you spell out a couple of those, George? Will that take another two hours?

George Dawson: Let's talk just about this valley, because we can visualize it. We've got a river valley down in the bottom and a mesa on each side. You've got a population pressure coming up from El Paso and from Las Cruces. They're building their houses in the valley. Every time you do that you take land out of production, you likewise reduce the size of the farms, inefficient farming operations, etc. -- the whole ball of wax. There is an alternative.

If we, as the people, think beyond the end of our noses with respect to our own economic welfare and think about the quality of life, what kind of economic life do we want our followers to have? Right now the farmer has the land there at the edge of Las Cruces. Somebody wants to build a housing development on it.

He can pay that farmer \$10 thousand an acre for that land for that purpose. The farmer doesn't really want to sell it, because he really wants to farm, but he'd also like to make a living farming. Right now the price of agricultural commodities is such that that's a tough row for him to hoe. But he has an alternative, and that's where the public comes in.

We're a public domain state. We have a lot of acres out there where we could be building houses that we can trade, at a like value of those acres for that water, that development right down here in the valley. Leave the farmer in the valley, farming, on his land, with his water right, but preserve it to agriculture and put the houses out on the mesa. In doing that it hasn't cost you one damn dime. Not the farmer, not the public, because you are trading a public good out here. I own part of that mesa, you do too, or some piece of forest land, or some place else. I want to trade my right in that public land for my right and the future generation's right to have agriculture down here in the valley. We can do it, folks, and it does not cost us money. How many proposals in the legislature go up there, that come in to do these kind of things that want thousands and thousands of dollars? I'm not asking for that. I'm

asking for consideration of an idea that does not cost money. It costs us mind over matter with respect to looking at alternatives to what might be needed in the years to come -- not looking at just today.

Jim King: George, how does that help us out with respect to retirement of water rights away from agriculture? I can see how it helps with the land, but if given the fact that they developed the least number of acres on the mesa, they are going to get water here in declared basins now.

George Dawson: Let's assume that the best wisdom -- by looking at the future, the world population problems, our own population growth, the Sunbelt phenomenon -- says we want to preserve this for agriculture. So for the next umpteen years (we can see that far down the road), we are going to preserve it for agriculture. The water right that's with that land that Farmer Brown is still on and farming, it now belongs to the public. All right, some time down the road it is possible that that public that owns that property right might, in turn, make a new decision that they need some of that water for a higher better use -- to have drinking water for somebody. They then can

retire that water right. But that farmer then would have to be compensated for the difference between his residual dryland value and his agricultural value because that water was there. He traded off only his development right, not his agricultural value. The land in the valley will increase in value in accordance with the increasing demand for food. So his agricultural land value will increase and his land that he traded for out there in the development right will increase if these people keep coming to the sunbelt. And so, yes, the water might someday go to another use, but the public will decide that just like they said that it was important to keep that water in agriculture in the first place.

Steve Reynolds: Dr. Steinhoff?

Dr. Steinhoff: Why do you think there is a history in California of laws in which public land cannot be used for anything else but agriculture? That means industry has to go up the hills, residences have to go up the hills and in the canyons in order to preserve same and I think it behooves us that we do the same thing really.

George Dawson: Let me add quickly, though, this can be misunderstood. We do not want to zone it that way.

Zoning is taking away the rights, the property value of that person. What I'm asking for is not to deprive anybody of anything at no public cost, no out of pocket cost. Zoning merely says, "OK, we're going to zone this area of five miles. You can't sell that to anything else." Now, you have deprived Farmer Brown of his inheritance right. Because now his value dropped immediately from that development right value down to agricultural value, and in this particular case it might be \$4, \$5, \$6 thousand an acre. If you got a hundred acre farm, folks, or more, that's a significant amount of deprivation. Let's not fall into the zoning trap when we have alternatives which will not penalize either the farmer or the public.

Steve Reynolds: We've got time for one more.

Bill Stephens: It seemed to me like almost perpetual motion, George. I did not quite see how you are going to get by this without any cost if you are going to pay the farmer for his development rights. Would you run that by again? You lost me.

George Dawson: Well, that's why we need to devote a conference for this. I am not paying the farmer for a development

right. I am substituting the value. Let's make a simple example. He's got an acre of land down here and right now he could sell it for \$10 thousand an acre to somebody to build houses on or build a municipal plant or an industrial plant. But when you look at what he's producing agriculturally and the income, capitalized income value of that for agriculture, the way he has to make his living it is worth \$3 thousand an acre. You've got \$7 thousand difference. That's the development value. You go out here on the mesa and what is an acre of that worth? Let's assume it's worth \$1 thousand an acre right now. You give him seven acres for his one down here of development rights. So he still has his acre in the valley and he's got seven acres out here. He's not been hurt. In fact, he'll be helped because he's gonna have two things inflating now instead of one. We will be better off because we still have agricultural potential.

Bill Stephens: Thank you, George.

Steve Reynolds: Back here and that will be the last question.

T. C. Horton: I'd like to ask the Colonel how much of New Mexico's water is tied up on military reservations. It's a

point that hasn't been asked. There are large areas of the state that are tied up. Unfortunately, I have a bad taste in my mouth for the efficiency of the federal government and the sagebrush rebellion is coming up. But I'd like to know how much water the federal government has tied up on these military reservations that I'm sure Mr. Reynolds has no control over, nor does the State.

Colonel Roth: I would suspect first that Mr. Reynolds would debate whether he has control over it or not, since he and I have had debates along that line on occasion. The military installations -- I don't have a volume figure; I would be happy to get one for you -- use water to meet their industrial, municipal needs, whatever they may be. They have as the federal government has, I believe, Steve, the right of eminent domain were they to need to seize more water. They have not seen fit to do that. In many cases they buy their water or get their water from a local water-producing source. Fort Bliss, Texas is a good example. A good part of the water used by Fort Bliss is acquired from the City of El Paso. So the military installation is not really the issue. If you're going to ask me how much of the water underlying federal

properties, most of which is not military by the way, and how much water they control, I would really have to defer to Steve because I'm not going to enter into who controls that water, the Feds or the State government. But I will tell you that the military installations have historically, and I think will also in the future, ensure by virtue of federal law that they retain enough water to operate the military installations. That is why, for example, I am a protestor to El Paso's drilling in one basin, because I feel that that impacts on the military's use of water underlying the military installation. So that's about the best I can do with that. If you want a volume figure, we can try to scrape one together for you.

Steve Reynolds: I would think a number would probably be impossible. I would suggest you not undertake to do that in the absence of counsel. As a matter of law, as I understand it, if and when the federal government withdraws from the public domain lands for a military reservation it acquires a reserved right to the amount of then unappropriated water required for the purposes of that reservation. Obviously, the amount required generally for a military purpose is quite small. So

far as I know they do very little irrigation over there at Fort Bliss.

Unless there's something truly urgent, Tom, or unless you have some announcements that need to be made at this time, we are finished.

CONFERENCE PARTICIPANTS

W. V. Abeele
Los Alamos National Lab.
P.O. Box 1663
Los Alamos, NM 87532

Craig Andrews
City of Las Cruces,
Utilities Division
P.O. Drawer CLC
Las Cruces, NM 88001

Aziz H. Abuadhmah
P.O. Box 4071, UPB
Las Cruces, NM 88003

Daniel Galaviz Arellano
Universidad Autonoma de Chihuahua
Escuela de Agricultura, Hermanos Escobar
Cd. Juarez, Chihuahua
MEXICO

Katherine L. Adam
League of Women Voters
416 Apodaca Hill
Santa Fe, NM 87501

Estevan Arellano
The Self-Reliance Foundation
Box 1
Las Trampas, NM 87576

Jeffrey A. Albers
New Mexico Natural
Resources Department
Room 118, Villagra Bldg.
Santa Fe, NM 87503

Marjorie S. Arrington
USDA-ASCS
Drawer M
Las Cruces, NM 88004

Earl F. Aldon
Rocky Mtn. Expt. Sta.
2205 Columbia, S.E.
Albuquerque, NM 87106

H. Arthur
Bureau of Indian Affairs
U.S. Dept. of the Interior
Window Rock, AZ 86515

Ronald D. Alexander
The Federal Land Bank
of Wichita
151 N. Main
Wichita, Kansas 67202

Jack D. Atkins
State Engineer Office
P.O. Box 1717
Roswell, NM 88201

Phelps Anderson
Diamond A Cattle Company
P.O. Box 1000
Roswell, NM 88201

Robert Batley
San Juan County
Farmington, NM 87401

Robert Benear
General Irrigation Inc.
1000 Airport Rd.
Box 4
Santa Fe, NM 87501

Richard Bowman
Olivarez & Bowman Associates
11000 Candelaria, N.E.
Albuquerque, NM 87112

Richard Bernhardt
P.O. Box 532
Mesilla, NM 88046

Frank Bradley
State Engineer Office
P.O. Box 1717
Roswell, NM 88201

Robert D. Bishop
Soil & Water Cons. Div.
1418 Luisa
Santa Fe, NM 87503

Don Brooks
Bernalillo County
505 Central, N.W.
Albuquerque, NM 87106

Karl D. Bjarke
1306 Wyoming, #2
Las Cruces, NM 88001

C. Louis Buescher
Rt. 6, Box 107B
Las Cruces, NM 88001

Linn Blancett
San Juan Co. Comm.
Box 55
Aztec, NM 87410

Edward B. Burns
Sierra Club
Rt. 3, Box 115-D
Las Cruces, NM 88001

Beverly Bogle
2610 1/2 S. Solano
Las Cruces, NM 88001

Fernando Cadena
P.O. Box 3CE, NMSU
Las Cruces, NM 88003

Horace L. Bounds
Wigwam Land Co.
Wigwam Ranch
San Lorenzo, NM 88057

Lloyd A. Calhoun
President-Water, Inc.
2016 N. Fowler
Hobbs, NM 88240

Richard Bowen
El Paso Nat. Gas Co.
P.O. Box 1492
El Paso, TX 79978

Howard R. Calkins
Edgewood Water Utility Inc.
P.O. Box 388
Edgewood, NM 87015

Daniel Carr
Bureau of Indian Affairs
P.O. Box 166
Laguna, NM 87026

Jasper Coombes
Army Corps of Engineers
3301 La Moncha
Albuquerque, NM 87104

Pat Castillo
U.S. BIA
P.O. Box 1667
Albuquerque, NM 87103

Larry M. Coons
810 Lees St.
Las Cruces, NM 88001

Bernard Chavez
USDI-BLM
2800 Cerrillos
Santa Fe, NM 87501

Quincy Cornelius
San Juan County
Suite 014
Petroleum Plaza Bldg.
Farmington, NM 87401

Harold Christ
Middle Rio Grande
Conservancy District
P.O. Box 581
Albuquerque, NM 87103

D. J. Cotter
Dept. Horticulture
P.O. Box 3530, NMSU
Las Cruces, NM 88003

Mary E. Clanton
2001 Cole Village
Las Cruces, NM 88001

M. J. Coyle
Western Farm Mgt. Co.
619 Webber St.
Santa Fe, NM 87501

Ira G. Clark
P.O. Box 253
Mesilla Park, NM 88047

Ing. Leonardo Cruz
Esc. Agricultura Hinos Escobar
Universidad Autonoma Chihuahua
Cd. Juarez, Chihuahua
MEXICO

Richard A. Cole
P.O. Box 4901, NMSU
Las Cruces, NM 88003

Roy A. Cunniff
Physical Science Lab.
P.O. Box 3PSL, NMSU
Las Cruces, NM 88003

M. Bradley Compton
State Engineer Office
Water Resources Division
Bataan Memorial Building
Santa Fe, NM 87503

Francisco Ochoz Cunningham
Esc. Agricultura Hnos Escobar
Post Office 2119
Cd. Juarez, Chihuahua
MEXICO

Wayne P. Cunningham
New Mexico Dept. of Ag.
P.O. Box 5600, NMSU
Las Cruces, NM 88003

Duncan Ellison
Water, Inc.
P.O. Box 367
Lubbock, TX 79408

Fred A. Day
Dona Ana Co. Planner
Room 209, Courthouse
Las Cruces, NM 88001

Charlee Elliott
Evana Land & Sea Corp.
Box 636, Rt. 4
Las Cruces, NM 88001

Ngarioina Dedjir
915 University, #16
Las Cruces, NM 88001

Franklin Flint
Arch Hurley Cons. Dist.
Rt. 4, Box 89
Tucumcari, NM 88401

Bill Deese
P.O. Box 3249
Las Cruces, NM 88003

Susan Jane Flynn
Agua Azul Investments
Rt. 7, Box 53A
Santa Fe, NM 87501

Hilton A. Dickson, Jr.
Kennecott Copper
Box 1219
Silver City, NM 88062

William L. Foster
Fish & Wildlife, NMSU
Rt. 1, Box 1800
Las Cruces, NM 88001

Carol Dimeff
New Mexico Soil & Water
Conservation Division
1418 Luisa St., #2
Santa Fe, NM 87501

Lucy Fox
Energy & Minerals Dept.
P.O. Box 2770
Santa Fe, NM 87501

Henry Edgar
Box 1306
Albuquerque, NM 87103

R. S. Freeburg
P.O. Box 4420, NMSU
Las Cruces, NM 88003

Larry Eix
OEWU Dona Ana Branch
330 Richards Ave.
Las Cruces, NM 88001

Charles Garcia
1415 Wyoming
Las Cruces, NM 88001

George Garcia
USDA Rocky Mtn. Expt. Sta.
2205 Columbia, S.E.
Albuquerque, NM 87106

Michael C. Hayes
Box 4901, NMSU
Las Cruces, NM 88003

H. E. Gary
Rt. Box 23
Rincon, NM 87940

Mary L. Hays
State Engineer Office
2340 Menaul, N.E.
Albuquerque, NM 87107

John Goodfellow
Bureau of Indian Affairs
1708 Boulder Rd.
Carrizozo, NM 87301

Charles Hendrickson
NM Env. Imp. Agency
P.O. Box 965
Las Cruces, NM 88004

James L. Goodrich, P.E.
Swifts & Goodrich-Bartlett
& Associates
1105 Gardner
Las Cruces, NM 88001

Sandra Henry
Dept. of Ag. Econ.
P.O. Box 3193
Las Cruces, NM 88003

Helen F. Gram
Los Alamos Technical Assoc.
206 Rio Bravo
Los Alamos, NM 87544

Doug Henson
Elephant Butte Irr. Dist.
530 S. Melendres
Las Cruces, NM 88001

Gordon Hamley
NMSU
Las Cruces, NM 88003

C. M. Hohn
P.O. Box 3AE, NMSU
Las Cruces, NM 88003

Steve Hamp
Bureau of Land Mgt.
P.O. Box 1420
Las Cruces, NM 88001

Austin Hoover
NMSU Archives
Box 3475, NMSU
Las Cruces, NM 88003

Ralph E. Hauke
WAPRS
P.O. Box 252
Albuquerque, NM 87103

Rita S. Horton
Entramosa Water, Inc.
NSR Box 150
Edgewood, NM 87015

T. C. Horton
Entranosa Water, Inc.
NSR Box 150
Edgewood, NM 87015

David C. H. Hsi
NMSU-MRG Exp. Station
1036 Miller, S.W.
Los Lunas, NM 87031

Stephen H. Hubert
Martin, Martin, & Lutz
2100 N. Main
Las Cruces, NM 88001

Jim Huff
WAPRS
P.O. Drawer P
El Paso, TX 79952

Holly Jamison
P.O. Box 3387
Las Cruces, NM 88003

Scott D. Jenson
The Federal Land Bank
of Wichita
151 N. Main
Wichita, Kansas 67202

Forrest B. John
P.O. Box 3944
Las Cruces, NM 88003

James S. Johnson
P.O. Box 3354, NMSU
Las Cruces, NM 88003

Werner Arthur Johnson
810 Lees
Las Cruces, NM 88001

Fran Kaszeta
P.O. Box 3CE, NMSU
Las Cruces, NM 88003

Keith G. Kennedy
D'Appolonia
2340 Alamo S.E. #306
Albuquerque, NM 87104

Russell L. Koger
Earth Environmental
Consultants, Inc.
9426 Indian School Rd., N.E.
Albuquerque, NM 87112

Victoria A. Lara
NMSU
Las Cruces, NM 88003

Bert Levine
Consulting Engineer
P.O. Box 2848
Farmington, NM 87401

Rashalee Levine
433 Pocano
El Paso, TX 79912

Jeffrey W. Lewis
NM Soil & Water Cons. Div.
Suite 405, First National Tower
Las Cruces, NM 88001

Ing. Rodolfo Lopez E.
Universidad Autonoma Chihuahua
Escuela Agricultura, Hinos Escobar
Cd. Juarez, Chihuahua
MEXICO

John H. Lyman
905 Conway Ave - 42
Las Cruces, NM 88001

Patricia J. Lyman
905 Conway Ave. - 42
Las Cruces, NM 88001

Bill Mayfield
Star Route
Bent, NM 88314

John W. McCarthy
El Paso Natural Gas Co.
6605 La Cadena
El Paso, TX 79912

Darold C. McCrossen
Soil Cons. Service
Box 2007
Albuquerque, NM 87103

Scot E. McLelliand
NMSU
Las Cruces, NM 88003

Thomas M. Moody
New Mexico Dept. of
Game and Fish
State Capitol
Santa Fe, NM 87503

Donald W. Morris
Los Alamos Natl. Lab.
P.O. Box 1663, M.S. 603
Los Alamos, NM 87545

Amy V. Morse
Univ. Research Farm
Univ. of Massachusetts
Amherst, Mass. 01002

J. W. Mundy
Pueblo Farms
450 Rodeo Rd.
Santa Fe, NM 87501

Reza Namaki
1400 S. Alamo
Las Cruces, NM 88001

R. S. Nanninga
Middle Rio Grande
Conservancy District
P.O. Box 581
Albuquerque, NM 87103

Dave Netzel/Jack Myrick
Navajo Ag. Products Industry
P.O. Box 86
Farmington, NM 87401

Dennis Newman
10316 Quarai
Albuquerque, NM 87111

Thomas S. Nutt
President, Arch Hurley
Conservancy District
P.O. Box 1304
Tucumcari, NM 88401

Keith O'Brien
NM Bureau of Mines
Socorro, NM 87801

Adrian Ogaz
208 PAC
R.R. Box 54
Garfield, NM 87936

Chris M. Olsen
NM Wildlife Federation
P.O. Box 1246
Socorro, NM 87801

Bob Oney
Ag. Econ. Dept.-NMSU
P.O. Box 3344
University Park, NM 88003

Ben Ormand
Pacific Western Land Co.
P.O. Box 188
Gila, NM 88038

Fe J. Padilla
P.O. Box 3CE, NMSU
Las Cruces, NM 88003

Mark Palumbo
NM Tech
Socorro, NM 87801

Ken Parker
NM State Highway Dept.
Rt. 2, Box 312K
Santa Fe, NM 87501

William Pearson
City of El Paso
No. 2, Civic Ctr. Plaza
El Paso, TX 79999

Ing. Jose I. Perez Hdez.
University of Autonoma of Chihuahua
Escuela Agricultura, Hinos Escobar
Post Office 2119
Cd. Juarez, Chihuahua MEXICO

Don Porter
1125 Milton
Las Cruces, NM 88001

George Pringle
3427 Espina
Las Cruces, NM 88001

Michael Pulice
NM State Highway Dept.
P.O. Box 1149
Santa Fe, NM 87503

Lewis T. Putnam
State Engineer Office
P.O. Box 844
Deming, NM 88030

Paul C. Quintana
Arch Hurley Cons. Dist.
Rt. 4, Box 95
Tucumcari, NM 88401

Thomas H. Raines
U.S. Army Corps
of Engineers
P.O. Box 1580
Albuquerque, NM 87111

Charles M. Redman
NM Solar Energy Institute
P.O. Box 350L, NMSU
Las Cruces, NM 88003

Ken Rehfeldt
Geoscience Dept.
New Mexico Institute of
Mining and Technology
Socorro, NM 87801

David Riccitiello
MACOG
307 W. Aztec, #202
Gallup, NM 87301

Glenal E. Riley
2715 Ardos
Las Cruces, NM 88001

John W. Riley
RGCC-TX
P.O. Box 771
El Paso, TX 79936

Dr. Carlos Rincon-Valdes
Esc. Agricultura Hinos Escobar
Post Off. 2119
Cd. Juarez, Chihuahua
MEXICO

Dennis Risser
USGS-WRD
P.O. Box 26659
Albuquerque, NM 87125

Mark Rivera
SRG/COG
575 S. Alameda Blvd.
Las Cruces, NM 88001

Rusty Rodke
2133 Calle de Suenos
Las Cruces, NM 88001

William J. Saad
Elephant Butte Irr. Dist.
530 S. Melendres
Las Cruces, NM 88001

Henry Saastamoinen
NMSU Library
2110 S. Solano
Las Cruces, NM 88001

Arturo Sais
Middle Rio Grande
Conservancy District
P.O. Box 581
Albuquerque, NM 87103

Ted Sammis
Ag. Eng. Dept.
P.O. Box 3268, NMSU
Las Cruces, NM 88003

Harold Saunders
State Engineer Office
Bataan Memorial Building
Santa Fe, NM 87503

Larry Schmidt
USDA-Forest Service
517 Gold Ave.
Albuquerque, NM 87102

Douglas L. Schneider
NM EID
P.O. Box 968
Santa Fe, NM 87503

David G. Scholl
USDA Forest Service
2205 Columbia, S.E.
Albuquerque, NM 87106

Thomas Schruben
2610 1/2 S. Solano
Las Cruces, NM 88001

Geraldine Schwab
W.K. Summers & Assoc., Inc.
P.O. Box 684
Socorro, NM 87801

Vernon Scott
MAT
Box 363
Mescalero, NM 88340

Subhas Shah
Middle Rio Grande
Conservancy District
P.O. Box 581
Albuquerque, NM 87103

Thomas R. Shelley
Chino Mines Company
Hurley, NM 88043

Ray Shollenbarger
Middle Rio Grande
Conservancy District
P.O. Box 581
Albuquerque, NM 87103

Rose Lee Siow
822 Poe
Las Cruces, NM 88001

Russell Skaggs
3407 Espina St.
Las Cruces, NM 88001

Carl L. Slingerland
Interstate Stream Commission
Bataan Memorial Building
Santa Fe, NM 87503

A. A. Smith
Rockwell Int.
6612 Sandra, N.E.
Albuquerque, NM 87109

Hillard L. Smith
905 Conway - #44
Las Cruces, NM 88001

Mike D. Smith
P.O. Box 3J, NMSU
Las Cruces, NM 88003

Phil Soice
Public Service Co.
of New Mexico
Albuquerque, NM 87103

Forrest Sprester
El Paso Natural Gas Co.
11363 Quintana
El Paso, TX 79936

Ernst Steinhoff
New Mexico Research Inst.
P.O. Box 454
Alamogordo, NM 88710

Gail Stockton
Turney, Sayre, & Turney Eng.
312 Montezuma
Santa Fe, NM 87501

David N. Stone
NM State Engineer Office
6033 Calle Nueve, N.W.
Albuquerque, NM 87107

Glenn E. Stout
Univ. Of Illinois
208 North Romine
Urbana, IL 61801

L. C. Strawn
Rt. 4, Box 281
Tucumcari, NM 88401

J. C. Sutherlin
Dona Ana County Farm Bureau
Rt. 1, Box 171
La Mesa, NM 88044

Marianne Thaeler
2015 Huntington
Las Cruces, NM 88001

Paul R. Turner
1510 Brown Rd.
Las Cruces, NM 88001

Danny Valdez
Elephant Butte Irr. Dist.
530 S. Melendres
Las Cruces, NM 88001

H. W. Van Loo
Angel Fire Services Corp.
Angel Fire, NM 87710

Harlyn Via
Mescalero Apache Tribe
Mescalero, NM 88340

John Waconda
1314 Alumni
Las Cruces, NM 88003

Diana L. Weigmann
Dept. Fish & Wildlife
P.O. Box 4901, NMSU
Las Cruces, NM 88003

Ed Welder
USGS-WRD
P.O. Box 26659
Albuquerque, NM 87125

Sam West
Rt. 5, Box 1807-A
Las Cruces, NM 88001

Frank Westrick
State Engineer Office
P.O. Box 844
Deming, NM 88030

Greg White
Box 4459
Las Cruces, NM 88003

Peter Wierenga
P.O. Box 3Q, NMSU
Las Cruces, NM 88003

Cally Williams
Mesilla Valley 2000
331 Capri Arc
Las Cruces, NM 88001

Bob Wilson
Dept. Fisheries &
Wildlife Sciences
Box 4901, NMSU
Las Cruces, NM 88003

James Wood
R.S. Watershed Mgt.
1130 La Fonda
Las Cruces, NM 88001

Jim Wright
NM State Engineer Office
Box 1717
Roswell, NM 88201

WRI STAFF PARTICIPANTS

Thomas G. Bahr

R. Peter Herman

Darlene Reeves

Lynda MacKichan

Yolanda Arteaga

Cheryl I. Crawford

Kelly Kalk